University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Engineering Science and Materials

COURSE SYLLABUS

1. General Information:

Alpha-numeric codification: **INGE 3016**
Course Title: **Algorithms and Computer Programming**
Number of credits: **3**
Contact Period: **3 hours lectures per week**

2. Course Description:

English: Development of algorithms and their implementation in a structured high-level language. Programming techniques applied to the solution of engineering and mathematical problems.

Spanish: Desarrollo de algoritmos y su implantación utilizando un lenguaje estructurado de alto nivel. Técnicas de programación aplicadas a la solución de problemas de ingeniería y de matemáticas.

3. Pre/Co-requisites and other requirements:

Co-requisites: MATE 3005 or MATE 3143 or MATE 3172 or MATE 3174

4. Course Objectives:

After successful completion of the course the student would be able to apply acquired computer programming skills to the solution of problems, specially engineering related problems. More specifically, the student would be able to:

- Construct an algorithm for the solution of problems by means of program design tools, e.g., top-down design, flowcharts, pseudocode.
- Analyze and/or debug the programming and logic of a given piece of flowchart, pseudocode or code through desktop checking and debugging tools.
- Develop clear, robust and efficient code using conditional statements.
- Develop clear, robust and efficient code using loop statements.
- Construct codes by means of basic data structures, e.g., codes that involve creation and manipulation of arrays.
- Design a solution to a complex problem through division into simpler problems and implement it using modular design, e.g. library functions, user-defined functions, modules, and/or subroutines.

5. Instructional Strategies:

☒ Conference ☐ Discussion ☒ Computation ☐ Laboratory

☐ Seminar with formal presentation ☐ Seminar without formal presentation

☐ Workshop ☐ Art workshop ☐ Practice ☐ Trip

☐ Thesis ☐ Special problems ☐ Tutoring ☐ Research \

☐ Other, please specify:

6. Minimum or Required Resources Available:

Students may use the university computer laboratories or their own computers to complete course projects. For online lectures a laptop with camera and access to High Speed Internet are needed.

7. Course time frame and thematic outline:

Outline of Topic	Contact hours
The problem solving and algorithm design process	1.5
Flowcharts and pseudocode	1.5
Programs, functions	1.5
Modules. Programs composed of functions	1.5
Relational operators, logic operators, hierarchy of operations	1.5
Hands on workshop 1	1.5
Branching	1.5
Branching (continued)	1.5
Hands on workshop 2	1.5
Exam #1	1.5
Containers	1.5
Containers (continued)	1.5
Iteration: while loops	1.5
Iteration: for loops	1.5
Iteration: break, pass, continue, while-else, nested loops	1.5
Hands on workshop 3	1.5
Exam #2	1.5
Arrays (1D, 2D, creation, manipulation)	1.5
Arrays operations	1.5
Hands on workshop 4	1.5
Visualization (2D plots)	1.5
Vectorization	1.5
Hands on workshop 5	1.5
Input / output data files (basic data processing)	1.5
Nested loops, meshgrid, 3D plots	1.5
Hands on workshop 6	1.5
Exam #3	1.5
3D arrays [e.g. basic image processing]	1.5
Introduction to object-oriented programming [Classes, inheritance]	1.5
Hands on workshop 7	1.5
Total hours (equivalent to contact period):	**45**

Notes:

The course is offered with an active learning approach. The hands-on workshop sessions are provided for the students to engage on the solution of problems through algorithm design and its computer implementation.

The evaluation strategy is to be determined by the instructor, which might decide on a different number of tests. The content of each test is also subject to the consideration of the instructor.

It is expected from each instructor to develop attractive learning experiences for the hands-on workshop sessions and relevant and challenging problems for the computer projects. The applications would be tailored towards math, science and engineering. The following is a list of suggested topics for the hand-on workshops and computer projects.

1. Lines (slope, distance, intersection)
2. Evaluation of piecewise defined functions
3. Time value of money (engineering economics)
4. Series
5. Fractals
6. Guessing games / puzzles
7. Root Finding
8. Evaluation of functions of 2 variables (3D plots: surface, contour, quiver)
9. Solution of simultaneous equations
10. Optimization
11. Resource allocation
12. Random numbers:
    a. Probability distribution
    b. Montecarlo simulation
    c. Random walks
    d. Noise
13. Basic data processing:
    a. 2D and 3D visualization of data
    b. Basic statistical measures and high order statistical moments
    c. Outlier analysis
    d. Least squares fitting
    e. Numerical integration of data (right point, left point, & trapezoidal schemes)
    f. Numerical differentiation of data (forward, backward, & central schemes)
14. Image processing

8. Evaluation Strategies:

	Quantity	**Percent**
☒ **Exams**	2 to 4	40 to 60
☒ **Final Exam**	1	15 to 35
☒ **Short Quizzes**	Variable	0 to 10
☐ **Oral Reports**		
☐ **Monographies**		
☒ **Projects**	Variable	25 to 40
Other, specify:		
TOTAL:		**100%**

*Final exam: The instructor could opt to make the final exam optional to the students as long as all of the objectives of the course have been comprehensively assessed through other evaluation strategies.

