FLORIDA POLYTECHNIC UNIVERSITY

COP5531.01 - Advanced Algorithm Design and Analysis

Course Information

- **Course Number and Title**: COP5531 - Advanced Algorithm Design and Analysis
- **Credit Hours**: 3 (Lecture hours: 3, Lab hours: 0)
- **Current Academic Term**: Spring 2026

Prerequisite(s):

- Graduate Standing

Instructor Information

- **Instructor**: Dr. Paniz Abedin
- **Office**: BARC-2236
- **Office Hours**: MWF 1-2PM
- **Office Phone**: 863-874-8535
- **E-mail**: pabedin@floridapoly.edu
- **Class Meeting Day, Time & Location**: MW: 4 PM – 5:15 PM, IST-1065

Course Details

- **Delivery Mode**: Face-to-Face learning experience with class meetings twice a week in the class meeting location specified above. Please check the Canvas course website for all information, including announcements, discussions, and any supplementary material for topics covered in this course.
- **Course Website**: Canvas
- **Course Description**: The course covers theory of NP-completeness, methods for dealing with NP-complete problem. Selected topics in such areas as combinatorial optimization, computational geometry, cryptography, parallel algorithms. This course also discuss algorithms for graph theoretical applications, lower bounds, upper bounds, and average performance of algorithms. If time permits discussion on complexity theory will also discussed. Core results and techniques are introduced, which are useful to those planning to specialize in other areas in computer science. Moreover, some fairly advanced topics will be covered. This will provide an idea of the current research for the benefit of those who might wish to specialize in this area.
- **Communication/Computation Skills Requirement (6A-10.030)**: N
- **Reference Textbook**: Algorithms Design by Jon Kleinberg and Éva Tardos, ISBN-13: 978-0132131087, Edition: 2nd, Publisher: Pearson
- **Equipment and Materials**: Theoretical Course
- **Course Objectives**: At the end of this course, students should refresh their knowledge about how to analyze algorithms and design effective algorithms using several well-known techniques such as Greedy, Divide & Conquer, Dynamic Programming, and etc. Moreover, students should learn advance topics like coping with intractable problems utilizing design techniques such as approximation and randomization. Students will also be introduced Network Flows and more advanced algorithms concepts.

- **Course Learning Outcomes (Bloom's Learning Level)**:
  1. Design and analyze algorithms for basic numerical problems (Creating)
  2. Apply and analyze complex algorithmic paradigms (Analyzing)
  3. Solve optimization problems efficiently (Applying)
  4. Identify problems that are unlikely to admit efficient algorithms and evaluate their difficulty via computational complexity theory (Evaluating)
  5. Survey recent literatures (Analyzing)

- **Alignment with Program Outcomes**:
  Upon completion of the Master of Science in Computer Science Degree, students will be able to:

Master of Science – Computer Science: Program Learning Outcomes	**Course Learning Outcome and Learning Level**
1. Demonstrate mastery in analyzing complex problems and applying knowledge of computer and/or data science to formulate solutions.	1,2,3,4
2. Communicate computer and/or data science information clearly and effectively through presentations and technical writings to both expert and non-expert audiences.	4,5
3. Demonstrate critical evaluation of recent research literature.	5
4. Identify a novel relevant research problem in a chosen computer and/or data science research field, perform the literature survey for the problem, create a plan to solve the problem, carry on the plan, and defend the research.	4,5
5. Recognize appropriate practices in the different fields of computer science and their ethical implications.	1, 2

- **Official Email Address**: Florida Polytechnic University email is the official method of communication for the University. Students are required to check their email frequently.

Academic Support Resources

- **Library**: Students can access the Florida Polytechnic University Library through the University website and Canvas, on and off campus. Students may direct questions to library@floridapoly.edu.
- **Peer Learning Strategists (PLS)**: Are specially trained student leaders who help their peers strategize approaches to course content and work through solution methods. PLS work in collaboration with the courses they support so the content and methods are aligned with your instructors' expectations. Students can meet with a PLS in The Learning Center, which is located on the first floor of the Innovation, Science and Technology (IST) building in room 1019.
- **Academic Success Coaches**: All students at Florida Poly are assigned an Academic Success Coach. Your Academic Success Coach can assist you with academic success strategies. Please visit the Student Success Center on the second floor of the IST building to meet with an Academic Success Coach.
- **Writing Center**: Located on the second floor of the IST (2059/2061), the Writing Center helps students to develop their writing and presentation skills. Consultations are available in person and virtually. For more detail, visit https://floridapoly.edu/writingcenter.

