University of Puerto Rico at Bayamón
Department of Computer Science

ABET Self-Study Report 2018

for the
Bachelor in Computer Science
and for the Bachelor in Computer Science
with Emphasis in Information Systems

Submitted to the ABET Computer Accreditation Commission
June 2018

Contact Information

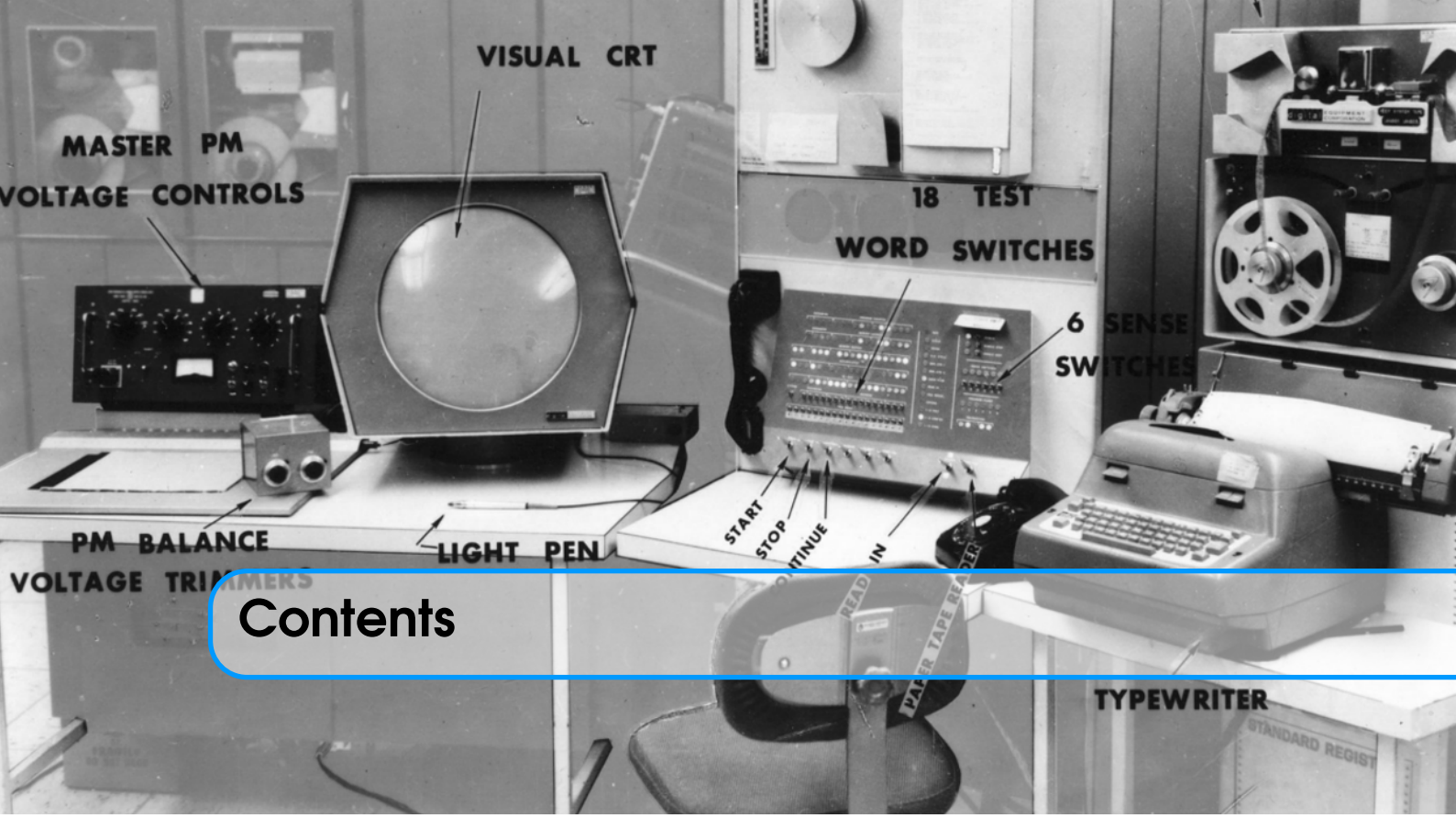
Dr. Miguel Vélez
Chancellor
University of Puerto Rico at Bayamón
170 Carr. 174, Industrial Minillas
Bayamón, PR 00959
Phone: 787-993-8850
Fax: 787-993-8900

Dr. Jorge Rovira
Dean for Academic Affairs
Phone: 787-993-8860
Fax: 787-993-8912
edna.miranda1@upr.edu

Mr. Javier Zavala
Director of:
Office of Planning and Institutional Evaluation
Phone: 787-993-8854
opei.uprb@upr.edu

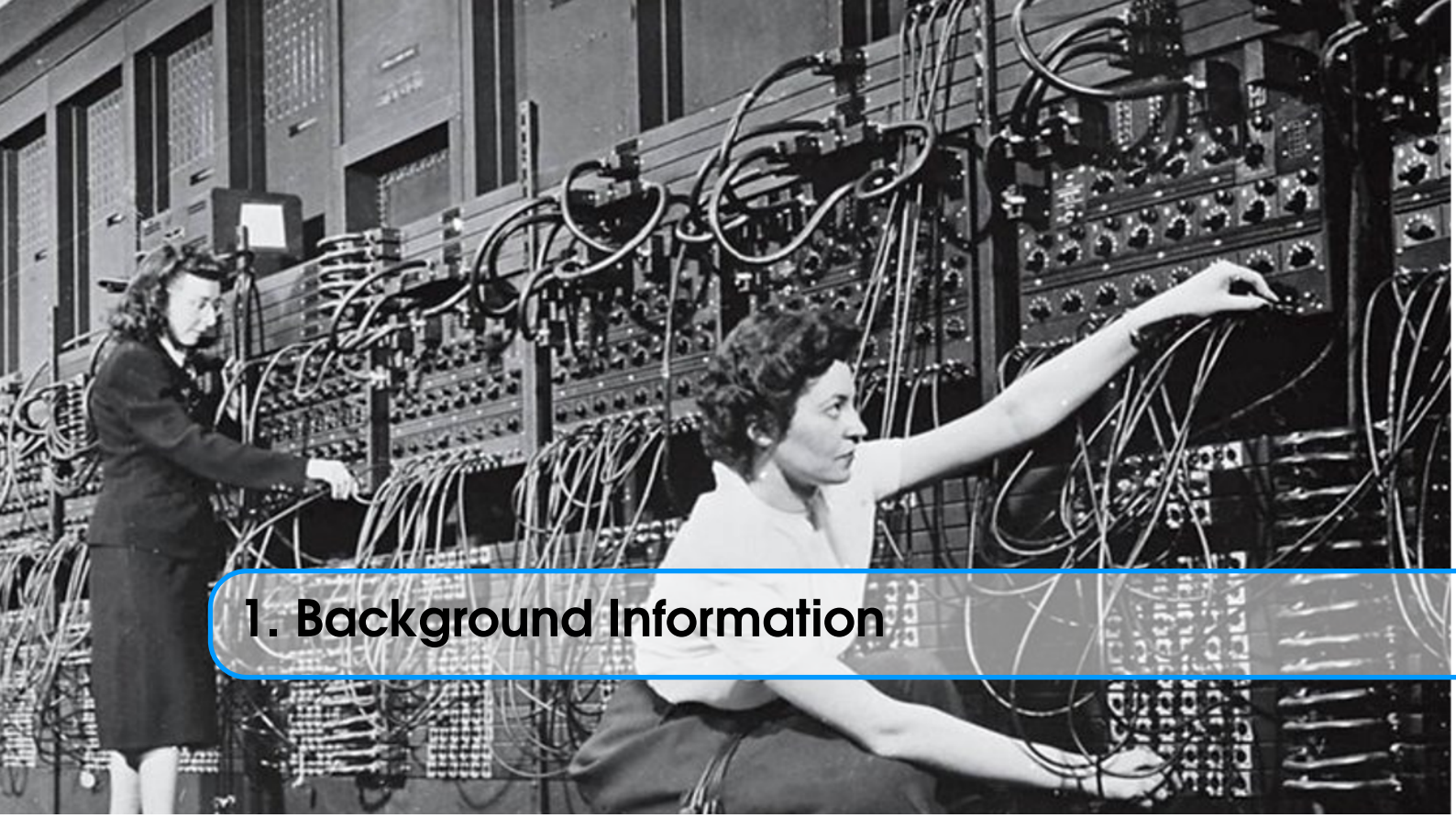
Dr. Nelliud Torres
Department Chair
Phone: 787-993-8878
Fax: 787-993-8918
antonio.huertas@upr.edu

Dr. Juan Solá-Sloan
Department Accreditation Coordinator
Phone: 787-993-0000 x 3310
Fax: 787-993-8918
juan.sola@upr.edu



Contents

Part One



1. Background Information

1.1 Brief History of University of Puerto Rico at Bayamón and the Computer Science Program

In 1947, the government of Puerto Rico embarked in an industrial program known as Operation Bootstrap[1]. It marked the beginning of an industrial planning based on external capital and tax exemptions. Puerto Rico entered into a period of rapid industrialization and strong economic growth. This period of prosperity lasted for several decades.

The need to provide more educational opportunities of post secondary character was evident as an outcome of Operation Bootstrap. From 1962 to 1966, the university authorities as well as the legislature of Puerto Rico established public policy to create an integrated network of regional colleges inside the UPR system. The main purpose was to address the registration problems of various population areas around Puerto Rico. Also, it was envisioned that these colleges include "semi-professional" programs for students who wanted to focus in a specific skill, within their second year of studies. In 1970, the Administration of Regional Colleges[2] of the University of Puerto Rico was created. Its mission was to "provide opportunities for university education and academic training programs for careers of complementary and superior technical character, according to the needs and aspirations of the communities within they are established." These colleges were subjected to the "comprehensive development plan of the University of Puerto Rico".

The Regional College at Bayamón[3] of the University of Puerto Rico was founded in 1971. The municipality of Bayamón donated a tract of land in Road 174 within Minillas Industrial Area. The college objectives were: (1) offer instruction at the university level, (2) develop two-year technical programs of occupational character, (3) develop two year programs in liberal arts, that facilitate the transfer to bachelor degree programs on the main campuses of the UPR system[4]. Based

[1] Operación "Manos a la Obra,"
[2] "Administración de Colegios Regionales" (ACR) in Spanish
[3] The Regional College at Bayamón was the name of our institution from 1971 to 1979
[4] Rio Piedras and Mayagüez Campuses

on these objectives, the Regional College at Bayamón was the first college of the UPR System which featured a wide range of technical programs. The original enrollment was 515 students in 1971-1972 and reached 1,300 in 1972-1973. As construction of more buildings advanced during the decade it reached an enrollment of around 5,000 students.

The Associate Degree in Computer Science was created in 1971. It was the first Computer Science program among all the UPR regional colleges and campuses back then. Also, it was the program with the highest enrollment rate. The program was created in order to satisfy the need for computer programmers due to the installation of several industries during the end of the '60s and '70s.

The government of Puerto Rico approved a proposal for the expansion of the Regional College at Bayamón on January 30, 1979. The academic offerings were expanded to include bachelor degrees in technical areas for the academic year 1979-80. The bachelor degrees approved in the proposal were: (a) Business Administration, (b) Electronics, (c) Secretary Sciences, and (d) *Computer Science*. The main purpose of the bachelor degree was to provide depth in several areas that the associate degree did not covered. The name of the institution was changed to Bayamón Technological University College[5] with this expansion.

In 1998, the Board of Trustees approved the conversion of the Bayamón Technological University College into an autonomous institution within the University of Puerto Rico's system. The institution name changed again to the University College of Bayamón, and to the University of Puerto Rico at Bayamón in the year 2000. This change was evident since the institution evolved from a two-year institution into a four-year institution[6].

In 2000, a committee of 5 professors and 1 student requested the moratorium of the Associate Degree in Computer Science, based on the low enrollment rate for this degree. The president of the University of Puerto Rico signed Certification # 29 (2003-2004) which formally approved the moratorium alongside with three other associate degree programs.

In 2008, the Bachelor Degree in Computer Science was revised to include two new emphasis areas: (1) Applied Computer Science and (2) Information Systems and Technology. Student were to select an area of emphasis during his sophomore year. The area of emphasis in Computer Science focuses on the design and comparison of programming languages, the theory of computing, and the scientific method. The area of emphasis in Information Systems focuses on the development and management of information systems for commercial organizations.

In February 2012, our department chair, solicited an official change in the name of our emphasis areas. The purpose was to eradicate the confusion that could arise from the name of the Information Systems and Technology emphasis area with the area of Information Technology or Information Engineering Technology (not currently offered)[7]. Also, it was proposed that the name of the Applied Computer Science emphasis area change just to Computer Science.

In 2014, the Academic Senate approved a certification in which all the academic programs were required to comply with a common general education component. Our department seize the opportunity to modify our curriculum introducing minor changes. Most of these changes were done to address the requirement of the certification. Moreover, course COTI 4260 Intro. Information Security was included on the CS program during this revision.

In 2015, the UPR Administration inaugurated the new Science and Technology Complex. A

[5] "Colegio Universitario Tecnológico de Bayamón" in Spanish

[6] The UPR at Bayamón became the third largest institution of the UPR system

[7] The Proposal for the establishment of an Information Engineering Technology Program is currently under the review by the Government Board.

brand new three building complex for four (4) STEM disciplines[8]. Building A houses the Computer Science laboratories. Since 2016, all the CS courses have been moved to this brand new facility.

The UPR System was impacted by a two month student strike that disrupted the continuation of classes during Spring 2017. However, as soon as the strike ended, the academic calendar was amended so that the spring semester could be completed. Spring 2017 ended on June 18.

Two natural disasters hit the island during fall 2017. Hurricane Irma barely touched land, but tropical storm winds and heavy rain affected the northern part of the Island. Moreover, on September 20, 2017 Puerto Rico was right on the middle of the path of Hurricane Maria. Maria was a category 5 storm with incredible force. The hurricane was devastating. Puerto Rico has not been hit by a category 5 hurricane for approximately 87 years. UPRB suffered damages that were estimated in around 5 million dollars. Building 400 that houses mostly the business administration courses suffered heavy damage. That building have been declared unusable. Fortunately non of the classroom assigned for our department suffered considerable damage. The campus is currently coping with rebuilding and fixing its infrastructure.

1.2 Options

As mention in Section 1.1 the department offers two emphasis areas[9] that are reflected on the student transcript: (1) Computer Science and (2) Information Systems. Students select an area of emphasis during sophomore year.

1.3 Program Delivery Modes

Traditional lecture and lab courses are offered during the daytime. Evening classes have been taught accordingly to the demand.

1.4 Program Locations

The program is offered completely at the University of Puerto Rico at Bayamón.

1.5 Public Disclosure

There are several places where information concerning the program is disclose. Since, our institution is an HSI on the commonwealth of Puerto Rico and serves 100% Spanish speakers, information is in Spanish and English. English versions of the material can be provided upon request if they are not available in English. Table 1.1 presents the places where the information is disclose. The information is available at the Department Assessment Website[10], the Institutional Website[11] and the Brochure[12].

[8] Engineering, Biology, Electronics and Computer Science

[9] majors on the SIS System

[10] http://sici-acred.uprb.edu

[11] http://www.uprb.edu/ sample-page/ decanato-de-asuntos-academicos/ departamentos-academicos-2/ ciencias-de-computadoras/

[12] Available at the department's office

Item	Location	English	Spanish
Program Educational Objectives	Department Assessment Website Institutional Website Brochure	✓	 ✓ ✓
Student Outcomes	Department Assessment Website Link on Institutional Website	✓	 ✓
Annual Student Enrollment	Institutional Website	✓	✓
Graduation Data	Institutional Website	✓	✓
Mission and Vision	Department Assessment Website Institutional Website	✓	✓ ✓

Table 1.1: Public Disclosure Location and Language

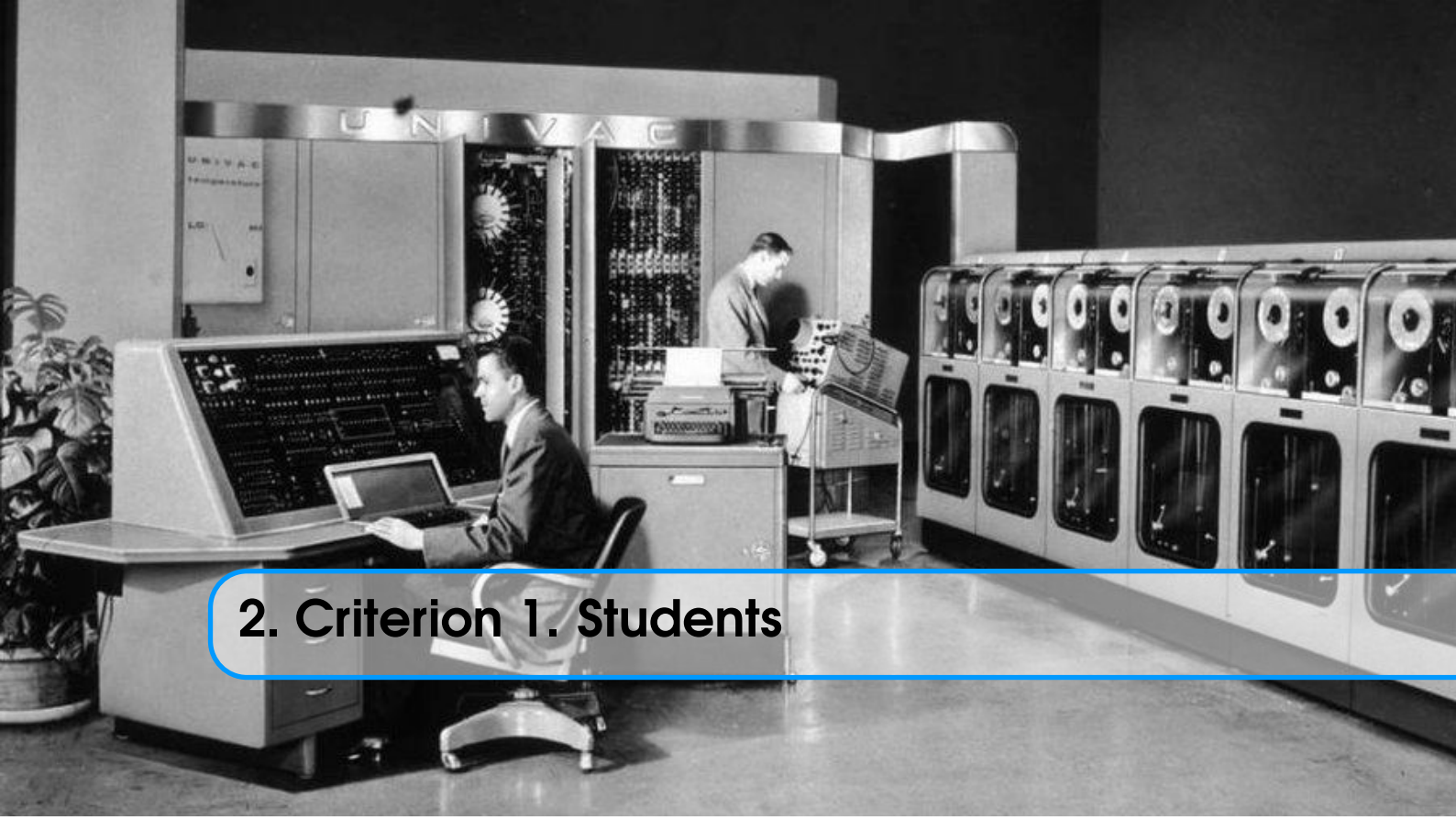
1.6 Concerns from the Final Report and Actions Taken

In this section deficiencies, weaknesses or concerns documented in the Final Report from the previous evaluation and the actions taken to address them are presented. The Final Statement findings were the same for both programs. These were:

> **Criterion 4: Continuous Improvement:** The significant changes in how some outcomes will be assessed, combined with a concern that adequate institutional support may not be available to faculty for assessment activities should be carefully monitored in the future to insure continue compliance with the criterion.
>
> **Criterion 8: Institutional Support:** Recent administrative compensation charges for accreditation and assessment activities have the potential to negatively impact these processes.

1.6.1 Actions taken to Address Criterion 4 and Criterion 8

Compensation for assessment and accreditation activities have slightly increased since the Interim Visit. The financial crisis of the Government of Puerto Rico has also impacted our institution. The department offered 3 credits in compensation for the professors working on assessment and accreditation prior to the Interim Visit. A compensation of only 1 credit per semester was paid during the semester of the Interim Visit. This compensation has increased to 2 credits after the concerns were presented on the Final Statement Report. We are one of the few departments that compensates professors for these activities.



2. Criterion 1. Students

2.1 Student Admissions

Applicants need to fill out an admissions form used for all of the units of the University of Puerto Rico (UPR) System and pay an application fee. Requirements include a high school diploma from an accredited public or private school which must be licensed by Puerto Rico's General Education Council or an equivalent entity. If proceeding from another state, a certified transcript of all courses and grades at high school is needed. The student can also pass the high school equivalence test given by the Department of Education. Applicants must also take the Academic Aptitude Test (verbal and Mathematics) and the Academic Achievement Tests (Spanish, English and Mathematics) offered by the College Entrance Examination Board. In addition, applicants under the age of 21 must meet vaccination requirements.

The following elements are used as admissions criteria throughout the UPR System:

1. Verbal scores in the Aptitude Test
2. Math scores in the Aptitude Test
3. High school grade point average(GPA)
4. Special talents or abilities of the applicant

The first three elements are converted to a scale using a formula which produces the General Admissions Index (IGS in Spanish). The selection of candidates is done by using the IGS. The UPR Administrative Board certifies annually the General Admissions Index and the number of applicants that can be admitted to the program according to the recommendations made by each Department. Table 2.1 includes the admission standards during the past five years, while Table 2.2 includes the data of enrollment trends for these same five years.

Academic Year	High School GPA		Composite CEEB Scores		Percentile Rank in High School		Number of New Students Enrolled
	Min	Avg.	Min	Avg.	Min	Avg.	
2013-2014	2.79	3.56	2123	2816	n/a	n/a	86
2014-2015	2.48	3.49	2219	2825	n/a	n/a	77
2015-2016	2.72	3.55	2015	2816	n/a	n/a	87
2016-2017	2.54	3.55	2173	2872	n/a	n/a	92
2017-2018	2.78	3.65	2432	2894	n/a	n/a	79

Table 2.1: Freshmen Admissions History for Last Five Years

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Full-time Students	285	276	311	334	323
Part-time Students	60	68	59	61	50
Students FTE[1]	323	316	347	373	352

Table 2.2: Enrollment Trends for Last Five Years

2.2 Evaluating Student Performance

This section presents the tools used by the Registrar's Office, Department Chair and the Professors for evaluating student performance.

2.2.1 Student Information System Software

The University of Puerto Rico at Bayamon (UPRB) has an in-house Student Information System (SIS) software. This system is used for evaluating the student performance and monitoring its progress through all its academic life. It contains data for all of UPRB's academic programs. The SIS includes:

- information about required/core courses and its pre-requisites
- produce course recommendations to the student regarding course sequences
- provides the information regarding graduation requirements.

2.2.2 University of Puerto Rico's Portal

Tasks that were previously performed through the SIS are slowly moving to the new system wide UPR Portal[2]. This is a Web based software that eventually will replace the SIS. New modules has been introduced in this new platform that replace some functionalities for the professors, students and administrators. It is envision that UPR Portal will replace the SIS in the future.

2.2.2.1 Tasks migrated to the UPR Portal

Professors use the UPR Portal to look at the official enrollment list, enter students' grades, generate the assistance report, and emailing the students enrolled in a specific course.

[2] http://portal.upr.edu

2.2.2.2 Pre-Registration Period

During the pre-registration period, each student receives an automated report containing suggested courses for the next semester based on the curriculum and the student's own performance. The student is allowed to make adjustments in his or her academic schedule within predefined parameters. Non-compliance with pre-requisites and co-requisites is avoided by the software. If the student has not obtained a passing grade in a pre-requisite course, then it is not allowed to be registered in the next course.

2.2.2.3 Freshmen or Transfer Students Process

An automatic registration for first semester courses is generated based on the curriculum, when the student is admitted. Transfer courses for which a student has obtained credit are input manually into the student's electronic record.

Each student is required to meet individually with either the department chair or any other designated person from the department's staff, if further advising is required. Also, the student should meet with the department chair for solving any particular issues that might arise during the enrollment process.

Finally, if everything is Ok, the system validates the registration. If some courses are not passed, continuation courses will be automatically deleted.

2.2.2.4 Graduation Requirements

The Registrar's Office uses the SIS to generate a list of graduation candidates. The student must requests graduation for further evaluation of its record. This record is evaluated finally evaluated by the program chair and, if favorable, a recommendation is made to the Registrar's Office. Finally, the degreee is awarded to the student.

2.3 Transfer Students and Transfer Courses

There are two types of transfer categories at the UPR each with their respective requirements: students from another program or another UPR unit, and students from outside the UPR system.

2.3.1 Students from another UPR unit

A transfer from one unit to another within the UPR System is possible for active and inactive students. Transfer requests are processed at each unit Registrar's Office according to the academic calendar. Students must meet the minimum requirements to be transfer to another unit:

- If the student has less than 30 credits approved at the UPR system, then his/her academic progress must be satisfactory. He or she must also have a General Admission Index (IGS) above the minimum established by the university.
- If the student has more than 30 credits approved at the UPR system, then his/her academic progress must be satisfactory and must meet the criteria established for the applied program.

2.3.2 Students outside the UPR system

Students attending or who have attended an accredited university, but have not studied at the UPR system previously, may apply for admission to the University of Puerto Rico at Bayamon. There

are two ways to do so:

- If the student has less than 30 approved credits, then, his/her IGS must be above the minimum established for the year when the student was admitted to the university where he/she is currently studying or has studied.
- If he/she has 30 or more approved credits, he/she must meet the desired program's admission criteria and must show academic progress.

The Registrar's Office of the unit that was previously hosting the student, must send the necessary documentation within the dates specified in the academic calendar to the new academic unit. Then, the Registrar's Office, of the new unit, sends the documents to the department chair for further evaluation. The Registrar's Office, of the new academic unit, informs the final decision to the student. A similar process is used for students wanting to transfer from other universities.

Transfer requests for the spring semester are considered based on course availability. At the UPRB, transfer students must also comply with residency requirements. Residency consists of completing at least the last 25% of courses required to complete the program from which graduation is desired. The UPRB reserves the right to determine which courses are accredited to students who transfer from other higher education institutions. Transfer requests have a $33.00 non-refundable fee. The request must be submitted to the UPRB Admissions Office before the deadline. Requests submitted after the deadline are considered late and have a fee of $49.50. Table 2.3 presents the number of students admitted through the transfer process for the past five years.

2.3.3 Reclasification

Reclassification is the process which allows students to switch to a different academic program within the same UPR campus. The student must meet the following requirements:

- If the student has less than 30 approved credits, he or she must also have a General Admission Index above the minimum established for the year in which he or she was admitted at the university.
- If the student has 30 or more approved credits, he or she must have had satisfactory academic progress at the program where he or she was originally admitted.

Students must submit a reclassification request according to the dates specified in the academic calendar.

If the student is accepted to the program, the department chair is responsible for determining which of the student's previous courses are accepted according to a table. The UPR reserves the right to accept transfer credits for courses completed with a minimum grade of "C" at an institution of higher education other than the UPR. The university may accept up to half of the credits corresponding to the student's major. The accepted credits appear with a "P" on the transcript, and will be added to the number of credits required for the degree sought, however, the courses will not be used to calculate the student's general GPA[3]. Veteran students or their beneficiaries who transfer to the UPRB must submit an official transcript from all the institutions where they studied, before being certified.

[3]Certification No. 064-1999-2000 of the Academic Senate of the University of Puerto Rico at Bayamon

Academic Year	Transfer Students
2013-2014	6
2014-2015	22
2015-2016	24
2016-2017	25
2017-2018	5

Table 2.3: Transfer Students for Past Five Academic Years

2.4 Advising and Career Guidance

The UPRB Counseling and Orientation Department serves towards strengthening academic, emotional and social aspects and promoting students' integration as future professionals into society. It fosters the creation of a university environment based on prevention, lessens risk factors that affect academic achievement and promotes effective psycho-environments that benefit the academic, social and mental development of students and the general academic community. This is achieved by working together with the faculty and staff. The services provided by the UPRB Counseling and Orientation Department include:

- Personal Counseling: for dealing with delicate situations related to crisis, mental health, and problems derived from circumstances that may affect academic performance.
- Career Counseling: helps students to develop decision-making skills regarding future professional life and to clarify academic goals. Occupational tests are offered, as well as access to career information.
- Educational Counseling: provides information about procedures, regulations, norms and academic offerings, including help with academic and administrative probation and transfers, among others.
- Psychological Services: offers therapy, crisis intervention and interventions that address student development needs.
- Referral Services: in special situations, counselors may refer cases to professional resources outside the community.

The UPRB Counseling and Orientation Department is currently working towards achieving accreditation by the International Association of Counseling Services (IACS). The UPRB also has a Career Development and Placement Center that helps students to develop the necessary skills and attitudes to plan and develop for their careers. The Center also serves as a liaison between students, industries, professors and the administration for the creation, dissemination and development of new job opportunities. It also supports the business community by facilitating its presence in the Institution and addressing its needs for qualified personnel. The Center organizes activities such as the Annual Employment Fair for University students, on-campus recruitment, resume clinics, lectures and visits to companies with Faculty and students. The services offered by the Center include:

- Services to university students:
  - Education on full-time or part-time job searching.
  - Development of internship opportunities.
  - Resume writing and editing services on an individual basis and through resume clinics.
  - Preparation for job interviews.
  - Orientations on time management for working and studying.
  - Coordinate and promote new employment experiences.
- Services to companies and recruiters:

  - Pre-screening of candidates for new job opportunities.
  - Access to student resume banks created by the academic programs.
  - Promotion and publication of employment opportunities among students and faculty.
  - Group recruitment at the University.
  - Resume referrals.
  - Serve as a liaison between student organizations, companies and the Institution to develop special projects such as personnel training, scholarships, and grants.

In addition, counseling services are also provided by the Department Chair at the time of course selection and enrollment or through appointments throughout the year. Faculty members also offer informal guidance regarding courses and careers.

2.5 Graduation Requirements

To obtain a degree at the UPRB, students must meet the following requirements:

- Pass the required courses with minimum general and major GPAs of 2.00.
- Meet residency requirements for the institution. This means taking at the UPRB and passing the courses corresponding to the last 25% of the total courses in the program[4].
- Complete all courses required for the degree in a period of time that is less than twice the amount of time established for the academic program. If the student takes longer, he or she may be asked to repeat or take a comprehensive exam for the courses that the Director of the program determines that need to be reviewed.
- Meet all financial obligations with the institution.
- Fill out the Graduation Request Form available at the Registrar's Office at the beginning of the semester or period in which he or she should be completing all the requirements.
- Obtain a recommendation for graduation from the Director of the Department.
- Have maintained good conduct during his or her university career.

The University holds commencement ceremonies at the end of the second semester. Students who meet the graduation criteria in the summer or in December may apply for a certificate of completion of the degree at the end of that academic session.

[4]Certification No. 022-1999-2000 of the Academic Senate of the University of Puerto Rico at Bayamon

3. Criterion 2. Program Educational Objectives

3.1 General Mission of the University of Puerto Rico

Art. 2. Objectives of the University of Puerto Rico. (18 L.P.R.A. sec. 601)[1]

1. The University, as a higher education organ, because of its service duty to Puerto Rico and its due faithfulness to the ideals of an integrally democratic society, has the essential mission of reaching the following objectives, which are in coexistence with the widest freedom in teaching and scientific research:
   (a) To transmit and increase knowledge through the sciences and the arts, placing it at the service of the community through the action of its professors, researcher students, and alumni.
   (b) Contribute to the cultivation and enjoyment of culture's ethical and esthetical values.
2. In the faithful fulfillment of its mission, the University must:
   (a) Conserve, enrich and disseminate Puerto Rico's cultural values and the strengthening of the unit's conscience in the common task of finding solutions to problems in a democratic fashion.
   (b) Seek the student's full development and instill a sense of an individual' responsibility towards the general good of the community.
   (c) Develop fully an intellectual and spiritual richness in our people so that the intelligence and spirit of those exceptional individuals that arise in all social levels, especially the economically underprivileged, can be of service to the Puerto Rican community.
   (d) Collaborate with other organizations within the action sphere appropriate for the University in the study of Puerto Rico's problems.
   (e) Remember that, because of its nature as a university and its identification with Puerto Rico's ideals, the University of Puerto Rico shares in an essential manner with the values and interest of the whole democratic community.

[1] As established in Article 2 of Puerto Rico's Law #1 from January 20, 1966, also known athe Law of the University of Puerto Rico: http://www.lexjuris.com/ LEXMATE/ educacion/ lex66001.htm - *Spanish document*

(f) Cultivate the love for learning as it leads to freedom and stimulate the search and discussion of knowledge in an atmosphere of respect and creative dialog.

3.2 Mission of the University of Puerto Rico at Bayamon (UPRB)

To facilitate significant, continuous and long-lasting learning with the ultimate goal of having students become responsible citizens who will help transform the world with a heightened sense of the ethics, aesthetic and actions that will contribute to change. To achieve this, the institution should advocate the establishment of support systems for learning, research and collaboration with the Puerto Rican society[2].

3.3 Vision and Mission of Computer Science Department

The vision and mission of the CS department have changed over time. It is part of our Continuous Improvement Plan presented in Chapter 5. We have held meetings with our External Advisory Board to revised the vision and mission in more than one occasion. The vision and mission was revised following a recommendation of the faculty during the 2013-2016 cycle. The vision and mission changes were suggested by the EAB.

Previous Vision:

The Computer Science Department aims to offer the most successful program in this discipline in Puerto Rico

Current Vision:

The Computer Science Department aims to have the leadership and academic excellence to develop competent professionals in computing.

Previous Mission:

Provide university education in the discipline of Computer Science forming graduates capable of responding to the demands of society as professionals of excellence. We want our students to develop the academic and professional skills necessary for optimum performance within a framework of accountability with their peers and society in general.

Current Mission:

Develop professional entrepreneurs with high ethical standards by offering higher education in computing. Our focus is to develop academic skills, leadership and collaboration.

3.4 Program Educational Objectives

After completing the program, the graduate should be able to:

1. Our graduates will have the professional competences that will add value to their careers in Computer Science and/or Information Systems

[2] As published in the UPRB Catalog, page 5: http://docs.uprb.edu/ dec-academico/ catalogo/ english-version.pdf

2. Our graduates will apply mathematical tools, problem solving skills, and essential knowledge in the process of computational solution development in the practice of Computer Science, Information Systems and/or related application areas.
3. Our graduates will demonstrate a sense of societal, human, and ethical responsibility in their professional endeavors.
4. Our graduates will engage in professional development or post-graduate education amid future technological changes as well as to the needs of society.
5. Our graduates will communicate effectively in English and Spanish.
6. Our graduates will perform efficiently in team environments either as members or leaders.

Program graduates achieve some of the PEOs as a result of experiencing a meaningful, continuous and lasting learning process through the formative years at the university. They are align with the institutional mission. The PEOs are integral in nature, as them contemplates how the graduate will perform at a broader level[3]. The PEOs enables the graduate to collaborate, not only with the Puerto Rican society, but also at a global scale by appreciating current social, environmental and ethical issues.

3.5 Program Constituencies

The Computer Science Department has identified the following as the constituents of its two programs:

- Department Faculty - Faculty members who teach the courses and who are in direct contact with the students, often providing informal academic and professional counseling and serving as mentors and role models.
- Students - who are currently enrolled in the program - They are the essence of the program. They also benefit as a group from the improvements to the program, not only through courses, but also, other activities which prepare them for their careers.
- Program alumni - They have experienced the transition from students to professionals at first hand. They have passed the experience of seeking that first job opportunity nowadays. Once employed, they have been through particular on-the-job training, promotions, downsizing, and other real-life experiences. As such, they tend to have a clear perspective of how the program has prepared them to face daily challenges. Also they know if there is room for improvement.
- UPRB Administration - University administrators participate in the daily decision-making process and long-term challenges that can directly or indirectly affect the program. They have a clearer perspective of the strengths and weaknesses of the program. They can see the program with another perspective.
- Staff members - Staff members continuously play an important supporting role in the daily activities of the department. Staff members aid the enrolled students with tasks such as the enrollment process, handing out program literature, and assisting them with computer issues. On occasion, they listen to students concerns and can provide feedback to the faculty regarding day-to-day issues.
- Employers - Employers have direct contact with program graduates and can providinformation as far as their needs in new employee knowledge, skills and attitudes. Theare direct beneficiaries of the program and can contribute clear and precise inpuregarding trends in the market.

[3] As a professional that can communicate with others and is well aware of its surrounding environment

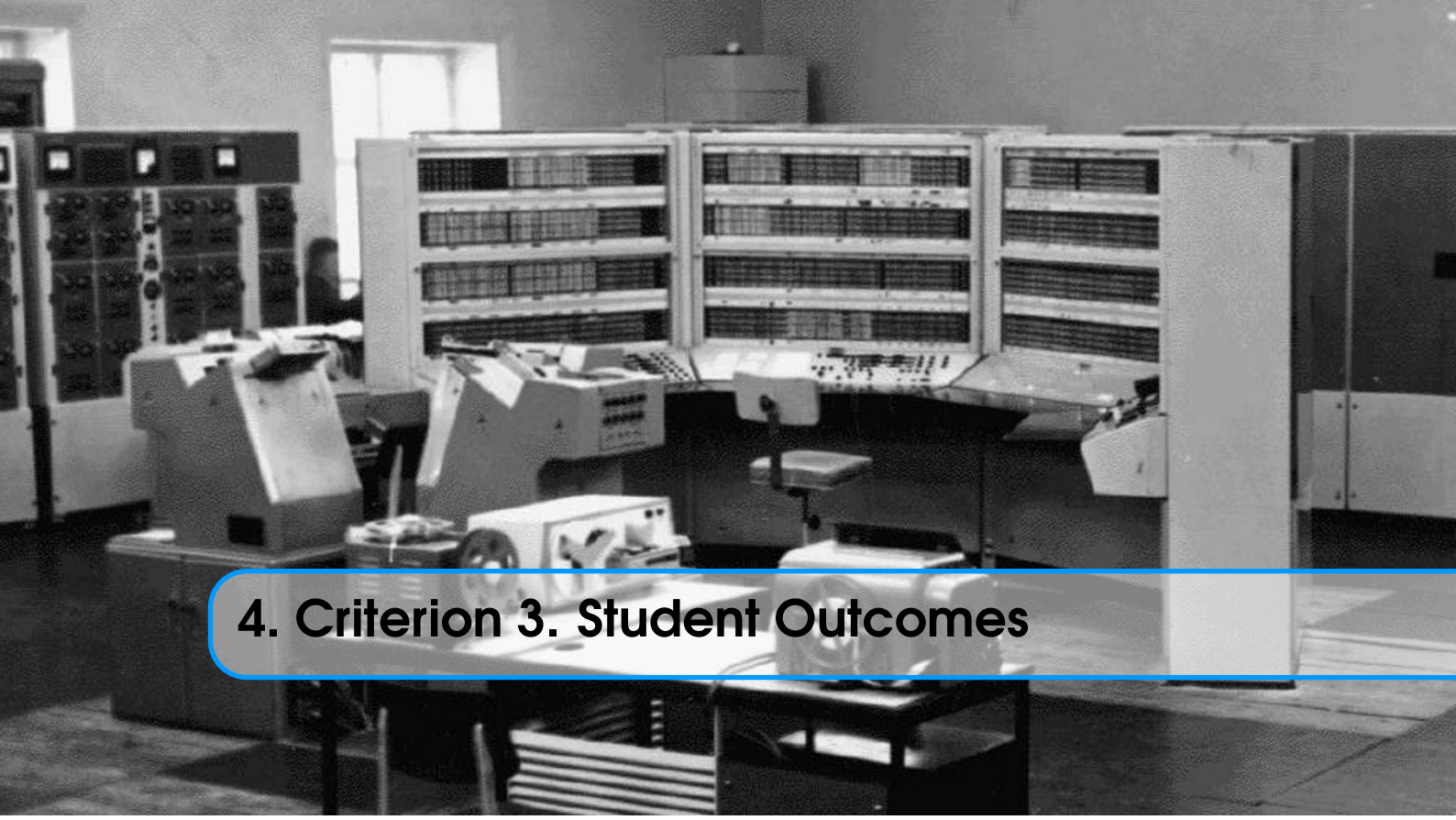
- Representatives of other related industry sectors - Even though these do nonecessarily employ recent program graduates, they are an integral part of a bigger grouthat sees where the local and global market trends are moving and can provide a broadeperspective as far as to the direction in which the program should evolve.

Other program constituents include prospective high-school students and the parents of present and future students, among others. The Department considers these to be indirect constituents and keeps them informed of improvements to the programs through the Department's web page which is open to the general public, and activities such as the Department's open-house.

3.6 Process for Review of the Program Educational Objectives

The department's program educational objectives are review by the AAC. The AAC determines if the PEO's need revision. If the PEOs are revised, updated or rephrased, they are presented to the constituents for discussion, evaluation and approval. This entails presenting the changes to the External Advisory Committee and the faculty for further discussions and modifications. The changes are finally submitted to the Dean of Academic Affairs for final approval, if necessary.

A request for the revision of the Program Educational Objectives can also originate from the External Advisory Board, the students, or a faculty member, in which case the same procedure described above applies.



4. Criterion 3. Student Outcomes

4.1 Process for the Revision of the Student Outcomes

The AAC adopted the student outcomes for the CS and IS programs drafted by ABET[1] We choose this alternative since the alignment of the ABET student outcomes with our PEOs was straightforward. The student outcomes were aligned with the PEOs and with the Institutional Educational Objectives[2]. Section 4.2 presents the Student Outcomes and the way they were classified for emphasis areas. Section 4.3 presents the mapping between the Educational Objectives and the Student Outcomes as well as the mapping within the courses. During the 2013-2016 cycle, the performance indicators (PI) of each outcome were revised. The student outcomes were divided into twenty nine (29) performance indicators for the Computer Science program and twenty seven (27) for the Information System program. These are presented in Chapter 5.

4.2 Student Outcomes

The student outcomes are categorized in three. Section 4.2.1 presents the core student outcomes. These student outcomes are common to both CS and IS. Section 4.2.2 presents additional outcomes for the students enrolled on the Computer Science emphasis area. Section 4.2.3 presents the outcomes for the students in the Information Systems area.

4.2.1 Core Outcomes

The outcomes presented in this section are common for all students enrolled in the Computer Science department.

- (a) An ability to apply knowledge of computing and mathematics appropriate to the discipline.

[1] Criteria for Accrediting Computing Programs Version 1.0
[2] Educational Goals

- (b) An ability to analyze a problem, identify and define the computing requirements appropriate to its solution.
- (c) An ability to design, implement, and evaluate a computer-based system, process, component or program to meet desired needs.
- (d) An ability to function effectively on teams to accomplish a common goal.
- (e) An understanding of professional, ethical, legal, security and social issues and responsibilities.
- (f) An ability to communicate effectively with a range of audiences.
- (g) An ability to analyze the local and global impact of computing on individuals, organizations, and society.
- (h) Recognition of the need for and an ability to engage in continuing professional development.
- (i) An ability to use current techniques, skills, and tools necessary for computing practices.

4.2.2 Student Outcomes of the Computer Science Emphasis Area

The outcomes presented in this section are exclusive for all students enrolled in the Computer Science emphasis area.