**Projects: Computer projects are considered a major part of this class and are expected to have a major impact in the student final grade. Nevertheless, the instructor may set a threshold value on the exams' grades average below which the projects grade will not be considered for the final grade.

9. Bibliography:

Textbook:

Handouts and other instructional materials will be distributed by the instructor.

References:

Wentworth, P., Elkner, J., Downey, A., & Meyers, C. (2020). How to Think Like A Computer Scientist: Learning with Python 3. <free e-book>, < https://howtothink.readthedocs.io/en/latest/>

Spronck, P. (2017). The Coder's Apprentice: Learning Programming with Python 3. <free e-book>, <http://www.spronck.net/pythonbook/>

Fangohr, H. (2020). Python for Computational Science and Engineering. Faculty of Engineering and the Environment University of Southampton. <open access book> < https://github.com/fangohr/introduction-to-python-for-computational-science-and-engineering/blob/master/Readme.md >

Deitel, P., Deitel, H. (2015) C How to Program – with an Introduction to C++, 8th Edition. Pearson.

11. Reasonable Accommodation (Law 51):

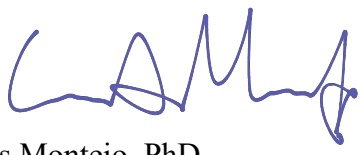
The University of Puerto Rico at Mayagüez (RUM) recognizes that each student has an inherited right to request reasonable accommodation according to Law 51: Law for Integral Educational Services for People with Disabilities. Every student has the right to receive reasonable accommodation if he/she presents the necessary evidence to be evaluated by the Office of Services to Students with Disabilities (OSEI-RUM), and the related information can be found at the following link: https://www.uprm.edu/cms/index.php/page/85. If your case is approved by OSEI-RUM, you will receive reasonable accommodation in your courses and evaluation, and you must contact each professor for course registered. For additional information contact OSEI-RUM at Sánchez Hidalgo 410 or via telephone 787-832-4040 extension 3107.

12. Academic Integrity:

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR Students General Bylaws (Board of Trustees Certification 13, 2009-2010) states that academic dishonesty includes, but is not limited to: fraudulent actions; obtaining grades or academic degrees by false or fraudulent simulations; copying the whole or part of the academic work of another person; plagiarizing totally or partially the work of another person; copying all or part of another person answers to the questions of an oral or written exam by taking or getting someone else to take the exam on his/her behalf; as well as enabling and facilitating another person to perform the aforementioned behavior. Any of these behaviors will be subject to disciplinary action in accordance with the disciplinary procedure laid down in the UPR Students General Bylaws.─.

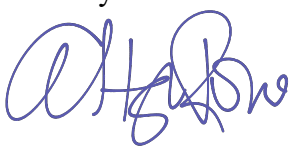
13. Policy Against Discrimination Based on Sex, Sexual Orientation, and Gender Identity:
The University of Puerto Rico prohibits discrimination based on sex, sexual orientation, and gender identity in any of its forms, including that of sexual harassment. According to the Institutional Policy Against Sexual Harassment at the University of Puerto Rico, Certification Num. 130, 2014-2015 from the Board of Governors, any student subjected to acts constituting sexual harassment, may turn to the Office of the Student Ombudsperson, the Office of the Dean of Students, and/or the Coordinator of the Office of Compliance with Title IX for an orientation and/or formal complaint.
14. Sexual Harassment: Certification 130-2014-2015 states:
Sexual harassment in the workplace and in the study environment is an illegal and discriminatory act and is against the best interests of the University of Puerto Rico. All persons who understand they have been subject to acts of sexual harassment at the University of Puerto Rico may file a complaint and request that the institution investigate, where necessary, and assume the corresponding action by the university authorities. If the complainant is a student, he or she must refer his or her complaint to the Office of the Student Ombudsperson or that of the Dean of Students.
15. Certification 06-43 of the Academic Senate states, "The academic guidelines for offering online courses," defines:
Traditional face-to-face courses are those that have less than 25% of the course's regular contact hours via the Internet. Therefore, a three-credit course will be considered "face to face" if, of the 45 hours of regular contact, 11 or less are taught via the Internet. According to certification 16-43 of the Academic Senate, a course may include up to 25% of its total contact hours via the Internet. The objective of this is so that all professors have this alternative in the case of any unscheduled eventuality.

Revised by:



Luis Montejo, PhD
Coordinator, Programming Committee

Approved by:



Aidsa I. Santiago Román, PhD
Department Chair

Revised: June 2020