Course Policies:

- **Contact Policy**
  The **email subject must start** with the course code and the section number "**COP5531:**" followed by the topic. Any email received from an address other than floridapoly.edu will be ignored. Send the emails to pabedin@floridapoly.edu

- **Attendance** (see also University Policy)
  Students in **face-to-face (this includes labs and C-courses)** courses are expected "to attend all of their scheduled University classes and to satisfy all academic objectives as defined by the instructor" (University Policy, FPU-5.0010AP). If you know that you will miss a class for any reason discuss the situation with your instructor in a timely manner. Exceptions to any attendance requirements may be made on a case-by-case basis.

- **Participation**
  Students are expected to participate in the classroom experience. The use of earbuds/headphones during class is specifically not allowed and students who engage in this behavior may be asked to leave the class for the day (noting exceptions for authorized accommodations). In addition, students who routinely do not bring materials to class that are required for participation, will not be given credit for class attendance, and if this becomes a pattern of behavior, may be asked to leave the class for the day. Persistent problems with participation may result in a code of conduct referral.

- **Grading Scale**: (See also University Grading Policy).

A : above 93%
A-: 90% - 92%
B+: 87% - 89%
B : 83% - 86%
B-: 80% - 82%
C+: 77% - 79%
C : 73% - 76%
C-: 70% - 72%
D+: 67% - 69%
D : 63% - 66%
D-: 60% - 62%
F : below 60%

- **Evaluation Methods**:

Assignments	30%
Presentations	15%
Quizzes	10%
Exam 1	20%
Final Exam	20%
Attendance	5%
Total	100%

- **Late Work**: Late submissions for assignment are not accepted. No exceptions.
- **Make-Ups:** No make-up will be given to any of the assignments of this course. No makeup quizzes without providing written proof of absent (doctor note, etc).
- **Homework Assignments:** There will be several assignments and paper reviews. They will be posted on Canvas.

- **Quizzes:** There will be multiple pop quizzes or take home quizzes during the semester.
- **In class presentations:** Details of presentations will be discussed in class. Each presentation can take up to 20 minutes. It will introduce a computer science problem and explain how it is efficiently solved utilizing one of the techniques discussed in class.
- **Individual Work:** You need to do your homework, assignments and presentations individually.

University Policies

Reasonable Accommodations

The University is committed to ensuring equal access to all educational opportunities. The University, through the Office of Disability Services (ODS), facilitates reasonable accommodations for students with disabilities and documented eligibility. It is the student's responsibility to self-identify as a student with disabilities and register with ODS to request accommodations.

If you have already registered with ODS, please ensure that you have requested an accommodation letter for this course through the ODS student portal and communicate with your instructor about your approved accommodations as soon as possible. Arrangements for testing accommodations must be made in advance. Accommodations are not retroactive.
If you are not registered with ODS but believe you have a temporary health condition or permanent disability requiring an accommodation, please contact ODS as soon as possible.

The Office of Disability Services (ODS):
DisabilityServices@floridapoly.edu
(863) 874-8770
The Access Point
ODS website: www.floridapoly.edy/disability

Accommodations for Religious Observances, Practices and Beliefs

The University will reasonably accommodate the religious observances, practices, and beliefs of individuals in regard to admissions, class attendance, and the scheduling of examinations and work assignments. (See University Policy.)

Title IX

Florida Polytechnic University is committed to ensuring a safe, productive learning environment on our campus that prohibits sex discrimination and sexual misconduct, including sexual harassment, sexual assault, dating violence, domestic violence and stalking. Resources are available if you or someone you know needs assistance. You may speak to your professor, but your professors have an obligation to report the incident to the Title IX Coordinator. Please know, however, that your information will be kept private to the greatest extent possible. You will not be required to share your experience. If you want to speak to someone who is permitted to keep your disclosure confidential, please seek assistance from the Florida Polytechnic University Ombuds Office, BayCare's Student Assistance Program, 1-800-878-5470 and locally within the community at Peace River Center, 863-413-2707 (24-hour hotline) or 863-413-2708 to schedule an appointment. The Title IX Coordinator is available for any questions to discussion resources and options available.

Academic Integrity

The faculty and administration take academic integrity very seriously. Violations of academic integrity regulation include actions such as cheating, plagiarism, use of unauthorized resources (including but not limited to use of Artificial Intelligence tools), illegal use of intellectual property, and inappropriately aiding other students. Such actions undermine the central mission of the university and negatively impact the value of your Florida Poly

degree. Suspected violations will be fully investigated, possibly resulting in an academic integrity hearing and sanctions against the accused student if found in violation. Sanctions range from receiving a zero on the exam or assignment, to expulsion from the university. Repeat offenders are subject to more severe sanctions and penalties.