- (j) An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices
- (k) An ability to apply design and development principles in the construction of software systems of varying complexity

4.2.3 Student Outcomes of the Information Systems Emphasis Area

The outcomes presented in this section are exclusive for all students enrolled in the Information Systems emphasis area.

- (j) An understanding of processes that support the delivery and management of information systems within a specific application environment.

4.3 Student Outcomes Mapping

This section presents different mappings between the Student Outcomes, the Educational Objectives, the Institutional Objectives, and the Courses. Table 4.1 presents the relationship between the Educational Objectives and the Student Outcomes.

4.4 Enabled Student Characteristics

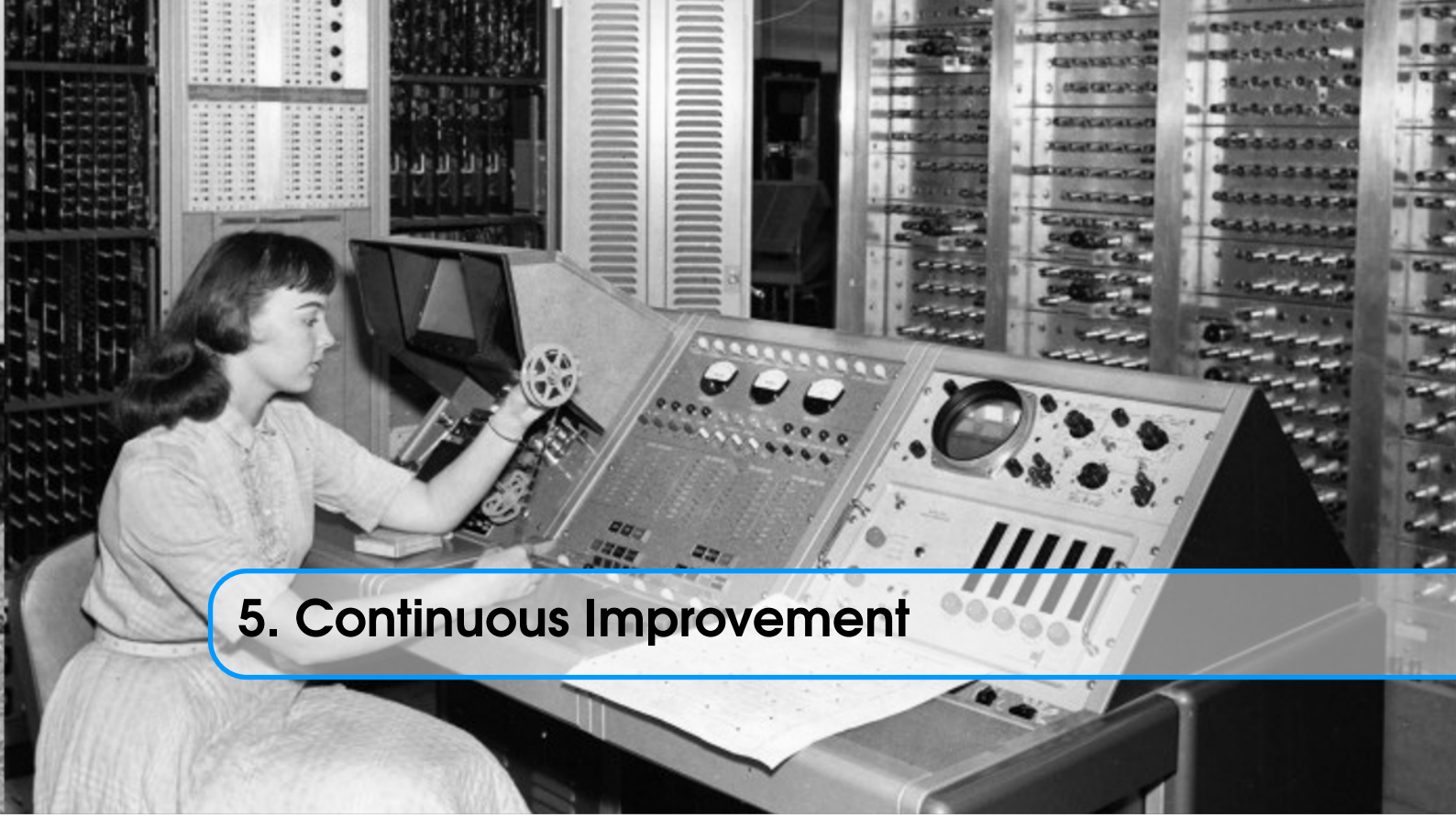
There are two main tools to measure the attainment of the student outcomes. These are the post-test and the graduate questionnaire. Both tools the post-test and the graduate questionnaire are imparted as part of the Capstone Course (SICI 4038). The post-test have been revised two times and aims to measure all the PIs. There are a few performance indicators that are not measured through the post-test. Rubrics and data obtained directly from the courses are used to assess these PIs. Through the PIs, the AAC determines if the student outcomes are met.

Educational	Core Outcomes									CS		IS	
Objectives	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(j)	Totals
1	✓	✓	✓	✓					✓	✓			6
2	✓	✓	✓						✓	✓	✓	✓	7
3					✓		✓						2
4								✓	✓				2
5						✓							1
6				✓									1
	2	2	2	2	1	1	1	1	3	2	1	1	

Table 4.1: Educational Objectives vs. Student Outcomes Mapping

Ambiguity could arise between the results from the post-test and the graduate questionnaire. If this is the case, then, the AAC contacts faculty to obtained additional data from the courses. Triangulation is done after the analysis of the data from the post-test, questionnaire and the data obtained from the courses. Then, the AAC determines the level of success.

Chapter 5 presents the continuous improvement plan that further explain the process to determine the attainment of the student outcomes.



5. Continuous Improvement

This Chapter emphasizes in Continuous Improvement. The Continuous Improvement Plan (CIP) encompasses an ongoing effort to improve our programs over time. This Chapter is divided as follows. Section 5.1 present the Student Outcomes and the way they are measured. Section 5.2 presents the Assessment Process and the way it is carried out. Also this section presents the expected level of attainment for each outcome. Also Section 5.2 presents how the results are documented and maintain. The results summary is presented in 5.3. However, more detailed analysis is presented in Appendix E. Section 5.4 presents reflections about out three year cycle. The materials that will be available for review during the visit are presented in Section 5.5. Documents related to the assessment process are discussed and presented in Section 5.6.

5.1 Student Outcomes and Performance Indicators

The Assessment and Accreditation Committee (AAC) decided to use Performance Indicators (PIs) to measure the attainment level of each Student Outcome (SO). Therefore, each SO is divided into several measurable performance indicators. This aims to simplify the way the SOs are analyzed. Each PI includes an action verb that describe the type of learning been measured. A list of these action verbs were download from the official ABET website. This list is grouped by three types of learning (cognitive, affective and psycho-motor). It was decided that direct assessment methods for each type of learning would be used as follows:

- Cognitive learning: measured through mostly on the Post-Test.
- Affective learning: measured through behavioral observation rubric
- Psychomotor learning: - not measured at all -[1]

[1] Notice that none of the performance indicators drafted covered Psycho-motor learning. The nature of our program does not covered this aspect.

5.1.1 Student Outcomes and their corresponding Performance Indicators

The program outcomes and their corresponding performance indicator are available online at out website[2]. However, they are also included here.

5.1.1.1 Computer Science

The Student Outcomes for the Computer Science (CS) program are the following:

- a. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
  - (a.1) Select the appropriate algorithm for a specific situation (Cog-Knowledge).
  - (a.2) Analyze the asymptotic running time of algorithms using big-O notation (Cog-Analysis)
  - (a.3) Apply mathematical concepts in the solution of a given problem (Cog-Application)
- b. An ability to analyze a problem, identify and define the computing requirements appropriate to its solution.
  - (b.1) Analyze a problem (Cog-Analysis)
  - (b.2) Identify and define the computational requirements needed in a real situation (Cog-Synthesis).
  - (b.3) Choose the appropriate software and/or hardware tools to meet the desired goals (Cog-Evaluation).
- c. An ability to design, implement, and evaluate a computer-based system, process, component or program to meet desired needs.
  - (c.1) Design solutions using pseudo code, diagrams or natural language (Cog-Synthesis).
  - (c.2) Implement an algorithm using the appropriate programming language (Cog-Application).
  - (c.3) Perform both unit and systems testing (Cog-Evaluation).
- d. An ability to function effectively on teams to accomplish a common goal.
  - (d.1) Evaluate a given problem within a team environment (Cog-Evaluation).
  - (d.2) Perform the duties assigned when working on a team (Affective-Responding).
- e. An understanding of professional, ethical, legal, security and social issues and responsibilities.
  - (e.1) Evaluate the ethical implications of an issue in the computing discipline (Cog-Evaluation).
  - (e.2) Evaluate the social impact of a given computing technology (Cog-Evaluation).
  - (e.3) Recognize the responsibilities inherent to the profession (Cog-Knowledge).
- f. An ability to communicate effectively with a range of audiences.
  - (f.1) Present different topics both orally and/or in writing (Affective-Responding).
  - (f.2) Explain technical concepts using the correct terminology (Affective-Valuing).
  - (f.3) Display knowledge of technical report writing skills (Cog-Knowledge)
- g. An ability to analyze the local and global impact of computing on individuals, organizations, and society.
  - (g.1) Understand computational or technological advances and their impact on individuals, organizations and society. (Cog-Comprehension).
  - (g.2) Recognize the global and local impact of a given technology (Cog-Knowledge).
  - (g.3) Be aware of the state of the art in computing technology (Cog-Comprehension).
- h. Recognition of the need for an ability to engage in continuing professional development.
- i. An ability to use current techniques, skills, and tools necessary for computing practices.
  - (i.1) Use hardware and software tools currently available (Cog-Application).

[2] http://sici-acred.uprb.edu

  - (i.2) Use current techniques and skills in the practice of the profession (Cog-Application).
- j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices.
  - (j.1) Solve problems using the principles from discrete mathematics (Cog-Application).
  - (j.2) Solve problems using the principles from continuous mathematics (Cog-Application).
  - (j.3) Determine the most appropriate data structures needed to solve a given problem (Cog-Evaluation)
  - (j.4) Appraise whether a given problem has a computational solution (Cog-Evaluation).
  - (j.5) Determine the most appropriate programming paradigm needed to solve a problem (Cog-Evaluation).
- k. An ability to apply design and development principles in the construction of software systems of varying complexity.
  - (k.1) Perform object oriented and structured analysis and design of software systems (Cog-Application).
  - (k.2) Construct software systems of varying complexity (Cog-Synthesis).

Table 5.1 presents where each PI is measured. Also the table presents the courses and which instruments are used to measured each PI.

PI	Core IS/CS	Instruments
(a.1)	Core	Post-Test, Grad. Questionnaire
(a.2)	Core	Post-Test, Grad. Questionnaire
(a.3)	Core	Post-Test, Grad. Questionnaire
(b.1)	Core	Post-Test, Grad. Questionnaire
(b.2)	Core	Post-Test, Grad. Questionnaire
(b.3)	Core	Post-Test, Grad. Questionnaire
(c.1)	Core	Post-Test, Grad. Questionnaire
(c.2)	Core Core	Course:SICI 4038 (Capstone) (projects), Grad. Questionnaire Course:CS: COTI-4039 Comp. of Prog. Languages (coursework)
(c.3)	Core	Course:SICI-4036 Data Structures (rubric), Grad. Questionnaire
(d.1)	Core	Course:SICI-4037 Data Communications (rubric), Grad. Questionnaire
(d.2)	Core	Course:SICI-4037 Data Communications (rubric), Grad. Questionnaire
(e.1)	Core	Post-Test, Grad. Questionnaire
(e.2)	Core	Post-Test, Grad. Questionnaire
(e.3)	Core	Post-Test, Grad. Questionnaire
(f.1)	Core	Course:SICI-4037 Data Communications (rubric), Grad. Questionnaire
(f.2)	Core	Course:SICI-4019 Computer Architecture (rubric), Grad. Questionnaire
(f.3)	Core	Course:SICI-4019 Computer Architecture (rubric), Grad. Questionnaire
(g.1)	Core	Post-Test, Grad. Questionnaire
(g.2)	Core	Post-Test, Grad. Questionnaire
(g.3)	Core	Post-Test, Grad. Questionnaire
(h)	Core	Cont. Education Questionnaire, Grad. Questionnaire
(i.1)	Core	SICI-4036 Data Structures (rubric), Grad. Questionnaire
(i.2)	Core	SICI-4036 Data Structures (rubric), Grad. Questionnaire
(j.1)	CS only	Post-Test, Grad. Questionnaire
(j.2)	CS only	Post-Test, Grad. Questionnaire
(j.3)	CS only	Post-Test, Grad. Questionnaire
(j.4)	CS only	Post-Test, Grad. Questionnaire
(j.5)	CS only	Post-Test, Grad. Questionnaire
(k.1)	CS only	SICI 3015 Analysis and Design (coursework), Grad. Questionnaire
(k.2)	CS only	SICI 4038 (Capstone) (project), Grad. Questionnaire

Table 5.1: Instruments used to measure the PIs for the CS Program

5.1.1.2 Information Systems

The Student Outcomes for the Information Systems (IS) program are the following:

- a. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
  - (a.1) Select the appropriate algorithm for a specific situation (Cog-Knowledge).
  - (a.2) Analyze the asymptotic running time of algorithms using big-O notation (Cog-Analysis)
  - (a.3) Apply mathematical concepts in the solution of a given problem (Cog-Application)
- b. An ability to analyze a problem, identify and define the computing requirements appropriate to its solution.
  - (b.1) Analyze a problem (Cog-Analysis)
  - (b.2) Identify and define the computational requirements needed in a real situation (Cog-Synthesis).
  - (b.3) Choose the appropriate software and/or hardware tools to meet the desired goals (Cog-Evaluation).
- c. An ability to design, implement, and evaluate a computer-based system, process, component or program to meet desired needs.
  - (c.1) Design solutions using pseudo code, diagrams or natural language (Cog-Synthesis).
  - (c.2) Implement an algorithm using the appropriate programming language (Cog-Application).
  - (c.3) Perform both unit and systems testing (Cog-Evaluation).
- d. An ability to function effectively on teams to accomplish a common goal.
  - (d.1) Evaluate a given problem within a team environment (Cog-Evaluation).
  - (d.2) Perform the duties assigned when working on a team (Affective-Responding).
- e. An understanding of professional, ethical, legal, security and social issues and responsibilities.
  - (e.1) Evaluate the ethical implications of an issue in the computing discipline (Cog-Evaluation).
  - (e.2) Evaluate the social impact of a given computing technology (Cog-Evaluation).
  - (e.3) Recognize the responsibilities inherent to the profession (Cog-Knowledge).
- f. An ability to communicate effectively with a range of audiences.
  - (f.1) Present different topics both orally and/or in writing (Affective-Responding).
  - (f.2) Explain technical concepts using the correct terminology (Affective-Valuing).
  - (f.3) Display knowledge of technical report writing skills (Cog-Knowledge)
- g. An ability to analyze the local and global impact of computing on individuals, organizations, and society.
  - (g.1) Understand computational or technological advances and their impact on individuals, organizations and society. (Cog-Comprehension).
  - (g.2) Recognize the global and local impact of a given technology (Cog-Knowledge).
  - (g.3) Be aware of the state of the art in computing technology (Cog-Comprehension).
- h. Recognition of the need for an ability to engage in continuing professional development.
- i. An ability to use current techniques, skills, and tools necessary for computing practices.
  - (i.1) Use hardware and software tools currently available (Cog-Application).
  - (i.2) Use current techniques and skills in the practice of the profession (Cog-Application).
- An understanding of processes that support the delivery and management of information systems within a specific application environment.
  - (j.1) Analyze the information flow in an organization (Cog-Analysis).
  - (j.2) Understand the process operations within an organization (Cog-Comprehension).
  - (j.3) An ability to discern between transactional-processing system, management infor-

mation system, and decision support system (Cog-Evaluation).
- (j.4) Recommends viable solutions using computer systems as main solution (Cog-Evaluation).
- (j.5) Construct an Information System (Cog-Synthesis).

Table 5.2 presents where each PI is measured. Also the table presents the courses and which instruments are used to measured each PI.

PI	Core IS/CS	Instruments
(a.1)	Core	Post-Test, Grad. Questionnaire
(a.2)	Core	Post-Test, Grad. Questionnaire
(a.3)	Core	Post-Test, Grad. Questionnaire
(b.1)	Core	Post-Test, Grad. Questionnaire
(b.2)	Core	Post-Test, Grad. Questionnaire
(b.3)	Core	Post-Test, Grad. Questionnaire
(c.1)	Core	Post-Test, Grad. Questionnaire
(c.2)	Core Core	Course:SICI 4038 (Capstone) (projects), Grad. Questionnaire Course:IS: COTI-4150 Prog. Info. Systems (coursework)
(c.3)	Core	Course:SICI-4036 Data Structures (rubric), Grad. Questionnaire
(d.1)	Core	Course:SICI-4037 Data Communications (rubric), Grad. Questionnaire
(d.2)	Core	Course:SICI-4037 Data Communications (rubric), Grad. Questionnaire
(e.1)	Core	Post-Test, Grad. Questionnaire
(e.2)	Core	Post-Test, Grad. Questionnaire
(e.3)	Core	Post-Test, Grad. Questionnaire
(f.1)	Core	Course:SICI-4037 Data Communications (rubric), Grad. Questionnaire
(f.2)	Core	Course:SICI-4019 Computer Architecture (rubric), Grad. Questionnaire
(f.3)	Core	Course:SICI-4019 Computer Architecture (rubric), Grad. Questionnaire
(g.1)	Core	Post-Test, Grad. Questionnaire
(g.2)	Core	Post-Test, Grad. Questionnaire
(g.3)	Core	Post-Test, Grad. Questionnaire
(h)	Core	Cont. Education Questionnaire, Grad. Questionnaire
(i.1)	Core	SICI-4036 Data Structures (rubric), Grad. Questionnaire
(i.2)	Core	SICI-4036 Data Structures (rubric), Grad. Questionnaire
(j.1)	IS only	Post-Test, Grad. Questionnaire
(j.2)	IS only	Post-Test, Grad. Questionnaire
(j.3)	IS only	Post-Test, Grad. Questionnaire
(j.4)	IS only	COTI 4430 Project Management (coursework), Grad. Questionnaire
(j.5)	IS only	SICI 4038 (Capstone) (project), Grad. Questionnaire

Table 5.2: Instruments used to measure the PIs for the IS Program

5.1.2 Expected Level of Attainment

The performance indicators are measured using mostly the Post-Test and the Graduate Questionnaire. If there is discrepancy between these tools, then, data from the courses is analyzed for triangulation. The analysis of each performance indicators is as follows:

- Satisfactory (or met) - Level of achievement 75% or more (grade of A or B).
- Developing - Level of achievement 50% to 75% (grade of C).
- Unsatisfactory - Level of achievement of less than 50% (grade of D or F).

The level of achievement of each outcome depends directly on the level of achievement of each performance indicator. If all the performance indicators related to one outcome are achieved with a satisfactory level, then, the outcomes is classified as **met**. If the performance indicators related to an outcome at least have one with satisfactory level and none in unsatisfactory level, then, the outcome

is classified as **partially met**. Otherwise, the outcome is classified as **not met**. It is expected that most of the outcomes are classified as met.

Section 5.3 presents a summary of the results obtained on the Continuous Improvement Report. Appendix E presents in detail the analysis on the level of attainment for the program

5.2 The Assessment Process and the CIP

The Continuous Improvement Plan (CIP) encompasses an ongoing effort to improve our programs over time. Our previous plan was composed of seven phases or stages. However, it has evolved to eight phases/stages that must be completed at specific times.

The AAC decided to use a three year cycle for completing all the CIP. This cycle is discussed in Section 5.2.1. During this period activities are divided into non-recurrent, and recurrent events. The recurrent events are those events used to gathered important data from our students. The recurrent events are used to administered data gathering using the following instruments: Post-Test, Graduate Questionnaire, and Continuous Education and Career Path Questionnaire. These three instruments are administered every time SICI 4038 (Capstone Course) is offered. This course is offered each semester. Additional data is gathered through the use of rubrics and coursework. This data is gather every time the course is offered. The Post-Test is our main direct measuring tool. Graduate Questionnaire is our main non-direct measuring tool. The non-recurrent events are discussed in Section 5.2.2.

5.2.1 The Three Year Cycle

The AAC modified the assessment cycle for spanning more than two years. Previous CIP for the 2011-2012 Cycle indicated that the assessment cycle spanned two academic years[3]. The AAC decided to use a three year cycle instead after our experience with a two year cycle. The decision for choosing a three year cycle is tied to the curricular revision of August 2013. Freshmen that entered on August 2013 enrolled directly on the new programs. However, there are students from the August 2008 curriculum that changed to the new curriculum. The AAC has the required data to perform a final analysis in May 2016 from those students that are now enrolled into the new curriculum.

5.2.2 Stages of the Continuous Improvement Plan

Figure 5.1 presents the Continuous Improvement Plan Map. The plan consists of eight phases:

1. Educational Objectives, Student Outcomes and Performance Indicators Revision.
2. Course alignment, Syllabus Revision.
3. Post-Test Revision, Mission and Vision Revision, External Advisory Board and Faculty Meeting.
4. Surveys Revision and Delivered, Second Faculty Meeting.
5. Post-Test, Surveys and Preliminary Analysis.
6. Additional Data Gathered and Focus Groups.
7. Final Analysis and Recommendations.
8. Curricular Revision, Preparations for Next Cycle.

[3] from August 2011 to May 2013

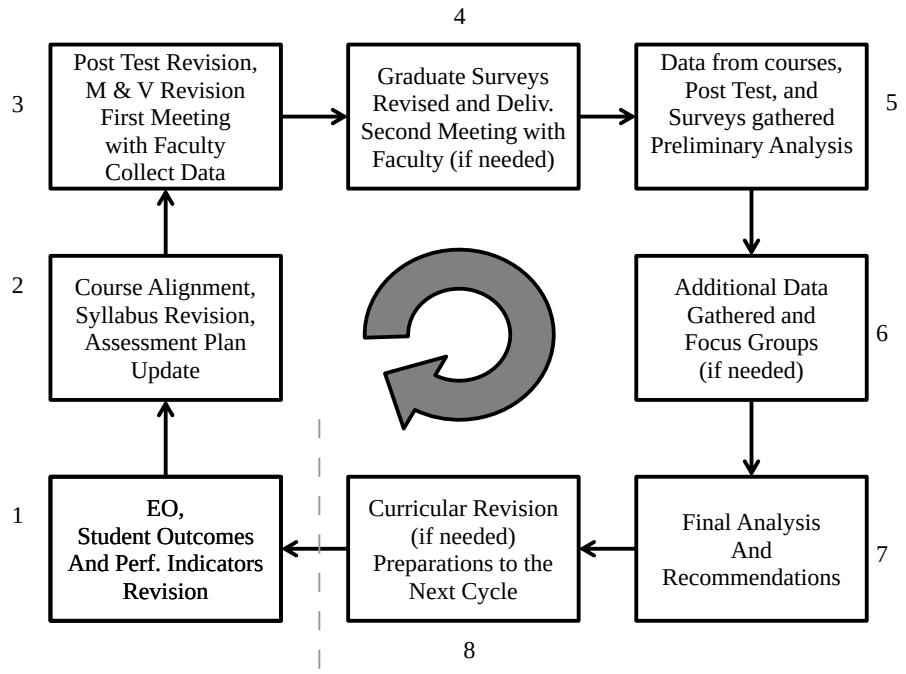


Figure 5.1: Continuous Improvement Plan Map

5.2.2.1 Educational Objectives, Student Outcomes and Performance Indicators Revision

Revision of the SOs could surface as a result of the previous cycle. Consequently, PIs could also change. This also could affect our Program Educational Objectives (PEO)s. The AAC must align them based on the recommendations obtained from the previous cycle. If there is a change on our SOs or PIs, the AAC should prepare a document stating the change[4].

Current PEOs are a result of the continuous improvement tasks. The process of revising the PEOs is as follows: The PEOs are presented to the External Advisory Board (EAB) and to the Department's Faculty for discussion, evaluation and approval. The AAC also evaluates the data gathered from Alumni Surveys. Suggestions gathered from this process are finally incorporated into the PEOs. The changes are then submitted to the Dean of Academic Affairs for final approval.

A request for the revision of the PEOs can also originate from the External Advisory Board or the faculty, in which case the same procedure described above would apply.

5.2.2.2 Course alignment, Syllabus Revision and Update to our Assessment Plan

Syllabi must be revised after the PIs have changed. After the PI revision, a modification to the alignment of the SOs with the courses for each program must be performed. It is possible that some courses need to be revised in order to include assessment tools to measure some PIs. Therefore, a faculty meeting is held to present the course alignment. This meeting or meetings could be held with all the professors or individually. The purpose of these meetings is to re-focus some courses.

[4]The External Advisory Board is key on this phase since they suggest changes to the program educational objectives

During this stage the professors make a compromise with the AAC of which assessment tools will be used to measure each PIs.

The Documents prepared at this stage are:

- Course alignment table
- Revised Syllabi.

5.2.2.3 Post-Test Revision, Mission and Vision Revision, External Advisory Board and Faculty Meeting

The AAC studies and revise the Post Test if needed. The Post Test is extremely important to the assessment process. The Post Test is the **main direct measure** of this process. Last Post Test revision was performed during the first semester of academic year 2015-2016. This new revision have been administered since December 2015. Currently the Post Test is administered using our institutional Moodle web site[5].

Also, the AAC considers to revised the Mission and Vision during this phase. This revision is made with the participation of all the constituents. The process is as follows. The AAC consults the faculty of our department first, then it consults the EAB. Further changes need to be suggested and approved by all the constituents, if and only if, there is a change in the wording of the Vision and Mission. If there is no change on the Mission and Vision there is no need to contact any constituents.

A faculty meeting is held to discuss the updated course alignment, and the assessment tools that will be used to measure the Student Outcomes. Also deadlines are set so the professors could hand in the material needed by the AAC on time.

Documents prepared or revised at this stage are:

- Post Test Revision document
- Mission and Vision revision document (optional).
- Course alignment tables (if needed).

5.2.2.4 Surveys Revision and Delivered, Second Faculty Meeting

A revision of the Alumni and Employers surveys is performed during this stage. Also the administration of the surveys begins at this stage. These surveys tend to capture quantitative and qualitative data of our program. The results are used to evaluate and assess our Program Educational Objectives. The data gathered by these surveys have to be analyzed as part of the Final Analysis at stage 7.

It is possible that we need another faculty meeting as a follow up of our continuous improvement process. Sometimes this meeting is needed to keep in touch with the schedule. If the Mission and Vision was modified it is presented to the faculty during this meeting.

Documents revised at this stage are:

- Employee Survey.
- Graduate Survey.

Alumni and employer surveys are tools used to assess alumni achievement of the PEOs. Respondents are allowed to select the level of achievement from four choices. These are (a) high, (b)

[5] http:// moodle.uprb.edu

intermediate, (c) low, or (d) does not apply. Alumni survey also includes questions for collecting data pertaining to the alumnus activities after graduation, including:

- How much time it took to complete the degree.
- Overall opinion of the education provided by the program
- Pursuing graduate studies or continuing education[6].
- Salary range
- Current position.
- If it works on the island, on the states or outside USA and the territories.
- Continuing education activities
- Professional certifications and associations.
- Interest in participating in focus groups or interviews pertaining to program ass essment

These answers are used for establishing tendencies as to what is the current competence the program graduates should have after obtaining the degree. One of the most important aspects we are considering is the feedback obtained when they are asked what technologies or materials should be applied to enrich the curriculum.

In addition to the employer and alumni surveys, focus groups and formal and informal interviews are included as a strategy to provide a deeper understanding of issues that might arise from the two surveys. For example, if a particular PEO is identified as being weak, the Assessment Committee can design a focus group from among the respondents to identify the causes of the weakness and establish possible improvements to the program to strengthen them.

The Employer Survey is administered after some tasks are performed a priori. First, the industries, government agencies, academic institutions, and organizations who have been employing our graduates are identified in collaboration with the placement office[7] of the UPRB. Then, unique keys are generated by the survey system an sent to each employer's contact via email including a link to our Continuous Improvement Website. The employer's contact access the survey with this key and answers it. The data gathered by this survey is used to assess the level of achievement of the PEOs. The employer survey also includes questions for collecting the following data:

- Type of organization that employs graduates.
- Number of program graduates hired.
- Number of new hires that the company expects for the next five years.
- Question for indicating new skills or knowledge that graduates should have.
- Invitation to participate in focus groups, interviews or as part of the External Advisory Committee.

The AAC analyze the results and separates the data according to areas of study within the survey, after receiving the completed employer and alumni surveys.

5.2.2.5 Post-Test, Surveys and Preliminary Analysis

The AAC compiles all the data gathered from the assessment tools (Post Test, questionnaires, surveys) needed to perform the analysis during this stage. Also a preliminary analysis is drafted formally. This gives the AAC an idea if there are extra materials needed to gather additional data. Also the AAC knows if focus groups are needed to discuss or analyze additional data.

Documents drafted at this stage are:

[6] ie. Certification
[7] Oficina de Empleos

- Continuous Improvement Report is at a very early stage.

5.2.2.6 Assessment via Focus Groups

This phase is a result of the previous phase. If the AAC determines that further analysis of the data obtained is needed focus groups are created. These groups could be composed of a subset of the program constituents[8].

Since this is a continuous improvement process it is possible that not all the data needed to perform a final analysis is available. If data is missing or needed to further strengthen the analysis of the preliminary results, the AAC could request to gather additional data on specific courses.

No documents are drafted during this stage.

5.2.2.7 Final Analysis and Recommendations

During this stage the Final Analysis is performed. The AAC meets regularly to analyze all the data gathered from previous stages. The Continuous Improvement Report is prepared for the IS and CS programs[9].

The AAC knows that there are some PIs that cannot be measured only via de Post Test or the Graduate Survey. These PIs are analyzed with other assessment tools (usually rubrics)[10]. Therefore, rubrics are used to measure them.

The achievement of each and every student outcome is classified based on the level of achievement of each performance indicator. The classifications used are:

- Met
- Partially Met
- Not Met

Finally, recommendations are drafted and presented to the faculty. A document named as *Implementation of Recommendations and Status Report* is drafted for each program of the Computer Science Department. This report must contain the status and the recommendations to improve on each and every criterion that is evaluated by the Accreditation Agency (or Agencies) that review our programs.

Documents drafted at this stage are:

- A final version is drafted of the Continuous Improvement Report.
- Implementation of Recommendations and Status Report

5.2.2.8 Preparations to the Next Cycle

This is a new stage that did not exist on previous CIP. This stage links the first and the last. We really began the three year cycle using this stage. A curricular revision resulted from previous cycle. Therefore, we needed time for readjusting to our new curriculum. We envision that this is a possible outcome of the CIP for the next cycle. The following tasks resulted from a curricular revision:

- Creation, adoption of new courses

[8] For example: faculty only, alumni only, faculty and students, faculty and the EAB etc.

[9] one for each program

[10] For example, outcomes: (d) An ability to function effectively on teams to accomplish a common goal, or, (f) An ability to communicate effectively with a range of audiences.

- Modification (update) of current courses
- Faculty approval of the modified curriculum
- Meeting with other departments
- Change on the pre-requisite structure of the courses
- Submitting the changes to higher echelons
- Approval of the changes by all the higher echelons
- Implementation of the changes at the department level
- Update of our promotional materials
- Changes on our SIS (Student Information System)
- Modification of the UPRB Website
- Orientation to our staff about the new curriculum
- Student orientations of our revised curriculum
- Offer to our currently enrolled student the option of changing to our revised curriculum.

The AAC nor the faculty of our department envision all this work in our previous CIP. Therefore, this stage was added to the CIP.

5.3 Summary of Results

Appendix E contains the Continuous Improvement Reports for the CS and IS programs. These two reports present the analysis and the attainment level of each outcome in detail. Also, each report presents recommendations and actions to take in order to increase the attainment level of each outcome. In addition, the report compare and contrast the results obtained from previous cycles.

Tables 5.3 and 5.5 present a summary of the level of achievement for each performance indicator and student outcomes for the CS and IS program respectively. Tables 5.4 and 5.6 presents a summary of the analysis exposed in the Continuous Improvement Report.

5.4 Reflections about our Three Year Cycle

This time the cycle was out of scheduled. As a department we should have ended this cycle on May 2016, however, due to the unrest of a strike and several natural disasters[11] the three year cycle was not completed until 2017. Even though, the "three-year" cycle was closed before this self study was produced. It has been very difficult to keep up with the proposed assessment schedule due to unfortunate events. We need to keep with the proposed schedule in the future.

5.5 Materials that will be available for review during the Visit

Our Continuous Improvement Plan is documented. Part of this documentation has been included in this Self-Study. However, the full extent of the documentation will be available for the visiting team. Also, we are currently uploading most of it into our assessment website. The documents, materials and tools that will be available for the review visit are:

- Continuous Improvement Plan (last version)
- Performance Indicators Revision Document (for both programs)
- Student Outcomes and Performance Indicators Course Alignment Tables (for both programs).

[11] Student strike, Hurricanes María and Irma

Perf. Ind.	Post Test	Grad. Quest	Courses	Other Tool	PI Level	Outcome Level
(a.1)	91%	92%			Satisfactory (or met)	Partially
(a.2)	56%	76%	71%		Developing	Met
(a.3)	49%	89%	74%		Developing	
(b.1)	73%	97%	81%		Satisfactory (or met)	Met
(b.2)	89%	83%			Satisfactory (or met)	
(b.3)	90%	84%			Satisfactory (or met)	
(c.1)	75%	95%			Satisfactory (or met)	Partially
(c.2)		87%	Capstone**		Satisfactory (or met)	Met
(c.3)		68%	SICI 4036**		Developing	
(d.1)		92%	76%		Satisfactory (or met)	Met
(d.2)		95%	76%		Satisfactory (or met)	
(e.1)	93%	88%			Satisfactory (or met)	Met
(e.2)	86%	80%			Satisfactory (or met)	
(e.3)	88%	87%			Satisfactory (or met)	
(f.1)		84%	86%, 96%		Satisfactory (or met)	Met
(f.2)		84%	89%		Satisfactory (or met)	
(f.3)		89%	88%		Satisfactory (or met)	
(g.1)	83%	84%			Satisfactory (or met)	Met
(g.2)	83%	84%			Satisfactory (or met)	
(g.3)	83%	80%			Satisfactory (or met)	
(h)		94%		91%	Satisfactory (or met)	Met
(i.1)		88%	86%		Satisfactory (or met)	Met
(i.2)		88%	93%		Satisfactory (or met)	
(j.1)	75%	80%			Satisfactory (or met)	Met
(j.2)	73%	82%			Satisfactory (or met)	
(j.3)	83%	87%			Satisfactory (or met)	
(j.4)	75%	87%			Satisfactory (or met)	
(j.5)	91%	80%			Satisfactory (or met)	
(k.1)		92%	81%		Satisfactory (or met)	Met
(k.2)		94%	Capstone**		Satisfactory (or met)	

Table 5.3: Achievement Level of the Outcomes for IS

- Preliminary Analysis Report.
- Gather Additional Data from Courses Document (work document).
- Final Analysis Report (for both programs).
- Post-Test Revision Document.
- Post-Test Sample.
- Graduate Questionnaire Sample.
- Continuous Education and Career Path Questionnaire Sample.
- Alumni and Employee Surveys (working documents)
- Other analysis documents

5.6 Copies of Documents of the CIP

Appendix E presents copies of some of the documents and tools used for our Continuous Improvement Plan. The AAC have included the Final Analysis Report for the CS and IS programs. Also, a sample of the Post-Test, Graduate Survey and the Continuous Education and Career Path Questionnaire are available online in http://sici-acred. uprb. edu.

Student Outcome	Attainment Level	Recommendations Summary
(a)	Partially Met	Improve PI (a.2), Reinforce PI (a.3)
(b)	Met	-
(c)	Partially Met	Improve PI (c.3)
(d)	Met	-
(e)	Met	Add or Modify PIs to include topics in Legal Aspects and Information Security
(f)	Met	-
(g)	Met	-
(h)	Met	However: Lecture could be given earlier
(i)	Met	However: Experience is only in the MS environment
(j)	Met	However: Post Test questions for PI (j.4) need revision
(k)	Met	-

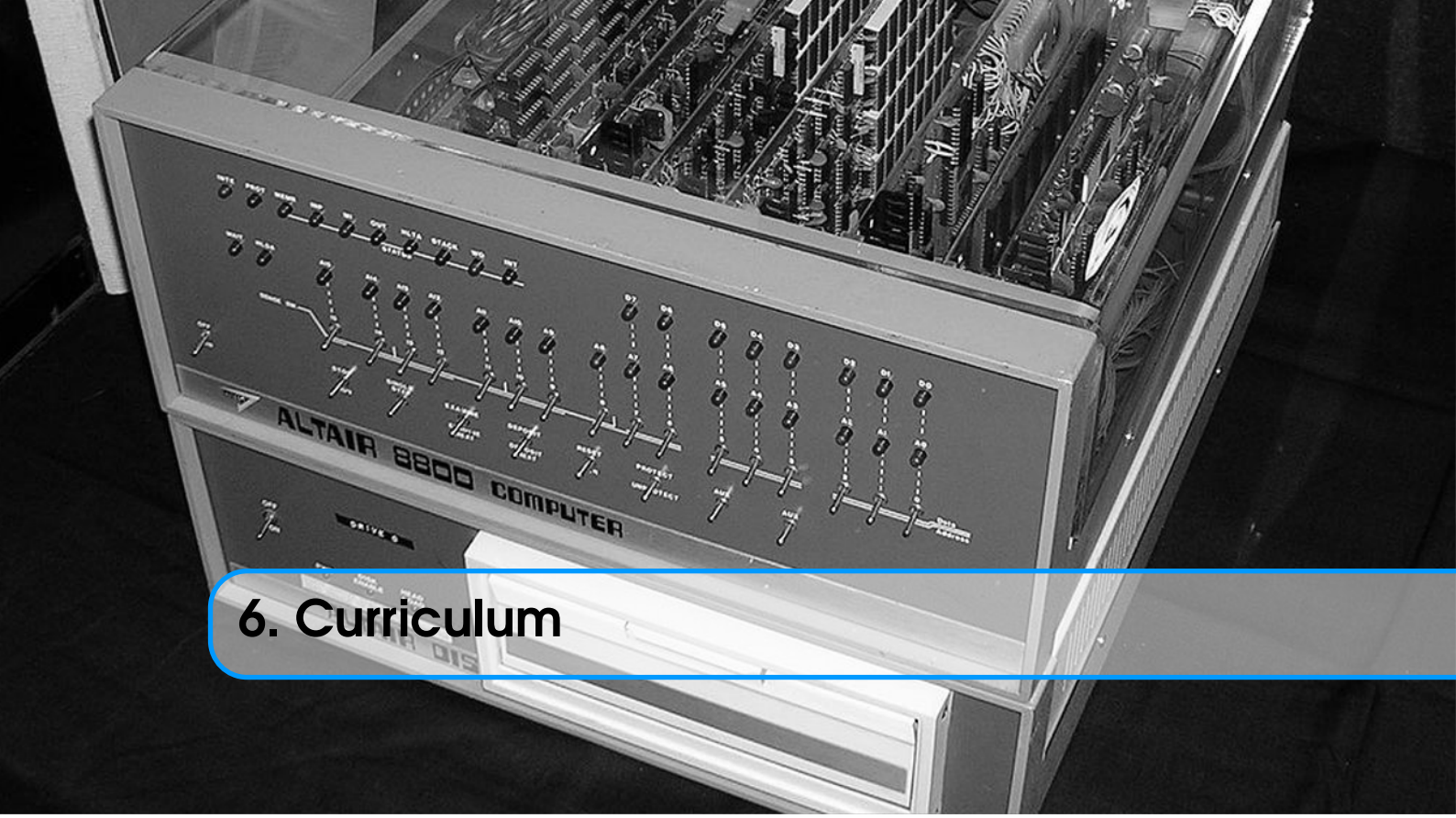
Table 5.4: Results and recommendations summary for CS

Perf. Ind.	Post Test	Grad. Quest	Courses	Other Tool	PI Level	Outcome Level
(a.1)	84%	89%			Satisfactory (or met)	Partially
(a.2)	43%	78%	71%		Developing	Met
(a.3)	40%	81%	87%		Satisfactory (or met)	
(b.1)	68%	98%	81%		Satisfactory (or met)	Met
(b.2)	79%	91%			Satisfactory (or met)	
(b.3)	85%	91%			Satisfactory (or met)	
(c.1)	50%	89%	82%		Developing	Partially
(c.2)		91%	Capstone**		Satisfactory (or met)	Met
(c.3)		72%	SICI 4036**		Developing	
(d.1)		92%	76%		Satisfactory (or met)	Met
(d.2)		95%	76%		Satisfactory (or met)	
(e.1)	90%	96%			Satisfactory (or met)	Met
(e.2)	75%	96%			Satisfactory (or met)	
(e.3)	83%	95%			Satisfactory (or met)	
(f.1)		84%	86%, 96%		Satisfactory (or met)	Met
(f.2)		84%	89%		Satisfactory (or met)	
(f.3)		89%	88%		Satisfactory (or met)	
(g.1)	94%	98%			Satisfactory (or met)	Met
(g.2)	77%	95%			Satisfactory (or met)	
(g.3)	92%	91%			Satisfactory (or met)	
(h)		90%		99%	Satisfactory (or met)	Met
(i.1)		88%	86%		Satisfactory (or met)	Met
(i.2)		88%	93%		Satisfactory (or met)	
(j.1)	62%	92%	84%		Satisfactory (or met)	Partially
(j.2)	36%	92%	74%		Developing	Met
(j.3)	75%	92%			Satisfactory (or met)	
(j.4)		97%	89%		Satisfactory (or met)	
(j.5)	97%		Capstone**		Satisfactory (or met)	

Table 5.5: Achievement Level of the Outcomes for IS

Student Outcome	Attainment Level	Recommendations Summary
(a)	Partially Met	Revision of questions for PI (a.3) in the post-test only for IS.
(b)	Met	However: Review questions for PI (b.1) for IS. They are the same questions for the CS program
(c)	Partially Met	Reinforce PI (c.1), Improve PI (c.3)
(d)	Met	-
(e)	Met	Add or Modify PIs to include topics in Legal Aspects and Information Security
(f)	Met	(Reflections)
(g)	Met	-
(h)	Met	However: Lecture could be given earlier
(i)	Met	However: Experience is only in the MS environment
(j)	Partially Met	Reinforce PI (j.2) and revise questions for this PI. Reinforce PIs (j.3) and (j.4)

Table 5.6: Results and recommendations summary for IS



6. Curriculum

6.1 Computer Science at UPRB

The Computer Science program at UPRB studies how to solve problems through the development of computer programs (software) and how to use the hardware required to run these programs (the hardware). Graduates of our Bachelor Degree in Computer Science possess the theoretical and practical knowledge in developing computer systems using state of the art technology.

The students on the current curriculum must choose an emphasis area when finalizing their sophomore year. These areas are: Computer Science or Information Systems. The area of Computer Science emphasizes on theory of computing, analysis of algorithms and comparison of programming languages. Students of these area covered fourteen (14) credits on science courses. The Information Systems emphasizes on the development and management of technologically complex information systems for commercial organizations. This program has a defined information system environment focused on business. Students on these area take fifteen credits (15) on the Business Administration Department.

6.1.1 Meeting ABET Criteria (CS Program)

The CS program meets with the ABET-CAC Criteria for Accrediting Computing Programs Version 1.0 for the Computer Science component and Math and Science Component. The CS Program has more than two years in coverage of the fundamentals of algorithms, data structures, software design, concepts of programming languages, computer organization and architecture. Also our students are exposed to a variety of programming languages and systems. Among these are: JAVA, F#, C, Prolog, PHP, Javascript, assembly language of MIPS among others. Most of our courses used JAVA as a way to introduce algorithmic concepts, data structures, client-server programming, threads, therefore, our students develop a proficiency by coding examples and projects using the language. Also, there are advanced courses that builds on the fundamental course work that provide depth. Among these are: Analysis of Algorithms, Data Communications, Capstone course, Computational

Theory among others. Also our program meets the math and science component. Our program has more than one half year in math which includes discrete mathematics, pre-calculus, numerical analysis, calculus and statistics. Also, our program has a Science component which includes Physics and elective courses in Biology or Chemistry with their respective lab components.

The student's load for the CS program is distributed as follows:

- 49 credits in Computer Science
- 23 credits in Math
- 14 credits in Science
- 33 credits in General Education
- 2 credits in Ethics
- 12 credits in Electives
- 3 hours (0) credits in Personal Development and University Success

6.1.2 Meeting ABET Criteria (IS Program)

The IS program meets with the ABET-CAC Criteria for Accrediting Computing Programs Version 1.0. The IS Program posses coverage of the fundamentals of application development, data management, networking and data communications, security of information systems, systems analysis and design and the role of Information Systems in organizations. Also our students are exposed to a variety of programming languages and systems. Among these are: JAVA, C#, PHP, Javascript, assembly language of MIPS among others. Most of our courses used JAVA as a way to introduce algorithmic concepts, data structures, client-server programming, threads, therefore, our students develop a proficiency by coding examples and projects using the language. Also, there are advanced courses that builds on the fundamental course work that provide depth. Among these advanced courses are: Programming of Information Systems, Project Management and the CAPSTONE course. The IS program includes a cohesive set of topics that provide and understanding of business environment. This environment include courses in Accounting, Economics, Administrative Theory and Entrepreneurship. Also, students on the IS program are required to take more than one half year in math courses. Among these are: pre-calculus, calculus and statistics.

The student's load for the IS Program is distributed as follows:

- 48 credits in Computer Science
- 20 credits in Math
- 6 credits in Science
- 33 credits in General Education
- 2 credits in Ethics
- 12 credits in Electives
- 15 credits in Business Administration
- 3 hours (0) credits in Personal Development and University Success

6.2 Our curriculum

Tables 6.1, 6.2 and 6.3 present the plan of study for students enrolled in the Computer Science program and tables 6.4, 6.5 and 6.6 present the plan of study for the Information Systems program. Both the CS and IS programs share the same first years. However, there is difference in both

programs on the third year and fourth year[1].

During the first and second semesters (tables 6.1 and 6.4) students could take two different English courses depending on the grades obtained from the College Board exam. Students that show proficiency in English should take INGL 3221 Introduction to English Literature I and INGL 3222 Introduction to English Literature II instead. If they take this advanced English courses, they do not have to take INGL 3113 English Lab I or INGL 3114 English Lab II.

The load is mostly the same for the general education, ethics and the free electives. The environment for the CS programs is in Science. Therefore, students enrolled in the CS program take 8 credits more in Science and 3 credits more in Math. The environment for the Information System program is Business. Notice that students in IS take 15 credits in Business Administration.

Course	Plan of Study Year	Type	Math & Science	Comp F or A	Gen. Educ.	Other	Last Two Terms the Course was Offered	Average Seciton Enrollment
1st Semester								
COTI 3101 Algorithms and Program Development I	1	R		F			2017-2018 F S	21
MATE 3171 Pre-Calculus	1	R	X				2017-2018 F S	N/A
CISO 3121 Intro. To Social Sciences I	1	R	X				2017-2018 F S	N/A
ESPA 3101 Basic Spanish I	1	R			X		2017-2018 F S	N/A
*INGL 31__ English Course 1st Year	1	R			X		2017-2018 F S	N/A
*INGL 3113 English I Laboratory	1	R			X		2017-2018 F S	N/A
++EDFU 3005 Personal Development and University Success Seminar	1	R				O	2017-2018 F S	30
2nd Semester								
COTI 3102 Algorithms and Program Development II	1	R		F			2017-2018 S	21
MATE 3172 Pre-Calculus	1	R	X				2017-2018 F S	N/A
CISO 3122 Intro. To Social Sciences II	1	R	X				2017-2018 F S	N/A
ESPA 3102 Basic Spanish I	1	R			X		2017-2018 F S	N/A
*INGL 31__ English Course 1st Year (2)	1	R			X		2017-2018 F S	N/A
*INGL 3114 English II Laboratory	1	R			X		2017-2018 F S	N/A
3rd Semester								
COTI 3205 Computer Organization	2	R		F			2017-2018 F S	20
SICI 3015 Systems Analysis and Design	2	R		F			2017-2018 F 2016-2017 F	20
MATE 3175 Discrete Mathematics	2	R	X				2017-2018 F 2016-2017 F	N/A
HUMA 3111 Comp. Western Civilization I and II	2	R			X		2017-2018 F S	N/A
HIST 3245 History of Puerto Rico	2	R			X		2017-2018 F S	N/A
INGL 3344 Tech. Rep Writing in English	2	R			X		2017-2018 F S	N/A

Figure 6.1: Curriculum For Computer Science Table 1/3

6.2.1 Pre-requisite Structure

Figure 6.7 and 6.8 presents the pre-requisite structure of the IS and CS programs respectively. Notice, that the Computer Science core courses are displayed in light blue, General Education courses in orange, Math and Sciences in green, and elective courses in white in both figures.

[1]Last change of our curriculum occur in 2016

4th Semester								
SICI 4019 Computer Architecture	2	R		F			2017-2018 S 2016-2017 S	20
SICI 4036 Data Structures	2	R		F			2017-2018 S 2016-2017 S	21
MATE 3031 Calculus I	2	R	X				2017-2018 F S	N/A
HUMA 3112 Comp. Western Civilization II	2	R			X		2017-2018 F S	N/A
ESCO 4005 Tech. Rep Writing in Spanish	2	R			X		2017-2018 F S	N/A
5th Semester								
SICI 4029 Fundamentals of Operating Systems	3	R		F			2017-2018 F 2016-2017 F	20
SICI 4030 Data base Programming	3	R		F			2017-2018 F 2016-2017 F	20
MATE 3032 Calculus II	3	R	X				2017-2018 F S	N/A
COTI 4039 Comp. of Programming Languages	3	R		A			2017-2018 F 2016-2017 F	20
FISI 3011 Univ. Physics I	3	R	X				2017-2018 F 2016-2017 F	N/A
FISI 3013 Univ. Physics I Lab.	3	R	X				2017-2018 F 2016-2017 F	N/A
6th Semester								
COTI 3305 Sem. Comp. Ethics and Society	3	R		F			2017-2018 S 2016-2017 S	22
MATE 3026 Intro. To Statistics With Computers	3	R	X				2017-2018 S 2016-2017 S	N/A
COTI 4260 Information Security	3	R		A			2017-2018 S 2016-2017 S	16
COTI 4306 Undergraduate Seminar	3	R		A			2017-2018 S 2016-2017 S	20
SICI 4009 Intro. Numerical Analysis	3	R		A			2017-2018 S 2016-2017 S	20
FISI 3012 Univ. Physics I	3	R	X				2017-2018 S 2016-2017 S	N/A
FISI 3014 Univ. Physics I Lab.	3	R	X				2017-2018 S 2016-2017 S	N/A

Figure 6.2: Curriculum For Computer Science Table 2/3

However, courses of the IS emphasis area are colored in purple, and the CS emphasis area are in tan.

7th Semester								
COTI 4210 Web Programming	4	R		A			2017-2018 F 2016-2017 F	21
SICI 4028 Computer Operational Research	4	R		A			2017-2018 F 2016-2017 F	18
SICI 4037 Data Communication	4	R		A			2017-2018 F 2016-2017 F	21
COTI 4255 Intro. to Analysis of Algorithms	4	R		A			2017-2018 F 2016-2017 F	16
--- Elective Course in Biology, Chemistry or Physics	4	SE	X				2017-2018 F S	N/A
--- Free Elective Course	4	E				O	2017-2018 F S	N/A
8th Semester								
SICI 4038 Research Workshop (Capstone)	4	R		A			2017-2018 F S	15
COTI 4250 Intro. Computational Theory	4	R		A			2017-2018 S 2016-2017 S	15
--- Elective Course in Biology, Chemistry or Physics	4	SE	X				2017-2018 F S	N/A
--- Free Elective Course	4	E				O	2017-2018 F S	N/A
--- Free Elective Course	4	E				O	2017-2018 F S	N/A
--- Free Elective Course	4	E				O	2017-2018 F S	N/A

Figure 6.3: Curriculum For Computer Science Table 3/3

6.3 Alignment with Program Educational Objectives

The curriculum is aligned with the PEOs via the student outcomes and performance indicators. The performance indicators are mapped to the courses via the program syllabus (see Appendix A). Is the responsibility of the course coordinators to supervised, formally or informally, if the performance indicators are covered in the course. This is done since coordinated courses have coordinated exams, quizzes, homeworks, projects, term papers, presentations or any other coursework.

6.4 Materials that will be available for review during the Visit

Materials that will be available are:

- Textbooks
- Detailed Syllabi (Spanish or English)[2]
- Sample Student Work
- Student Posters

[2]Transaltor or translation could be available during the visit upon request

Course	Plan of Study Year	Type	Math & Science	Comp F or A	Gen. Educ.	(BA)Bs. Adm. (O)ther	Last Two Terms the Course was Offered	Average Seciton Enrollment
1st Semester								
COTI 3101 Algorithms and Program Development I	1	R		F			2017-2018 F S	21
MATE 3171 Pre-Calculus	1	R	X				2017-2018 F S	N/A
CISO 3121 Intro. To Social Sciences I	1	R	X				2017-2018 F S	N/A
ESPA 3101 Basic Spanish I	1	R			X		2017-2018 F S	N/A
*INGL 31__ English Course 1st Year	1	R			X		2017-2018 F S	N/A
*INGL 3113 English I Laboratory	1	R			X		2017-2018 F S	N/A
++EDFU 3005 Personal Development and University Success Seminar	1	R				O	2017-2018 F S	30
2nd Semester								
COTI 3102 Algorithms and Program Development II	1	R		F			2017-2018 S	21
MATE 3172 Pre-Calculus	1	R	X				2017-2018 F S	N/A
CISO 3122 Intro. To Social Sciences II	1	R	X				2017-2018 F S	N/A
ESPA 3102 Basic Spanish I	1	R			X		2017-2018 F S	N/A
*INGL 31__ English Course 1st Year (2)	1	R			X		2017-2018 F S	N/A
*INGL 3114 English II Laboratory	1	R			X		2017-2018 F S	N/A
3rd Semester								
COTI 3205 Computer Organization	2	R		F			2017-2018 F S	20
SICI 3015 Systems Analysis and Design	2	R		F			2017-2018 F 2016-2017 F	20
MATE 3175 Discrete Mathematics	2	R	X				2017-2018 F 2016-2017 F	N/A
HUMA 3111 Comp. Western Civilization I and II	2	R			X		2017-2018 F S	N/A
HIST 3245 History of Puerto Rico	2	R			X		2017-2018 F S	N/A
INGL 3344 Tech. Rep Writing in English	2	R			X		2017-2018 F S	N/A

Figure 6.4: Curriculum For Information Systems 1/3

4th Semester								
SICI 4019 Computer Architecture	2	R		F			2017-2018 S	20
SICI 4036 Data Structures	2	R		F			2017-2018 S	21
MATE 3031 Calculus	2	R	X				2017-2018 F S	N/A
HUMA 3112 Comp. Western Civilization II	2	R			X		2017-2018 F S	N/A
ESCO 4005 Tech. Rep Writing in Spanish	2	R			X		2017-2018 F S	N/A
5th Semester								
SICI 4029 Fundamentals of Operating Systems	3	R		F			2017-2018 F 2016-2017 F	20
SICI 4030 Data base Programming	3	R		F			2017-2018 F 2016-2017 F	20
MATE 3032 Calculus II	3	R	X				2017-2018 F S	N/A
SICI 3211 Found. Information Systems	3	R		A			2017-2018 F 2016-2017 F	20
CONT 3105 Found. Accounting I	3	R				BA	2017-2018 F 2016-2017 F	N/A
--- Elective Course in Biology, Chemistry or Physics	4	SE	X				2017-2018 F S	N/A
6th Semester								
COTI 3305 Sem. Comp. Ethics and Society	3	R		F			2017-2018 S 2016-2017 S	22
MATE 3026 Intro. To Statistics With Computers	3	R	X				2017-2018 S 2016-2017 S	N/A
COTI 4150 Info. System Programming	3	R		A			2017-2018 S 2016-2017 S	16
ADMI 4005 Intro. Business Mngmnt	3	R				BA	2017-2018 S 2016-2017 S	20
CONT 3106 Found. Accounting II	3	R				BA	2017-2018 S 2016-2017 S	20
--- Elective Course in Biology, Chemistry or Physics	4	SE	X				2017-2018 F S	N/A

Figure 6.5: Curriculum For Information Systems 2/3

7th Semester								
COTI 4210 Web Programming	4	R		A			2017-2018 F 2016-2017 F	21
SICI 4028 Computer Operational Research	4	R		A			2017-2018 F 2016-2017 F	18
SICI 4037 Data Communication	4	R		A			2017-2018 F 2016-2017 F	21
COTI 4430 Infor. Systems Management	4	R		A			2017-2018 F 2016-2017 F	20
ECON 3021 Economics Principles	4	R				BA	2017-2018 F S	N/A
--- Free Elective Course	4	E				O	2017-2018 F S	N/A
8th Semester								
SICI 4038 Research Workshop (Capstone)	4	R		A			2017-2018 F S	15
ADMI 3301 Entrepreneurs Development	4	R				BA	2017-2018 S 2016-2017 S	15
--- Free Elective Course	4	E				O	2017-2018 F S	N/A
--- Free Elective Course	4	E				O	2017-2018 F S	N/A
--- Free Elective Course	4	E				O	2017-2018 F S	N/A

Figure 6.6: Curriculum For Information Systems 3/3

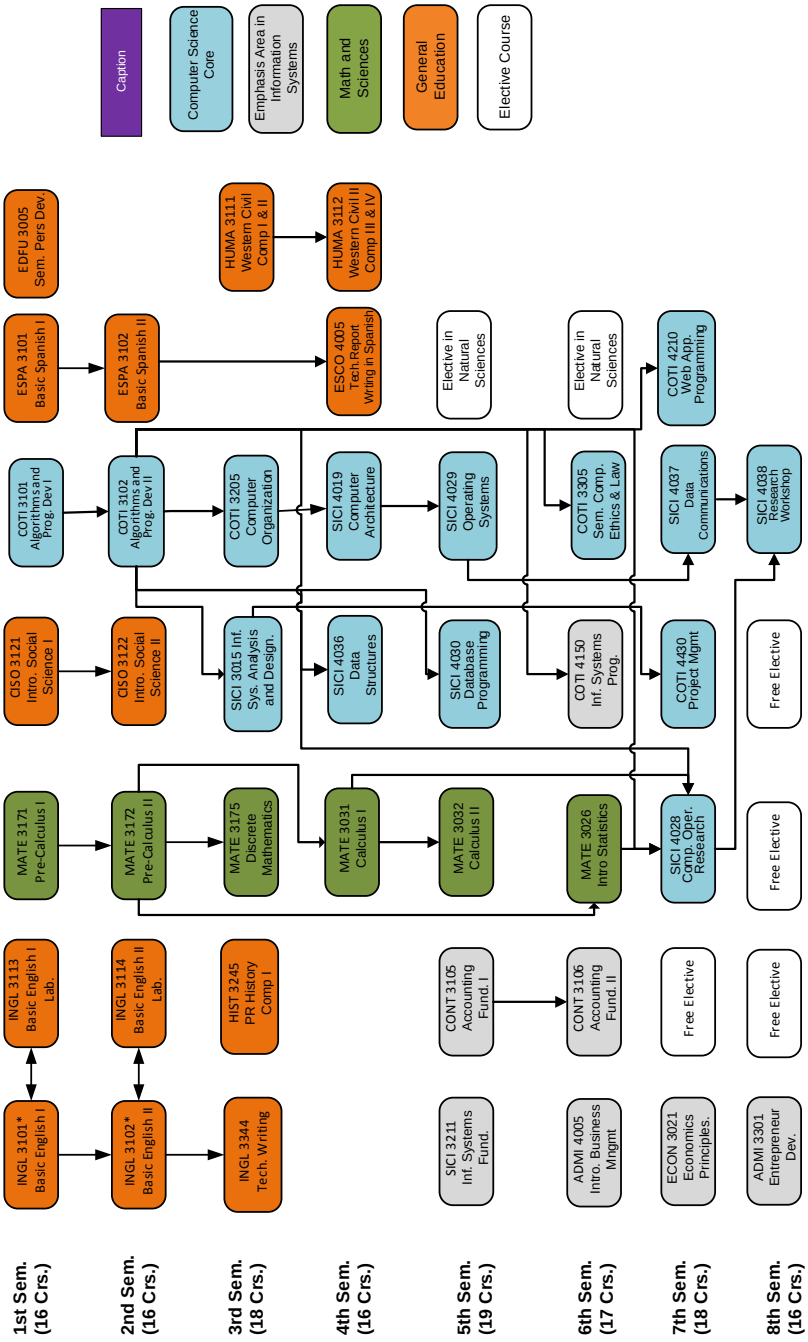


Figure 6.7: Pre-Requisite Structure for IS

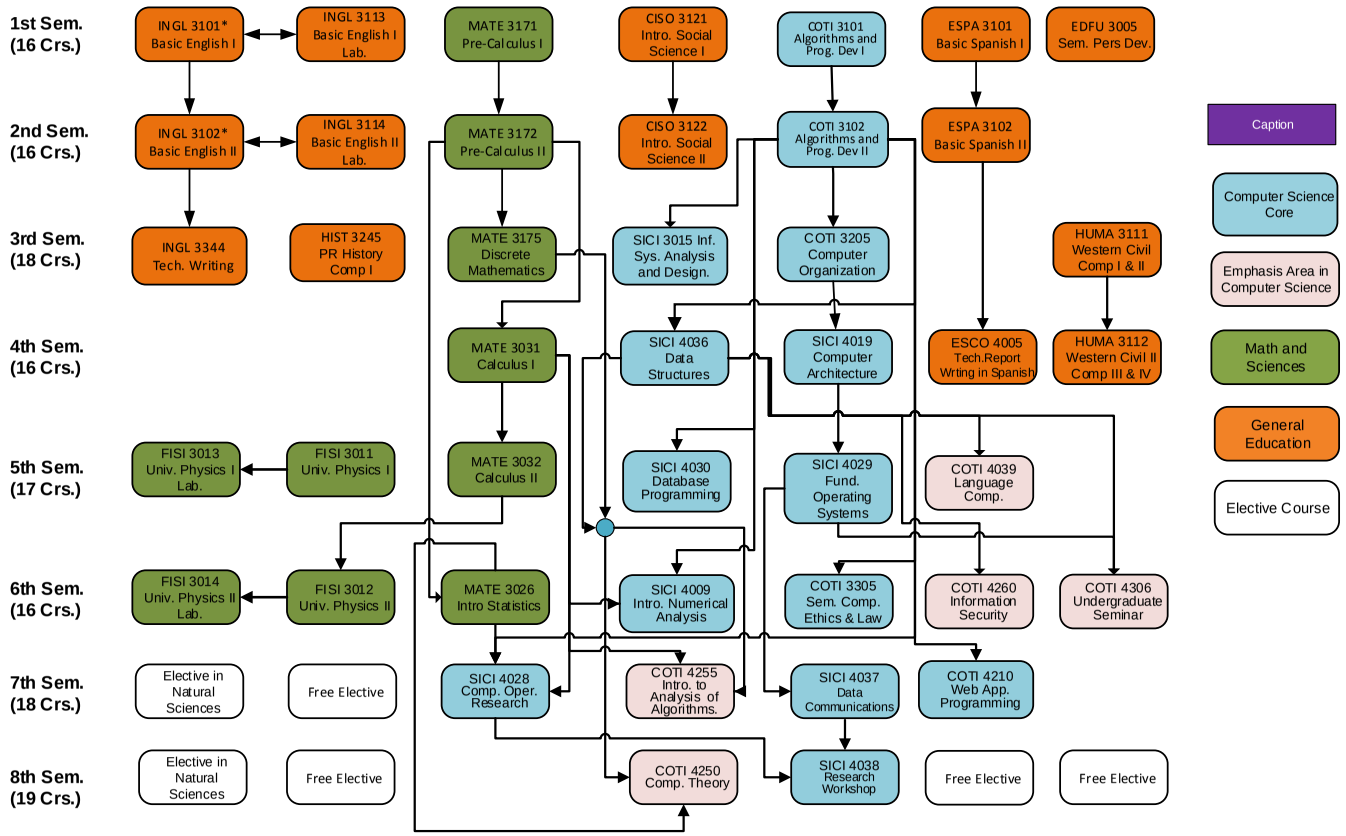


Figure 6.8: Pre-Requisite Structure for CS

7. Criterion 6. Faculty

There are nine (9) full-time faculty members in the department. All of them have tenure. There is one Instructor, two Assistant Professors, two Associate Professors, and four Full Professors. On average there are four Adjunct Professors. All faculty members have strong academic background and expertise. Among the full-time professors, four professors have earned a doctoral degree, while five others hold a master degree. Currently, there is one professor pursuing a doctorate degree. Faculty Qualifications are presented in Table 7.1.

The diversity of the program's topics is well addressed through the variety of educational backgrounds and expertise areas of the faculty. The faculty members are alumni of the University of California at Berkeley, Fairleigh Dickinson University, Nova Southeastern University, Capella University, Interamerican University of Puerto Rico, Turabo Univeristy of Puerto Rico, University of Puerto Rico at Mayagüez, and the University of Puerto Rico at Río Piedras. Faculty expertise is oriented to Computer Science and Information Systems. The degrees obtained by the faculty range from the following topics: Computer Science, Information Systems, Operational Research, Applied Mathematics, Educational Computing, Open Systems, Computer Information Science and Engineering and Computer Engineering. Faculty members are also members of a variety of professional associations, including ACM, IEEE, ISOC, ICANN and ISACA. Most faculty members have both academic and professional experience, either through private practice or services to other institutional units.

7.1 Faculty Workload

Full time faculty members have a minimum workload of twelve credit hours per semester, with at least half of it for teaching. Full-time professors can select up to 3 different subjects to teach and 21 credits as their maximum academic load. Professors are expected to teach the program's courses, to actively participate in departmental and institutional committees as well as to conduct research[1].

[1] For some of those who posses doctoral degrees

Faculty Name	Highest Degree	Type	Acad. Appoint.	Years in Govnt. Indus. Practice	Years in this Institution	Prof. Certs	Level of Activity		
							Prof. Orgs.	Prof. Dev.	Consult. Summer Work
Filiberto Arniella	M.S./A.B.D.	T	AST	10	32	-	L	L	L
José Díaz	M.S.	T	P	10	26	-	L	L	L
Omar Díaz	M.A.	T	I	26	15	ACM	L	H	L
Antonio Huertas	M.S.	T	AST	2	21	-	L	L	L
Elio Lozano	Ph.D.	T	ASC	12	8	-	L	H	H
Rafael Nieves	D.B.A.	NTT	A	10	7	$\alpha\beta\Sigma$	H	H	H
Gerardo Ortega	M.S.	NTT	A	-	2	ISACA/ISOC	H	H	L
Luis Ortiz	M.S.	NTT	A	9	3	IEEE	L	H	L
René Rodríguez	M.S./M.S.	T	P	12	22	-	L	M	M
Juan M. Solá	Ph.D.	T	ASC	18	8	ACM	M	H	M
Nelliud Torres	D.B.A.	T	P	-	22	ACM	H	H	L
José Valles	Ph.D.	NTT	A	9	6	-	L	H	L
Miguel Vélez	Ph.D.	T	P	-	19	ISOC/ICANN	H	H	H

Table 7.1: Faculty Qualifications

They are also expected to actively engage in student advising, and to be active members of various department, college or institutional committees.

7.2 Faculty Size

The faculty size is adequate as evidenced by the fact that all of the course sections are covered every semester. Faculty members willingly choose additional courses beyond the full load of twelve credits. The faculty in conjunction with the Department's student association (AECC, its Spanish acronym)[2] organizes activities every semester. One of the most important activities are the Computer Programming Inter-University Contest, and the ACM International Collegiate Programming Contest (ACM-ICPC) on Spring and Fall every year. More information could be found at *http://profesor.uprb.edu /ntorres /competencias.htm* Also, the AECC offers seminars and mentoring in computer programming to freshmen and sophomores.

Table 7.3 presents the faculty classified by their expertise. Notice that out of the 13 faculty, 6 emphasizes in CS and 7 in IS.

7.3 Service Courses and Adjunct Professors

Our department offers courses that serve other academic departments. These courses are:

- SICI 3017 *Introduction to Electronic Data Processing* for the Department of Biology.
- SICI 3211 *Foundations of Information Systems* for the Business Administration Department.
- SICI 4066 *Computer Applications in Education* for Pre-School Teaching and Phys. Ed. Department.

These courses introduce students to the use of computers and their software tools. These courses are oriented specifically to their respective academic programs. The courses cover: Computer Literacy, Word Processing, Electronic Spreadsheet, Presentation Tools, and Databases. SICI 3211 has an MIS theory component as part of the course as shown in the Syllabus presented in Appendix A.

[2]Computer Science Student Association in English

Faculty Member	PT or FT	Classes Taught Last Two-Terms	Program Activity Dist. Teaching	Research or Scholarship	Other	% of Time Devoted to the Program
Filiberto Arniella	FT	COTI 3205, SICI 3211 SICI 4019	100.00%			100%
José Díaz	FT	COTI 3101, COTI 3102 SICI 3017, SICI 3028	70%	30% Personnel Board		100%
Omar Díaz	FT	SICI 3211	100%			100%
Antonio Huertas	FT	COTI 4150, COTI 3205 SICI 4997, SICI 4036	75%		25% Acad. Senate Admin.Board Coordinator	100%
Elio Lozano	FT	SICI 4066, SICI 4038 COTI 4250,	82%	18%		100%
Rafael Nieves	PT	SICI 3211	100%			25 %
Gerardo Ortega	PT	SICI 3211	100%			25 %
René Rodríguez	FT	SICI 3017, SICI 4009	100%			100 %
Juan M. Solá	FT	COTI 3305, SICI 4037 COTI 4260, SICI 4038 COTI 4306	80%	20 %	100 % Acred. Coordinator	
Nelliud Torres	FT	SICI 4030, SICI 4066	50%		50% Dept. Chair	100%
José Valles	PT	SICI 3105, SICI 4008	100%			50 %
Miguel Vélez	FT	COTI 3101, COTI 3102 INTD 4995, INTD 4998	100%			100 %

Table 7.2: Faculty Workload Summary

The Computer Science department hires adjunct professors to cover must of the service courses. Eight (8) of the fourteen (14) sections of the service courses have been imparted by adjunct professors, in these past two terms. This represents a 57% of these courses (see Table 7.2).

Student advising is formally done by the Department Chair, Program Coordinators and the Administrative Officer during the pre-registration and registration period. However, students usually seek advice during the office hours of the coordinators and program chair.

7.4 Professional Development

The Faculty is encouraged to attend seminars, workshops and conferences to seek professional development. Some of our professors have participated in nationwide workshops during the last five years. Also, the Faculty attends seminars within campus. The UPRB holds an annual "Faculty Development Day"[3], which includes a series of concurrent sessions/workshops with local and guest speakers. The topics range from the use of software tools, research projects, research on student learning, assessment and teaching methods. The Department Faculty also offers workshops, seminars, and conferences which are relevant to the academic community. Certification 36-2010-2011 of the Academic Senate of the UPRB updated the guidelines for the Professional Development of the Faculty of the UPRB. This certification emphasized that faculty must comply with 14 hours of professional development every academic year. All these activities are considered when applying for promotion in rank and to gain tenure. Evidence regarding professional development activities will be provided by request to the evaluation team at the time of the visit.

[3] "Jornada Docente" in Spanish

Faculty Member	PT FT	Computer Science	Information Systems
Filiberto Arniella	FT	✓	
José Díaz	FT	✓	
Omar Díaz	FT		✓
Antonio Huertas	FT		✓
Elio Lozano	FT	✓	
Rafael Nieves	PT		✓
Gerardo Ortega	PT		✓
Luis Ortiz	PT	✓	
René Rodríguez	FT	✓	
Juan M. Solá	FT	✓	
Nelliud Torres	FT		✓
José Valles	PT		✓
Miguel Vélez	FT		✓

Table 7.3: Faculty Classified by Their Expertise

7.5 Authority and Responsibility of Faculty

The Department's Faculty, as a group, works in committees. The committees currently existing in the Department are:

- Assessment and Accreditation Committee (AAC): Established in 2009 to lead the Department's assessment and accreditation efforts. This committee is an evolution from a previous committee named *The Assessment Committee*. The AAC has been involved in assessment and accreditation processes since day one. It is the AAC responsibility to schedule the activities of the continuous improvement plan and updating it. Also the AAC and the Curriculum Committee are responsible for designing curriculum related corrective actions, including the implementation of changes.
- External Advisory Board (EAB): Established in 2010 and evolved since. This external committee is formed by Employers, Alumni and Faculty. This committee has been active in commenting about changes to the program educational objectives, overseeing the curricular revisions, including suggesting courses and course topics; suggesting actions for ensuring the achievement of the educational objectives; and serving as a compass by providing the general directions in which the program should move. Also, the EAB suggest changes to the department's vision and mission.
- Curricular Committee : This committee evaluates input from the AAC, the Office of the Dean for Academic Affairs, the Vice-Presidency for Academic Affairs, the Department's Faculty, the UPRB Academic Senate, the External Advisory Board among other academic entities when designing changes to our curriculum. The Committee proposes changes to the program as adding topics to specific courses, the creation of new courses to address changes in the program outcomes or educational objectives, to major and minor curricular revisions with these recommendations and assessment data. It also oversees the program's compliance with new certifications or guidelines.
- Personnel Committee: Aids the Department Chair in overseeing the general aspects related to the Department's personnel. This includes faculty members in the tenure-granting or rank promotions processes, evaluation of potential new faculty members, the periodic evaluation of the faculty members through peer-evaluations and student evaluations, and the awards and recognitions to faculty members, among others. This committee has representation at the campus level in the Institutional Personnel Committee.

- Research and Development Committee: Promotes and supports the Faculty's involvement in research and development activities. Has representation at the campus level.
- Laboratory Committee : Aids the Department Chair in matters pertaining the availability, maintenance and update of software and hardware tools needed by the courses and the student community.
- Student Affairs Committee : This committee serves as a liaison between our students and faculty. The committee provide ways to notify the students of internships, workshops, conferences, seminars, summer Research Experience for Undergraduates (REU), computer programming contests, and programming challenges.
- "Tesina" Committee (Capstone Course Comittee): Since Capstone is the most important course in our department, the program chair decided to create a committee to coordinate and to supervised the students.

Regarding the implementation of the outcomes, the Faculty, through the work and interactions of its committees, has been directly involved in the general bearing of the programs. This has been achieved through the following activities; syllabus revision, revision of course topics, materials, textbooks, and reference materials, interactions with individual students or student groups, the acquisition and maintenance of the equipment and facilities, and developing curricular revisions.

8. Criterion 7. Facilities

8.1 Offices, Classrooms and Laboratories

8.1.1 Department Office

The Department Office is located in Academic Building # 1 (see Figure 8.1). The Department Chair and the administrative assistant all have their office spaces located at the Department's Main Office. The equipment at these offices consists of four desktop computers, two printers, a photocopier that acts also as printer and fax.

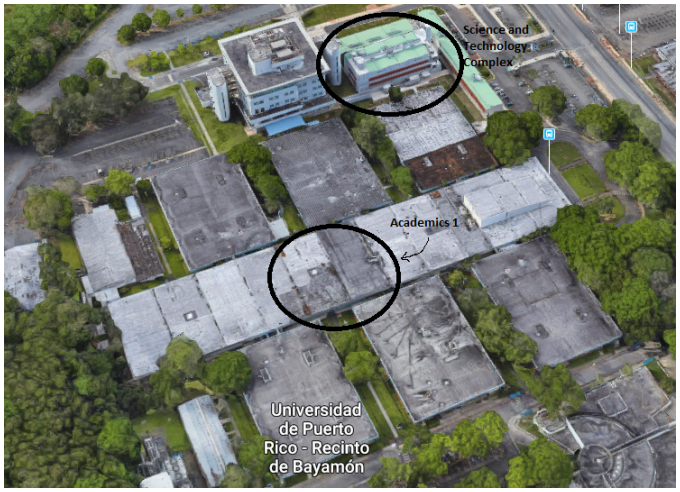


Figure 8.1: UPRB Photo (Google Maps)

8.1.2 Faculty Offices

Each Faculty member has an office space where they are required to hold at least six weekly office hours. Offices vary in size. Some of these offices accommodate a single professor while others accommodate two. These offices have computers with access to the UPRB domain. The offices are located also in Academic Building # 1.

8.1.3 Classrooms and Laboratories

The computer labs are equipped mostly with the latest software available, similar to those to which program graduates are expected to find in their professional work environment. The UPRB domain links all of the Department's computers. This domain provides access to the software needed for programming, project management, as well as for writing reports and creating tables and presentations. Also, it provides Internet access for registered users.

The Department has six computer laboratories. All of them are located in the Science and Technology Complex Building A. This building was concluded in 2015 and is one of the campus newest buildings (see Figure 8.1).

Four out of six computer labs are used exclusively for courses. All of them are equipped with a digital projector, projector screen and white boards. These rooms are A208, A209, A108, A109. Laboratories A107[1], and A210 are exclusively for the students of our department. Each lab have around 20 computers for the students each equipped with the following software:

1. Windows 7
2. MS Office 2013
3. Visual Studio 2013 and Blend 2013
4. Eclipse and Netbeans IDE
5. SharePoint
6. Oracle Database 11g
7. Java JDK (Java 8)
8. Notepad++

Some of the laboratories have additional software. Among these are:

1. Android Studio
2. CodeBlocks
3. Pencil
4. Microsoft SQL Server 2008
5. SWI-Prolog Editor
6. Scratch 2
7. Microsoft Expresion Web 4
8. Greenfoot 3.03
9. Alice 3
10. Raptor
11. Octave
12. Arduino 1.6.9
13. RGUI
14. Dia 0.97.2
15. Torque Game Engine

[1] After the damage cause to some other buildings in our institution by the aftermath of Hurricane Maria this room have been temporary lend to the Physics department.

16. GIMP 2.6

Also, our institution is part of the Microsoft Academic Alliance. This enables the college community to download academic versions of some Microsoft software. Students are able to download software from this library to use them on courses[2].

Laboratory A107 is known as the "servers and research" lab. This multi-purpose lab has been used for projects in several courses, for undergraduate research projects under the advise of Dr. Elio Lozano, and for the use of the AECC.

Table 8.1 present a description of the computers that the department has on their respective rooms and offices.

Lab	Quantity	Type	Computer Model	Usage
A 210	21	Desktop PC	Dell Optiplex 780	Laboratory Computer Only for students of our department
A 209	21	Desktop PC	Dell Optiplex 9020	Classroom Computer
A 208	21	Desktop PC	Dell Optiplex 9020	Classroom Computer
A 109	21	Desktop PC	Dell Optiplex 9020	Classroom Computer
A 108	21	Desktop PC	Dell Optiplex 790	Classroom Computer
A 107	8	Servers Other PCs	Dell Pow.Edge SC 1420 Xeon	Laboratory Computer Only for students of our department and research
Professor's Office	10	Desktop	Optiplex 9010	Professors Computer

Table 8.1: Department Computers and their Respective Use

8.2 Computing Resources

The Department has a local Ethernet network which is connected to the UPRB network. Users connect at 100 Mbit/s or 1Gbit/s to the switches. The UPRB network connects to the UPR network through a broadband link.

In addition, the college community can access the Internet anytime through wireless LAN[3] access points. These access points are available throughout the campus. Students must login into the UPRB's network in order to use the wireless infrastructure.

The UPRB Information Systems Office (OSI, in Spanish) maintains and operates the UPRB network. The Computer Science Department has two technicians who are also responsible for the maintenance and operation of Department's PCs and networks.

Students, Faculty and Staff members are assigned individual UPR system-wide e-mail accounts. These accounts can be access anywhere. Also, UPRB network accounts allow them to access most computers throughout the UPRB campus.

8.3 Guidance

Since our courses are taught in computer laboratories, the professor of each course provides the appropriate guidance regarding the use of the tools, equipment, computing resources and

[2]For example: Visio and Microsoft Project are used by our students in some of the courses
[3]Wi-fi

laboratories. Moreover, students are required to complete lab exercises during the class in which they most demonstrate knowledge of how to use these tools.

8.4 Maintenance and Upgrading of Facilities

Students are required to pay a technology fee at the moment of registration. Yearly, the Chairman of the Department of Computer Science submits a request to the Office of the DAA detailing the needs for the department. The DAA provides funding to the department for the acquisition, upgrade and maintenance of equipment based on money raised from the technology fee and the needs identified by the Chairman. Information that presents the software and hardware that has been acquired for the past five years will be available at the time for the evaluation team.

8.5 Library Services

Through the use of the UPRB network, students and Faculty members can access the Center for Learning Resources and its information databases. Faculty and students are able to access digital libraries of scholar level (i.e. ACM and IEEE Digital Library). This provides the opportunity to browse over two million documents including research articles, standards, transactions and conference proceedings.

8.6 Some Words About Hurricane Maria's Aftermath

Hurricane Maria impacted our island heavily. Maria was the strongest natural disaster that have ever been recorded in Puerto Rico's history. It is the Katrina of the Caribbean. Our campus suffered damages to some of the old buildings. The Science and Technology Complex is a concrete building that suffered no damage whatsoever. However, we are currently recovering from the damage suffered to Academic Building # 1. This is the building that houses our faculty offices. Situation have been difficult in this area, since, water keeps leaking into the building. Some professors have move their office hours to other places in the campus. However, the administration is coping with the hurricane aftermath recovery[4]. We hope this situation will be solved before the review team visit.

[4] march 2018

9. Criterion 8. Institutional Support

9.1 Leadership

9.1.1 Department Chair

The Department Chair serves as a hub between the Department Faculty, committees, administrative and technical staff, students, campus Administration, the support and service offices, and other academic and non-academic entities within the campus. At the Department level, the Chair leads the efforts towards the achievement of the program EOs and the enforcement of any policies and regulations affecting them. The Department Chair also designs and implements mechanisms to ensure the quality, consistency and effectiveness of the EOs.

9.1.2 The Dean of Academic Affairs

The Office of the Dean for Academic Affairs (DAA) acts as a hub between:

- The academic programs
- The degree-granting departments
- The service departments
- The Office of the Dean for Student Affairs (DSA)
- The Office of the Dean for Administrative Affairs (DAdA)
- Underlying dependencies
- The Chancellor's Office
- The UPR Vice-Presidency for Academic Affairs.

The DAA is the administrative official responsible:

- For matters associated to the academic departments and programs
- Formulating guidelines to ensure academic excellence
- The optimal performance of curricular processes.

The Dean also coordinates:

- The efforts to maintain an assessment culture of student learning.
- The *accreditation of academic programs and services*
- The Center for Learning Resources (*Library*).

The key goals of the DAA office are to promote, monitor and coordinate academic activities, the teaching-learning processes, and to stimulate and support academic research. The Office of the DAA, through its activities, policies and actions, helps campus-wide students to meet the EOs of each of the programs. These activities, policies and actions were outlined by the UPRB Administrative Board through *Certification 16-2008-2009*[1], and established in the UPRB Institutional Strategic Plan. Some of these include:

- Ensure that each semester's academic course offerings allow students to complete their respective programs on time.
- Increase student participation in academic and research activities in and out of the University.
- Provide and promote among the alumni continuing education options.
- Encourage and support the continuous and systematic review of the academic offerings in order to adapt to the development trends of each discipline, and the social and cultural demands, as well as the needs of the various employers in terms of knowledge, skills and attitudes.
- Encourage and support continuous improvement through the systematic assessment of the quality and effectiveness of academic programs and services, including professional and specialized accreditation at the program level, and the units' accreditation at the institutional level.
- Aim the available financial resources towards the achievement of each program's educational objectives.
- Lead and promote the professional development of the academic community, including the Faculty, staff, administration officials, and alumni through professional development programs.
- Stimulate the integration of the Faculty's outside professional experience within the courses and extracurricular activities.
- Encourage departments to establish agreements with other departments, industry, universities, and other external entities, thus promoting an integral development of the students.
- Encourage departments to integrate experiences of community service and social responsibility as part of their development.

9.1.3 The Chancelor

The Chancellor is the highest academic and administrative authority on campus. His office serves as the hub connecting the campus to the rest of the University community, including other campuses, the UPR Central Administration, the Municipal Government, District Senators and Representatives in PR's Government, and the external community in general. In the exercise of his or her corresponding duties, the Chancellor guides and supervises the academic staff in teaching, research, administrative and technical duties. This falls under the provisions of the University Law and the General Rules. This person presides the Academic Senate, the Administrative Board, and the campus's Faculty meetings, and represents the UPRB in official ceremonies, functions, and academic events. The Chancellor appoints the three deans, who are then ratified by the

[1] This plan remains in effect until June 30, 2018 by certification of the Administrative Board of the UPRB. Currently, a new plan is being developed that is expected to be available for the next academic year

Board of Trustees, after a process of consultation with the faculty. Each Department Head is also appointed by the Chancellor, with the recommendation of the Dean for Academic Affairs and in consultation with the corresponding academic departments' Faculty. The appointment or hiring of the rest of the university support staff is also overseen by the highest ranking official. Based on the recommendations and evaluation of the unit's budgetary requests, the Chancellor submits the UPRB budget request to the Administrative Board for approval. The budget request is then submitted to the UPR President and the University Board for consideration. The budget is eventually approved by the Board of Trustees.

In addition, the following offices are directly under to the Chancellor's Office:

- Budget Office
- Legal Counsel Office
- Office of Information Technology and Telecommunications
- Student's Ombudsman

The Chancellor's Office, through the following tasks, helps the students meet each program's educational objectives. These activities are included in the UPRB Institutional Strategic Plan, approved by the Administrative Board through *Certification 16 - 2008-2009*.

- Encourage student participation in committees working on issues concerning the university community.
- Stimulate technology transfer, commercialization of intellectual property and research of impact for Puerto Rico's socio-economic development.
- Create mechanisms to facilitate access to electronic information needed for research.
- Set the internal audit mechanisms for the UPRB meeting the highest quality in the administration and provision of university services.
- Making informed decisions on the administrative structure, the re-engineering of business processes and the redistribution of fiscal resources.
- Providing effective access to the network infrastructure and the technological equipment for students and professors, and hosting training sessions to strengthen their computer skills.
- Fostering the participation of professors and students in activities outside the institution and vice versa.
- Create conditions for students to participate in exchanges, volunteering, internships and other experiences including training in academic centers and other institutions.
- Encouraging sponsoring agreements with organizations or entities to subsidize student participation in exchange programs.
- Promote the active participation of professors and students in forums, debates and conferences.
- Promoting through a detailed work schedule and the allocation of resources, the maintenance, preventive care, conservation and improvement of structures, physical facilities, and the surrounding environment.
- Manage the construction of quality spaces for the most suitable environment for learning, research, creation, recreation and sport. In particular, provide professors and researchers with the appropriate individual office spaces.
- Support the ongoing efforts to continue working on the Physical Development and Programmatic Framework.
- Carry out activities and special events at both the academic and cultural levels, improving the relationship between the institution and its graduates.