Any "special" instructions that are appropriate for academic integrity and the course should go here.
(It is essential that a heading and a statement on what constitutes, includes, academic integrity be included in the syllabus, and that the students be made aware of academic integrity at the beginning of a course.)

Recording Lectures

Students may, without prior notice, record video or audio of a class lecture for a class in which the student is enrolled for their own personal educational use. Recordings may not be used as a substitute for class participation or class attendance. Recordings may not be published or shared in any way, either intentionally or accidently, without the written consent of the faculty member. Failure to adhere to these requirements is a violation of state law (subject to civil penalty) and the student code of conduct (subject to disciplinary action).

Recording class activities other than class lectures, including but not limited to lab sessions, student presentations (whether individually or part of a group), class discussion (except when incidental to and incorporated within a class lecture), and invited guest speakers is ***prohibited****.*

Important Dates

- January 19th: Martin Luther King Jr. Holiday – No classes
- February 10th: Career Day – No classes
- March 16th - March 20th: Spring Break – No classes
- April 28th: Last Day of Classes
- May 13th: Final Grades Available

Course Tentative Schedule: We will cover most of the topics listed below. We might not cover all.

Week	Dates	Topic	Milestones/ Assignments
1	1/12/2026 - 1/16/2026	Complexity Analysis • Input Size, Basic Operations • Asymptotic growth • Worst-Case, Average-Case, Best-Case complexity	
2	1/19/2026 - 1/23/2026	• Big O, Omega, Theta • Properties of Order • Recurrence relations	Assignment 1: Complexity Analysis
3	1/26/2026 - 1/30/2026	Divide and Conquer Approach • Binary Search, Merge Sort, Quick Sort, Closest Pair • Integer multiplication • Recurrence relations	Paper review 1: Complexity Analysis
4	2/2/2026 - 2/6/2026	Greedy Approach • Scheduling, Scheduling with Deadlines • Spanning Tree, Minimum Spanning Tree • Prim's, Kruskal's, and Dijkstra's Algorithm • 0-1 Knapsack Problem, Coding - Encoding Problems, Huffman codes and Data Compression	Paper review 2: Greedy Approach Assignment 2: Greedy Approach
5	2/9/2026 - 2/13/2026	Dynamic Programming • Fibonacci Numbers, Binomial Coefficient • Floyd's Algorithm, Traveler Salesman Problem	Assignment 3: Dynamic Programming
6	2/16/2026 - 2/20/2026	Dynamic Programming • Coin-row problem, Coin collecting by robot • Subset sums and Knapsacks Problem • Sequence Alignment Graphs • Basic Definitions and applications	Assignment 3: Dynamic Programming

		• Graph Connectivity and Traversals • Directed Acyclic Graphs and Topological Ordering	
7	2/23/2026 – 2/27/2026	Complexity Theory: P, NP, NP-complete Definitions	2/23 Exam 1
8	3/2/2026 - 3/6/2026	Complexity Theory: P, NP, NP-complete problems • Polynomial time reduction • The satisfiability problem • Graph Coloring	
9	3/9/2026 - 3/13/2026	Lower Bound Proofs Approximation Algorithms • Greedy Algorithms and Bounds on the Optimum • Center Selection • Set Cover • Linear Programming	Assignment 4: Approximation Algorithms, Randomized algorithms
10	3/16/2026 - 3/20/2026		Spring Break
11	3/23/2026 - 3/24/2026	Randomized Algorithms • Minimum Cut • Random Variables and Their Expectations Hiring Problem	
12	3/30/2026 - 4/3/2026	Randomized Algorithms • Monte Carlo and Las Vegas type algorithm	Assignment 5: Randomized Algorithms
13	4/6/2026 - 4/10/2026	Network Flows • The maximum-Flow Problem • Minimum Cuts in a network Bipartite Matching Problem	Assignment 6: Network Flows
14	4/13/2026 - 4/17/2026	String Algorithms • Pattern Matching algorithms • Tries Suffix Trees	
15	4/20/2026 - 4/27/2026	Presentations	
16	4/27/2026 - 5/1/2026	Review and Final Exam	

Disclaimer: This syllabus is tentative and may be subject to change. Everything in the syllabus might change except for: 1) the Course Description; 2) the textbook; and 3) the grading policy."