9.2 Program Budget Process and Financial Support

The UPR System's operational budget is provided by the Government of Puerto Rico as an annuity established by Law, which constitutes 9.6% of the revenues collected by Puerto Rico's General Fund. The UPR Board of Trustees oversees the distribution of this assigned budget.

On a yearly basis, the Deans of Academic Affairs from each of the system's eleven campuses request each of their department's the budgetary needs for the next academic year. Each department chair submits the budget needed with recommendations from its Faculty members and administrative personnel. Each Dean harmonizes the various departmental budget needs and presents them as a whole to the Chancellor. Then, the Chancellor submits this request to the Office of the President of the UPR System. This includes the recommendations from the unit's Administrative Board. The President in turn submits the budget for the UPR System[2] to the UPR Board of Trustees, with the University Board's recommendations.

The UPRB's support for the Department's programs is evidenced by the fact that, even under financial hardship, the assigned budget for the past five years has enabled the CS Department to retain its faculty members and administrative personnel. In addition, the University has assigned additional funds to fully cover the required academic load with approximately four part-time professors per semester.

The primary source of financial support for the UPR is the government of Puerto Rico. The second financial source is the enrollment costs, paid by each of the students. Some additional funding is available through proposals submitted by Faculty and staff members, and/or students to a University-wide review committee and a Campus-wide review committee. These proposals can include requests for funding equipment, software, and technological classroom improvements. Table 9.1 lists projects that have been approved and funded in recent years.

A technology fee is part of the enrollment cost of each student. This technology fee is used to acquire, maintain and upgrade the technology infrastructure, facilities and equipment used.

Project Title	PI	2013-2014	2014-2015	2015-2016	2016-2017
Stereoscopic 3D Anaglyph Video	Dr. Elio Lozano-Inca	$ 7,087.00			
Real time Embedded Machine Video System	Dr. Elio Lozano-Inca		$ 6,362.00		
Stereoscopic vision-based obstacle detection and avoidance method for autonomous mobile robots	(PI) Dr. Elio Lozano-Inca (CoPI) Elias Beauchamp			$ 29,215.00	
Stereoscopic Image-based path planning for autonomous mobile robots	Dr. Elio Lozano-Inca				$ 20,715.00

Table 9.1: Faculty Funded Research Projects

9.3 Staffing

The Department's support personnel consist of one full-time administrative officer, one full-time secretary, and two Computer & Telecommunications Equipment Specialists. The following is a brief description of the tasks performed by each of them:

[2] as a whole consolidated budget

- Administrative Officer: Supervises the department administrative work and helps students with their registration process.
- Department Secretary: Processes departmental purchasing requests, maintains all files, schedules meetings, prepares mailings, provides assistance to students in the enrollment process, arranges faculty travel, and processes reimbursements.
- Computer and Telecommunications Equipment Specialists: Assist with technical support on software and equipment. The specialist is responsible for the maintenance and reliability of the laboratories and the equipment, as well as the inventory list. They also distribute some equipment and laboratory materials and components to the students.

In addition, the institutional services available at the UPRB include:

- Admissions Office
- Athletic Activities Department
- Career Development and Placement Center
- Counseling and Orientation Department
- Disabled Student Services
- Division of Continuing Education and Professional Studies
- Financial Aid Office
- Health Services Office
- Information Systems Office
- Learning Resources Center (formerly called the UPRB Library)
- Office for Institutional Research and Planning (OPEI)
- Students Ombudsperson
- Quality of Life Program
- Registrar's Office
- Special Programs Office
- Student Council
- Student Organizations Office
- Social and Cultural Activities Office
- University Student Child Care Program (ACUDEN)

Additional information on these services is available in the UPRB Catalog, which can be downloaded in English at *http: //docs.uprb.edu/ dec-academico/ catalogo/ english-version.pdf*. The support personnel and institutional services necessary to achieve the Program Educational Objectives and Program Outcomes are considered adequate and sufficient.

The UPRB obtains funds from diverse sources. The greatest financial contribution to the UPRB comes from state government's general funds. The global recession has had an impact on the Island's economy since 2006. As a result, PR's Government Appropriations have steadily declined and currently reflect a reduction of approximately 14% in tax revenues, which aggravates the Government's deficit. Consequently, the UPR's budget has confronted a proportional decline for the current and upcoming fiscal years.

The UPRB Administration has assigned additional discretionary funding based on priorities and department's necessities, in an effort to alleviate this situation. In addition, the UPRB has created internal mechanisms to improve the administration of financial resources and meeting the established precautionary measures. These mechanisms include an intramural practicum plan, external funds from projects and research, and a planned growth of the non-traditional student population through the UPRB's Extended University Division. These measures are expected to alleviate the institutional economy in the future.

All of the needs from the Computer Science Department's Faculty and its administrative personnel have been covered despite the present situation.

9.4 Support of Faculty Professional Development

The UPRB provides adequate professional development through:

1. Leaves of absence: The UPRB provides a program for Faculty development through the support of obtaining doctoral or post-doctoral degrees.
2. Sabbatical leaves: The UPRB provides a program for doctoral-level Faculty members to conduct research experiments with the intent of further developing the Faculty in general.
3. Individual: Release time is provided to Faculty members as encouragement to attend professional and academic seminars and meetings outside of the Institution. The UPRB can also provide financial support for attending these meetings depending on the availability of funds and the institutional needs.
4. Institutional Seminars: The UPRB holds an annual activity for the Campus Faculty which includes seminars in diverse topics, aimed at professional development. These are presented by different speakers, including guests.

9.5 Faculty Hiring and Retention

The UPR recognizes that the faculty members are central to the Institution's teaching and learning process. The UPR faculty members are qualified professionals by virtue of their education, training,experience and skills. Until June 2006, the minimum education requirement for a tenure track position as a faculty member was a master's degree[3]. In June 2006, the Board of Trustees of the UPR approved Certification 145 2005-2006 which requires a doctoral degree as the minimum academic qualification to be recruited in a tenure-track position. Therefore, any candidate for a tenure-track position as a professor or researcher must have a doctoral degree or equivalent in the teaching or research discipline[4] according to the policies and procedures established by the President of the UPR. In addition, the Academic Senate has approved internal policies and procedures for the recruitment of new faculty members.

The Department Chair regularly schedule meetings with the Department's Personnel Committee members who make suggestions about the human resources needs of the program. Together, the director and committee identify desirable characteristics and skills of personnel. The hiring and assignment process is adjusted according to the trend of the program. Whenever there is a change in the program trend, a faculty opening occurs. Then, the faculty member hired must conform to those needs. When a vacancy occurs, the Department looks into the pool of candidates that qualifies to fill the vacancy. The Personnel Committee invites the qualified candidates to come to an interview. The one who best matches the vacancy requirements at the time of hiring is selected. The faculty is hired and assigned according to the program needs. All faculty appointments are made among the candidates who respond to the public announcement/ call to a position. This announcement is made once the Dean's Office of Academic Affairs authorizes the department to appoint someone to a tenure-track position. In accordance with Article 46 of the UPR Regulations, the criteria for the selection of personnel are:

1. the quality of the academic record and university where studies were made

[3] UPR General Bylaws, Article 42; Section 42.1

[4] except of those disciplines with a proven difficulty in recruitment

2. mastery of the subject to be taught and capacity to integrate it in related areas
3. teaching experience and the application of knowledge in a particular area
4. publications and presentations made
5. identification with the University Law's philosophy and objectives
6. the capacity for scientific research or creative work.

A candidate for any faculty position must submit his or her academic credentials, a curriculum vitae and a letter of intention to the Department Director. The Department Personnel Committee members perform the peer evaluation of the candidate taking into consideration the recruitment plan, the strategic plan, the academic and professional qualifications of the candidate and the results of the personal interview. When confronted with the decision of filling a position, the Program takes into account some influential or crucial criteria (for example: teaching or other related experience of the candidate, professional certifications, service projects or research).

The main criterion for recruitment in the UPR is the academic preparation. However, the Department Personnel Committee considers professional experience and certifications.

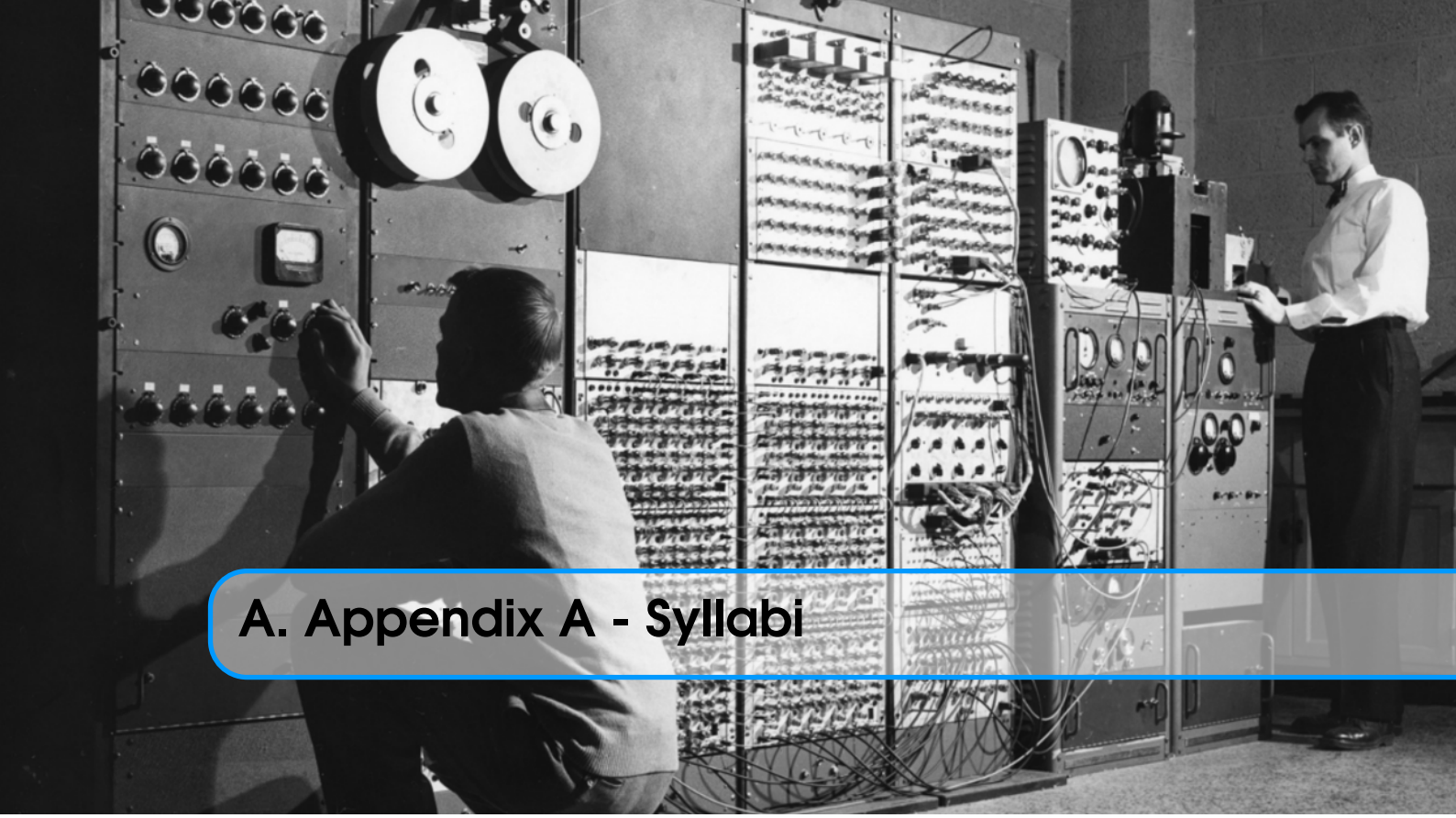
The academic departments, as well as the UPRB, recognize the importance of the faculty's professional development in order to reach the goals and promote excellence in student learning. Faculty is maintained updated on technical aspects in their teaching area through participation in workshops, lectures, seminars, and congresses, among others. To maintain updated in the practice of their discipline, professors also have the opportunity to offer consultant services, work in industry, and offer workshops and lectures in business and industry. There are professors who are in charge of coordinating internships, which allows them to be in contact with industry. By having professors specialized in different areas, students are exposed to different facets of knowledge thereby providing them with a broader academic preparation. Our faculty has liaisons and contacts with the public and private sector, and some faculty are members of professional organizations in their field.

The faculty promotion process has three evaluation phases. The first stage is conducted by the Department Personnel Committee; the second one is performed by the Institutional Faculty Committee; and the last step is made by the Administrative Board. The evaluations and the original recommendations concerning promotions are made by the Department Personnel Committee, who presents its reports through the corresponding channels.

The recommendations of the departmental committee are sent to the Dean's Office of Academic Affairs via the department chairperson. The reports should include the foundations and conclusions upon which they are based, as well as the list of recommended candidates in order of priority. The Institutional Personnel Committee evaluates each of the candidate's files and recommends promotions to the academic dean. The dean presents the promotions proposed to the chancellor with the recommendations made by the dean's office, the Institutional Personnel Committee, and the department chairperson. When the petitions for promotions are presented to the chancellor, copies are also sent to the Administrative Board. Each academic year, the Administrative Board establishes the date for the ratification of the evaluation reports of the faculty for possible promotions. The Administrative Board, as proposed by the chancellor, evaluates the cases for the possible promotions of faculty and either approves or denies the promotion. As established by Certification No. 32-2002-2003, the Administrative Board (appendix F-10)agreed that promotions be given in descending order of points with one promotion for each rank beginning with full professor until the available funds are depleted. Faculty may be promoted to Auxiliary Professor, Associate Professor or Full Professor. The specific guides and procedures for faculty's application for promotion are described in the process handbook Instruction Guide on the Summary of Points for Promotions of the UPRB Faculty revised in 2017.

II

Part Two



A. Appendix A - Syllabi

Note: This appendix presents short English versions of the Computer Science Department syllabi. The syllabi used at the University of Puerto Rico in Bayamon are more extensive and mostly written in Spanish.

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 3101	Algorithms & Prog. Dev. I	Required	4.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
NONE	NONE	Four hours weekly	

Course Description:

This is the first of two courses that offer an initial view of computer science, focusing in modern programming techniques for problems solving. In this one-year sequence the following topics are studied: basic computer concepts, the design of algorithms and the development of computer programs using object-oriented language. Also, the course analyzes the impact of computer science in modern society and ethical aspects related to the development and implementation of computer programs.

Textbook:

Gaddis, T. (2015). *Starting Out with Java: From Control Structures through Objects* (6th ed.). Boston, MA: Addison-Wesley.

References:

Deitel, H. M. & Deitel, P. J. (2014). Java How to Program (10th ed.). Englewood Cliffs, NJ: Prentice-Hall.

Eck, D. (2015). Introduction to Programming Using Java (7th ed.). Retrieved from http://math.hws.edu/javanotes/

Farrell, J. (2014). Programming Logic and Design, Comprehensive (8th ed.). Boston, MA: Course Technology.

Gaddis, T. (2015). Starting Out with Programming Logic and Design (4th ed.). Boston, MA: Addison-Wesley.

Liang, Y. D. (2014). Introduction to Java Programming -- Comprehensive (10th ed.). NJ: Prentice-Hall, Inc.

Sedgewick, R. (2007). Introduction to Programming in Java: An Interdisciplinary Approach. Boston, MA: Addison-Wesley. Web site: http://introcs.cs.princeton.edu/java/home.

Oracle. (2015). The Java Tutorials. Redwood City, CA. Retrieved from https://docs.oracle.com/javase/tutorial.Deitel, H. M. & Deitel, P. J. (2009). *Java How to Program Late Object Version* (8th ed.). Englewood Cliffs, NJ: Prentice-Hall.

Course Objectives (Learning Outcomes):

1. Students will know historical development of computers and their impact in society.
2. Students will be able to describe basic computer's components: hardware and software.
3. Students will be able to analyze problem requirements and develop an algorithm for its solution.
4. Students will be able to use structure charts, flowcharts and pseudo-code to analyze and

document a problem's solution.

5. Students will be able to implement algorithms using a modern programming language. For this they will be able to use different control structures such as sequence, selection and repetition.
6. They will be able to use methods/procedures of different types for organizing programs.

Contribution of Course to Program Outcomes (Performance Indicators)
Performance Indicators introduced in this course
A.1, A.3, B.1, C.1, C.2, I.1,

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Computer history
2. Computer components
3. Tools for analyzing problem's solution: problem analysis chart, structure chart, flowchart and pseudo code.
4. Introduction to programming with Java
5. Control structures: sequence, selection, repetition
6. Methods, files and parameters

Evaluation Criteria:

1.	Exams	60%
2.	Project	20%
3.	Homework's	20%

By Prof. Antonio F Huertas **Date: May 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 3102	Algorithms and Programs Development II	Required	4.00

Prerequisites:	**Co- requisites:**	**Schedule:**
COTI 3101	NONE	Four hours weekly

Course Description:

This is the second of two courses that provide an initial overview of Computer Science, emphasizing modern programming techniques to solve problems. This one-year sequence of courses covers, in theory and practice, basic computer concepts, design of algorithms and computer software development using object-oriented languages. In addition, the course examines the impact of Computer Science in contemporary society and discusses the ethical aspects related to the development and implementation of programs.

Textbook:

Gaddis, T. (2015). *Starting Out with Java: From Control Structures through Objects* (6th ed.). Boston, MA: Addison-Wesley.

References:

Deitel, H. M. & Deitel, P. J. (2014). *Java How to Program* (10th ed.). Englewood Cliffs, NJ: Prentice-Hall.

Eck, D. (2015). *Introduction to Programming Using Java* (7th ed.). Retrieved from http://math.hws.edu/javanotes/

Farrell, J. (2014). *Programming Logic and Design, Comprehensive* (8th ed.). Boston, MA: Course Technology.

Gaddis, T. (2015). *Starting Out with Programming Logic and Design* (4th ed.). Boston, MA: Addison-Wesley.

Liang, Y. D. (2014). *Introduction to Java Programming -- Comprehensive* (10th ed.). NJ: Prentice-Hall, Inc.

Sedgewick, R. (2007). *Introduction to Programming in Java: An Interdisciplinary Approach*. Boston, MA: Addison-Wesley. Web site: http://introcs.cs.princeton.edu/java/home.

Oracle. (2015). *The Java Tutorials*. Redwood City, CA. Retrieved from https://docs.oracle.com/javase/tutorial.

Course Objectives (Learning Outcomes):

1. Determine the requirements of an intermediate problem and design solutions using the most appropriate algorithm.
2. Structure the program data using the most appropriate data types, either those provided by the language or defined by the programmer.
3. Implement algorithms using a modern programming language that allows object-oriented programming.
4. Implement data collections using arrays of one or more dimensions.
5. Knowledge of the basic sorting and searching algorithms.

6. Develop robust and fault tolerant applications following the principles of Software Engineering.
7. Develop applications with a Graphical User Interface.

Contribution of Course to Program Outcomes (Performance Indicators)

A.1 , A.3, B.1, C.1, C.2, I.1, I.2

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. One-dimensional arrays	8
2. Multidimensional arrays and ArrayList class	8
3. Inheritance and polymorphism	8
4. Object-Oriented Modeling	8
5. Exception Handling	6
6. Files Management	10
7. Principles of GUI Programming	12

Evaluation Criteria:

1. Exams	60%
2. Project	20%
3. Homeworks	20%

By: Antonio Huertas **May 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 3205	Computer Organization	Required	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
COTI 3102	None	Three hours weekly	

Course Description:
This course emphasizes the study of general concepts associated to the internal organization of any computer. During his professional life current students will find computer from different manufactures, with diverse organizations and different instructions sets. Therefore, concepts and techniques that apply to a large class of computers will be emphasized.

Main Reference:

Kjell, B. (2015). *Programmed Introduction to MIPS Assembly Language*. Retrieved from http://programmedlessons.org/AssemblyTutorial

References:

Null, L. (2015). *The Essentials of Computer Organization and Architecture* (4th ed.). Sudburry, MA: Jones and Bartlett.

Patterson, D. & Hennessy, J. (2014). *Computer Organization and Design: The Hardware Software Interface* (5th ed.). Boston, MA: Morgan Kaufman.

Stallings, W. (2016). *Computer Organization and Architecture: Designing for Performance* (10th ed.). Upper Saddle River, NJ: Prentice Hall.

Tanenbaum, A. (2013). *Structured Computer Organization* (6th ed.). Upper Saddle River, NJ: Prentice Hall

TutorialsPoint. (2018). *Computer Organization*. Retrieved from https://www.tutorialspoint.com/computer_organization/index.asp

Course Objectives (Learning Outcomes):
By the end of course the student would be able to:

1. Describe the basic organization of modern computer systems.
2. Describe how data is represented internally.
3. Compare different representations of data according to use.
4. Develop assembly language programs for processors using different instruction formats and addressing modes.

Contribution of Course to Program Outcomes (Performance Indicators)
A.1, A.3, B.1, C.1, C.2

Contribution of Course to Meeting Requirements of Criteria 5:
This course contributes to the development of the technical content core knowledge.

Main Topics Covered:
I. Introduction to Computer Organization

- Components of a Computer System
  1. Processor
  2. Memory
  3. I/O
- Von Neumann architecture
- Levels of abstraction in a computer system

II. Data Representation
- Introduction to positional number systems
- Integer representations
- Floating pint representations
- Character representation

III. Instruction Sets
- Instruction formats
- Addressing modes
- Assembly Language for different processors

Evaluation Criteria:

1.	Exams	50%
2.	Project	25%
3.	Homework	25%

By Prof. Antonio F. Huertas & Filiberto Arniella **August 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 3305	Computing Ethics and Society Seminar	Required	2.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
COTI 3102	NONE	Two hours weekly	

Course Description:

The course examines the nature and social impact of computer technologies in society and the various organizations that are part of it. Professional ethics codes applicable to the computing professional are studied and analyzed using various actual cases related to the areas that have impact on ethical issues such as system security, privacy, freedom of expression, intellectual property and copyright. The laws associated with these aspects will also receive special attention as part of course topics

Textbook:

Quinn, M. J. (2014). *Ethics for the Information Age* (6th ed.). Boston, MA: Addison-Wesley.

References:

Bynum, T. (2001) Computer Ethics: Basic Concepts and Historical Overview. Stanford, CA: Metaphysics Research Lab, CSLI, Stanford University. Web site: http://plato.standford.edu/entries/ethics-computer.

Gehringer, E. F. (2006) Ethics in Computing. Raleigh, North Carolina: North Carolina State University. Web Site: http://ethics.csc.ncsu.edu.

Reynolds, G. (2009). Ethics in Information Technology (3rd ed.). Boston, MA: Thomson Course Technology.

Special Interest Group on Computers and Society (2005). Broadway, New York, NY: SIGCAS Association for Computing Machinery, Inc. Web site: http://www.sigcas.org/index.html.

Stamatellos, G. (2007) Computer Ethics: A Global Perspective (1st ed.). Boston, MA: Jones and Bartlett Computer Science.

Course Objectives (Learning Outcomes):

1. Value the importance of ethics on the profession and future computing working environments.
2. Knowledge about code of ethics available at the professional level and its impact in the field of computing.
3. Identify, manage and prevent unethical situations by reviewing case studies.
4. Discuss privacy laws, freedom of expression and intellectual property, and their implications in Computer Ethics.
5. Apply appropriate ethical practices related to the process of using and developing application programs.

Contribution of Course to Program Outcomes (Performance Indicators)

E.1, E.2, E.3, G.1, G.2, G3

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.
Main Topics Covered: 1. Introduction, Definition and Concepts 2. Professional Computing Ethics 3. Case Studies 4. Intellectual Property Rights 5. Information and Privacy
Evaluation Criteria: 1. Quizzes/Exams 40% 2. Final Test 40% 3. Homework 15% 4. Participation and Attendance 5%

UNIVERSITY OF PUERTO RICO AT BAYAMON

Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 4039	Comparative Programming Languages	Required – Computer Science	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
SICI 4036	NONE	Three hours weekly	

Course Description:

Introduction to principles of programming languages design and implementation. Concepts, such as syntax and semantics of high-level programming languages will be examined. The main programming paradigms (imperative/procedural, object-oriented, functional and logic) will be compared using appropriate languages.

Textbook:

Webber, A.B. (2011). *Modern Programming Languages: A Practical Introduction* (2nd ed.). Sherwood, OR: Franklin, Beedle & Associates.

References:

Awesome Princess (2017.) *F# Programming*. Retrieved from http://en.wikibooks.org/wiki/F_Sharp_Programming.

Blackburn, P., Bos, J. & Striegnitz, K. (2012). *Learn Prolog Now!* London, UK: College Publications.

Gabrielli, M. & Martini, S. (2010). *Programming Languages: Principles and Paradigms*. London, UK: Springer.

Harper, R. (2013). *Practical Foundations for Programming Languages*. Cambridge, UK: Cambridge University Press.

Scott, M. (2009). *Programming Languages Pragmatics* (3rd ed.). San Francisco, CA: Morgan Kaufmann.

Sebesta, R. (2015). *Concepts of Programming Languages* (11th ed.). Boston, MA: Addison-Wesley.

Sestoft, P. (2012). *Programming Languages Concepts*. London, UK: Springer.

Tate, B.A. (2010). *Seven Languages in Seven Weeks: A Pragmatic Guide to Learning Programming Languages*. The Pragmatic Programmers.

ZenTut. (2015). *C Tutorial*. Retrieved from http://www.zentut.com/c-tutorial.

Course Objectives (Learning Outcomes):

At the end of this course, the student will be able to:

1. Define the syntax and semantics of various programming languages using formal notations such as (Extended) Backus-Naur Form, Syntax Diagrams, and operational semantics.
2. Describe the main phases in the compilation process and compare compilation with other processing mechanisms such as interpretation.
3. Compare and contrast the main characteristics of the principal programming paradigms, such as imperative/procedural, object-oriented, functional and logic paradigms.
4. Select the most appropriate programming paradigm for the development of specific application.
5. Write programs in representative languages for each of the paradigms studied.

Contribution of Course to Program Outcomes (Performance Indicators)

A.1, B.1, B.3, C.2, J.5

Contribution of Course to Meeting Requirements of Criteria 5: This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Introduction to the theory of programming languages
2. Imperative/procedural programming
3. Object-oriented programming
4. Functional programming
5. Logic programming

Evaluation Criteria:

1. Exams and/or quizzes 60%
2. Final exam or quiz 20%
3. Homeworks 20%

By Prof. Antonio F. Huertas **May 2018**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 4150	INFORMATION SYSTEMS PROGRAMMING	Required – Information Systems	3
Prerequisites:	**Co- requisites:**	**Schedule:**	
COTI 3102	NONE	Three hours weekly	

Course Description:

This course studies the design and development of information systems using structured programming or an object-oriented approach. In addition, studies different file organizations and database management. This course use one or more programming languages with a business approach.

Textbook:

Boehm, A. & Murach, J. (2016). *Murach's C# 2015*. Fresno, CA: Murach Books.

References:

C# Corner. (2018). *C# Tutorial*. Retrieved from http://www.c-sharpcorner.com/beginners/

C# Station. (2016). *ADO.NET Tutorial*. Retrieved from http://csharp-station.com/Tutorial/AdoDotNet

C# Station. (2016). *C# Tutorial*. Retrieved from http://csharp-station.com/Tutorial/CSharp/SmartConsoleSetup.aspx

Deitel, P. & Deitel, H. (2016). *C# 6 for Programmers* (6th ed.). Upper Saddle River, NJ: Prentice Hall.

FunctionX. (2015). *FunctionX Tutorials*. Retrieved from http://www.functionx.com

Miles, R. (2016). *C# Programming Yellow Book* (8.1th ed.). Retrieved from http://www.robmiles.com/c-yellow-book/

Nagel, C. (2016). *Professional C# 6 and .NET Core 1.0*. Indianapolis, IN: Wiley.

Nakov, S., Kolev, V. (2013). *Fundamentals of Computer Programing with C#*. Sofia, Bulgaria: Nakov. Retrieved from http://www.introprogramming.info/tag/bulgarian-c-book/

Troelsen, A. & Japikse, P. (2017). *Pro C# 7: With .NET and .NET Core* (8th ed.). New York, NY: Apress.

Course Objectives (Learning Outcomes):

At the end of this course, the student will be able to:

1. Use an enterprise integrated development environment.
2. Design, code and test business applications with graphical user interfaces using an object-

oriented language.
3. Develop file-processing application that use text, binary and XML files.
4. Develop database applications using a multi-layer architecture and the client-server model.

Contribution of Course to Program Outcomes (Performance Indicators)

A.1, A.3, B.1, B.2, B.3, C.3, I.1, I.2

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Introduction to Business Applications
2. Essential Concepts of C#
3. Object-Oriented Programming
4. Graphical User Interfaces
5. File Processing
6. Database Applications Development

Evaluation Criteria:

1.	Exams or Quizzes	60%
2.	Final Exam or Quiz	20%
3.	Homeworks	20%

By Prof. Antonio Huertas **May 2018**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 4210	Web Application Programming	Required for Information Systems	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
COTI 3102, SICI 3020	NONE	Three hours weekly	

Course Description:

This course provides a comprehensive introduction to the tools and skills required to build and maintain dynamic web sites that provide interactivity to users. Both client-side and server-side programming tools are presented

Textbook:

Sebesta, R.W. (2015). *Programming the World Wide Web* (8th ed.). Boston, MA: Pearson Higher Ed.

References:

Comer, D. E. (2007). *The Internet book: everything you need to know about computer networking and how the Internet works* (4th ed.). Upper Saddle River, NJ: Pearson Prentice-Hall, Inc.

Deitel, H. M. & Deitel, P. J. (2008). *Internet & World Wide Web: How to Program* (4th ed.). Upper Saddle River, NJ: Pearson Prentice-Hall, Inc.

Ducket, J. (2008). *Beginning Web Programming with HTML, XHTML, and CSS* (2nd ed.). Indianapolis, IN. Wiley Publishing, Inc.

Felke-Morris, T. (2009). *Web development and design foundations* (4th ed.). Boston, MA: Pearson Addison Wesley.

Internet Society. (2011). Reston, VA: ISOC. Web Site: http://www.isoc.org

Welling, L. & Thomson, L. (2009). *PHP and MySQL Web Development* (4th ed.). Indianapolis, IN. Pearson Education, Inc.

World Wide Web Consortium. (2011). Cambridge, MA: W3C, MIT. Web Site: http://www.w3c.org

Course Objectives (Learning Outcomes):

At the end of this course, the student will be able to

1. Arguing on general aspects of the Internet and World Wide Web in historical terms, operation and application development possibilities.
2. Arguments and recommendations on the general aspects related to programming for the Web, including client-server programming and access to databases.
3. Develop Web applications using various tools available.
4. Perform basic configuration of a Web server and necessary services.

5. Implement Internet applications developed for web servers.
Contribution of Course to Program Outcomes (Performance Indicators) G.1, G,2, I.1, I.2
Contribution of Course to Meeting Requirements of Criteria 5: This course contributes to the development of the technical content core knowledge.
Main Topics Covered: 1. Fundaments of web programming 2. Basic elements, tables, frames, forms in XHTML 3. Properties of text, images, forms in CSS 4. Basic fundaments of JavaScript and Even-driven programming 5. Basic fundaments of PHP and database access 6. Database management in SQL and MySQL
Evaluation Criteria: 1. Individual Implementations 60% 2. Programs 10% 3. In Class Participation 10% 4. Final Project 20%
By Dr. Elio Lozano **August 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 4250	Introduction to the Theory of Computation	Required for Computer Science	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
MATE 3015, MATE3175, SICI4036	NONE	Three hours weekly	

Course Description:

This course addresses traditional areas of the theory of computation: automata, computability and complexity. These areas address the possibilities and limitations of computers. The course will study topics

such as finite automata, regular expressions and languages, context-free grammars, Turing machines, decidable languages, undecidability, complexity of algorithms and the classes P and NP.

Textbook:

Carol Critchlow & David Eck (2011) Foundations of Computation. Department of Mathematics and Computer Science. Hobart and William Smith Colleges, Geneva, NY 14456.

References:

Arindama Singh (2009) Elements of Computation Theory. Springer.

Cooper, B. S. (2003). Computability Theory. Chapman & Hall/CRC.

Cooper, B. S. & Löwe, B. (2005). New Computational Paradigms: First Conference on Computability in Europe, CiE 2005, Amsterdam, The Netherlands, June 8-12, 2005, Proceedings (1st ed.). Springer.

Dexter C. Kozen (2011) Theory of Computation. Springer.

Homer, S. & Selman, A. L. (2006). Computability and Complexity Theory (1st ed.). Springer.

Hopcroft, J. E., Motwani, R. & Ullman, J. D. (2006). Introduction to Automata Theory, Languages, and Computation (3rd ed.). Addison Wesley.

Kozen, D. (2011). Theory of Computation. Springer-Verlag: London, UK.

Martin, J. (2002). Introduction to Languages and the Theory of Computation. New York, NY: McGraw Hill.

MIT Open Courseware (2006). Theory of Computation.
Web site: http://ocw.mit.edu/courses/mathematics/18-404j-theory-of-computation-fall-2006/

Natarajan, A.M., Tamilarasi, A., Balasubramani, P. (2008) Theory of Computation. New Age International.

Simonson, S. (2001). Theory of Computarion. Web site: http://www.aduni.org/courses/theory/

Sipser, M. (2006). Introduction to the Theory of Computation (2nd ed.). Thomson Course Technology.

Course Objectives (Learning Outcomes):

At the end of this course, the student will be able to:

1. Explain the theoretical limits of computational solutions to both complex and undecidable problems.
2. Describe specific examples of undecidable or not feasible problems.
3. Determine and analyze the complexity of procedures to determine the properties of limited computing automata.
4. Understand formal definitions of different models of machines.
5. Prove the undecidability or complexity of different problems.

Contribution of Course to Program Outcomes (Performance Indicators)

A.3, J.1, J.4

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.
Main Topics Covered: 1. Introduction, Concepts and Math Review 2. Regular Expressions and Finite Automata 3. Grammars 4. Complexity Theory, P and NP classes
Evaluation Criteria: 1. Exams 75% 2. Homework 15% 3. In Class Participation 10%
By Dr. Elio Lozano **March 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 4255	Introduction to the Analysis of Algorithms	Required for Computer Science	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
MATE 3031, MATE 3175, SICI 4036	NONE	Three hours weekly	

Course Description:
This course introduces the concepts, principles and techniques related with the design an analysis of algorithms. Situations are studied in which the application of the correct algorithm results in efficient results both in terms of space and time. Topics include methodologies for algorithm analysis, the methodology of divide and conquer greedy algorithms, dynamic programming and the backtracking technique among others.

Textbook:

Sedgewick, R. & Wayne, K., Algorithms (4th ed.), Addison-Wesley, 2011.

References:

Cormen T., Leiserson C, Rivest R., Stein C., Introduction to Algorithms (3rd ed.), MIT Press, 2010.

Knuth, D., The Art of Computer Programming, Volume I: Fundamental Algorithms (3rd ed.), Addison-Wesley, 1998.

Neapolitan R., Naimipour K., Foundations of Algorithms, (4th ed.), Jones and Barlett, 2011.

Weiss M., Data Structures and Algorithm Analysis in Java, (3rd ed.), Prentice Hall, 2012.

HackerRank: www.hackerrank.com

Course Objectives (Learning Outcomes):

After aproving this course, the student will:

1. Design efficient algorithms in accordance to the problem that needs to be solved.
2. Classify an algorithm based on asymptotic analysis.
3. Know the techniques: divide and conquer greedy algorithm, dynamic programming and backtracking.
4. Reduce problems using graphs and incidence and adjacency matrices.
5. Learn the difference between an algorithm that is solved in polynomial time (P) and non-polynomial time (NP).
6. An ability to program advanced data structures such as priority queues, balanced binary trees, mounds and matrices

Contribution of Course to Program Outcomes (Performance Indicators)

A.1, A.2, A.3, C.1, C.2, C.3, J.1, J.3, J.4, J.5
Contribution of Course to Meeting Requirements of Criteria 5: This course contributes to the development of the technical knowledge in Computer Science
Main Topics Covered: 1. Basic Concepts 2. Sorting Algorithm Analysis and Heaps 3. Symbol Tables 4. Hashing 5. Algorithm Paradigms and Solution Methods 6. Graph Theory and Applications
Evaluation Criteria: 1. Exams 70% 2. Homework 20% 3. Programs 10%
By Dr. Juan Manuel Solá-Sloan **April 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 4260	Introduction to Information Security	Required – Computer Science	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
SICI 4036	NONE	Three hours weekly	

Course Description:

This course provides a general overview of information security. The technical content of the course discusses essential concepts and methods for providing and evaluating security in information processing systems, including the security of operating systems, networks, applications and the web. In addition, case studies will be used to present the ethics of information management and the impact that administrative decisions have on our society.

Main Reference:

Stallings, W. (2014). *Cryptography and network security: Principles and practice* (6th ed.). Upper Saddle River, N.J.: Prentice Hall.

References:

Baase, S. (2013). A gift of fire: Social, legal, and ethical issues for computing technology (4th ed.). Pearson Higher Ed.

Bishop, M. (2005). Introduction to computer security. Boston: Addison-Wesley.

Easttom, W. (2012). Computer Security Fundamentals (2nd Edition). Paperback. Pearson Certification

Freund J and Jones J. (2014) Measuring and Managing Information Risk: a Fair Approach (1st Ed). Butterworth-Heinemann.

Gollmann, D. (2011). Computer Security (3rd Edition). John Wiley & Sons.

Hodeghatta U. (2014). The Infosec Handbook: An Introduction to Information Security Paperback. Apress open.

Pfleeger, C. (2015). Security in computing (5th ed.). Upper Saddle River, NJ: Pearson Learning PTR.

Quinn, M. (2015). Ethics for the Information Age. (6th ed.) Upper Saddle River, NJ: Pearson Learning PTR.

ACM Digital Library (2010). Disponible electrónicamente en http://librarians.acm.org/digital-library

Anderson, R. (2008). Security engineering: A guide to building dependable distributed systems (2nd ed.). New York: Wiley. Disponible electrónicamente en http://www.cl.cam.ac.uk/~rja14/book.html

Infosecurity. (2016). Infosecurity Magazine Webminars. Disponible electrónicamente en http://www.infosecurity-magazine.com

ISF. (2015). Information Security Forum. Disponible electrónicamente en https://www.securityforum.org/

ISSA forum (2015). Information System Security Association. Disponible electrónicamente en https://www.issa.org/

Course Objectives (Learning Outcomes):

At the end of the course, the student will:

1. Know the historical development related to information security.
2. Know the concepts of "information assurance", information security, computer security, network security, and Internet security.
3. Eplain the concepts related to cryptography, the four cryptanalysis techniques, symmetric and asymmetric cryptography, digital signatures, message authentication codes, hash functions and encryption and decryption modes.
4. Know and distinguish the difference between the definitions of "hackers" and the terminology related to information security
5. Understand the concepts about malicious code and how to protect systems from it.
6. Analyze the legal, ethical and social implications of the management of information systems.
7. Understand the concept of buffer overflow and how to create scheduled to reduce this effect.
8. Know concepts about the security of operating systems.
9. Know the difference between block encryptions and bursts
10. Understand the concepts of confusion and dissemination that are used in current encryption.
11. Know the security concepts in current networks with special emphasis on HTTPS, Secure HTTP, Secure Socket Layer (SSL), Transport Layer Security (TLS) and Secure Shell (SSH) protocols.
12. Be able to explain the concepts and ways in which operating systems and anti-virus manage the reliable and unreliable code.
13. Have the ability to analyze, design and implement technologies related to the protection of information.
14. Describe the security requirements for information systems, guaranteeing reliability, integrity and secrecy.
15. Analyze the relevance of the applicability of mechanisms and services focused on protecting information.

Contribution of Course to Program Outcomes (Performance Indicators)

C.1, C.2, D.1, D.2, E.1, E.2, E.3, F.1, I.2, (CS: J.4)

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Introduction and Related Fields
2. Definitions and concepts
3. Ethics on management of Information
4. Cryptography and Cryptoanalysis
5. Encryption Evolution
6. Modern Cyphers
7. Number Theory “crash course”
8. Public Key and Private Key Encryption
9. Firewalls
10. Web Security
11. Steganography

Evaluation Criteria:

1.	Exams	40%
2.	Project	40%
3.	Homework	20%

By Dr. Juan M Solá Sloan **February 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 4306	Undergraduate Seminar	Required for Computer Science	1.00

Prerequisites:	**Co- requisites:**	**Schedule:**
SICI 4029, SICI 4036	NONE	One hour weekly

Course Description:
This seminar aims to familiarize students with the most relevant research topics in Computer Science. It provides the skills and knowledge of technological tools needed to conduct research in the area. Students will be oriented don the importance of academic and research integrity.

Textbook:
No textbook assigned

References:
John W. Creswell Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research, 4th Edition Pearson Learning. 2012.

Kopka Helmut, Daly Patrick. Guide to Latex: Document Preparation for Beginners and Advanced Users. 4th Edition Addison-Wesley Longman Publishing Co., Inc. Boston, MA. 2003.

Sola Sloan Juan. How to make a poster of your Research. http:// www.uprb.edu/ profesor /jsola/ ppts/ poster.pdf.

The IEEE Xplore digital library http://ieeexplore.ieee.org/Xplore/home.jsp?reload=true

ACM Digital Library. http://dl.acm.org/.

Course Objectives (Learning Outcomes):
At the end of the semester, the student will possess:

1. A positive attitude towards research in Computer Science.
2. Knowledge about the principles of academic and research integrity.
3. Knowledge about current research topics in Computer Science.
4. Knowledge about how to select appropriate references for a scientific/technical paper.
5. Experience in the preparation of scientific/technical papers using tools such as LATEX.
6. Knowledge about opportunities in research internships.
7. Motivation to continue graduate studies in Computer Science.

Contribution of Course to Program Outcomes (Performance Indicators)
F.1, F.2, F.3, H

Contribution of Course to Meeting Requirements of Criteria 5:
This course contributes to the development of the technical knowledge in Computer Science

Main Topics Covered:

1. What is research?
2. Contemporary topics in Computer Science

3. What is a scientific literature review?
4. How to use digital libraries and their databases?
5. How to quote and paraphrase
6. How to write the references
7. Introduction to LATEX and its alternatives
8. How to prepare and give effective presentations
9. Papers, posters and conferences

Evaluation Criteria:

1.	Homework	60%
2.	Scientific Paper	20%
3.	Final presentation	20%

By Dr. Juan Manuel Solá-Sloan **August 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
COTI 4430	INFORMATION SYSTEMS PROJECT MANAGEMENT	Required – Information Systems and Technologies	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
COTI 3102	NONE	Three hours weekly	

Course Description:
This course study project management roles and work environments, the project and software development life cycle and various techniques for work planning, procurement, control an evaluation to achieve project objectives. In addition, we will study the most important tools for project management.

Textbook:

Schwable, K. (2013) Information Technology Project Management (7th Edition). Cengage Learning Australia.

References:

Bidgoli, H. (2016). MIS (6th ed.). Boston, MA: Course Technology Cengage Learning.

Cole, R., & Scotcher, E. (2015). *Brilliant Agile project management: A practical guide to using Agile, Scrum and Kanban* (1st ed.). Pearson

Gido, J., & Clements, J. P. (2015). *Successful project management* (6th ed.). Cengage.

Kloppenborg, T. J. (2015). *Contemporary project management* (3rd ed.). Mason, OH: South-Western Cengage Learning.

Helmers, S. A. (2015). *Microsoft Visio 2016 step by step* (1st ed.). Redmond, WA: Microsoft Press.

Pinto, J. K. (2013). *Project management: Achieving competitive advantage* (4th ed.). Boston: Pearson

Course Objectives (Learning Outcomes):

1. Create a real-life environment where the student, as part of a project team, participates in the management, planning, analysis, design, development, implementation, and documentation of an information system project.
2. Define the characteristics of a project and explain the need for project management.
3. Identify leadership styles of project managers.
4. Analyze optimal resources utilization for cost effectiveness and schedule efficiency.
5. Develop cost estimates and budgets to plan project expenditures.
6. Describe how project managers conduct audit of project performances to apply cost and schedule constraints.
7. Explain how project managers must communicate results to stakeholders in order to manage expectations.
8. Identify causes associated with project success and failure.

9. Specify ways in which a project can be terminated upon completion.

Contribution of Course to Program Outcomes (Performance Indicators)

B.1, B.2, B.3, C.1, C.2, C.3, D.1, D.2, I.1, I.2

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Introduction to Project Management
2. The Project Management and Information Technology
3. Microsoft Visio Workshop
4. The Project Management Process Group
5. Project Integration Management
6. Project Scope Management
7. Microsoft Project Workshop
8. Project Time Management
9. Project Cost Management
10. Project Quality Management
11. Project Human Resource Management
12. Project Communications Management
13. Project Risk Management
14. Project Procurement Management

Evaluation Criteria:

1.	Exams	50%
2.	Project	25%
3.	Homework	25%

By Prof. Omar Díaz **Sept 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
SICI 3015	ANALYSIS DESIGN INF SYST	Required	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
COTI 3102	NONE	Three hours weekly	

Course Description:
This course provides to the student the skills to develop competences in analysis, design and implementation of computerized systems. It includes the discussion, application and solution of real problems in industry.

Textbook:

Satzinger, J, Jackson, R and Burd, S. (2015) . *Systems Analysis and Design in a Changing World* (7th Edition) Cengage Learning.

References:

Bidgoli, H. (2016). MIS (6th ed.). Boston, MA: Course Technology Cengage Learning.

Helmers, S. A. (2015). Microsoft Visio 2016 step by step (1st ed.). Redmond, WA: Microsoft Press.

Pham, P., & Pham, A. (2012). Scrum® in Action: Agile Software Project Management and Development (1st ed.). Course Technology.

Pinto, J. K. (2013). Project management: Achieving competitive advantage (4th ed.). Boston: Pearson.

Rosenblatt, H. J. (2014). Systems analysis and design (10th ed.). Cengage.

Shneiderman, B. (2017). Designing the user interface: Strategies for effective human-computer interaction (6th ed.). Boston: Pearson.

Valacich, J. S., George, J. F., & Hoffer, J. A. (2015). Essentials of systems analysis and design (6th ed.). Pearson.

Course Objectives (Learning Outcomes):

1. Understand the concepts related with the Software Development Life Cycle (SDLC).
2. Develop skills to solve problems, using basics principles of the SDLC.
3. Learn to identify inputs and outputs for the software development.
4. Learn teamwork skills.
5. Create models and diagrams related with software design.
6. Develop detail and accurate systems specifications.
7. Design solutions using structured diagrams.
8. Recognize the principles of ethics in computing.

Contribution of Course to Program Outcomes (Performance Indicators)

B.1, B.2, B.3, C.2, I.1, (CS:K.1), (IS: J.1, J.2, J.3)

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Introduction to analysis and design
2. Information systems planning
3. Information systems analysis
4. Data and process modeling tools
5. System analysis and development strategies
6. Completing the system analysis process
7. System output and user interface specifications design
8. Database design techniques
9. Software architectures
10. Completing system design process
11. System development and implementation
12. Completing the system development and implementation
13. Training strategies
14. System upgrades strategies
15. Systems operations, support and security

Evaluation Criteria:

1.	Exams	50%
2.	Project	25%
3.	Homeworks	25%

By Prof. Omar Díaz **September 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON

Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
SICI 3211	Foundations of Information Systems	Required Information Systems	3.00

Prerequisites:	**Co- requisites:**	**Schedule:**
None	NONE	Three hours weekly

Course Description:

In this course the fundamentals of Computerized Information Systems in a company are analyzed. It studies the strategic importance of these systems, the support they offer and their role in operations, decision making and competitive advantages, as well as their influence on the management of the company and the global economy. Also computer and communications technologies, information as a critical resource in the organization, the process of system development, social and ethical aspects associated with the use of technology and professional development are study. Students prepare practice exercises using tools for productivity and Operating Systems.

Textbook:

Bidgoli, H. (2017). *MIS* (7th ed.). Stamford, CT: Cengage Learning.

References:

Association for Information Systems (2017). http://home.aisnet.org

Benítez, D. (2012). Sistemas de información, aplicación en empresas, *Contribuciones a la Economía*. Web: http://www.eumed.net/ce/2012/

Beskeen, D. (2014). *Microsoft Office 2010 Illustrated: Introductory, First Course*. Stamford, CT: Cengage Learning.

Brien, J. A., & Marakas, G. M. (2011). *Management information systems* (10th ed.). New York: McGraw-Hill/Irwin.

GoStats (2008). *The Ethics of Computing*. http://gostats.com/resources/computing-ethics.html

Grauer, R.; *et al.* (2013). *Exploring Microsoft Office 2010, Vol. 1*, 2nd ed. Upper Saddle River, NJ: Pearson - Prentice Hall.

Laudon, K. & Laudon, J. (2016). *Essentials of Management Information Systems*, 11th ed. Upper Saddle River, NJ: Pearson - Prentice Hall.

Quinn, M. J. (2016). *Ethics for the information age* (6th ed.). Upper Saddle River, N.J.: Pearson Education/Addison-Wesley.

Stair, R. & Reynolds, G. (2016). *Principles of Information Systems*, 12th ed. Stamford, CT: Cengage Learning.

The Ethics of Computing (2017). *Association for Computing Machinery*. http://www.acm.org

The Journal of Modern Project Management. (n.d.). *The Journal of Modern Project Management*. Retrieved January 20, 2014, from http://www.journalmodernpm.com/index.php/jmpm

Vermaat, M. E., Sebok, S. L., Freund S. M., Campbell, J. T. & Frydenberg M. (2016). *Discovering Computers 2016*. Boston, MA: Shelly Cashman Series.

Weixel, S.; Wempen F., & Skintik, C. (2011). *Learning Microsoft Office 2010, Deluxe Edition*. Boston, MA: Pearson Education.

World Wide Web Consortium (2017). http://www.w3c.com

Course Objectives (Learning Outcomes):

At the end of the course, the student will be able to:

1. Explain the importance of information systems, emphasizing their influence on processes, administration and competitive advantages in organizations.
2. Describe the characteristics, operation and use of information technologies, such as infrastructure of information systems.
3. Describe the importance of communication networks in a globalized society.
4. Describe the phases, activities and tasks required for the development and implementation of information systems.
5. Explain the professional, ethical, legal and global aspects associated with information systems.
6. Develop fundamental skills in the use of tools for productivity such as word processors, spreadsheets and preparers of presentations and database managers, as well as operating systems.
7. Relate to professional associations, publications and offers of continuing education in information systems.
8. Identify and evaluate aspects of effective communication, leadership and teamwork related to typical work of a professional in information systems..

Contribution of Course to Program Outcomes (Performance Indicators)

G.1, G.2, G.3, I.1, I.2, (IS: J.1, J.2, J.3)

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Information Systems on an Enterprise

2. Computer History
3. Data Bases Definition
4. Intro to Data Communications
5. Ethical Aspects
6. Ecommerce
7. Systems at the Enterprise
8. Intelligent Information Systems
9. State of the Art Technology and Trends
10. Software Applications: Excel, Word, PowerPoint

Evaluation Criteria:

1.	Exams and/or quizzes	40%
2.	Projects	35%
3.	Homework	15%

By Dr. Miguel Velez **Sept. 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON

Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
SICI 4009	INTROD NUMERICAL ANALYSIS	Required for CS	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
COTI 3102, MATE 3031	NONE	Three hours weekly	

Course Description:

Provides students with basic concepts of numerical analysis. Includes the study of numerical systems, floating point, algorithms, numerical methods used in problem solving, interaction and process, matrix theory, top down programming and optimization problems, logics, Boolean algebra, basic elements of logics applied to computers, logic diagram, numerical integration and differentiation and graph sketching.

Textbook:

No textbook assigned

References:

Chapra, S. C., (2011). *Applied Numerical Methods With MATLAB: for Engineers & Scientists, 3rd Edition*, McGraw-Hill.

Fausset, L. V., (2008). *Applied Numerical Analysis Using MATLAB, 2/e,* Pearson

Cheney, W. & Kincaid, D., (2012). *Numerical Mathematics and Computing, 7/e* Thomson Brooks/Cole

Datta, N. (2003). *Computer Programming and Numerical Analysis – An Integrated Approach 2nd Edition.* Sangam Books Ltd.

Epperson, J. F. (2013). *An Introduction to Numerical Methods and Analysis.* New Jersey: Wiley Publishers.

Zarowski. (2008). *Introduction to Numerical Analysis for Electrical and Computers Engineers.* John Wiley & Sons.

Ralston, A. & Rabinowitz, P. (2003). *A First Course in Numerical Analysis.* Courier Dover Publications.

Johnston, R. L. (1982). *Numerical Methods A Software Approach*. John Wiley and Sons.

Kuo, S. S. (1972). *Computer Application of Numerical Methods*. Addison-Wesley Publishing Company.

Trefethen, L. N. (2006). *Numerical Analysis. Oxford University*.

<http://www.comlab.ox.ac.uk/nick.trefethen/NAessay.pdf>

Course Objectives (Learning Outcomes):

1. Knowledge of the numerical analysis and its importance to the field of Computer Science.
2. Distinguish between traditional analytical methods and numerical methods available for solving numerical problems.
3. Properly select the most appropriate numerical method for solving a scientific nature.
4. Prepare computer programs which effectively integrate the various numerical methods.
5. Learn about the various forms of representation of numerical data into a computer.
6. Understand how the method of representation of a number can influence the development of approximation errors in scientific computing.
7. Know the different algorithms available to perform matrix operations and to solve systems of linear equations.

Contribution of Course to Program Outcomes (Performance Indicators)

A.1, A.3, B.1, B.2, C.3, J.2

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Introduction, definition and importance of the Numerical Analysis
2. Numerical Systems and the error concept.
3. The representations and numeric conversions.
4. Floating point number representations in the development of errors of approximation (representation of rounding and truncation)
5. Methods and algorithms for finding roots of nonlinear continuous functions (Bisection, regula falsi, secant, Newton and Muller)
6. Matrices and Systems of Linear Equations 27
7. Iterative methods of Gauss, Gauss-Jordan and Gauss-Thomas
8. Cramer's rule and systems of linear equations

Evaluation Criteria:

1.	Exams	80%
2.	Homework	15%
3.	In Class Participation	5%

By Prof. Rene Rodriguez **March 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
SICI 4019	Computer Architecture	Required	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
COTI 3205	NONE	Three hours weekly	

Course Description:

Provides the description, organization and design of a computer. It explains how the different computer systems and components are related. Topics discussed may include: operating systems, microprogramming, central processing unit (CPU), and disk.

Textbook:

Stallings, W. (2012). *Computer Organization and Architecture: Designing for Performance* (9th ed.). Upper Saddle River, NJ: Prentice Hall.

References:

Britton, Robert L. (2004). MIPS Assembly Language Programming. Upper Saddle River, NJ: Prentice Hall.

Ellard, Daniel J. (1994). MIPS Assembly Language Programming: CS50 Discussion and Project Book. Available at http://www.eecs.harvard.edu/~ellard/Courses/cs50-asm.pdf

Kjell, B. (2015). Programmed Introduction to MIPS Assembly Language. Available at http://chortle.ccsu.edu/assemblytutorial/

Machanick, P. (2015). MIPS2C: Programming from the Machine Up. RAMpage Research.

Null, L. (2011). The Essentials of Computer Organization and Architecture (3rd ed.). Sudburry, MA: Jones and Bartlett.

Patterson, D. & Hennessy, J. (2013). Computer Organization and Design: The Hardware Software Interface (5th ed.). Boston, MA: Morgan Kaufman.

Schneider M. (1987) Computer Organization and Assembly Language Programming for the VAX (1st ed) Wiley and Sons.

Stokes, J. (2015). Inside the Machine: An Illustrated Introduction to Microprocessors and Computer Architecture (1st ed.). San Francisco, CA: No Starch Press, Inc.

Tanenbaum, A. (2013). Structured Computer Organization (6th ed.). Upper Saddle River, NJ: Pearson.

Course Objectives (Learning Outcomes):

After completing the course, the student will be able to:

1. Describe the historic development of modern computer technology.
2. Apply digital logic concepts the design of logical circuits.
3. Understand the basic Von Newman's architecture.
4. Understand systems interconnections including ports and buses.
5. Understand the differences among memory media.
6. Understand how the processor works and its interaction with the other system's components.

Contribution of Course to Program Outcomes (Performance Indicators)

F.1, F.2, F.3, (CS:J1),

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Introduction to Computer Architecture
2. Boolean Algebra and Digital Logic
3. Main Memory
4. Secondary Memory

Evaluation Criteria:

1. Exams 66%
2. Term Paper 34%

By Prof. Filiberto Arniella **November 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
SICI 4028	Computer Operations Research	Required	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
MATE 3026, SICI4009	NONE	Three hours weekly	

Course Description:
The course covers various basic aspects of the operational study used in planning and research related to computer information systemization. Topics discussed include: PERT, CPM, linear models, simplex method, sensitivity, networks, dynamic models, inventory schedules, dynamic programming, optimizations, and simulations with computers.

Textbook:
No textbook assigned

References:

Hillier, F. S. & Lieberman, G. J. (2009). Introduction to Operations Research (9th ed.). McGraw-Hill.

Jensen, P. A. & Bard, J. F. (2003). Operations Research Models and Methods. John Wiley and Sons, Inc.

Moskowitz, H. & Wright, G. P. (1979). Operations Research Techniques for Management. Prentice-Hall.

Problem Solving Techniques (1995-2006). London, UK: Mind Tools, Ltd.
Web site: http://www.mindtools.com/pages/main/newMN_TMC.htm.

Project Planning & Management Tools (1995-2006). London, UK: Mind Tools, Ltd.
Web site: http://www.mindtools.com/pages/main/newMN_PPM.htm.

Rardin, R.L. & Horton, M. (1997). Optimization in Operations Research. Prentice-Hall.

Taha, H. A. (2017). Operations Research: An Introduction (10th ed.). Prentice-Hall.

Taylor III, B. W. (2004). Introduction to Management Science (8th ed). NJ: Prentice Hall.

www.usna.edu/Users/weapsys/avramov/.../LP.pdf -

theory.stanford.edu/~megiddo/pdf/lpencyc1.pdf

Linear Programming with Excel: www.mccd.edu/faculty/powerd/M15/m15_LinProgLab.htm

Introduction to Queuing Theory: www.research.rutgers.edu/~xili/cs352/queuing-theory.pdf

Queuing Theory: cswilliams.ncat.edu/comp755/Q.pdf

www.ee.cktyu.edu.hk/~zuderman/c/assnotes.pdf

Queuing Theory Calculator. www.supositorio.com

Course Objectives (Learning Outcomes):

At the end of the course, the student will be able to:

1. Use relevant algorithms to maximize profits and productivity while minimizing costs and the use of external resources in a variety of situations and/or projects.
2. Discuss the merits of mathematical functions for maximization and minimization, linear programming, the concept of duality, the simplex method, queuing theory and Pert/CPM for project management.
3. Make recommendations for the best way to optimize services and process in an enterprise using concepts from Operations Research.
4. Use network analysis to solve classical network problems such as finding the shortest path

Contribution of Course to Program Outcomes (Performance Indicators)

A.3, B.1, D.1 (CS: J.1, J.2)

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Linear Programming
2. Project Management
3. Queueing Theory (Markov Chains)
4. Break Even Point

Evaluation Criteria:

1.	Exams	90%
2.	Homework	10%

By Prof. Filiberto Arniella **Sept 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON

Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
SICI 4029	Fundamentals of Operating Systems	Required	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
SICI 4019	NONE	Three hours weekly	

Course Description:

An extensive study of the general principles of Operating Systems. The basics of multiprocessing, managing real and virtual memories, merging of processes and resources, solution to deadlocks.

Main Reference:

Stallings, W. (2015) Computer Organization and Architecture. (10th Edition) Upper Saddle River, NJ Prentice Hall

References:

Stallings W. (2014) Operating Systems: Internals and Design Principles. (8th Edition). Upper Saddle River, NJ: Prentice Hall.

Computing Classification System, 2012 Revision (2012) . Association for Computing Machinery. http://www.acm.org/about/class/class/2012

Tanenbaum, A. (2015) Modern Operating Systems (4th Edition) Pearson Education

Course Objectives (Learning Outcomes):

After completing the course, the student will be able to:

1. Know the history of the Operating Systems.
2. Understand the von Neumann architecture and cycle with the interrupt concept.
3. Understand the concept of Process.
4. Know the difference between Process and Thread.
5. Understand the concept of Virtual Memory.
6. Know all the major functions of the Operating System.

Contribution of Course to Program Outcomes (Performance Indicators)

A.1, A.3, B.1, C.1, F.1, I.1, I.2

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Introduction Structure and function
5. Process / Process Control Block
6. Threads / Thread Control Block
7. Concurrency
8. Semaphores & Monitors
9. Memory Management
10. File System / Disk

Evaluation Criteria:

1.	Programs	90%
2.	Other works	10%

By Prof. Jose Diaz Caballero **August 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON

Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
SICI 4030	DATABASE PROGRAM DEVELOPM	Required	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
COTI 3102	NONE	Three hours weekly	

Course Description:

Main characteristics and database management systems (DBMS) is discussed. Design and database implementation is also explained. The course emphasize in creation, query and update of databases using different tools available in the market. Explanation of concepts like: Database models, file organization mechanics, entity relation model, and query a database. Practice experience in database design and manipulation is provided.

Main Reference:

Connolly T. M. & Begg C. E. (2014). Database Systems: A Practical Approach to Design, Implementation, and Management (6th ed.) Addison-Wesley.

References:

Hoffer, J. A., Venkataraman, R. & Topi, H. (2015). *Modern Database Management* (12th). Upper Saddle River, NJ: Prentice Hall.

Coronel, C, Morris, S. & Rob, P. (2016). *Database Systems: Design, Implementation and Management* (12th ed.). Boston, MA: Course Technology.

Elmasri, R. & Navathe, S. (2015). *Fundamentals of Database Systems* (7th ed.). Addison Wesley.

García Molina, H., Ullman, J. & Widom, J. (2014). *Database Systems: The Complete Book* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Course Objectives (Learning Outcomes):

At the end of the course the student will:

1. Understand differences between traditional file systems and Database systems
2. Realize the rol of the database applications in contemporary organizations.
3. Model data using entity-relation diagrams.
4. Design normalize tables in relational databases.
5. Analyze database impact in applications' structure.
6. Use SQL language to create, query and update relational databases.

7. Knowledge about languages and tools used to connect databases.
8. Learn about database administrator's functions and responsibilities.

Contribution of Course to Program Outcomes (Performance Indicators)

A.3, B.1, B.2, C.1, I.2

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Introduction to Databases
2. Relational Database Model
3. Modeling using Entity Relationship Diagrams
4. Normalization
5. Relational Algebra
6. SQL Language
7. Database Application Development
8. Basic Data Base Management System Administration
9. New Trends in Database

Evaluation Criteria:

1.	Exams	50%
2.	Project	30%
3.	Homework	20%

By Dr. Nelliud Torres Batista **Sept 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON
Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
SICI 4036	Data Structures	Required	3.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
COTI 3102		Three hours weekly	

Course Description:
Concepts of terminology related to the most common data structures such as arrays, records, linked list, stacks, queues and trees. Sorting and searching algorithms are also covered.

Main Reference:

Carrano, F. (2012). Data Structures and Abstractions with Java (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

Dale, N.B., Joyce, D.T., & Weems, C. (2011). *Object-Oriented Data Structures Using Java* (3rd ed.). Sudbury, MA: Jones and Bartlett.

Deitel, H.M., & Deitel, P.J. (2012). *Java How to Program: Early Objects Version* (9th ed.). Upper Saddle River, NJ: Prentice Hall.

Lewis, J., DePasquale, P.J., & Chase, J. (2010). *Java Foundations: Introduction to Program Design & Data Structures* (2nd ed.). Boston, MA: Pearson Education.

Lewis, J., DePasquale, P.J., & Chase, J. (2010). *Java Software Structures: Designing and Using Data Structures* (3rd ed.). Boston, MA: Pearson Education.

Oracle (2013). *The Java Tutorials*. Retrieved from http://docs.oracle.com/javase/tutorial/index.html

Preiss, B. (1999). *Data Structures and Algorithms with Object-Oriented Design Patterns in Java*. Retrieved from http://www.brpreiss.com/books/opus5/

Swartz, F. (2007). *Java Notes*. Retrieved from http://leepoint.net/notes-java/index.html

Weiss, M.A. (2009). *Data Structures and Problem Solving Using Java* (4th ed.). Boston, MA: Addison Wesley

Course Objectives (Learning Outcomes):
At the end of this course, the student will be able to:

1. Select the most appropriate data structure to store and organize a collection of data so that it can be used efficiently.
2. Implement and analyze the most common sorting and searching algorithms.
3. Determine when an iterative problem should be solved using recursion or loops.
4. Design and code programs of medium complexity in a modern language that supports object-oriented programming.
5. Explain the importance of abstraction and abstract data types in Computer Science.
6. Implement the most common abstract data types such as stacks, queues, lists, and trees using the data structures such as arrays and linked structures.

Contribution of Course to Program Outcomes (Performance Indicators)

A.1, A.2, A.3, B.1, C.2, C.3, H.1 (CS: J3, J4, K.1)

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. Review of object-oriented programming
2. Analysis of algorithms: the searching and sorting problem
3. Basic data structures: arrays and linked structures
4. The indexed list abstract data type and its implementation
5. The stack abstract data type and its implementation
6. The queue abstract data type and its implementation
7. Recursive algorithms
8. The binary search tree abstract data type and its implementation
9. Maps and Dictionaries

Evaluation Criteria:

1.	Exams and/or quizzes	60%
2.	Final exam or quiz	20%
3.	Home works	20%

By Prof. Antonio F. Huertas **January 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON

Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
SICI 4037	DATA COMMUNICATION	Required	3.00

Prerequisites:	**Co- requisites:**	**Schedule:**
SICI 4019 SICI 4029	NONE	Three hours weekly

Course Description:

Provides the basic knowledge of the systems and methods used in data communication. The course covers all aspects of data communication: terminals, modems, telephone lines, data communication language, considerations for installation of hardware, software communication and networking.

Textbook:

Comer, D. E. (2014). Computer Networks and Internets (6th ed.), Pearson Higher Ed.

References:

Comer, D.E (2006) Internetworking with TCP/IP Principles Protocols and Architectures. (5th Ed). Prentice Hall.

Forouzan B. (2012) Data Communications and Networking. (5th Ed) McGraw-Hill Ed.

Harold R.E (2013) Java Network Programming. (4th Ed) O'Reilly Media.

Newton H. (2013) Newton's Telecom Dictionary (27th Ed) Telecom Publishing.

Stallings W. (2013) Data and Computer Communications. (10th Ed). Pearson.

Course Objectives (Learning Outcomes):

After approving this course, the student will:

1. The history and background of the main components of data communications.
2. Understand the model layer of system that is used in the design of data communication system (Internet and OSI).
3. Understand the protocol used in cloud computing and Internetworking.
4. Understand the difference between Personal, Local, Metropolitan and Wide Area Networks.
5. Know about the advantages and disadvantages of various communication media.
6. Know about the different access interconnection technologies for the consumers.
7. Understand the difference between packet switch and circuit switches networks.
8. Be able to recommend suitable equipment for real situations in the context of data communications.

9. Know how to choose among several technologies based on its cost, speed, security and reliability to accomplish a desired goal.
10. Know how to program a client server application.

Contribution of Course to Program Outcomes (Performance Indicators)

A.3, D.1, D.2, F.1

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

Main Topics Covered:

1. General concepts of data communications
2. The physical layer and media used.
3. Transmission Modes via Devices
4. Data Link Layer Technologies
5. Topologies, Network Interface Layer
6. Internetworking (TCP/IP)
7. Applications Sockets and Client Server
8. Tradeoff Exercises and Tools

Evaluation Criteria:

1.	Exams	50%
2.	Project	25%
3.	Homework	25%

By Prof. Juan M. Sola Sloan **April 2016**

UNIVERSITY OF PUERTO RICO AT BAYAMON

Department of Computer Science

Course Syllabus

Course code:	**Course Title:**	**Classification:**	**Credits:**
SICI 4038	RESEARCH WORKSHOP (Capstone)	Required	4.00
Prerequisites:	**Co- requisites:**	**Schedule:**	
SICI 4029, SICI 4037	NONE	Four hours weekly	

Course Description:

This is a capstone course to assess the students' capabilities to perform a scientific research or software development project depending on the student emphasis area. The student must demonstrate the application of the skills, methodologies, techniques, and tools learned through the bachelor degree to develop a term project. The project's problem or topic will be selected by the student in accordance with the criteria and approval of the computer science faculty committee. The student will prepare its conclusion a written report or scientific article.

Textbook:

No textbook assigned

References:

Bidgoli, H. (2016). MIS (6th ed.). Boston, MA: Course Technology Cengage Learning.

Creswell J.W. (2012) Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research. (4th Edition) Pearson Higher Ed.

Helmers, S. A. (2015). Microsoft Visio 2016 step by step (1st ed.). Redmond, WA: Microsoft Press.

Kopka Helmut, Daly Patrick. Guide to Latex: Document Preparation for Beginners and Advanced Users. 4th Edition

Addison-Wesley Longman Publishing Co., Inc. Boston, MA. 2003.

Pinto, J. K. (2013). Project management: Achieving competitive advantage (4th ed.). Boston: Pearson.

Rosenblatt, H. J. (2014). Systems analysis and design (10th ed.). Cengage.

Valacich, J. S., George, J. F., & Hoffer, J. A. (2015). Essentials of systems analysis and design (6th ed.). Pearson

The IEEE Xplore digital library http://ieeexplore.ieee.org/Xplore/home.jsp

ACM Digital Library. http://dl.acm.org/.

Course Objectives (Learning Outcomes):

1. Demonstrate the skills required in the research, planning and development of a computer based system.
2. Document and recommend viable solutions, using a computerized system as main solution.

3. Analyze objectives, functions, and the flow of information to understand the detail of the current operations of the user.
4. Analyze and assess alternatives, looking for procedures that conform to a viable solution to the problem.
5. Develop, implement, and document the solution.
6. Disseminate its findings

Contribution of Course to Program Outcomes (Performance Indicators)

B.1, B.2, B.3, C.2, H, I.2, (IS: J.1, J.2, J.3, J.4, J.5) (CS:K2)

Contribution of Course to Meeting Requirements of Criteria 5:

This course contributes to the development of the technical content core knowledge.

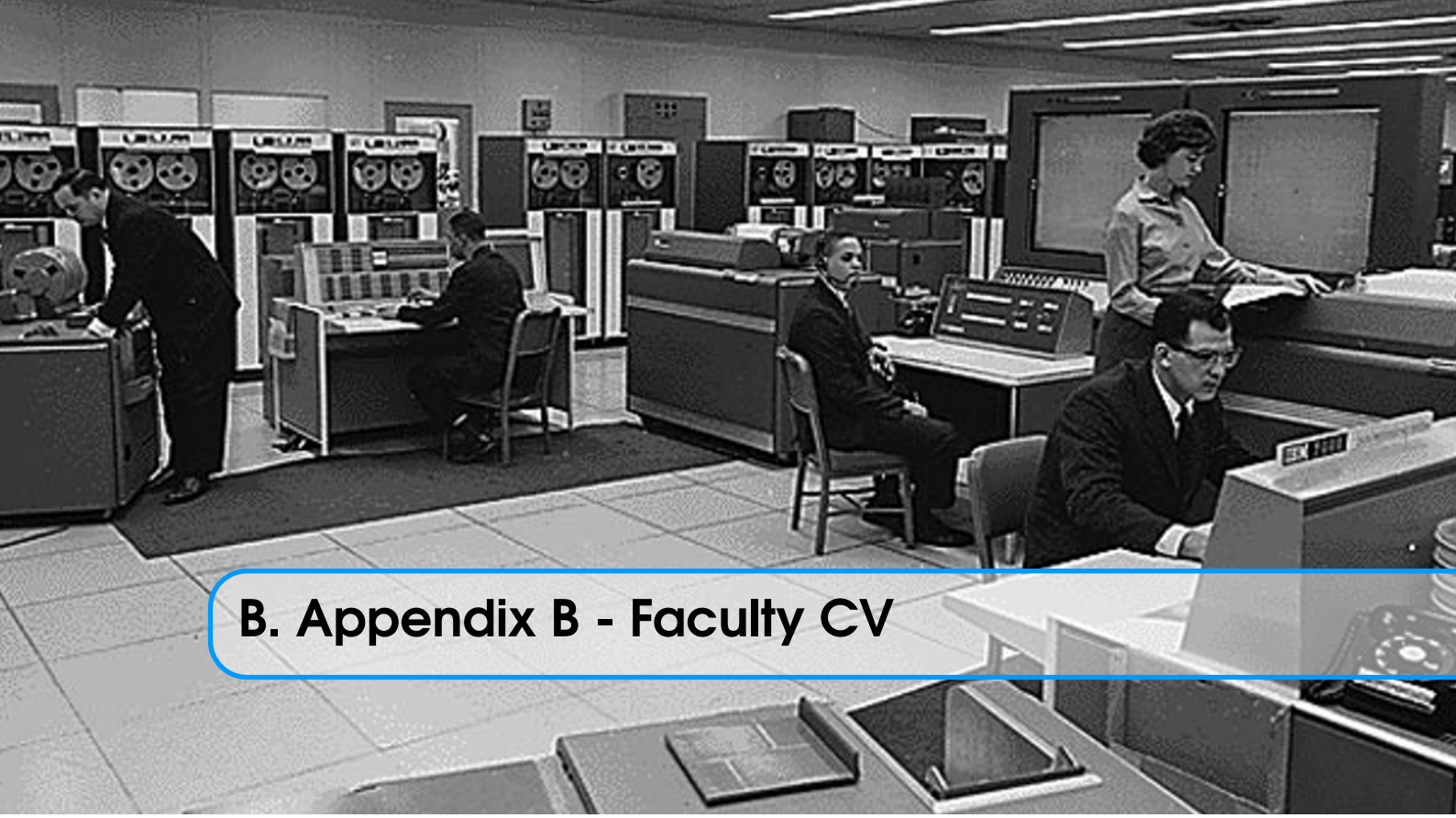
Main Topics Covered:

1. System Design
2. Development Coding
3. Proposal Preparation
4. Poster and Paper Orientation
5. Opportunities Before Graduation
6. Final Presentation

Evaluation Criteria:

1.	Letter of Intention	5%
2.	Written Proposal and Defense	20%
3.	Progress Reports (2 minimum)	10%
4.	Project Defense	20%
5.	Poster	10%
6.	Article or Written Document	30%
7.	Post Test (Assessment)	5%

By Dr. Juan Manuel Solá Sloan **December 2017**



B. Appendix B - Faculty CV

This appendix compiles the curriculum vitae of the full time and part time professors that teach most of the courses at the Department of Computer Science at the University of Puerto Rico in Bayamón.

Full Time Professors

Antonio F. Huertas-Bermúdez

Cond. Rexville Park, Apt. J-119
Bayamón, PR 00957
Web: profesor.upr.edu/ahuertas
Email: Antonio.Huertas@upr.edu
Cell: (787) 397-2120

EDUCATION:

Pursuing Ed.D. Higher Education — since 2012
Inter American University of Puerto Rico, Metropolitan Campus
San Juan, PR

M.S. Computing in Open Information Systems — 2008
Inter American University of Puerto Rico, Metropolitan Campus
San Juan, PR

M.S. Information Systems
EDP College of Puerto Rico, Hato Rey Campus — 1997
San Juan, PR

B.S. Mathematics (Computer Science Option) — 1994
Unversity of Puerto Rico, Mayagüez Campus
Mayagüez, PR

ACADEMIC EXPERIENCE

Assistant Professor — since 2003
Department of Computer Science
University of Puerto Rico at Bayamón
Bayamón, PR

Adjunct Professor — 2000-2005
Faculty of Science and Technology
Department of Computer Science
Inter American University of Puerto Rico, Metropolitan Campus
San Juan, PR

Instructor — 1996-2003
Department of Computer Science
University of Puerto Rico at Bayamón
Bayamón, PR

Computing Teacher — 1995
Micro Tech, Inc.
Caguas, PR

NON-ACADEMIC EXPERIENCE

Electronic Information Systems Programmer — 1995-1996
Puerto Rico Departamento of Labor and Human Resources
San Juan, PR

HONORS AND AWARDS

Highest Honor — 1997
Information Systems Program
EDP College of Puerto Rico, Hato Rey Campus
San Juan, PR

SERVICE ACTIVITIES

Auxiliar Dean of Academic Affairs — since 2017
University of Puerto Rico at Bayamón
Bayamón, PR

Academic Senator — 2015-2017
University of Puerto Rico at Bayamón
Bayamón, PR

Chairman — 2009-2014
Department of Computer Science
University of Puerto Rico at Bayamón
Bayamón, PR

Nelliud Torres Batista

#40 Monte Real
Villa Del Monte, Toa Alta PR
Email: nelliud@gmail.com

EDUCATION:

Ph.D. Information Systems, Universidad del Turabo	2011
MS Information Systems, EDP University	1995
BS Computer Science, Universidad de Puerto Rico en Bayamon	1984

ACADEMIC EXPERIENCE

Professor, Computer Science Department University of Puerto Rico at Bayamón	since 1995
Adjunct Professor, EDP University	2012-2014
Adjunct Professor, Universidad Interamericana de Puerto Rico	since 1999
Instructor, Allied Schools of Puerto Rico	1986-1988

NON-ACADEMIC EXPERIENCE

Chairman of the Computer Science Department,	since 2014
Chairman of the Computer Science Department,	1996-1998
Operating Systems Specialist, Administracion de Colegios Regionales, UPR	1994-1984

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS:

Professional Certificate in Open Systems Universidad Interamericana	2004

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

Association of Computer Machinery	since 2012

SERVICE ACTIVITIES

Chairman of the Computer Science Department University of Puerto Rico at Bayamón Bayamón, PR	since 2016
Coordinator of the Annual Programming Contest: *Interuniversity Programming Contest* at UPR Bayamon ACM-ICPC, Director, Puerto Rico	since 2012

PUBLICATIONS AND PRESENTATIONS (Books)

Aplicaciones Office 2010	2012
Aplicaciones Office 2007	2008
Aplicaciones Office 2003	2004
Aplicaciones Office XP	2002
Prende y aprende con tu PC	2001
Aplicaciones Office 2000	2000

Elio Lozano Inca, Ph. D.

Department of Computer Science
Office CC5 phone: (787) 933-0000. Ext 3305
Email: elio.lozano@upr.edu
Web: www.profesor.uprb.edu/elozano

EDUCATION:

Science and Engineering Ph. D., University of Puerto Rico at Mayagüez	2006
Scientific Computing MS, University of Puerto Rico at Mayagüez	2003
Mathematics BS, University of Sand Antonio Abad Cusco, P.E.	2000
Pursuing BS, Computer Engineering (Electrical), Polytechnic University of Puerto Rico	since 2016

ACADEMIC EXPERIENCE

Professor, Computer Science Department, University of Puerto Rico at Bayamón, PR	Since 2009
Professor, Electrical and Computer Engineering Department, Polytechnic University of Puerto Rico, PR	2006-2009
Network Administrator, Mathematics Department, University of Puerto Rico at Mayaguez, PR	2003-2006
Teaching Assistant, Mathematics Department, University of Puerto Rico at Mayaguez, PR	2001-2006
Teaching Assistant, Mathematics Department, Pontifical Catholic University of Perú, PE	2001
Auxiliary Professor, Mathematics Department, University of San Antonio Abad Cusco, PE	2000

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

Member of IEEE (#85009269) and Computer Society.

HONORS AND AWARDS

Graduate Research Fellowship CONCYTEC, Perú 2001.

Graduate Research fellowship supported by The Office of Naval Research (ONR) GRANT #N00014-00-1-0360, 2003. Co PI in the project "*Infrastructure to Enhance Research of Education in High Performance Computing, Visualization, Game Technology and Data Mining in Puerto Rico*" DOD (ONR) GRANT #DURIPARO, 2007.

Co PI in the project "Physical Environmental Variables Acquisition Using Universal Serial Bus", Academic Research Program at University of Puerto Rico at Bayamón, Aug. 2009.

Co PI in the project "How to implement a Smart Building", Academic Research Program at University of Puerto Rico at Bayamón, Aug. 2010.

Co PI in the project "Caribbean Computer Center for Excellence CCCE Alliance" leaded by Dr. Juan Arratia at UMET. Aug. 2011.

PI in the project "Machine Vision System Libraries to Improve Computer Science Curriculum", Academic Research Program at University of Puerto Rico at Bayamón, Aug. 2011.

PI in the project "*Procesamiento Digital de Señales Aplicado a Instrumentos de Medición y Control*", Academic Research Program at University of Puerto Rico at Bayamón, Aug. 2012.

PI in the project "*Stereoscopic 3D Anaglyph Video System*", Academic Research Program at University of Puerto Rico at Bayamón, Aug. 2013.

PI in the project "*Real Time Embedded Machine Vision System*", Academic Research Program at University of Puerto Rico at Bayamón, Aug. 2014.

PI in the project "*Stereoscopic vision-based obstacle detection and avoidance method for autonomous mobile robots",* Academic Research Program at University of Puerto Rico at Bayamón, Aug. 2015.

PI in the project "*Stereoscopic Image Based Path Planning for Autonomous Mobile Robots",* Academic Research Program at University of Puerto Rico at Bayamón, Aug. 2016.

PUBLICATIONS AND PRESENTATIONS

V. O. Santos, E. Lozano. 2016. AC13 Controller: Extendable Telepresence Robotics for Education and Beyond. International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE). Vol. 4, Issue 4.

E. Lozano. 2015. *Stereoscopic 3D Anaglyph Video System.* Interuniversity Seminar of research in Mathematics Science. Mayagüez – Puerto Rico.

E. Beauchamp & E. Lozano. 2014. "*Comparing USB Data Acquisition Instruments using Arduino and PIC18F4550 in LabVIEW and Matlab*". International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering (IJIREEICE) Vol. 2, Issue 9.

J. Olaya, E. Lozano, A. Cruz. 2012. *Clustering Hybrids: Genetic Algorithm with K-means and Fuzzy C-means*. International Conference on Machine Learning and Data Mining MLDM'2012, Berlin.

D. Sanchez, E. Lozano, and J. Sola-Sloan. 2012. *An Approach for Constraint Based Heuristic Method of Generating Houses and Building Blueprints for Real-time Applications*. International Journal on Computing Vol. 2, No. 1.

F. Perez-Laras, D. Díaz-Correa, E. Lozano, and J. Sola-Sloan. 2011. *Procedural Generation for a Virtual City*. Computing Alliance of Hispanic Serving Institutions CAHSI Annual Meeting, San Juan Puerto Rico.

V. O. Santos-Uceta, E. Lozano, and M. Rivera-Ayuso. 2011. *Measurement of Physical Variables using the Universal Serial Bus Standard*. Computing Alliance of Hispanic Serving Institutions CAHSI Annual Meeting, San Juan Puerto Rico.

E. Lozano and E. Acuña. 2011. *Comparing Clustering and Metaclustering Algorithms*. Machine Learning and Data Mining MLDM'11 in New York.

E. Lozano and E. Acuña. 2011. *Comparing Classifiers and Metaclassifiers.* Industrial Conference on Data Mining ICDM'11 in New York.

E. Lozano. 2011. *Comparing Edge Detection Algorithms on Grayscale Noise Image*. Interuniversity Seminar of Research in Mathematics Science. Humacao – Puerto Rico.

D. Sanchez and E. Lozano. 2009. *Procedural Generation of Building Blueprints for Real-Time Applications.* Master Thesis. Graduate School of Polytechnic University of Puerto Rico.

M. Omar and E. Lozano. 2009. *A Comparison of Various Outlier Detection Methods*. Master Project. Graduate School of Polytechnic University of Puerto Rico.

E. Lozano and E. Acuña. 2006. *High dimensional Data Visualization using Star Coordinates on Three Dimensions*. I International Conference on Multidisciplinary Information Sciences and Technologies (InSciT06), Merida, Spain.

E. Lozano and E. Acuña. 2005. *Parallel algorithms for distance-based and density-based outliers*. The Fifth IEEE International Conference on Data Mining. Houston, Texas, USA ICDM05.

E. Lozano and E. Acuña. 2005. *Parallel and Distributed Computing for Data Mining: A Review.* Interuniversity Seminar of research in Mathematics Science. Mayagüez – Puerto Rico.

E. Lozano and E. Acuña. 2003. *Parallel computation of kernel density estimates classifiers and their ensembles*. Proceedings of the International Conference on Computer, Communication and Control Technologies, Orlando Florida, USA.

E. Lozano. 2003. *Experimental validation of Bulk Synchronous Parallel on Origin 2000*. Computing Research Conference. University of Puerto Rico.

E. Lozano. 2002. *Pattern Recognition: Radial Basis Function*. Interuniversity Seminar of research in Mathematics Science. Ponce - Puerto Rico.

Filiberto Arniella Martínez

Email: filiberto.arniella@upr.edu
Email: farniella@hotmail.com

EDUCATION:

Completed course load towards Ph. D. degree in Operations Research. 1972-1974
The Wharton School of the University of Pennsylvania. UPR License

Master of Arts, Mathematics Major, University of California, Berkeley. 1969-1971
UPR President's Scholarship.

Bachelor of Sciences, with High Honors, University of Puerto Rico, 1965-1969
Río Piedras Puerto Rico, Mathematics MATH Department Medal

ACADEMIC EXPERIENCE

Professor of Computer Science and Math Instructor Since 1985
University of Puerto Rico, Bayamón Computer Science Department.

ASSEMBLER Language PDP-11, Data Structures MIS Introductory Course, 1984-1985
Calculus and Precalculus. Project Implementation
Interamerican University

NON-ACADEMIC EXPERIENCE

Project Management Course. IBM Corporation 1981

Productivity Institute, American Productivity Center, Houston, Texas 1981

Quality Circles, Instituto para la Productividad, Hato Rey, PR. 1980

Simulation Modeling Course. Professional Advance Education, San Francisco, California 1980

IBM'S Training in medium Size Systems (S34/S38) . 1977-1978
IBM Headquarters, Atlanta, Georgia

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

Statistics Society of Puerto Rico (Sociedad de Estadísticos de Puerto Rico) since 1986

HONORS AND AWARDS

Math Department Medal UPR, Rio Piedras

Thesis the Riemann Mapping Theorem (Publication) 1971

A Markovian Model for Population Scholarity Levels, PR planning board (Research) 1978

José Juan Díaz Caballero

Urb Villa Fontana, 3NS15 Vía Lourdes
Carolina PR 00983-4650
(787)630-6330
Email: jose.diaz39@upr.edu.

EDUCATION:

MS Computer Science, Fairleigh Dickinson University, New Jersey 1985

BS Chemical Engineering, Recinto Universitario de Mayagüez 1981

ACADEMIC EXPERIENCE

Professor, Computer Science Department University of Puerto Rico at Bayamón since 1991

NON-ACADEMIC EXPERIENCE

Senior Software Engineer, GEC-Marconi, Wayne, New Jersey 1984-1991

Electronics Engineer, Avionics Research and Development Activity, New Jersey 1981-1984

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS:

CompTIA Network+ 2006 2006

HONORS AND AWARDS

Reconocimiento Asociación de Profesores UPR Bayamón 2009

SERVICE ACTIVITIES

Director of Computer Science Department, UPR at Bayamón 1998 – 2000

Coordinator of Academic Computing, UPR at Bayamón 1994 - 1998

PUBLICATIONS AND PRESENTATIONS (Books)

Nuevo Excel ¡Rapidito! 2009

Excel ¡Rapidito! 2005

Juan M. Solá-Sloan

475 Eddie Gracia, Ext. Roosevelt
San Juan PR 00918
787-282-3212

EDUCATION:

Ph.D. Computing Science and Engineering 2009
Universidad de Puerto Rico, Recinto Universitario de Mayagüez

ACADEMIC EXPERIENCE

Associate Professor, University of Puerto Rico at Bayamón, Computer Science Department since 2014
Assistant Professor, University of Puerto Rico at Bayamón, Computer Science Department 2009-2014
Adjunct Professor**,** Polytechnic University of Puerto Rico, CSE Graduate Program and PhD Program since 2009
(only on Winter trimester and Spring sometimes)

NON-ACADEMIC EXPERIENCE

Consultant for MINI Computer Information Systems 1998-2000
Other consulting information available upon request

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

Association of Computer Machinery (ACM)
Society for Modeling and Simulation (SCS)

HONORS AND AWARDS

Distinguished Professor Award of the Computer Science Department, Dean of Academic Affairs 2013
Won third place for Scientific Presentation at the AGEM Winter Symposium 2007

SERVICE ACTIVITIES

Coach of various programing teams that represent the UPRB on the ACM-ICPC since 2013
Co-chairman of the Puerto Rico's ACM-ICPC since 2013
Co-chairman of the Inter-College Computer Programming Contest since 2009
Judge of the Third Programming Contest of the Inter-American University at San German 2011

PUBLICATIONS AND PRESENTATIONS

Humberto G. Ortiz-Zuazaga, Roberto Arce-Corretjer, Juan M. Solá-Sloan and José G. Conde, "SalHUD - A Graphical Interface to Public Health Data in Puerto Rico" International Journal of Environmental Research and Public Health, Vol 13., No. 1, pp 1 - 5, December 2015.

J. Padilla and J. Solá-Sloan, "Visualization of Dengue Fever Using SalHUD", Poster presented at the 2015 CAHSI Summit. September 10-12, 2015. San Juan PR 2015.

G. Duntley and J. Solá-Sloan,"Traffic Dynamics for the Roundabout vs. Traffic Lights Simulator", Poster presented at SACNAS 2012. October 12, 2012. Seattle Washington 2012

Daniel Sanchez, Elio Lozano and Juan M. Solá-Sloan, "An Approach for Constraint Based Heuristic Method of Generating Houses and Building Blueprints for Real-time Applications." GSTF: Global Science and Technology Forum: Journal on Computing, Vol 2., No. 1, pp. 220 - 225, April. 2012.

Juan M. Solá-Sloan and Isidoro Couvertier, "TOE-Em: The TCP Offload Engine Emulator for Approximating the Impact of Removing TCP/IP Protocol Processing From Apache HTTP Server." IJEI: International Journal of Engineering and Industries, Vol 2., No. 4, pp. 1 - 11, Jan. 2012. (Invited Paper)

S. Gonzalez-Fonseca and J. Solá-Sloan,"Web Server Bechmark Tools for httperf (Extended)", Poster presented at Universidad de Puerto Rico en Bayamón Expo Ciencias 2011 . May 19, 2011. Baymón, PR. (USA)

Juan Manuel Sola-Sloan. "Por una democracia 100% representativa", August 31, 2011. El Nuevo Día.

Juan M. Solá-Sloan and Isidoro Couvertier, "A formal approach to protocol offload for web servers applied to a TCP offload engine and Web traffic." Proceedings of the SCS ACM/SIGSIM 2010 Spring Simulation Multiconference.. Florida Hotel and Conference Center, Orlando, FL, (USA), April 11 - 15, 2010.

Daniel Sanchez, Elio Lozano-Inca and Juan M. Solá-Sloan, "Procedural generation of building blueprints for real-time applications." Proceedings of the SCS ACM/SIGSIM 2010 Spring Simulation Multiconference.. Florida Hotel and Conference Center, Orlando, FL, (USA), April 11 - 15, 2010.

Juan M. Solá-Sloan and Isidoro Couvertier, "A TCP Offload Engine Emulator for Estimating the Impact of Removing Protocol Processing From a Host Running Apache HTTP Server. Proceedings SCS ACM/SIGSIM 12th Communications and Networking Simulation Symposium (CNS'09)". San Diego California (USA), March 22 - 27, 2009.

PROFESSIONAL DEVELOPMENT ACTIVITIES

SEED Workshop, A Hands On Network Security Workshop, Syracuse University, June 4 -7, 2018

NASIG 2018 North American School of Internet Governance, Polythecnic University of Puerto Rico, March 7-9, 2018

ABET Foundation, Program Assessment Workshop Terraza Administración Central, Jardín Botánico, Universidad de Puerto Rico, San Juan, Puerto Rico. Feb. 6-7, 2015.

Faculty Research Network Symposium, The Global Imperative for Higher Education. Hotel Caribe Hilton, Universidad del Sagrado Corazón and Centro para Puerto Rico, San Juan, Puerto Rico. Nov. 21-22, 2014.

18th GENI Conference, Workshop on GENI in Education Polythecnic New York University NYU-POLY. Brooklyn, New York. Sponsored by the National Science Foundation. Oct 26-29, 2013.

Workshop on Teaching Information Assurance through Case Studies and Hands-on Experiences North Carolina A&T University. North Carolina, Sponsored by the National Science Foundation. May 20-24, 2013.

Computational Thinking Through Computing and Music Performamatics Workshop on Interdisciplinary Teaching and Learning. University of Massachusetts (UMASS) Lowell. Sponsored by the National Science Foundation. Award No. 1118435. June 21-22, 2012.

Faculty Training Workshop on Intermediate Parallel Programming and Cluster Computer DoD HPCMO and National Computational Science Institue. Polythecnic University of Puerto Rico and National Computational Science Institute. July 31 to August 6, 2011.

Broader Engamgement Program (SC'10) Super Computing Conference 2010. Supported by Lawrence Berkeley National Laboratory and National Science Foundation. Nov 13-19, 2010.

Academic Careers Workshops for Underrepresented Participants. Coalition to Diversify Computing (CDC), Center for Minorities and People with Disabilities IT (CMD-IT), Computing Alliance of Hispanic Serving Institutions (CAHSI). Houston Texas. March 5-7. 2010.

Workshop for the National Science Foundation (NSF)'s Faculty Early Career Development (CAREER) Program. Quality Education for Minorities. Las Vegas Nevada. Feb 19-20, 2010.

Miguel Vélez-Rubio

Braulio Dueño Colón,
I-23A 4th Street,
Bayamón, PR 00959
(787) 390-2064, (787) 993-8862,
miguel.velez5@upr.edu

EDUCATION:

Ph.D. in Information Technology – IT Education, 2009-2013
Capella University, Minneapolis, MN

Post Master Certificate in College Teaching, 2009-2011
Capella University, Minneapolis, MN

Master in Science in Software Engineering, 1996-2000
University of Puerto Rico - Mayagüez Campus, Mayagüez, PR

ACADEMIC EXPERIENCE

Interim Chancellor, since 2017
University of Puerto Rico at Bayamón

Associate Professor, since 1998
Computer Sciences Department, University of Puerto Rico at Bayamón

Part Time Professor, August 2016
Informatics Department, Interamerican University of Puerto Rico at Bayamón

Assistant Dean of Academic Affairs, 2009-2014
University of Puerto Rico at Bayamón

Computer Sciences Department Chair, 2003-2009
University of Puerto Rico at Bayamón

NON-ACADEMIC EXPERIENCE

Academic Computing Chair/Coordinator, 1998-2003
Academic Computing Office and Web Site,
University of Puerto Rico at Bayamón

Consultant and Trainer, since 1998
Some companies and individuals (occasionally)

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS:

Post Master Certificate in College Teaching, Capella University, October 2011
AutoCAD Level II Certification from Autodesk, November 1995

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

ACM Member, 2012 - Present
Internet Society of Puerto Rico Member, 2009 - Present

SERVICE ACTIVITIES

Chancellor at the UPRB
CEPR UPRB Link (Nov/2013 – Jun/2014)
Faculty Professional Improvement Committee (Dec/2007 – Jun/2014)
Institutional Technology Fee (Oct/2009 – Jun/2014)
Institutional Enrollment (Oct/2009 – Jun/2014)
MSCHE Steering Committee (2010 – 2011)
UPRB Management Board (Jan/2009 – Oct/2009)
Pilot Test Project for Non-Traditional Students (Jan/2004 – Oct/2009)
Institutional Technology (2007 – 2008)
Students Recruitment (2004 – 2005, 2006 – 2007)
Academic Research and Creation (2006-2007)
Internships and Practices Coordination and Programming (2006 – 2007)

Information Systems Program Coordinator (Jan/2015 - Present)
Department's Internships Program Coordinator (Jan/2015 - Present)
Computer Sciences Curriculum Committee (Aug/2001 – May/2012, Aug/2014 - Present)
Computer Sciences Laboratory Committee (Sep/1998 – May/2012, Aug/2014 - Present)
Department Personnel Committee (Aug/2003 – Oct/2009, Aug/2014 - Present)
Assessment Committee (Aug/2009 – Present)

Internet Society of Puerto Rico Board Member (Mar/2018 – Present)
NASIG 2018 Board Member (Mar/2017 – Mar/2018)
Boys Scout of Puerto Rico Leader (2016 – Present)
Puerto Rico Broadband Taskforce (2011 – 2013)
Dot PR Committee for the Redelegation of the .pr Domain (2009 – 2011)
CES Consultative Boards Member (Jan/2002 – Present)

PUBLICATIONS AND PRESENTATIONS

Introductory computer programming course teaching improvement using immersion language, extreme programming, and education theories (Dissertation Research – The research is still active after the defense approval in the University of Puerto Rico at Bayamón)

The Use of a Conversational Structure to Improve the Previous Button on A Web Browser (Thesis Research)

PROFESSIONAL DEVELOPMENT ACTIVITIES

On Line Courses Development Course (Apr – May / 2016)

René A. Rodríguez

4th Street C-14 Monte Sol
Toa Alta, PR 00953
787-636-2305

EDUCATION:

Master of Science in Computer Science Nova Southeastern University, Ford Lauderdale, FL	2003
Master of Science in Applied Mathematics Universidad de Puerto Rico, Rio Piedras, PR	1991
Bachelor of Science in Mathematics Universidad de Puerto Rico, Rio Piedras, PR	1983

ACADEMIC EXPERIENCE

Associate Professor, University of Puerto Rico at Bayamón, Computer Science Department	1995
Instructor, Bayamón Central University, Bayamon PR.	1991-1995
Coordinator of the Computer Information Systems program at the Business Administration Department.	1991-1995

NON-ACADEMIC EXPERIENCE

Operating Systems Specialist Regional Colleges Administration, University of Puerto Rico, Rio Piedras, PR	1984-1991

SERVICE ACTIVITIES

Dean of Administrative Affairs, Universidad de Puerto Rico, Carolina
University Board, Universidad de Puerto Rico, Bayamón
Administrative Board, Universidad de Puerto Rico, Central Adm.
Academic Senate, Universidad de Puerto Rico, Bayamón

Omar Diaz Rivera

1668 Calle Cuernavaca,
San Juan PR 00926-4728
(787) 384-9022
omar.diaz4@upr.edu

EDUCATION:

DBA (Candidate) Management of Information System, Univ. del Turabo	currently
MS Computational Education, Interamerican University, San Juan	1999
BS Computer Science, University of Puerto Rico at Bayamon	1986

ACADEMIC EXPERIENCE

Instructor, Computer Science Department University of Puerto Rico at Bayamón	since 2003
Adjucnt, Computer Science Department University of Puerto Rico at Bayamón	2000-2002
Adjucnt, Computer Science Department American University of Puerto Rico	1999-2000

NON-ACADEMIC EXPERIENCE

Senior Programmer, Banco Popular de Puerto Rico, San Juan	1999-2003
Computer Science Director, University of Puerto Rico Carolina Regional College	1992-1993
Computer Science Instructor, Dr. Victor Irizarry & Associates	1992-1998

Adjunct Professors

Awilda Morales Gómez

Email:amgo@prtc.net

EDUCATION:

Universidad del Turabo, Gurabo P.R. Doctor In Business Administration (DBA) 2012
concentration Management Information System Graduation Date June 13, Plus 12 Credits Approved In Masters Information System

Universidad del Turabo, Gurabo P.R. Maters in Business 1990
Administration concentration management, Graduation June

Universidad del Sagrado Corazon, Santurce P.R Bachelor in Sciences 1997
concentration computer programming, graduation May

ACADEMIC EXPERIENCE

JD College, Juana Diaz P.R. Position Computer Prof. Academic 2011-2012
coordinator in the University
area: Duties Teach in computer program courses Microsoft

Universidad del Turabo, Cayey P.R. position computer Present
Professor and Business Administration,
Duties teach in computer program course Microsoft

Universidad Inter Americana Bayamon P.R. 2010
Position Computer Professor Graduation program and sub grade
program course management systems and networks and data
communication analisis and desing information system integration project

Universidad Metro politana Comerio, P.R. 2008
Position Computer Professor courses introduction to programming network data communication

Colegio Universitario de San Juan position Present
Computer Professor Courses computer literacy,
network and data communication provide training, Microsoft office 2007

Universidad del Este Santa Isabel, P.R. position computer professor (part time) 2008
duties teach in computer program courses Microsoft office XP 2003

Columbia Centro Universitario, Caguas P.R. professor duties 2008
teach in computer program courses Microsoft office

Atlantic college Guaynabo P.R. (full time) 2001
Position computer professor and secretary program coordinator duties coordinate the secretary program teach management computer

EDP College Hato Rey, P.R. position computer professor (part time) 2001
duties teach in programa adultos courses pro 101

Puerto Rico Manufacturing extencion inc position system 1998
manager and consulting duties administration of the computerized
system with network

P.R society of CPA continuing education program position EDP 1996
manager duties administration of the computerized system in the continuing education program and administration department

Luis A, Ortiz Ortiz

Email:inglortiz@gmail.com

EDUCATION:

MSEE- University of Puerto Rico, Mayaguez Campus 1997

BSCoE- University of Puerto Rico, Mayaguez Campus 1992

Associate Degree in Scienses, University of Puerto Rico, Bayamón 1988

ACADEMIC EXPERIENCE

Assistant Professor, Computer Engineering Department 1997-2016
Polythecnic University of Puerto Rico

Adjunct Professor, Computer Science Department 2002-2009
University of Puerto Rico, Rio Piedras Campus, Part Time Professor
(languages-C,C++, and Java, data structures, Programming language)

Adjunct Professor, Computer Science Department 1998-2001
Interamerican University of Puerto Rico, Bayamón Campus

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

Institute of Electrical and Electronics Engineers (IEEE)

SERVICE ACTIVITIES

InterCollege Computer Programming Contest Judge since 2002
University of Puerto Rico at Bayamón

ABET Engineering seminar, July San Juan Hotel 2006

ABET Engineering Criteria, June 2000

Overview of ABET EC April 2000

Learning factory: implementing ABET March 1999

Rafael A. Nieves Rivera

rafnieves@bayamón.inter.edu

EDUCATION:

D.B.A. Information Systems, 2012
Turabo University

M.S. Information Systems, 1994
EDP College

MBA. Business Administration, 1988
Turabo University of Puerto Rico
B.A. Computer Science, 1985

Inter-american University of Puerto Rico 1982
A.D. Industrial Engineering,
University of Puerto Rico at Bayamón

ACADEMIC EXPERIENCE

Associate Professor, Inter-American
University of Puerto Rico, Bayamón Campus, Computer Science Department 1995

Adjunct Professor, "Colegio Universitario Del Este" Computer Science Department 1989

Adjunct Professor Caribbean University, Computer Science Department 1988-1994

NON-ACADEMIC EXPERIENCE

Computer Consultant: "Oficina de Servicio al Ciudadano", Corazal Municipality 1993

Consultant: Melissa Sales Corp. 1990-1994

Program Coordinator: Allied School of Puerto Rico 1985-1988

Luis M. Cardona Hernandez

Email: luiscard69@hotmail.com

EDUCATION:

M.A. in Computing Education, Interamerican University of Puerto Rico 1997
(Summa Cum Laude)

B.S. in Computer Science, Interamerican University of Puerto Rico 1993

ACADEMIC EXPERIENCE

Adjunct Professor Polytechnic University of Puerto Rico, 2000-2007
Information Systems Graduate Program,

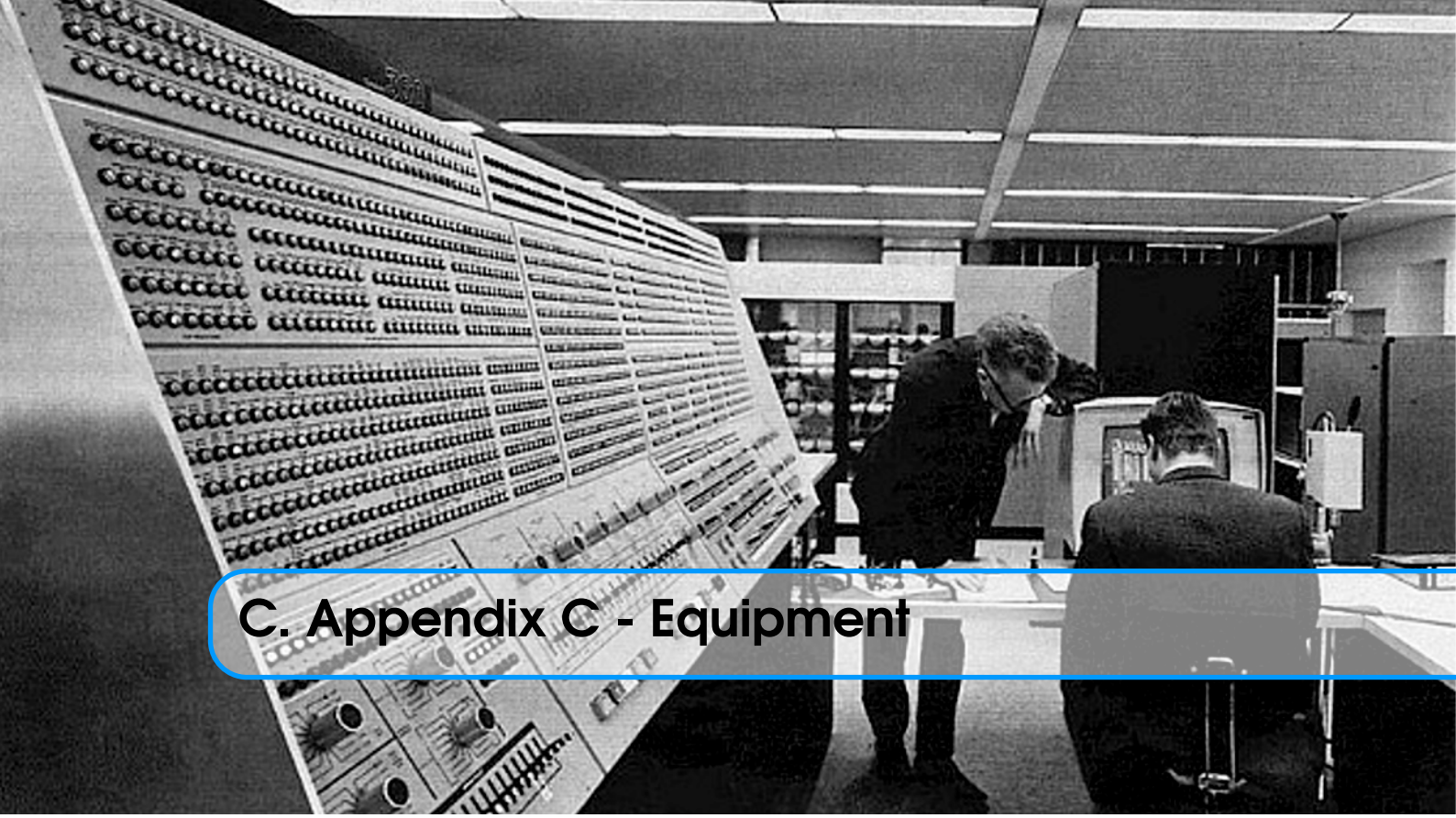
Adjunct Professor, University of Puerto Rico at Bayamón, since 1996
Computer Science Department, since

Associate Professor, Inter-american University of Puerto Rico, since 1995
Computer Science Department

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS:

Intensive Course in Computer Repairs and Networks 2000
Windows NT, Windows y Novell v5.0 Alfa One, Inc Prof. Enrique Garcia Soto

Vice President of the Graduate Students Educational Computing Association 1995-1996
Interamerican University of Puerto Rico



C. Appendix C - Equipment

This appendix summarizes the hardware and software used at the Department of Computer Science. Also presents supporting equipment of our laboratories.

C.1 Hardware

Note: New Desktops are on the way for two laboratories. We hope that they could be installed by the time of the team visit. However, the equipment we have now is presented in table C.1.

Lab	Quantity	Type	Computer Model	Usage
A 210	21	Desktop PC	Dell Optiplex 780	Laboratory Computer Only for students of our department
A 209	21	Desktop PC	Dell Optiplex 9020	Classroom Computer
A 208	21	Desktop PC	Dell Optiplex 9020	Classroom Computer
A 109	21	Desktop PC	Dell Optiplex 9020	Classroom Computer
A 108	21	Desktop PC	Dell Optiplex 790	Classroom Computer
A 107	8	Servers Other PCs	Dell Pow.Edge SC 1420 Xeon	Laboratory Computer Only for students of our department and research
Professor's Office	10	Desktop	Optiplex 9010	Professors Computer

Table C.1: Department Computers and their Respective Use

Each lab has an Infocus projector with wireless capabilities.

C.2 Software

The software installed in our computers may vary. However, most of the computers has installed:

1. Windows 7
2. MS Office 2013
3. Visual Studio 2013 and Blend 2013
4. Eclipse and Netbeans IDE
5. SharePoint
6. Oracle Database 11g
7. Java JDK (Java 8)
8. Notepad++

Some of the laboratories have additional software. Among these are:

1. Android Studio
2. CodeBlocks
3. Pencil
4. Microsoft SQL Server 2008
5. SWI-Prolog Editor
6. Scratch 2
7. Microsoft Expresion Web 4
8. Greenfoot 3.03
9. Alice 3
10. Raptor
11. Octave
12. Arduino 1.6.9
13. RGUI
14. Dia 0.97.2
15. Torque Game Engine
16. GIMP 2.6

Also, our institution is part of the Microsoft Academic Alliance. This enables the college community to download academic versions of some Microsoft software.

C.3 Computing Resources

The Department has a local Ethernet network which is connected to the UPRB network. Users connect at 100 Mbit/s or 1Gbit/s to the switches. The UPRB network connects to the UPR network through a broadband link.

In addition, the college community can access the Internet anytime through wireless LAN[1] access points. These access points are available throughout the campus. Students must login into the UPRB's network in order to use the wireless infrastructure.

The UPRB Information Systems Office (OSI, in Spanish) maintains and operates the UPRB network. The Computer Science Department has two technicians who are also responsible for the maintenance and operation of Department's PCs and networks.

[1] Wi-fi

D. Institutional Summary

D.1 The Institution

D.1.1 Name, Address and Brief Description of the System

The University of Puerto Rico at Bayamón address is:

#170 Carretera 174
Parque Industrial Minillas
Bayamón, PR 00959

The University of Puerto Rico (UPR) is an island wide university system composed of 11 units. These are: Río Piedras, Mayagüez, Medical Sciences, Ponce, Cayey, Humacao, Arecibo, Bayamón, Aguadilla, Carolina and Utuado campuses. The UPR at Bayamón is a four year institution that has the third largest population in the UPR system. It offers associate and bachelor's degree as well as transfer programs to the larger campuses[1].

D.1.2 President of the UPR System

The interim president of the University of Puerto Rico university system is Dr. Darrel Hillman. However, the process of finding a new president is under way. We expect to have a new president by August 2018. The president of the Board of Trustees is Prof. Walter Alomar. He has been appointed by the Governor of Puerto Rico, Dr. Ricardo Roselló.

D.1.3 Person submitting the Self-Study

The responsible persons for submitting the self-study are:

[1] mostly Mayagüez, Río Piedras

- Dr. Jorge Rovira : Dean of Academic Affairs of the UPR Bayamón
- Dr. Juan H. Sánchez : Chancellor Special Assistant

The Self-Study was prepared by Dr. Juan M. Solá-Sloan of the Department of Computer Science and coordinator of the Computer Science Emphasis Area.

D.1.4 Organizations by which the institution and department is accredited

Our institution is accredited by the Middle States Association of Colleges and Schools. Also by the *Consejo de Educación de Puerto Rico* (Educational Council of Puerto Rico). Moreover, many of our departments have been accredited with other accreditation commissions. Table D.1 presents a summary of these commissions and accreditation agencies.

Accreditation Commission	Department/Dependency
ABET-ANSAC	Bachelor in Materials Management
ABET-CAC	Bachelor in Computer Science
ABET-ETAC	Bachelor in Electrical Engineering Technology Associate's Degree in Instrumentation Technology Associate's Degree in Civil Engineering Technology Associate's Degree in Construction, Surveying and Roads Engineering Technology Assocaite's Degree in Industrial Engineering Technology
Association of College and Research Libraries (ACRL)	Library
Association of Collegiate Business Schools and Programs (ACBSP)	Bachelor in Business Administration Majors in: Accounting, Management Finance, Marketing
Council for the Accreditation of Educator Preparation (CAEP)	Bachelor in Special Physicial Education Bachelor in Pre School and Elementary Education

Table D.1: Departments That Offer Academic Support to the CS Department

D.2 Type of Control and Educational Unit

The University of Puerto Rico is a state institution run by the Commonwealth of Puerto Rico. Figure D.2 shows the organizational chart of part of the UPR System. It is important to notice that in Figure D.2 the boxes presented in yellow are related to the system wide administration. Figure D.1 and D.2 shows organizational charts for the UPRB.

D.3 Academic Support Unit

Table D.2 presents the academic department that support our programs.

D.4 Non-academic Support Unit

Table D.3 presents the non-academic support units of our programs.

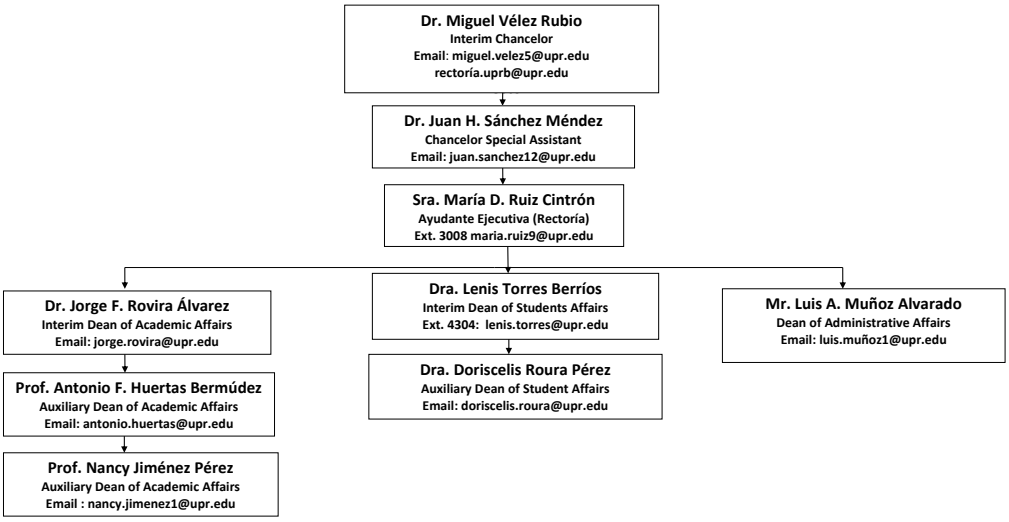


Figure D.1: Organizational Chart of the UPRB

Department	Type of Support	Chair
Mathematics	Math Courses	Prof. Angel Morera
Physics	Physics Courses	Dr. Javier Ávalos
Business Adm.	Business Adm. Courses	Prof. Yanet Cabrera
Humanities	Humanities and History Courses	Dr. Luis Pabón
Social Science	Social Science Courses	Dr. Elizabeth Crespo
Spanish	Spanish Courses	Dr. Raul Guadalupe
English	English Courses	Prof. Rose Hernández

Table D.2: Departments That Offer Academic Support to the CS Department

D.5 Credit Unit

On the UPRB one credit represents one class hour. One academic year represents 28 weeks exclusively for classes (14 per semester). There are a few days (mostly two) between the end of classes and the final examinations. This period is known as the review days. Then, there is one week for final examinations.

D.6 Tables

Table D.4 presents the official head count for the past five years as required by the Self-Study. Notice that we offer a four year degree in CS with two emphasis areas. This table shows the aggregate of both areas. Table D.5 presents the distribution of personnel in the Computer Science department. It is important to notice that the Interim Chancellor and Interim Auxiliary Dean of Academic Affairs are from our department since 2017. Also, Prof. René Rodriguez has been appointed the Dean of Administrative Affairs in the UPR Carolina Campus. Therefore, since 2017, our department has three professors working full time with the UPR administration. This has

Unit	Support	Chair
Office of Planification and Institutional Studies	Institutional Assessment	Mr. Javier Zavala
Office of Information Systems	Management of the academic and non academic computers and networks	Mrs. Barbara Landrau
Technology Center for Academic Support	Moodle, online courses support	Prof. Orlando Orengo
Educational Service	Tutoring, counseling, orientation	Linda Turner
Financial Support	Scholarships, fellowships, student loans	Mr. Marcos De Jesús
Employment Center	Alumni and graduate candidates placement	Mr. Nelson Vázquez
Student with Disabilities Office	Support students with disabilities	-
Learning Resource Center	Library	Dr. Raul Pagán

Table D.3: Non-Academic Support Units of the CS Department

resulted in increasing the load to the full time faculty and hiring more adjunct professors.

Academic Year		1st	2nd	3rd	4th	Total Undergrad	Grand Total	Bachelor Degrees Awarded
2017-2018	FT	83	65	28	147	323	323	n/a
	PT	1	2	2	45	50	50	
2016-2017	FT	172	55	48	59	334	334	31
	PT	4	11	7	39	61	61	
2015-2016	FT	153	65	55	38	311	311	24
	PT	11	5	7	36	59	59	
2014-2015	FT	133	73	36	34	276	276	21
	PT	13	9	9	37	68	68	
2013-2014	FT	142	62	32	49	285	285	41
	PT	9	8	7	36	60	60	

Table D.4: Official Head Count

	FT	PT	FTE
Administrative	3.50	0	N/A
Faculty (tenure)	6.75	0	9.8
Other Faculty (adjunct)	0	5	N/A
Student Teaching Assistant	0	0	N/A
Technicians/Specialists	2	0	N/A
Office/Clerical Employees	1	1	N/A
Others	0	0	N/A

Table D.5: Personnel

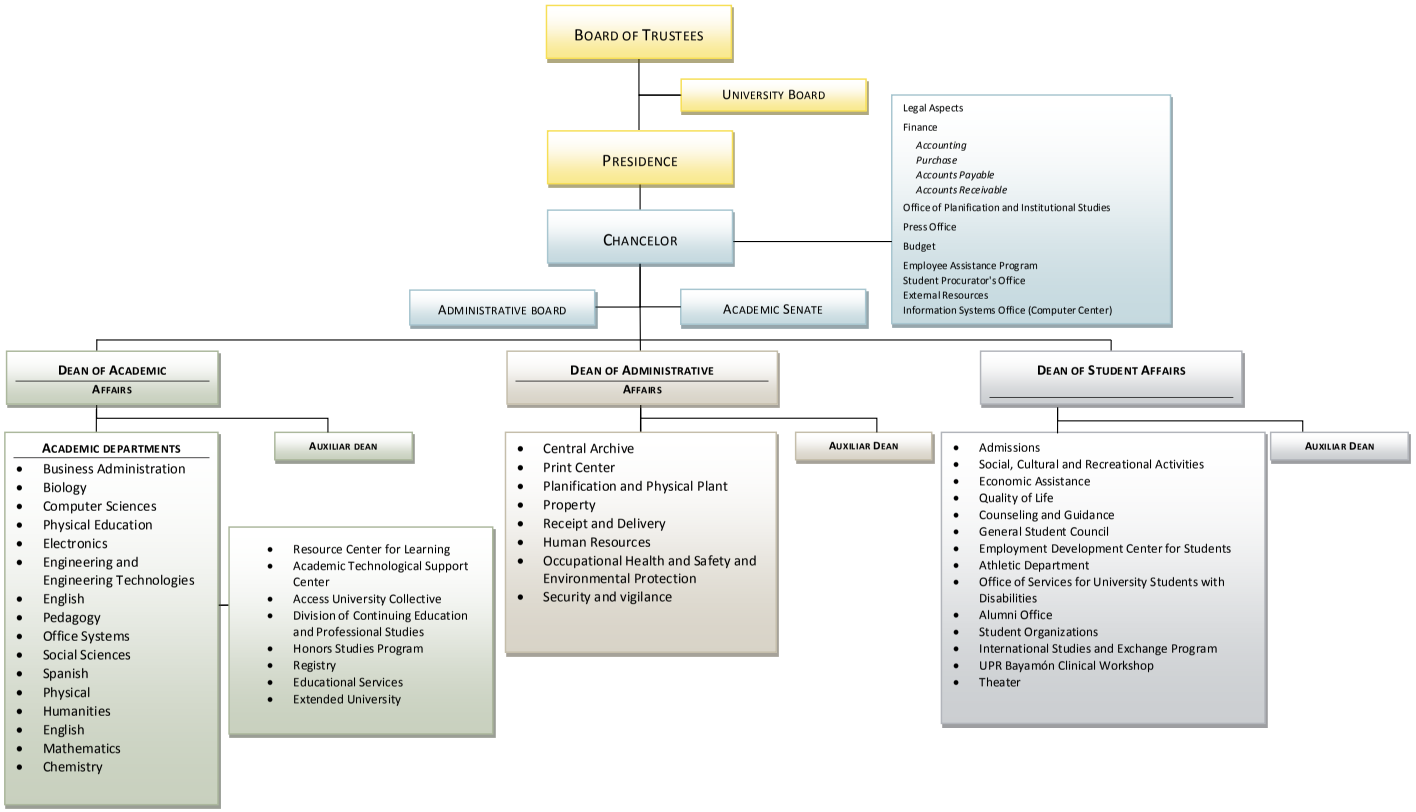


Figure D.2: Simplified Organizational Chart of the UPR System

E. Appendix E - Continuous Improvement Reports

This appendix presents the Continuous Improvement Reports for both programs. These reports show the analysis of the results of the assessment activities. Also, it compares the results obtained from this cycle versus the previous one. In addition, it presents recommendations, reflections and remarks of the way to improve the attainment level of the Student Outcomes.

University of Puerto Rico at Bayamón

2013-2016 Cycle

Continuous Improvement Report
Computer Science

This report provides the analysis of the achievement of the Student Outcomes for the Computer Science emphasis area of the Computer Science Department

Introduction

This document presents the assessment of the Student Outcomes (SO) of the Computer Science emphasis area (program) of the Department of the Computer Science for the University of Puerto Rico at Bayamón for the cycle 2013-2016. Analysis of the SOs is performed using two main tools: post-test and the graduate (exit) questionnaire. If there is a discrepancy between these tools data obtained from the courses is analyze for triangulation.

Remark on the Post-Test Results

Most of the data to evaluate the outcomes are made through Performance Indicators (PI). At least two questions are drafted in the post-test to measure most PIs. This is evident after the post-test revision of 2015. However, some of the data used for our analysis have included results prior to this revision. We harmonized results from the previous post-test and the revised them in order to prepare this report.

Computer Science Program - Student Outcomes Data Analysis

This section presents the analysis of the Student Outcomes for the Computer Science program (emphasis area) at the University of Puerto at Bayamón. Each outcome was further divided into performance indicators and were analyzed using at least two instruments: one direct measurement and one indirect measurement. The main direct measurement for most of the outcomes was the post-test given to all students enrolled in our Capstone course (SICI 4038). The other outcomes were assessed using data obtained from the courses either by rubrics or analyzing the coursework. The main indirect measure is a survey administered to the students in our Capstone course named the Graduate Questionnaire. Whenever a discrepancy is found, relevant materials from the courses are analyzed.

As in previous cycles we used the results from the post-test questions for further analysis. The analysis assumed the following scale:

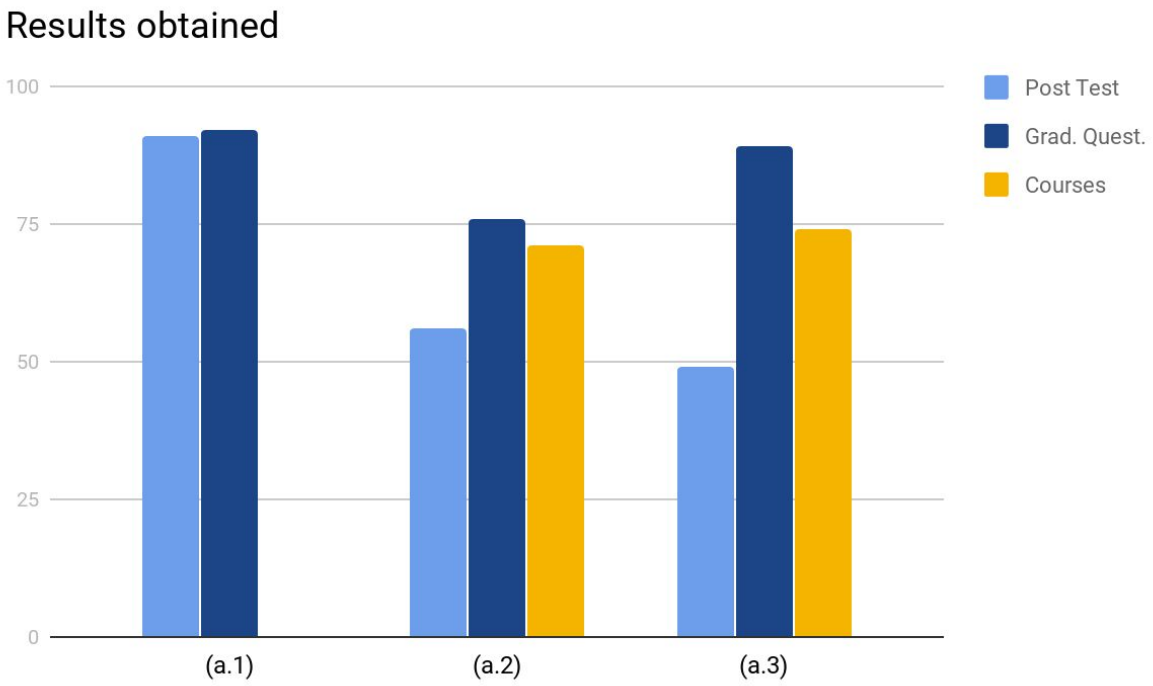
- Satisfactory – the question was correctly answered by at least 75% of the students.
- Developing – the question was correctly answered by at least 50% of the students but less that 75%.
- Unsatisfactory – the question was correctly answered by less than 50% of the students.

For the student survey, the analysis assumed the following scale:

- Satisfactory – the indicator was graded as A or B by the student.
- Developing – the indicator was graded as C by the student.
- Unsatisfactory – the indicator was graded as D or F by the student.

Student Outcomes Analysis

Outcome a: An ability to apply knowledge of computing and mathematics appropriate to the discipline



This outcome is measured by three main performance indicator.

(a.1) Select the appropriate algorithm for an specific situation

On average 91% of our student answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of A in average 92%. Therefore the AAC concluded that the achievement level for this PI was met.

(a.2) Analyze the asymptotic running time of algorithms using big-O notation

On average 56% of our student answered the questions related to this PI correctly. We considered this results to be Unsatisfactory. However, all the students that completed the graduate questionnaire gave this indicator a grade of 76% (high C). We analyze data obtained from Quiz #2 of the SICI 4036-Data Structures. These were the first 5 questions of section 1. After grading only this part for 18 quizzes we obtained a median of 71%. Therefore, we concluded that the achievement level for this PI is developing.

(a.3) Apply mathematical concepts in the solution of a given problem

On average 49% of our student answered the questions related to this PI correctly. However, all the students that completed the graduate questionnaire gave this indicator a grade of 89%. We analyze data obtained from question 3 part III of Exam 3 and question 2, part II of Exam 2 from SICI 4037-Data Communication course . After grading only these questions a median of 74% was obtained. Therefore, we concluded that the achievement level for this PI is developing.

Previous Cycle Comparison

Comparing last assessment cycle with this one we can see that for PI (a.1) there has been a 7% of improvement on the results obtained from the post-test. Also the students gave this indicator a strong satisfactory grade. On average 56% of the students answered the questions correctly for performance indicator (a.2) for this and for the last cycle. There has been no improvement whatsoever obtained from the post-test for this performance indicator. However, after analyzing the results from the courses there was an improvement of 10% in this performance indicator.
Comparing last assessment cycle with this one we can see that for PI (a.3) there has been a 10% of improvement on the results obtained from the post-test. Also there was an improvement of 14% in the level of satisfaction that the students perceived when answering the graduate/exit questionnaire.

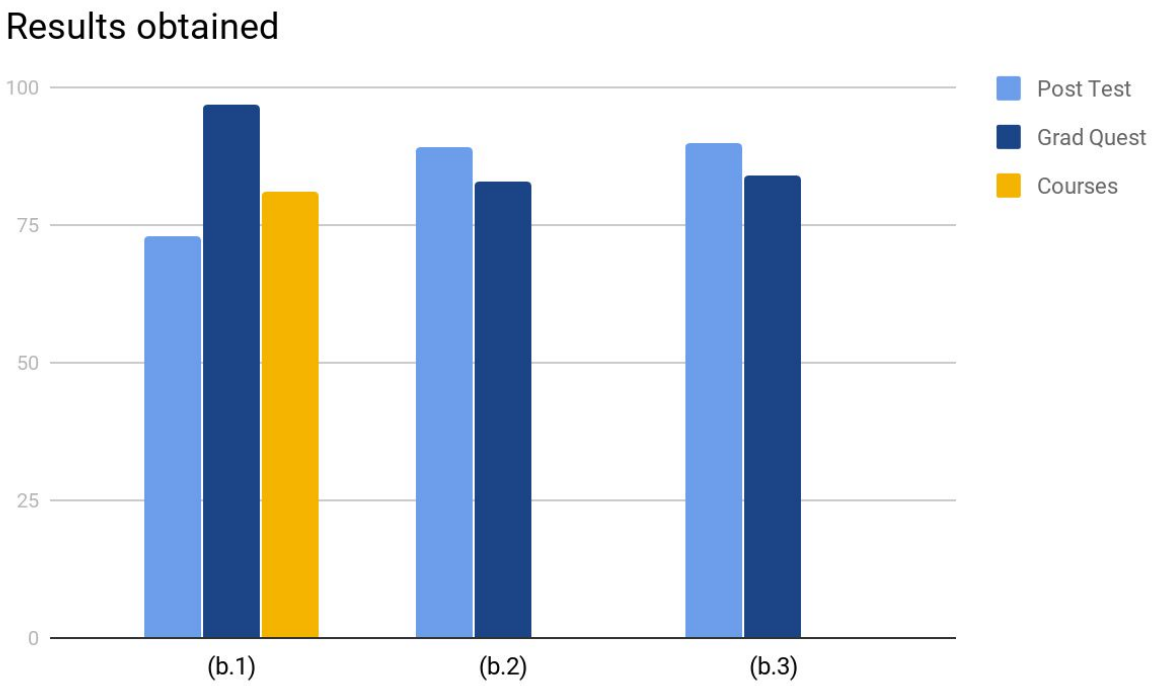
Conclusions and Recommendations

The AAC concluded that this outcome is partially met. There have been improvement in the achievement level of the outcome. Moreover, the committee recommends:

- Improvement on PI (a.2) : Emphasize on asymptotic analysis during next cycle. COTI-4255 Analysis of Algorithms have been introduced as a new course in our last curricular revision. However, we must analyze if the questions that are included in the post test are in tune with this performance indicator. Also, we have to analyze if the material in the courses is sufficient to meet this PI.
- Reinforcement of PI (a.3) : An analysis of the questions that are included in the post test needs to be done. An achievement level of 56% on the post-test is too low.

Outcome b: An ability to analyze a problem, identify and define the computing requirements appropriate to its solution.

This outcome is measured by three performance indicators. This PIs are the following:



(b.1) Analyze a problem

Only 73% of the student answered this question correctly. However, they show confidence in this PI on the graduate questionnaire since they graded themselves with 97%. The AAC decided to analyze data obtained from the course SICI 3015 Analysis and Design. In most of the practical exams given by the professor the students have to read a problem, analyze it and design a solution for the problem. We have decided to analyze the grade for the partial exam #2. The mean grade obtained in this exam was 81%. Therefore, the AAC concluded that the achievement level of this PI was met.

(b.2) Identify and define the computational requirements needed in a real situation
On the post-test 89% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 83%). Therefore, the AAC concluded that the achievement level of this PI was met.

(b.3) Choose the appropriate software and/on hardware tools to meet the desired goals

On the post-test 90% of the students answered the questions related to this PI correctly. Also, all the students that completed the graduate questionnaire gave this indicator a grade of B (as in previous PI an average of 84%). Therefore, the AAC concluded that the achievement level of this PI was met.

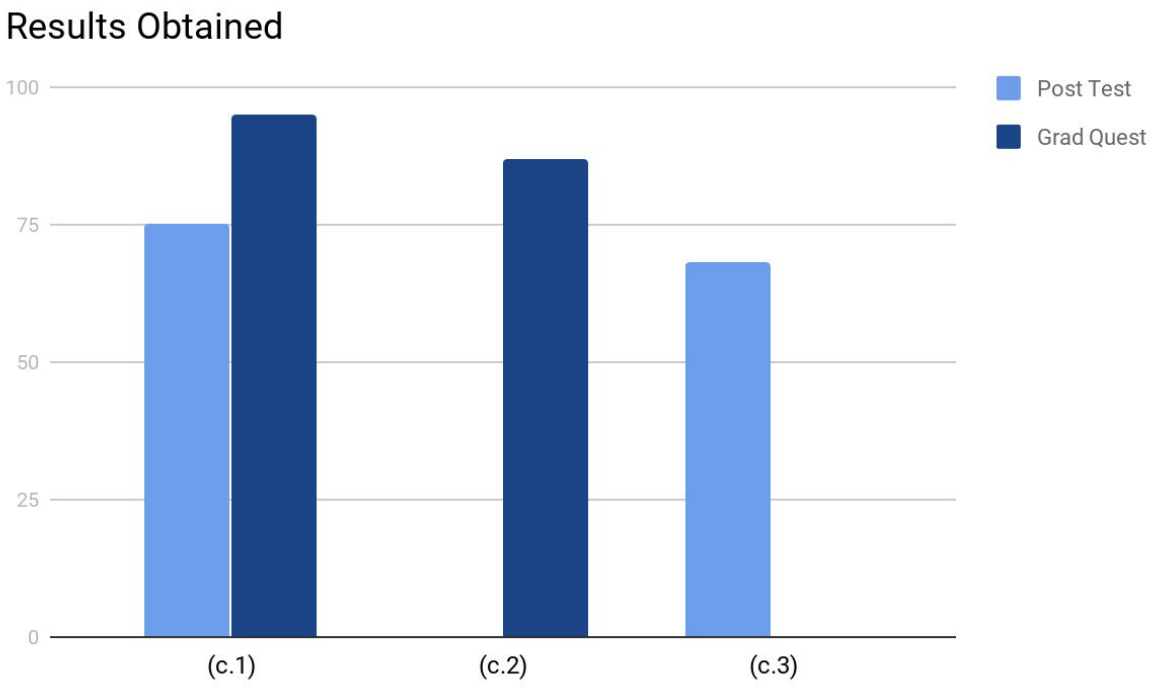
Previous Cycle Comparison

For PI (b.1) there has been a 6% of improvement on the results obtained from the post-test. Also the students gave this indicator a strong satisfactory grade. There has been a 16% of improvement on the results obtained from the post-test in this cycle when compared to the last one for PI (b.2). Also the students gave themselves a satisfactory grade. Also, there has been a 5% of improvement on the results obtained from the post-test for PI (b.3).

Conclusions and Recommendations

The AAC concluded that this outcome was met.

Outcome c: An ability to design, implement, and evaluate a computer-based system, process, component or program to meet desired needs.



This outcome is measured by three performance indicators. This PIs are the following:

(c.1) Design solutions using pseudo code, diagrams or natural languages.

On the post-test 75% of the students answered the questions related to this PI correctly. Also, all the students that completed the graduate questionnaire gave this indicator a grade of A (as in previous PI an average of 95%). Therefore, the AAC concluded that the achievement level of this PI was met.

(c.2) Implement an algorithm using the appropriate programming language

All the students that completed the graduate/exit questionnaire gave this indicator a grade of B (an average of 87%). A requirement of the CS program is COTI 4039 Comparison of Programming Languages. In this course, students implement in three different language paradigms and languages. Also, after examining the SICI 4038 (Capstone Course) projects we can conclude that students are able to implement a system in almost any language. We have seen many projects in Microsoft and Non Microsoft environment, for example, Android, Web based and even using the concept of Internet of Things. This have been evident to us when looking to the posters presented by the students in the capstone course. Therefore, the committee declared that this PI was met.

(c.3) Perform both unit and system testing

All the students that completed the graduate questionnaire gave this indicator a grade of D (an average of 68%). We now that just lately we have added this to the courses. Some students indicated on the graduate questionnaire that they don't have knowledge about this and this is true. All students that take course SICI 4036 Data Structures are using JUnit to test their programs. We now that just lately we have added this to the course. Some students have mentioned that they don't have knowledge about this and is true. However, many students performed unit and system testing when building programs of varying complexity but couldn't identify the type of test they were performing as a unit or system. They just only knew they test the program by "including and testing" each method/procedure or function they were added to the system. Therefore, the AAC classify this PI as developing.

Previous Cycle Comparison

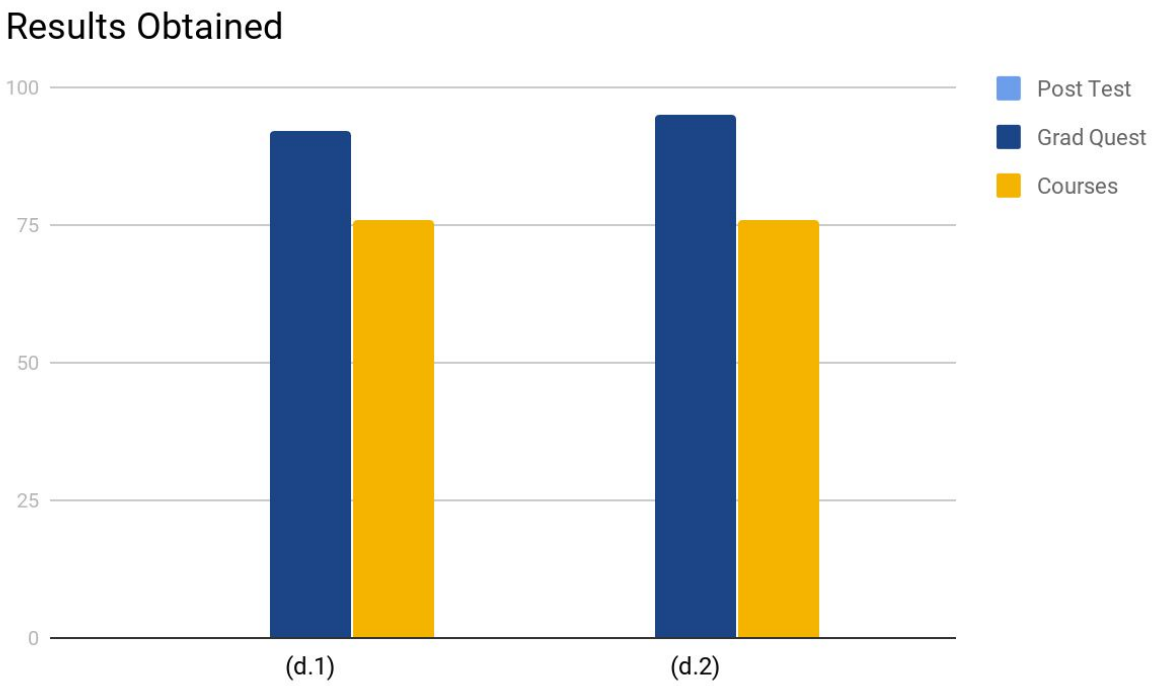
There were changes on the performance indicators related to this outcome during 2013-2016. Performance Indicator (c.1) previously was PI (3.d). Students that answered the questions on the post-test related to (c.1) showed a satisfactory grade vs. last cycle. There was in improvement on the students of the CS program. Performance indicator (c.2) previously was PI (3.c). Students have increased their confidence level when analyzing the data obtained from the graduate questionnaire from last assessment cycle to this one for PI (c.2). Performance indicator (c.3) was unsatisfactory and therefore, not met in last assessment cycle. However, it has increased to developing on this assessment cycle.

Conclusions and Recommendations

The AAC concluded that this outcome is partially met. The committee recommends:

- Reflection: Performance Indicator (c.3) should be met in next assessment cycle. It is envision that all the students would have an experience using Junit in the upcoming years. Students would understand the difference between the type of testings they are performing.

Outcome d: An ability to function effectively on teams to accomplish a common goal



This outcome is measured by two performance indicators. This PIs are the following:

(d.1) Evaluate a given problem within a team environment

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 92%). On SICI 4037-Data Communications students evaluate each other after finalizing the course project. They filled out the Group Skills rubric. After analyzing this instrument we found out that more than 76% of the students gave their peers the highest grade (4/4) in the skills of: problem solving, work attitude and *ability of* working with others. Therefore, the AAC concluded that the achievement level of this PI was met.

(d.2) Perform duties assigned when working on team

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 95%). We use the same instrument as the previous PI. After analyzing this instrument we found out that more that around 76% of the students gave their peers the highest grade (4/4) in the skills of:

contributions and quality of the work. Therefore, the AAC concluded that the achievement level of this PI was met.

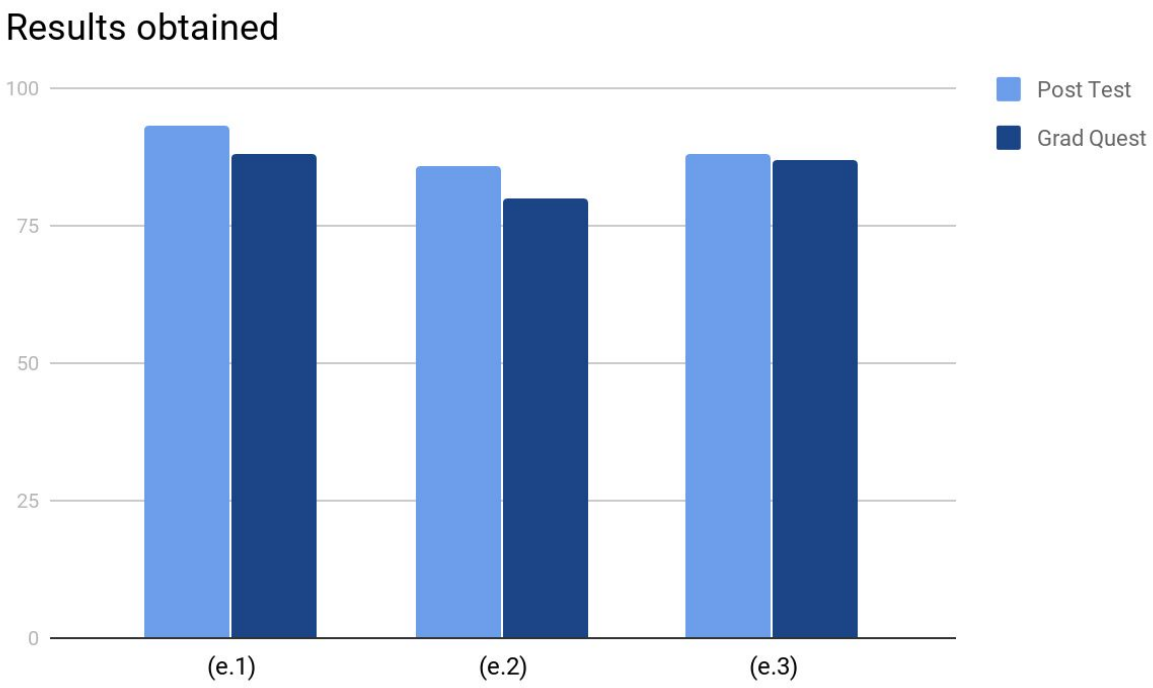
Previous Cycle Comparison

Comparing last assessment cycle with this one we can see that for PI (d.1) both results obtained from the rubric were 76%. This is an acceptable satisfactory grade. Also the students gave this indicator a strong satisfactory grade. There is an increased of 2% from previous cycle for the results obtained when assessing PI (d.2).

Conclusions and Recommendations

This outcome was met.

Outcome e: An understanding of professional, ethical, legal, security and social issues and responsibilities



This outcome is measured by three performance indicators. This PIs are the following:

(e.1) Evaluate the ethical implications of an issue in the computing discipline

On the post-test 93% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 88%. Therefore the AAC concluded that the achievement level for this PI was met.

(e.2) Evaluate the social impact of a given computing technology

On the post-test 86% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 80%. Therefore the AAC concluded that the achievement level for this PI was met.

(e.3) Recognize the responsibilities inherent to the profession

On the post-test 88% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 87%. Therefore the AAC concluded that the achievement level for this PI was met.

Previous Cycle Comparison

Comparing last assessment cycle with this one we can see that for PI (e.1) there was a 3% of difference between last cycle and this one (96% - 93%). The AAC sees this difference as negligible. Also the students gave this indicator a strong satisfactory grade. On the post-test 86% of the students answered the questions related to PI (e.2) correctly. There were no questions for this PI on the previous version of the post-test. Also, on previous cycle, the AAC use data from the courses to assess this PI. Last Cycle, the AAC classified this PI as developing. This cycle has been classified as satisfactory. There has been a 15% of increased on the achievement level. On the post-test 88% of the students answered the questions related to PI (e.3) correctly. There were no questions for this PI on the previous version of the post-test. The AAC used data from the courses to assess this PI on previous cycle. This PI has been has been classified as satisfactory.

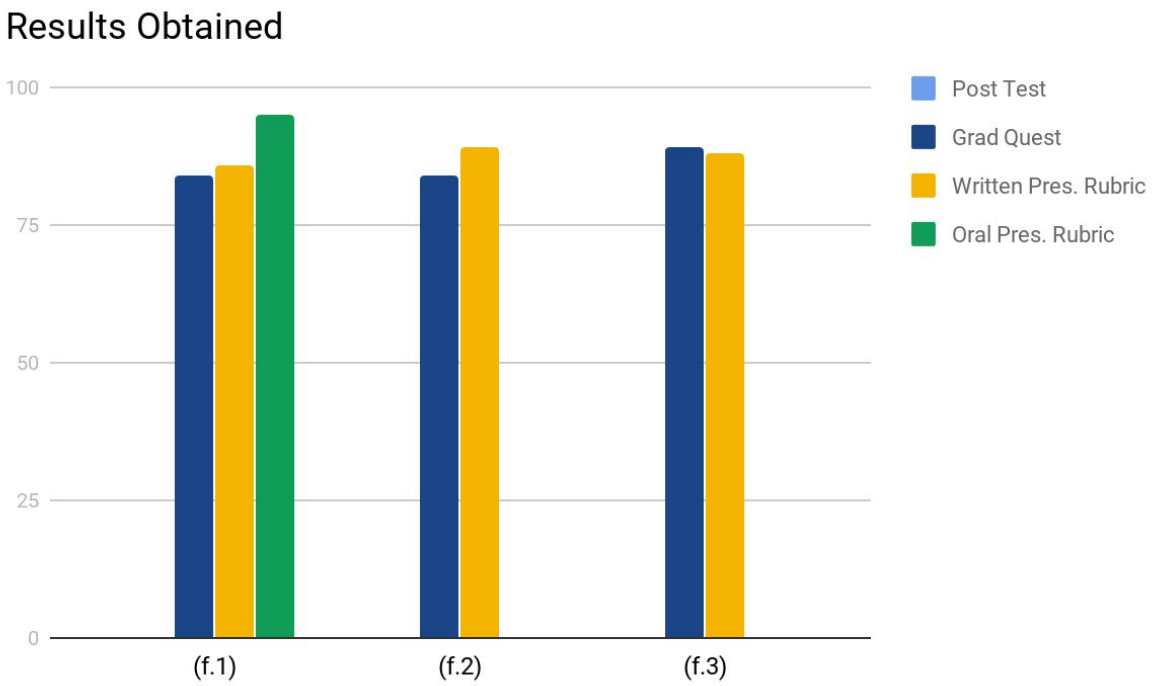
Conclusions and Recommendations

The AAC decided that this outcome was met. The AAC recommended the addition of a course in ethics and social impact of computing on the last assessment cycle. This course was created and currently been offered. Course is COTI 3305 Computing Ethics and Society. The addition of this 2 credit course on ethics have made our student more aware in their ethical behaviour. The AAC have focus on this cycle into improving outcomes e, and g.

- Reflection: Our curriculum has a course in Information Security and we don't have a performance indicator or a question in the test related to that. We need to at at least one PI on this outcomes that measures security aspects.

- Reflection: The legal aspects that are related to the field are covered in the course COTI 3305. However, there is no question in the post-test that address this. We need to add at least one PI or one question that measures this part of the outcome.

Outcome f: An ability to communicate effectively with a range of audiences.



This outcome is measured by three performance indicators. This PIs are the following:

(f.1) Present different topics both orally and/or in writing

All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 84%). The AAC decided to analyze the grade obtained from the first row of the rubric for the SICI 4019 Computer Architecture Term Paper. Moreover, the AAC decided to analyze the grade obtained from the oral presentation rubric from the SICI 4037 Data Communication course. The average grade obtained analyzing the first rubric was 17.22/20.00 = 86 %. The average obtained by analyzing the oral presentation rubric is 95.8%. Therefore the AAC concluded that the achievement level for this PI was met.

(f.2) Explain technical concepts using the correct terminology

All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 84%). The AAC decided to analyze the rubric for the SICI 4019 Computer Architecture Term Paper

specifically the 4th row. The average grade obtained analyzing this row was 17.85/20.00 = 89 %. Therefore the AAC concluded that the achievement level for this PI was met.

(f.3) Display knowledge of technical report writing

All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 89%). The AAC decided to analyze the overall grade obtained from the rubric used for the SICI 4019 Computer Architecture Term Paper. The mean grade obtained after analyzing the data was 88% (87.7). Therefore the AAC concluded that the achievement level for this PI was met.

Previous Cycle Comparison

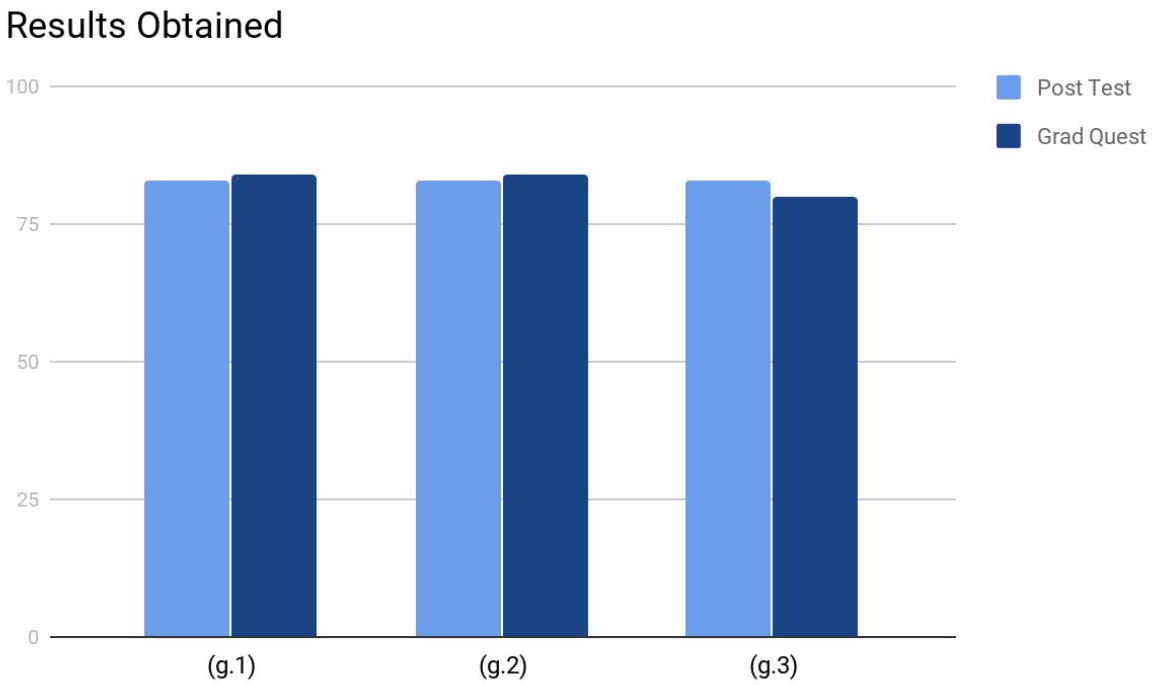
Comparing last assessment cycle with this one we can see that for PI (f.1) and PI (f.2) there was an improvement of 9% on the results obtained from the Graduate Questionnaire. This is very important for us, since, this tool measures the perception that students have on themselves. A larger improvement of 40% was found on the results obtained for PI (f.3).

Conclusions and Recommendations

The AAC decided that this outcome was met.

- Reflection: This outcome was met solidly on this cycle,however, we have analyzed the attainment of this outcome using mostly the data obtained from the SICI 4019 Term Paper and the SICI 4037 Final Project presentation. The outcome is An ability to communicate effectively *with a range of audiences*. Does the data obtained from these courses is sufficient? Where is that range of audience? Does professors and students is sufficient? Would it be better to measure this outcome in SICI 4038 our capstone course? The AAC must reflect about this.

Outcome g: An ability to analyze the local and global impact of computing on individuals, organizations, and society.



This outcome is measured by three performance indicators. This PIs are the following:

(g.1) Understand computational or technological advances and their impact on individuals, organizations and society.

On the Post-test 83% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 84%. Therefore the AAC concluded that the achievement level for this PI was met.

(g.2) Recognize the global and local impact of a given technology.

On the Post-test 83% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 84%. Therefore the AAC concluded that the achievement level for this PI was met.

(g.3) Be aware of the state of the art in computing technology.

On the Post-test 83% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 80%. Therefore the AAC concluded that the achievement level for this PI was met.

Previous Cycle Comparison

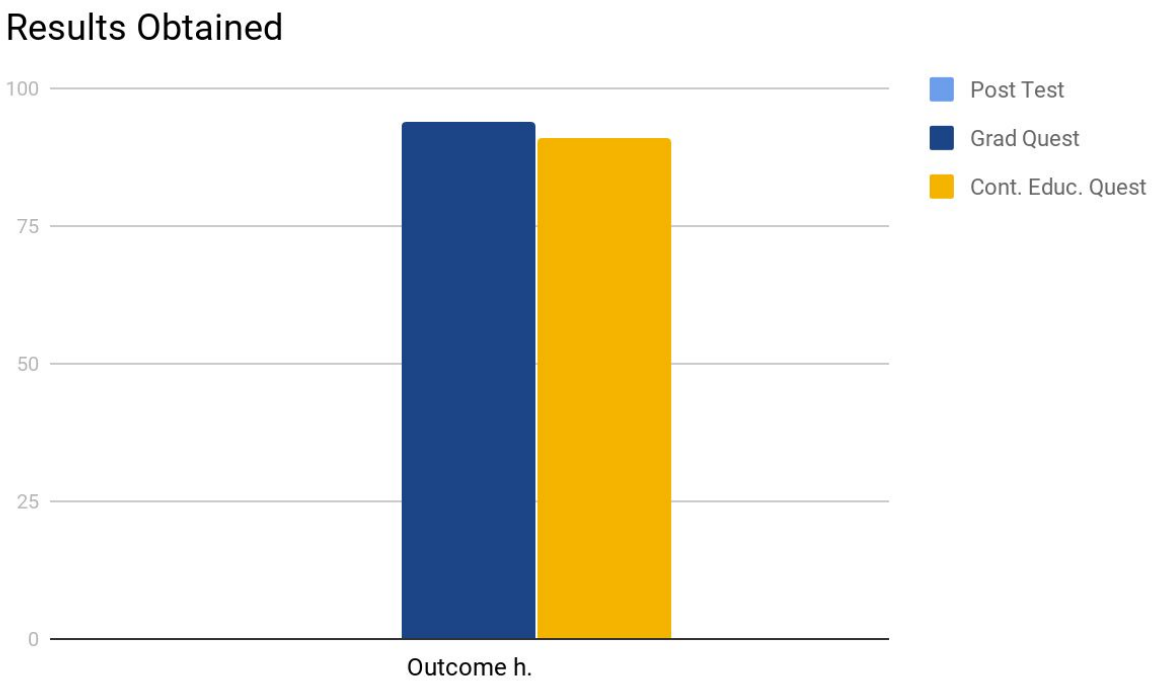
The performance indicators for this outcome received a major overhaul from previous cycle to this cycle. Therefore, each PI cannot be compared directly.

Conclusions and Recommendations

The AAC decided that this outcome was met.

- Reflection: Students that took the test show that they achieve all the PIs satisfactory. The AAC have focus on this cycle into improving outcomes e, and g. The changes on the course of SICI 4037 Data Communications and COTI 3305 Computing Ethics and Society has made us improve substantially on this outcome since last assessment cycle.

Outcome h: Recognition of the need for an ability to engage in continuing professional development



This outcome does not have any performance indicator. We are measuring the outcome directly.

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 94%). All the students take a lecture on *Continuous Education and Career Paths* on their Capstone Course (SICI 4038). They also answer a questionnaire about this outcome during this course. After analyzing the data 91% recognize the need to engage in continuing professional development. Therefore, the AAC concluded that the achievement level for this PI was met.

Previous Cycle Comparison

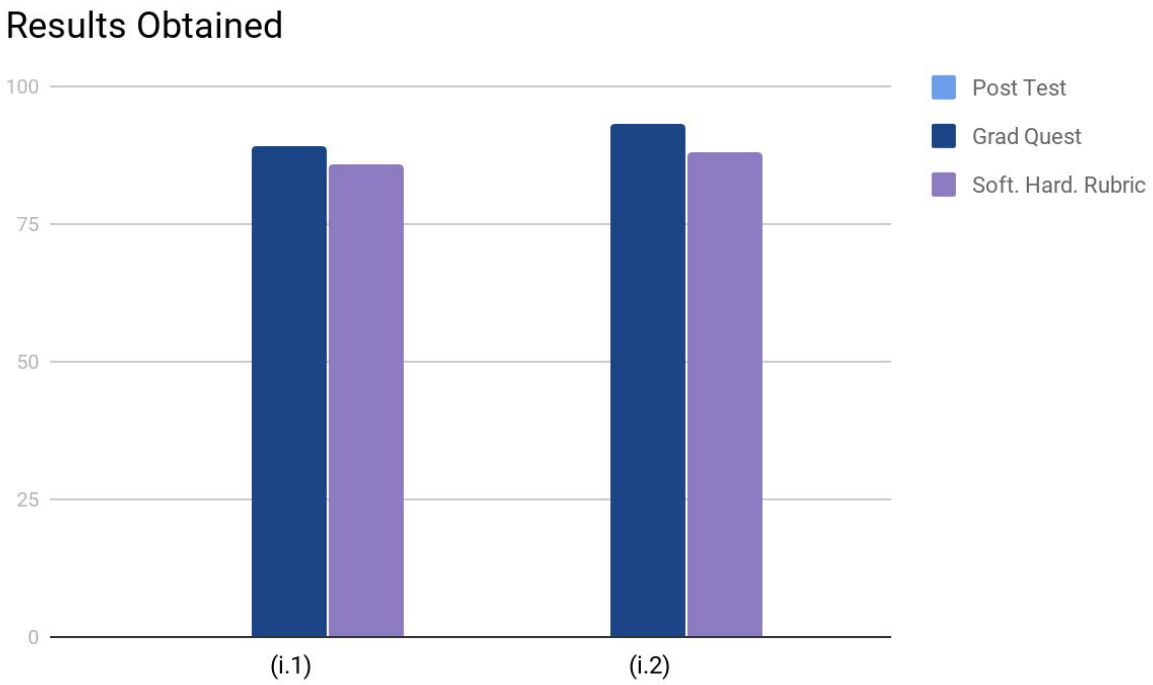
The AAC recommended developing suitable instruments to measure this outcome during the last cycle. Also, the AAC recommended the revision of all the performance indicators that were part of this outcome. The PIs were eliminated. Therefore, there was no way to compare each PI. However, a lecture on Continuous Education and Career Paths as a requisite of the SICI 4038 (Capstone course) was added to measure this outcome. Also, the students take a questionnaire after this lecture.

Conclusions and Recommendations

This outcome was met. Special attention was taken to this outcome during this cycle. Around 18% of the students indicated that they plan to pursue graduate school.

- Reflection: The AAC needs to analyze if this is too low. A discussion with the department needs to be schedule to analyze this. Also some professors have raised a concern that this lecture should be given earlier.

Outcome i: An ability to use current techniques, skills and tools necessary for computing practices.



This outcome is measured by two performance indicators. This PIs are the following:

(i.1) Use hardware and software tools currently available

Around 86% of the students used hardware and software tools currently available. This was obtain by looking at the results from the Rubric to Evaluate Software and Hardware Tools. All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 88%).

(i.2) Use current techniques and skills in the practice of the profession.

Around 93% of the students use current techniques and skills during the courses. This was obtained by looking at the results from the Rubric to Evaluate Software and Hardware Tools. All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 88%).

Previous Cycle Comparison

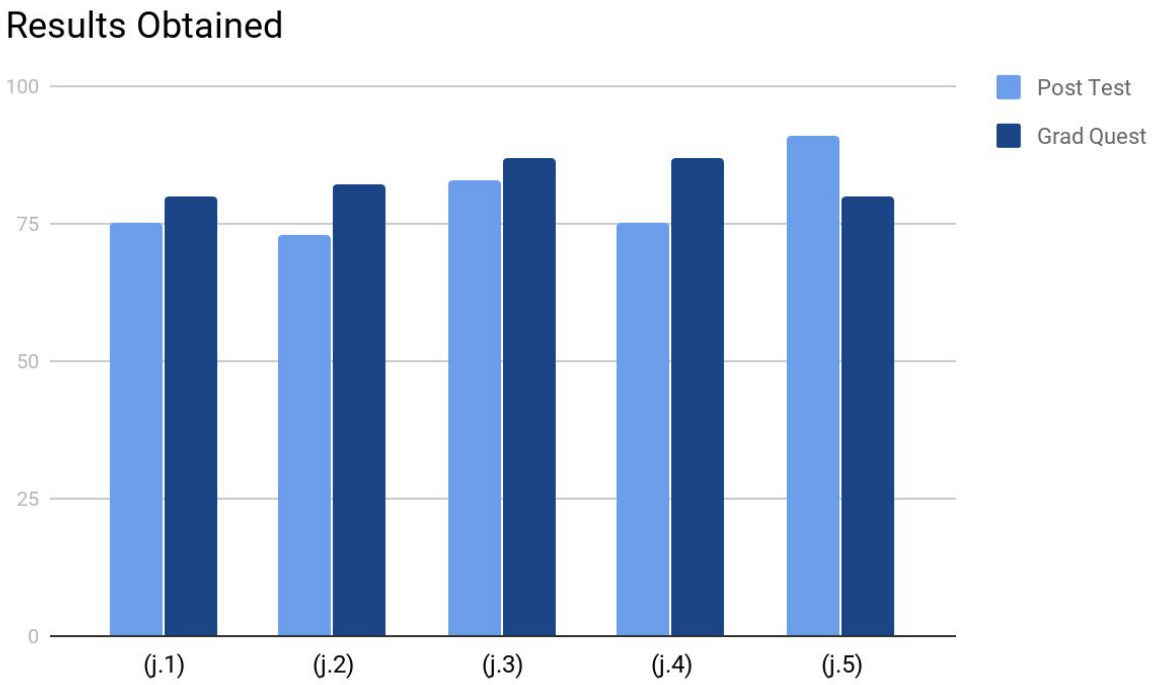
Current cycle percentages are even higher than on the previous cycle. Also the attainment level for this outcome was satisfactory.

Conclusions and Recommendations

Although this outcome was met:

- Recommendation: The only experience our students have is on the environment of Microsoft Windows. It is our knowledge there are students that own MAC or have installed linux on their laptops. However, this is not the norm. Some faculty have a concern on this matter. The department has set as a goal to add a Linux partition in every hard drive of the PCs of our laboratories. However, this task have not been completed. The AAC recommends that this goal should be set with a definitive deadline.

Outcome j: An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices.



This outcome is measured by five performance indicators. This PIs are the following:

(j.1) Solve the problems using the principles of discrete mathematics.

On the Post-test 75% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 80%. Therefore the AAC concluded that the achievement level for this PI was met.

(j.2) Solve the problems using the principles of continuous mathematics.

On the Post-test 73% of the students answered the questions related to this PI correctly. However, All the students that completed the graduate questionnaire gave this indicator a grade of B in average 82%. Therefore the AAC concluded that the achievement level for this PI was met.

(j.3) Determine the most appropriate data structures needed to solve a given problem

On the Post-test 83% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 87%. Therefore the AAC concluded that the achievement level for this PI was met.

(j.4) Appraise whether a given problem has a computational solution.

On the Post-test 75% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 87%. Therefore the AAC concluded that the achievement level for this PI was met.

(j.5) Determine the most appropriate programming paradigm needed to solve a problem

On the post-test 91% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 80%. Therefore the AAC concluded that the achievement level for this PI was met.

Previous Cycle Comparison

Performance indicator (j.1) and (j.2) were part of only one PI on our previous cycle. This was done to know specifically in which mathematics our students were so low. The AAC used data obtained from the courses SICI 4009 Numerical Analysis and COTI 4250 Theory of Computing. The Post-test included 4 questions regarding PIs (j.1) and (j.2) during this cycle. This time there was an improvement of at least 43% on the attainment level based on the scores obtained from the post-test. Also the students graded themselves on the survey with a satisfactory grade (80%). Therefore, taking special attention to PIs (j.1) and (j.2) paid off.

Improvements on PIs (j.3), and (j.5) has been attained. There is a slight 5% of improvement on the attainment level of PI (j.3) compared to last cycle. However, for PI (j.5) there is a big improvement (24%) when analyzed against last cycle.

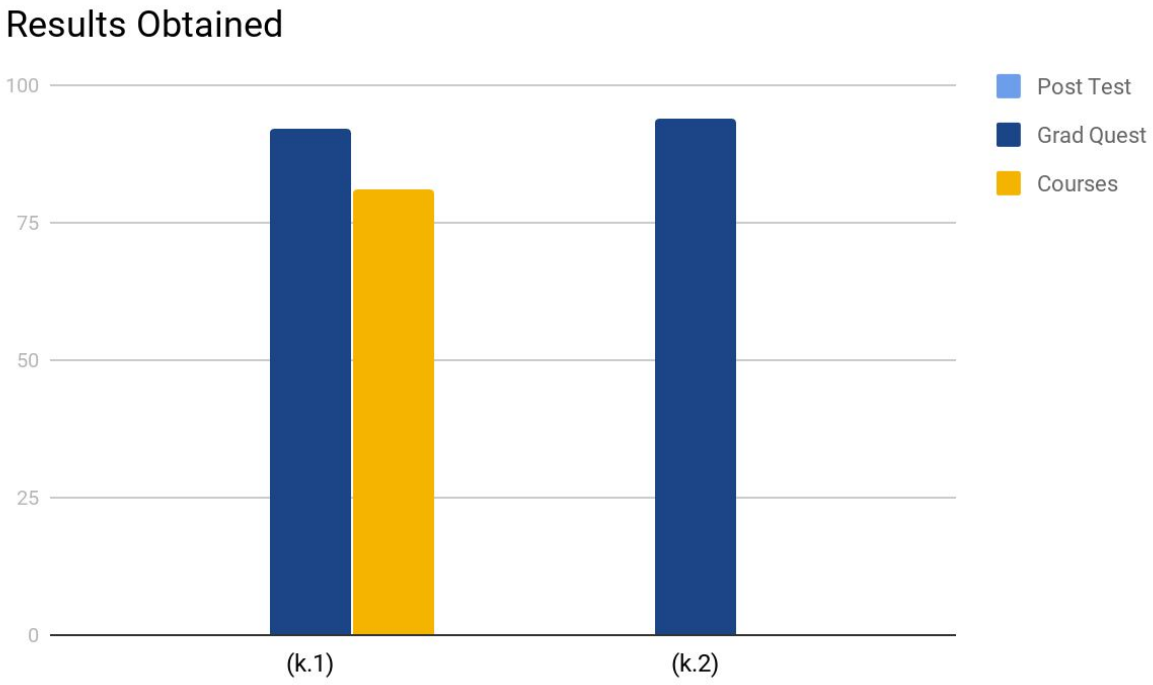
However, for PI (j.4) there has been a reduction of 14%.

Conclusions and Recommendations

The AAC decided this outcome was met.

- Recommendation: There is a reduction on the attainment level of PI (j.4) and (j.2) is borderlined developing. There has been a great improvement on PIs (j.1) and (j.2) and therefore the AAC decided that the outcome was met. However, there is space for improvement. The AAC must analyze the questions on the post-test for PI (j.4). Does this questions suffer a major overhaul during the revision of the post-test? This is a concern that must be addressed.

Outcome k: An ability to apply design and development principles in the construction of software systems of varying complexity.



This outcome is measured by two performance indicators. This PIs are the following:

(k.1) Perform object oriented and structured analysis and design of software systems.

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 92%). The post-test did not have a question to measure this PI. Therefore, the AAC decided to analyze data from the SICI 3015 Analysis and Design. On the second practical exam the students have to analyze a problem and design a system using the structural approach. The mean grade obtained from this test was 81%. On the final exam the students have to analyze a problem and design a system using

the object oriented approach. The mean grade obtained from this exam was 82%. Therefore the AAC concluded that the achievement level for this PI was met.

(k.2) Construct software systems of varying complexity

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 94%). After analyzing the projects that have been develop for SICI 4038 (Capstone Course) the AAC concluded that this performance indicator was met. Students have develop projects that span from an Appointment Notification System for Smartphones to Self Aligning Antennas.

Previous Cycle Comparison

The performance indicators for this outcome changed from previous cycle to this cycle. Therefore, we can analyze only the ones that remain. During previous cycle there was no suitable instruments to measure PI (k.1). Also, students present a satisfactory grade in previous cycle. In this cycle the data analyzed from the courses also gave us a strong satisfactory grade. Moreover, we were able to find a more suitable place to measure this PI on the SICI 3015 Analysis and Design on software systems. For PI (k.2) there was an improvement of 19% on the results obtained from the Graduate Questionnaire. This is relevant, since, this tool measures the awareness that students have on themselves.

Conclusions and Recommendations

Therefore, the AAC classify this outcome as met.

- Remark: It is evident that our students construct software systems of varying complexity since the first course (COTI 3101) to the last course (SICI 4038 Capstone Course). Students have even incorporated technologies that are not taught in many of our courses. For example, we have seen lately many Capstone projects using IoT (Internet of Things) or incorporating Arduino boards and programming. Also there are students that use Node.js and Angular on their projects.

University of Puerto Rico at Bayamón

2013-2016 Cycle

Continuous Improvement Report
Information Systems

This report provides the analysis of the achievement of the Student Outcomes for the Information Systems emphasis area of the Computer Science Department

Introduction

This document presents the assessment of the Student Outcomes (SO) of the Information Systems emphasis area (program) of the Department of the Computer Science for the University of Puerto Rico at Bayamón for the cycle 2013-2016. Analysis of the SOs is performed using two main tools: post-test and the graduate (exit) questionnaire. If there is a discrepancy between these tools data obtained from the courses is analyze for triangulation.

Remark on the Post-Test Results

Most of the data to evaluate the outcomes are made through Performance Indicators (PI). At least two questions are drafted in the post-test to measure most PIs. This is evident after the post-test revision of 2015. However, some of the data used for our analysis have included results prior to this revision. We harmonized results from the previous post-test and the revised them in order to prepare this report.

Information Systems Program - Student Outcomes Data Analysis

This section presents the analysis of the Student Outcomes for the Information Systems emphasis area (program) at the University of Puerto at Bayamón. Each outcome was further divided into performance indicators and was analyzed using at least two instruments: one direct measurement and one indirect measurement. The main direct measurement for most of the outcomes was the post-test given to all students enrolled in our Capstone course (SICI 4038). The other outcomes were assessed using data obtained from the courses either by rubrics or analyzing the coursework. The main indirect measure is a survey administered to the students in our Capstone course named the Graduate Questionnaire. Whenever a discrepancy is found, relevant materials from the courses are analyzed.

As in previous cycles we used the results from the post-test questions for further analysis. The analysis assumed the following scale:

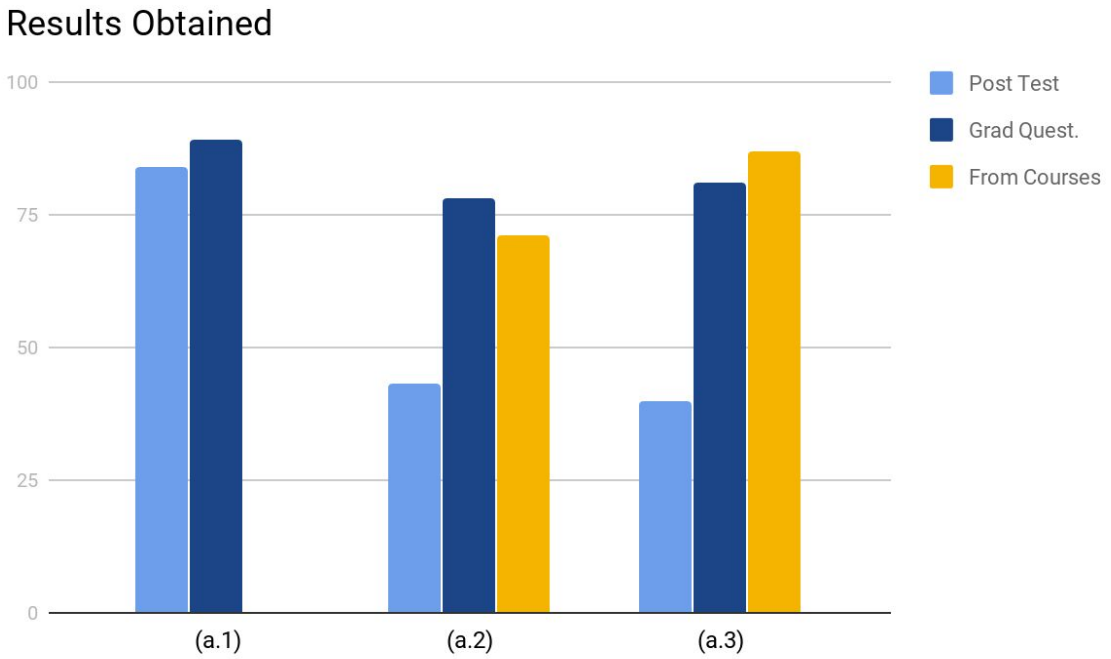
- Satisfactory – the question was correctly answered by at least 75% of the students.
- Developing – the question was correctly answered by at least 50% of the students but less that 75%.
- Unsatisfactory – the question was correctly answered by less than 50% of the students.

For the student survey, the analysis assumed the following scale:

- Satisfactory – the indicator was graded as A or B by the student.
- Developing – the indicator was graded as C by the student.
- Unsatisfactory – the indicator was graded as D or F by the student.

Student Outcomes Analysis

Outcome a: An ability to apply knowledge of computing and mathematics appropriate to the discipline



This outcome is measured by three main performance indicator.

(a.1) Select the appropriate algorithm for an specific situation
On average 84% of our student answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of B in average 89%. Therefore the AAC concluded that the achievement level for this PI was met.

(a.2) Analyze the asymptotic running time of algorithms using big-O notation
On average 43% of our student answered the questions related to this PI correctly. We considered this results to be very low. However, all the students that completed the graduate questionnaire gave this indicator a grade of 78% (high C). We analyze data obtained from Quiz #2 of the SICI 4036-Data Structures. These were the first 5 questions of section 1. After grading only this part for 18 quizzes we obtained a median of 71%. Therefore, we concluded that the achievement level for this PI is developing.

(a.3) Apply mathematical concepts in the solution of a given problem

On average 40% of our student answered the questions related to this PI correctly. However, all the students that completed the graduate questionnaire gave this indicator a grade of 81%. Therefore, we choose to analyze data obtained from the course COTI 4150 Information Systems Programming. After speaking with faculty we decided to analyze questions II.1 and II.2 of Quiz 3. An average of 87% was obtained from question II.1 and 75% for question II.2. Consequently, we concluded that the achievement level for this PI was met.

Previous Cycle Comparison

Comparing last assessment cycle with this one we can see that for PI (a.1) there has been a 9% increase on the grades obtained from the post-test. Also the students gave this indicator a strong satisfactory grade on the questionnaire. On average 43% of the students answered the questions correctly for performance indicator (a.2). This grade is lower than previous assessment-cycle. However, after analyzing the results from the courses there was an improvement of 23% in this performance indicator.

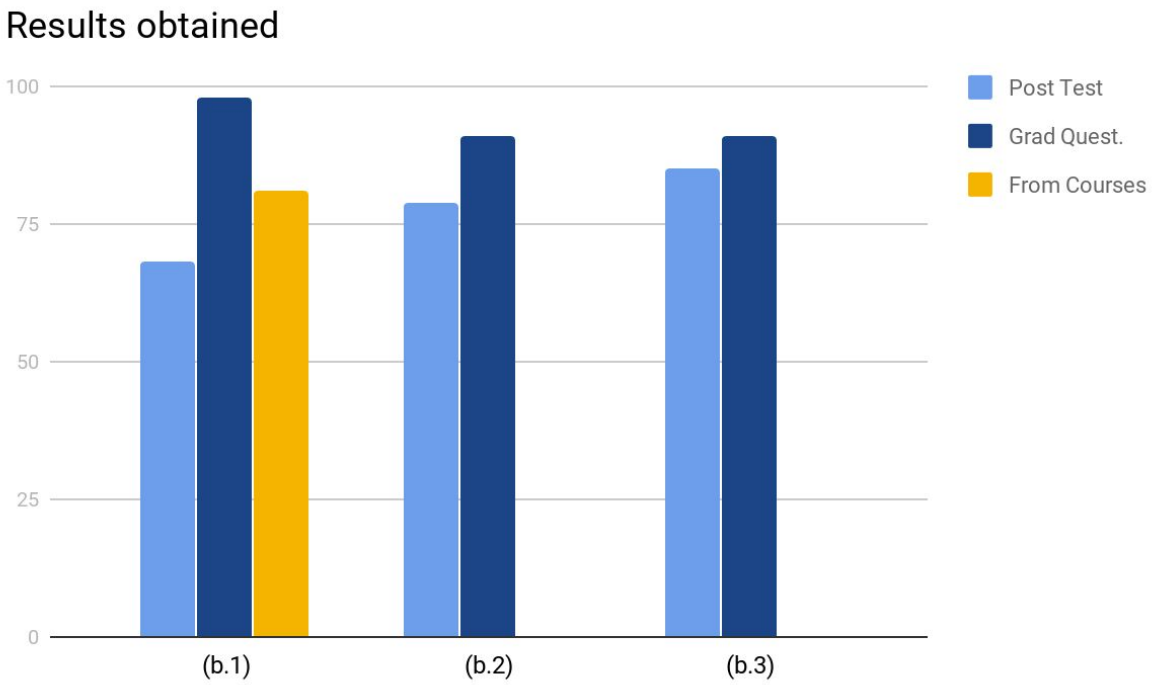
Comparing last assessment cycle with this one we can see that for PI (a.3) there has been a decrease of 10% on the results obtained from the post-test in this cycle. However, students show more confident on this PI when answering the graduate questionnaire (81%).

Conclusions and Recommendations

The AAC concluded that this outcome is partially met. The committee recommends:

- Reflection: Are the questions/problems in the post-test appropriate to Information Systems emphasis area? We are giving the same type of questions for the IS and CS programs. A question that we must made to ourselves is: Do students belonging to the IS program need to answer these questions? These are open questions we must address in the next post-test revision. Also, the type of mathematical concepts applied in course COTI 4150 are high school or freshmen level, for PI (a.3) (i.e. calculating GPA) and we used those questions to make our analysis.
- Recommendation: Since IS students are not required to take COTI 4255 Analysis of Algorithms questions in the post-test should be different than those questions asked to the CS students. Also, the AAC needs to identify if the topics entailing this PI need further reinforcement.

Outcome b: An ability to analyze a problem, identify and define the computing requirements appropriate to its solution.



This outcome is measured by thee performance indicators. This PIs are the following:

(b.1) Analyze a problem

Only 68% of the student answered this question correctly. However, they show confidence in this PI on the graduate questionnaire since they graded themselves with 98%. The AAC decided to analyze data obtained from the course SICI 3015 Analysis and Design. In most of the practical exams given by the professor the students have to read a problem, analyze it and design a solution for the problem. We have decided to analyze the grade for the partial exam #2. The mean grade obtained in this exam was 81%. Therefore, the AAC concluded that the achievement level of this PI was met.

(b.2) Identify and define the computational requirements needed in a real situation
On the post-test 79% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 91%). Therefore, the AAC concluded that the achievement level of this PI was met.

(b.3) Choose the appropriate software and/on hardware tools to meet the desired goals

On the post-test 85% of the students answered the questions related to this PI correctly. Also, all the students that completed the graduate questionnaire gave this indicator a grade of A (as in previous PI an average of 91%). Therefore, the AAC concluded that the achievement level of this PI was met.

Previous Cycle Comparison

Last time the AAC recommended to *build some assessment tools to effectively measure* the indicator. The problem was that last time we couldn't find a suitable place for measuring this outcome. This time we choose SICI 3015 SICI Analysis and Design as the suitable place for measuring the PIs.

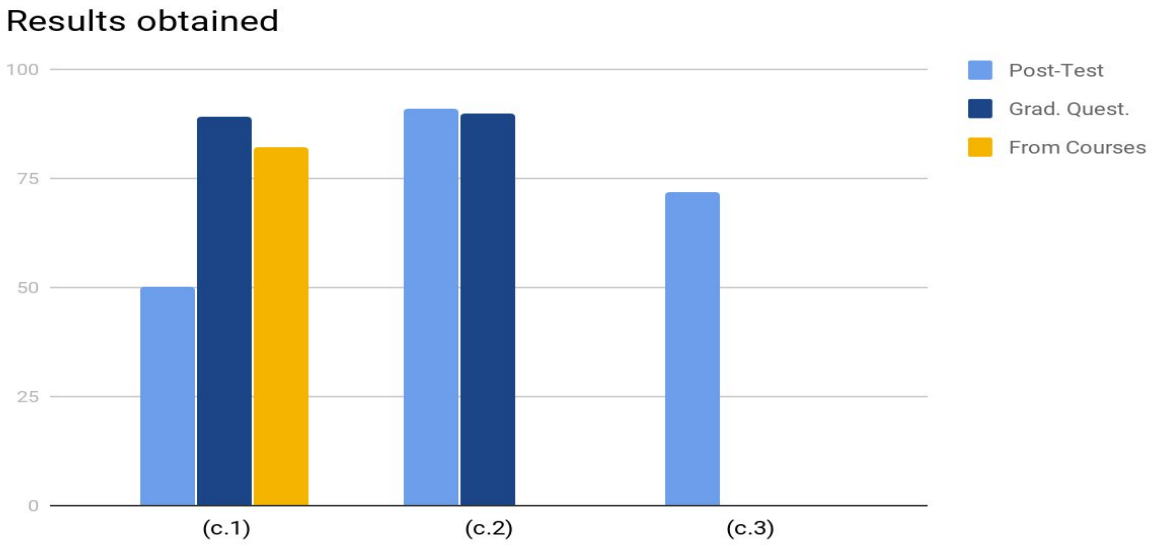
Comparing last assessment cycle with this one we can see that for PI (b.1) there has been a decrease on the grade obtain on the post-test. However, there was a slight increase of 2% for PI (b.2) and a 25% increase for PI (b.3) on the post-test. We didn't need to analyze grades obtained from the courses last time.

Conclusions and Recommendations

After analyzing each performance indicator for outcome b we can conclude that the outcome was met.

- Reflection: the mean grade of PI (b.1) was 68% in the post-test. It is drafting of the question the problem for PI (b.1)? Is the question is appropriate to IS? Students in CS were border line in this performance indicator with a mean grade of 74%. The AAC recommend to review the questions of the post-test for this PI.

Outcome c: An ability to design, implement, and evaluate a computer-based system, process, component or program to meet desired needs.



This outcome is measured by thee performance indicators. This PIs are the following:

(c.1) Design solutions using pseudo code, diagrams or natural languages.

On the post-test just 50% of the students answered the questions related to this PI correctly. This is unsatisfactory and alarming for the AAC. However, all the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 89%). Since there is an abysmal discrepancy the committee decided to examine the coursework. The AAC decided to analyze data obtained from the course SICI 3015 Analysis and Design. In this course, students have to develop diagrams as the Entity Relationship Diagram (ERD), use case, activity and state machine diagrams. The committee decided to analyze the grade from the final exam. The mean grade obtained in this exam was 82%. Therefore, the AAC concluded that the achievement level of this PI it is classified as developing.

(c.2) Implement an algorithm using the appropriate programming language

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 91%). After looking at some of the SICI 4038 (Capstone Course) projects we can conclude that students are able to implement a system in almost any language. We have seen many projects in Microsoft and Non Microsoft environment, for example, Android and Web based. This have been

evident to us when looking to the posters presented by the students in the capstone course. Therefore, the committee declared that this PI was met.

(c.3) Perform both unit and system testing

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 72%). All students that take course SICI 4036 Data Structures are using JUnit to test their programs. We now that just lately we have added this to the courses. Some students indicated on the graduate questionnaire that they don't have knowledge about this and this is true. However, many students performed unit and system testing when building programs of varying complexity but couldn't identify the test they were performing as a unit or system testing. They just only know they test the program by "including and testing" each method/procedure or function they were added to the system. Therefore, the AAC classify this PI as developing.

Previous Cycle Comparison

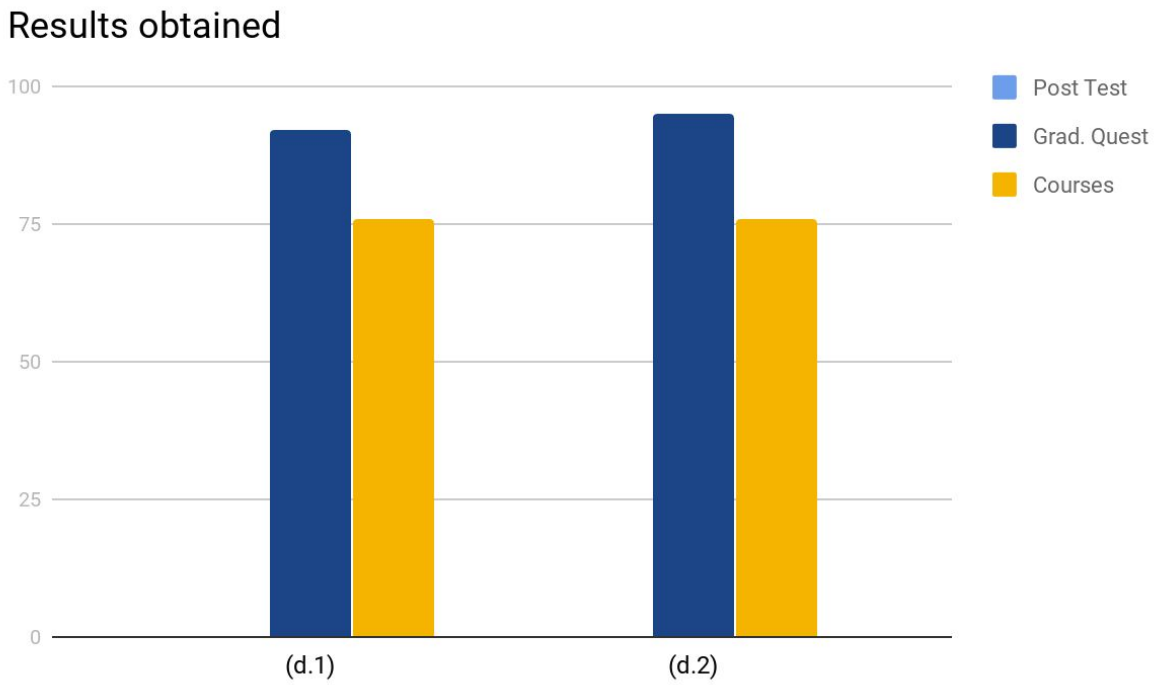
The PIs for this outcome changed during this cycle. However, some of the previous one remained. Therefore, PI (c.1) is similar but not equal to PI (3.d) from last assessment cycle. The results obtained from the post-test were not satisfactory and were way beyond the 84% that was previously obtained. We have to analyze if the problems were directly an impact of the changes made in the post-test. However, after analyzing the data obtained from the courses we can conclude that this outcome was met, even though, there was also a decreased in the data analyzed from the courses when compared with the last assessment cycle. Students have increased their confidence level when analyzing the data obtained from the graduate questionnaire from last assessment cycle to this one for PI (c.2). The increased was a 16%. Moreover, PI (c.3) obtained mostly the same confidence level of satisfaction.

Conclusions and Recommendations

The AAC concluded that this outcome is partially met. The committee recommends:

- Recommendation and reflection: Why students of the IS program did obtain a lower grade on the test than those in the CS program for PI (c.1)? It is an open question we need to analyze. This problem needs to be addressed.
- Reflection: Performance Indicator (c.3) should be met in next assessment cycle. It is envision that all the students would have an experience using Junit in the upcoming years. Students would understand the difference between the type of testings they are performing.

Outcome d: An ability to function effectively on teams to accomplish a common goal



This outcome is measured by two performance indicators. This PIs are the following:

(d.1) Evaluate a given problem within a team environment

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 92%). On SICI 4037-Data Communications students evaluate each other after finalizing the course project. They filled out the Group Skills rubric. After analyzing this instrument we found out that more than 76% of the students gave their peers the highest grade (4/4) in the skills of: problem solving, work attitude and *ability of* working with others. Therefore, the AAC concluded that the achievement level of this PI was met.

(d.2) Perform duties assigned when working on team

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 95%). We use the same instrument as the previous PI. After analyzing this instrument we found out that more that around 76% of the students gave their peers the highest grade (4/4) in the skills of: contributions and quality of the work. Therefore, the AAC concluded that the achievement level of this PI was met.

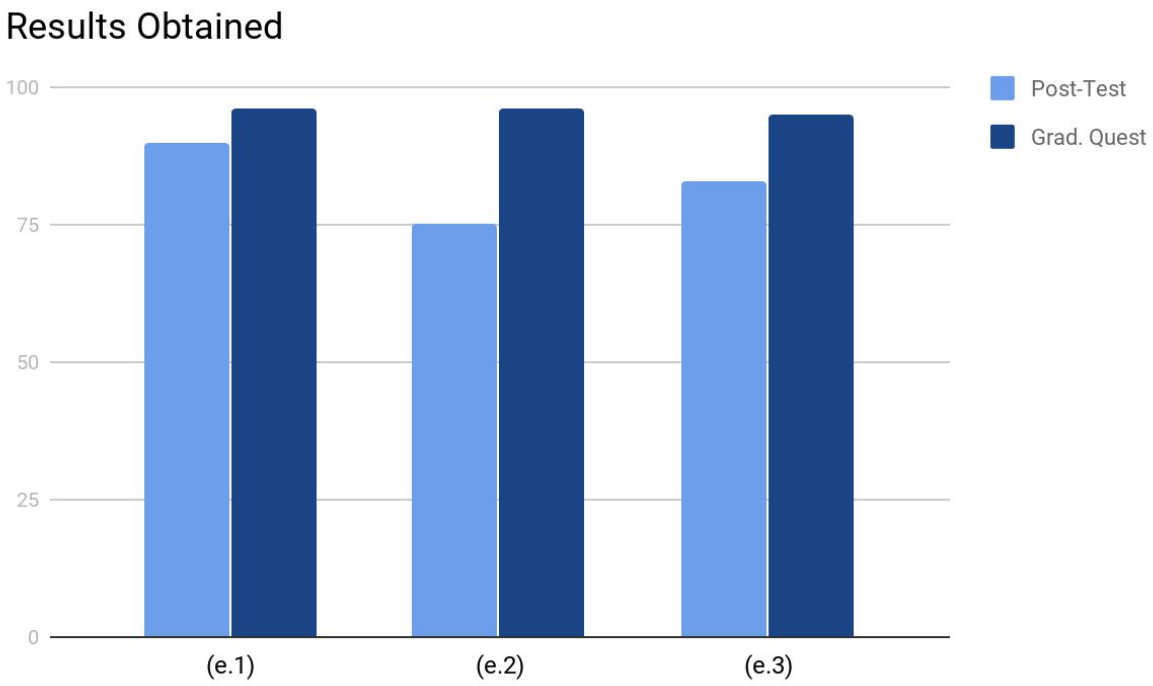
Previous Cycle Comparison

This outcome was trim down from 4 to 2 performance indicators for this assessment cycle. Curiously, we obtained the same figures for PI (d.1) and PI(d.2) on current and previous assessment cycles.

Conclusions and Recommendations

This outcome was met.

Outcome e: An understanding of professional, ethical, legal, security and social issues and responsibilities



This outcome is measured by three performance indicators. This PIs are the following:

(e.1) Evaluate the ethical implications of an issue in the computing discipline

On the post-test 90% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of A in average 96%. Therefore the AAC concluded that the achievement level for this PI was met.

(e.2) Evaluate the social impact of a given computing technology

On the post-test 75% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of A in average 96%. Therefore the AAC concluded that the achievement level for this PI was met.

(e.3) Recognize the responsibilities inherent to the profession

On the post-test 83% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of A in average 95%. Therefore the AAC concluded that the achievement level for this PI was met.

Previous Cycle Comparison

The AAC recommended last time the inclusion of a course named COTI 3XXX *Information, Computes and Society Seminar.* This course was named COTI 3305 Computing Ethics and Society to our curriculum for both emphasis areas (programs). This improved the attainment level of this outcome.

Comparing last assessment cycle with this one we can see that for PI (e.1) there was a 6% of difference between last cycle and this one (96% - 90%). The AAC sees this difference as negligible. Also the students gave this indicator a strong satisfactory grade. Also, during this cycle all efforts were focused into improving this particular outcome. The questions on the post-test were revised. Also, a new course was introduced to focus on this outcome.

On the post-test 75% of the students answered the questions related to PI (e.2) correctly. There were no questions for this PI on the previous version of the post-test. Also, on previous cycle, the AAC use data from the courses to assess this PI. Last Cycle, the AAC classified this PI as developing. This cycle has been classified as satisfactory. There has been a 4% of increased on the achievement level. Also, during this cycle all efforts were focused into improving this particular outcome.

On the post-test 83% of the students answered the questions related to PI (e.3) correctly. There were no questions for this PI on the previous version of the post-test. The AAC used data from the courses to assess this PI on previous cycle. This PI has been has been classified as satisfactory.

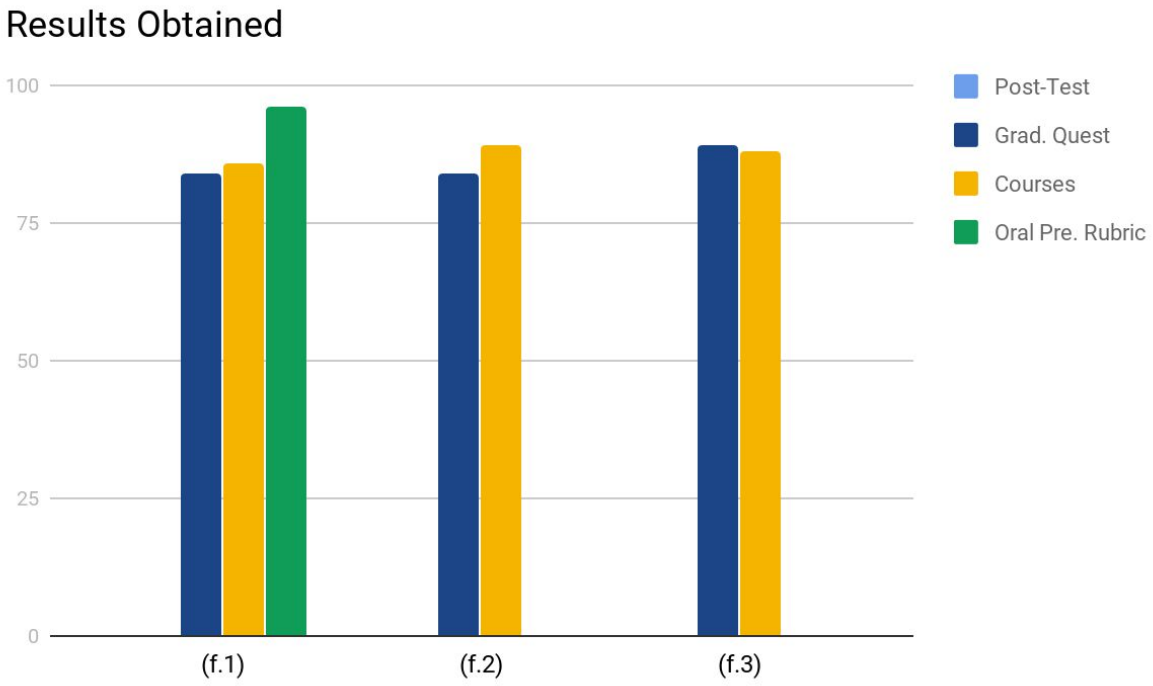
Conclusions and Recommendations

The addition of the 2 credit course COTI 3305 Computing Ethics and Society focuses on ethics and legal issues related to computing. The objective of this course is to increase the ethical awareness of our students.

The AAC comments:

- Reflection: Our curriculum has a course in Information Security and we don't have a performance indicator or a question in the test related to that. We need to add at least one PI that measures security aspects.
- Reflection: The legal aspects that are related to the field are covered in the course COTI 3305. However, there is no question in the post-test that address this. We need to add at least one PI or one question that measures this part of the outcome.

Outcome f: An ability to communicate effectively with a range of audiences.



This outcome is measured by three performance indicators. This PIs are the following:

(f.1) Present different topics both orally and/or in writing

All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 84%). The AAC decided to analyze the grade obtained from the first row of the rubric for the SICI 4019 Computer Architecture Term Paper. Moreover, the AAC decided to analyze the grade obtained from the oral presentation rubric from the SICI 4037 Data Communication course. The average grade obtained analyzing the first rubric was 17.22/20.00 = 86 %. The average obtained by analyzing the oral presentation rubric is 95.8%. Therefore the AAC concluded that the achievement level for this PI was met.

(f.2) Explain technical concepts using the correct terminology

All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 84%). The AAC decided to analyze the rubric for the SICI 4019 Computer Architecture Term Paper specifically the 4th row. The average grade obtained analyzing this row was 17.85/20.00 = 89 %. Therefore the AAC concluded that the achievement level for this PI was met.

(f.3) Display knowledge of technical report writing

All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 89%). The AAC decided to analyze the overall grade obtained from the rubric used for the SICI 4019 Computer Architecture Term Paper. The mean grade obtained after analyzing the data was 88% (87.7). Therefore the AAC concluded that the achievement level for this PI was met.

Previous Cycle Comparison

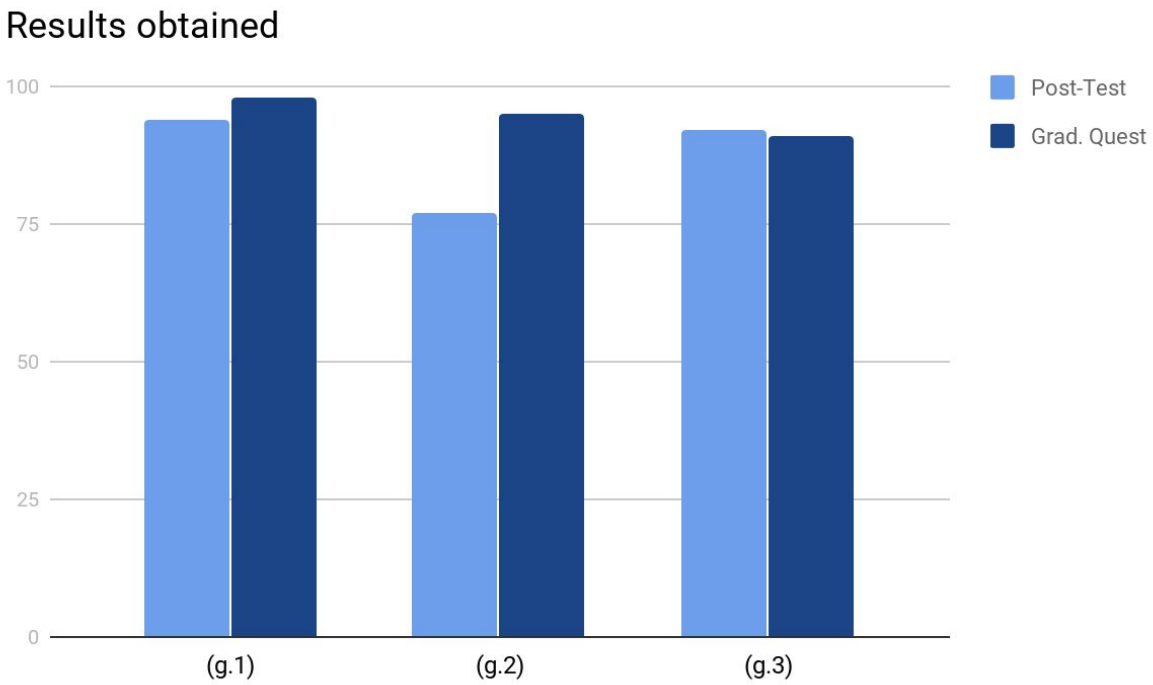
Comparing last assessment cycle with this one we can see that for PI (f.1) almost stay the same (86%-87%). However, there was an increase of around 12% on the grade obtained by analyzing the data obtained from the course. Moreover, for PI (f.3) students show a slight decrease of 4% on this PI. Last time the SICI 4038 Capstone Course was used to measure this PI. This time we use SICI 4019 Computer Architecture. An 88% and a 92% are strong satisfactory levels.

Conclusions and Recommendations

The AAC decided that this outcome was met. However the AAC make the following comments:

- Remark: This outcome was met solidly on this cycle,however, we have analyzed the attainment of this outcome using mostly the data obtained from the SICI 4019 Term Paper and the SICI 4037 Final Project presentation. The outcome is An ability to communicate effectively *with a range of audiences*. Does the data obtained from these courses is sufficient? Where is that range of audience? Does professors and students is sufficient? Would it be better to measure this outcome in SICI 4038 our capstone course? The AAC must reflect about this

Outcome g: An ability to analyze the local and global impact of computing on individuals, organizations, and society.



This outcome is measured by three performance indicators. This PIs are the following:

(g.1) Understand computational or technological advances and their impact on individuals, organizations and society.

On the Post-test 94% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of A in average 98%. Therefore the AAC concluded that the achievement level for this PI was met.

(g.2) Recognize the global and local impact of a given technology.

On the Post-test 77% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of A in average 95%. Therefore the AAC concluded that the achievement level for this PI was met.

(g.3) Be aware of the state of the art in computing technology.

On the Post-test 92% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of A in average 91%. Therefore the AAC concluded that the achievement level for this PI was met.

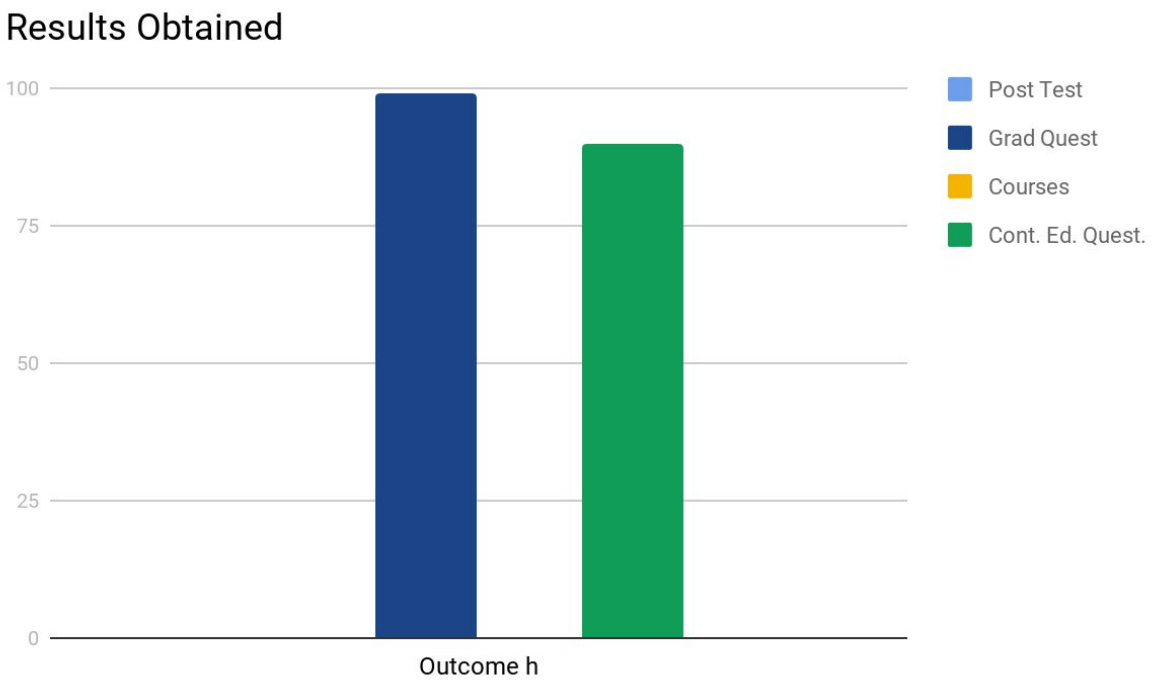
Previous Cycle Comparison

The performance indicators for this outcome received a major overhaul from previous cycle to this cycle. Therefore, each PI cannot be compared directly.

Conclusions and Recommendations

The AAC decided that this outcome was met.

Outcome h: Recognition of the need for an ability to engage in continuing professional development



This outcome does not have any performance indicator. We are measuring the outcome directly.

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 99%). All the students take a lecture on *Continuous Education and Career Paths* on their Capstone Course (SICI 4038). They also answer a questionnaire about this outcome during this course. After

analyzing the data 90% recognize the need to engage in continuing professional development. Therefore, the AAC concluded that the achievement level for this PI was met.

Previous Cycle Comparison

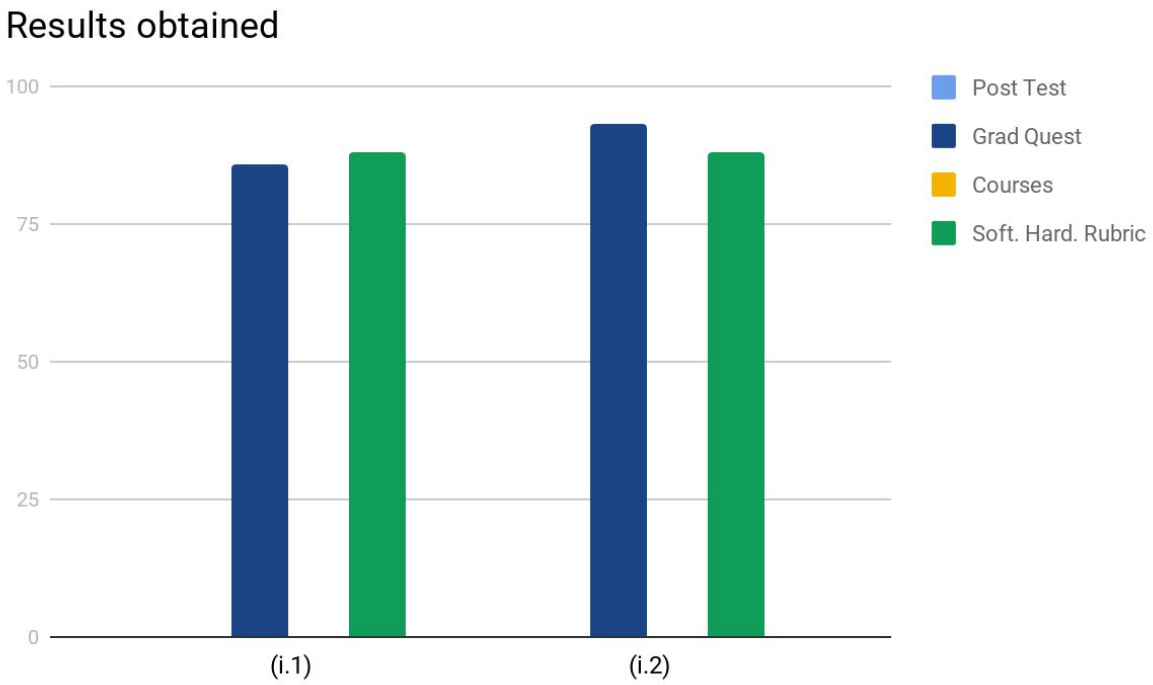
The AAC recommended developing suitable instruments to measure this outcome during the last cycle. Also, the AAC recommended the revision of all the performance indicators that were part of this outcome. The PIs were eliminated. Therefore, there was no way to compare each PI. However, a lecture on Continuous Education and Career Paths as a requisite of the SICI 4038 (Capstone course) was added to measure this outcome. Also, the students take a questionnaire after this lecture.

Conclusions and Recommendations

This outcome was met. Special attention was taken to this outcome during this cycle.

- Reflection: Around 15% of the students indicated that they plan to pursue graduate school. The AAC needs to analyze if this is too low. A discussion with the department needs to be schedule to analyze this. Also some professors have raised a concern that this lecture should be given earlier.

Outcome i: An ability to use current techniques, skills and tools necessary for computing practices.



This outcome is measured by two performance indicators. This PIs are the following:

(i.1) Use hardware and software tools currently available

Around 86% of the students used hardware and software tools currently available. This was obtain by looking at the results from the Rubric to Evaluate Software and Hardware Tools. All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 88%).

(i.2) Use current techniques and skills in the practice of the profession.

Around 93% of the students use current techniques and skills during the courses. This was obtained by looking at the results from the Rubric to Evaluate Software and Hardware Tools. All the students that completed the graduate questionnaire gave this indicator a grade of B (an average of 88%).

Previous Cycle Comparison

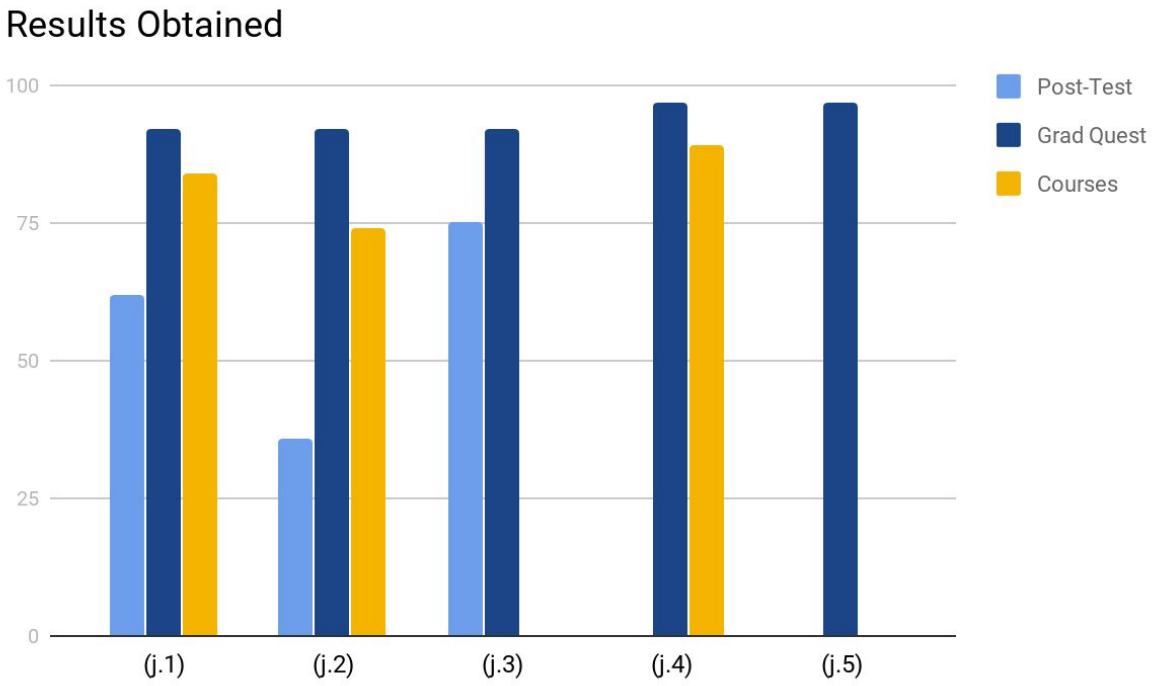
Current cycle percentages are even higher than on the previous cycle. Also the attainment level for this outcome was satisfactory.

Conclusions and Recommendations

Although this outcome was met:

- Recommendation: The only experience our students have is on the environment of Microsoft Windows. It is our knowledge there are students that own MAC or have installed linux on their laptops. However, this is not the norm. Some faculty have a concern on this matter. The department has set as a goal to add a Linux partition in every hard drive of the PCs of our laboratories. However, this task have not been completed. The AAC recommends that this goal should be set with a definitive deadline.

Outcome j: An understanding of processes that support the delivery and management of information systems within a specific application environment.



This outcome is measured by five performance indicators. This PIs are the following:

(j.1) Analyze the information flow in an organization.

On the Post-test 62% of the students answered the questions related to this PI correctly. However, all the students that completed the graduate questionnaire gave this indicator a grade of A in average 92%. Since there is a discrepancy we have to dig further and analyze data from the courses. The AAC decided to analyze data obtained from COTI 4430 Project Management class. The attainment level of this performance indicator on this course was 84%. Therefore, the AAC classified this PI as met.

(j.2) Understanding the process operations within an organization.

On the Post-test 36% of the students answered the questions related to this PI correctly. However, all the students that completed the graduate questionnaire gave this indicator a grade of A in average 92%. Since there is a discrepancy we have to dig further and analyze data from the courses. The AAC decided to analyze data from the courses COTI 4430 Project Management and SICI 3211 Information Systems

Fundamentals. On average, students achieve a 74% on this PI, a satisfactory grade. Therefore, the AAC classified this PI as developing.

(j.3) An ability to discern between transactional-processing system, management information system, and decision support system.

On the Post-test 75% of the students answered the questions related to this PI correctly. All the students that completed the graduate questionnaire gave this indicator a grade of A in average 92%. Therefore the AAC concluded that the achievement level for this PI was met.

(j.4) Recommends viable solutions using computer systems as main solution

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 97%). The AAC analyze data obtained from COTI 4430 Project Management and SICI 4038 Capstone Course. On average, students achieve 89% on this PI. Therefore, the AAC concluded that the achievement level of this PI was met.

(j.5) Construct an Information System

All the students that completed the graduate questionnaire gave this indicator a grade of A (an average of 97%). After analyzing the projects that have been develop for SICI 4038 (Capstone Course) the AAC concluded that this performance indicator was met. Students have develop projects that span from Inventory Systems to Law Offices Management Systems. Therefore, the AAC concluded that the achievement level of this PI was met.

Previous Cycle Comparison

There was an improvement in all areas of PI (j.1) even with low scores in the post-test. Last time the average grade obtained from the post test was 40%. Now, the grade has increase to 62%. Also there was an increase of 6% on the data analyze from COTI 4430. However, for PI (j.2) there was not a substantial increase whatsoever (32% to 34%) using the results from the post-test. A similar trait happens when analyzing the data from the courses (73% to 74%). For PI (j.3) there has been a decrease of -14% in the results obtained from the post-test (89% to 75%). For PI(j.4) the attainment level grew up approximately 11%

Conclusions and Recommendations

The AAC classifies this outcome as partially met.

- Recommendation: The post-test results for performance indicator (j.2) were too low. After analyzing the data obtained from the courses the results indicated that this PI was developing. The AAC recommends to reinforce PI (j.2) on the courses. On last assessment cycle we

recommended *the creation of assessment instruments to measures the indicator* in *Business Administration courses*. The truth is that we never created them. We need to study if the low results on the post-test results in poor drafting of the post-test. Also, the committee recommends to reinforce PI (j.2) on the courses that are exclusive for the IS program.

- Recommendation: Also, the committee recommends a revision of the questions presented on the post-test for PI (j.2)

- Recommendation: The AAC recommends that this outcome should be reinforce at all levels on the courses that the IS students take exclusively. Taking special care in PIs (j.2), (j.3), and (j.4).