PURDUE UNIVERSITY FORT WAYNE

Department of Computer Science
COLLEGE OF ENGINEERING, TECHNOLOGY, AND COMPUTER SCIENCE

Course Number and Name:
CRN = 11319 CS 48600-01 – Analysis of Algorithms (3 cr.)
Credits and contact hours: 3 credits; 3 contact hours (Two 75 mins weekly lectures)

Fall 2024 [August 26th, 2024 – December 22, 2024]
Tuesday, Thursday, 10:30 am – 11:45 pm, **Kettler Hall G52**)

Instructor or Course Coordinator:
Peter A. Ng, Ph.D.
Office: ETCS 125L
Phone: 260-481-6237 (office), 260-481-6803
E-mail: ngp@pfw.edu
Office hours: MW 11:00 am – 012:30 pm and by appointment **via Microsoft Teams**.
TTh 1:00 pm – 02:30 pm and by appointment **via Microsoft Teams**.
(Please call me before you come to ensure I will be in my office).

Graduate Teaching Assistants:

Catalog Description:
Techniques for analyzing the time and space requirements of algorithms and problems. Application of these techniques to sorting, searching, pattern-matching, graph problems, and other selected problems. Brief introduction to the intractable (NP-hard) problems.

Prerequisites: CS 26000 Data Structures and MA 16600 Analytic Geometry and Calculus II

Type of Course: Required

Textbook and Reading Materials:
Textbooks:
Introduction to The Design & Analysis of Algorithms, Anany Levitin, Addison Wesley 2012.

Supplemental Materials:
- Introduction to Algorithms (3rd Edition), T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, MIT Press, ISBN 978-0-262-03384-8, 2009 /McGraw-Hill
- The Art of Computer Programming (2nd Edition) (3 volumes), Donald Knuth, Addison-Wesley.

Microsoft Teams:
You are invited to be my guest on Microsoft Teams. If you download Microsoft Teams on your computer, you can access my lectures live via Microsoft Teams.

Course Objectives & Learning Outcomes:

The goal of this course is to introduce the student to the modern study of computer algorithms, analysis and implementation, and applications. A student who successfully fulfills the course requirements will be able to:

1. Knows to develop most standard algorithms for their common uses. (1, 2, 6)
2. Knows to analyze the expected performance of a particular algorithm in a specific context. (1, 6)
3. Knows to show that the algorithm is correct – that it does, in fact, what it is claimed to do. (1, 6)
4. Knows to apply mathematical techniques to analyze the efficiency of an algorithm. (1, 6)
5. Knows to modify familiar algorithms and devise new ones to cope with unfamiliar contexts. (1, 2, 6)
6. Knows to use techniques for analyzing and designing programs (algorithms) with complexity. (1, 2, 6)
7. Knows to apply algorithmic principles with applicable mathematical techniques in the analysis and design of programs to demonstrate an understanding of the tradeoffs involved in design and complexity choices. (1, 2, 6)
8. Knows to apply analysis and design of algorithms in constructing programs with varying complexity. (1, 2, 6)

Course Learning Outcomes to Student Outcomes Mapping

Course Learning Outcome	Program's Student Outcomes					
	1	2	3	4	5	6
1	●	●				●
2	●					●
3	●					●
4	●					●
5	●	●				●
6	●	●				●
7	●	●				●
8	●	●				●

Major Topics Covered

- Algorithms and Design (SDF)
  - Concept and properties of algorithms,
  - Role of algorithms,
  - Problem-solving strategies,
  - Separation of behavior and implementation
- Basis Analysis (AL)
  - Asymptotic Analysis, empirical measurement.
  - Differences among an algorithm's best, average, and worst-case behaviors.
  - Complexity classes include constant, logarithmic linear, quadratic, and exponential.
  - Recurrence Relations and their solutions.

    - Time and space trade-offs in algorithms.
- Algorithmic Strategies (AL)
    - Brute force, divide-and-conquer, transformation, greedy, dynamic programming, heuristics
- Fundamental Data Structures and Algorithms (AL)
    - Binary search, Insertion sort, Selection sort, Shell sort, Quicksort, Mergesort, Heapsort.
    - Binary heaps, Binary search trees, hashing.
    - Representations of graphs and Trade-offs
    - Fundamental graph algorithms, including BFS and DFS, Shortest paths, and Minimum spanning trees.
    - Substring search and pattern matching.
- Basic Automata, Computability and Complexity (AL)
    - Finite-state machines, Regular expressions
    - Complexity classes P, NP, NP-completeness, NP-complete problems, reductions
- Advanced Data Structures, Algorithms and Analysis (AL)
    - Balanced trees (e.g., Balanced search trees, AVL trees, Red-Black Trees, B-trees)
    - Graphs (Topological sort, Strongly connected components)
    - Advanced data structures (disjoint sets, mergeable heaps) [optional]
    - Network flows
    - Linear programming
    - Polynomials and the FFT
    - Number-theoretic algorithms, including Primality testing, RSA public-key cryptosystem
    - Approximation algorithms, including TSP
    - Computational geometry, including Convex hull, Geometric search, and intersection
    - Randomized algorithms such as Rabin-Karp string matching, String sorts, Tries
    - Data compression. [optional]
- Parallel algorithms, analysis, and programming (PD) [optional]
- Formal Models and Semantics (PD) [optional]

Knowledge Areas that contain topics and learning outcomes covered in the course

Knowledge Area	**Total Hours of Coverage**
Algorithms and Complexity (AL)	35-38
Software Development Fundamental (SDF)	1.5
Parallel and Distributed Computing (PD)	0-3

Requirements for the Grade of the Course

The grade will be based on

1) Attendance, Class Participation, and Quizzes (20%)
2) Homework Assignments/Project, and
3) Examinations

Each of the problems in the Exams and Homework Assignments/Projects will be allocated an equal percentage (%) and constitute 80% of the grade for the course. (We may adopt each of the problems given in the exams, assignments, or projects that will be assigned the same number of points or %.)

Grading Scale for the Course

The following scales will be used: A [100-90], B (90-80], C (80-65], D (65-50], and F (50-0]). Note that Plus-minus grading is not used.

Attendance and Participation (20% of overall grade)

Attendance policy
Class attendance is mandatory unless there is a good reason to miss a class. Students must attend all lecture meetings. Please email the instructor, Peter Ng, before the meeting if a class meeting needs to be missed.

Poor attendance can result in the loss of a letter grade, as Attendance and Participation are 20% of the final grade for the course. Missing 30% or more of the classes for unexcused reasons will result in the participation points being docked from your final grade.

What constitutes participation?
Participation in this class will consist of three components:

- Weekly endcap quizzes - Quizzes may be given in class and graded on a participation basis.
- Attendance – Attendance is mandatory, and missing classes will hurt your participation score and, therefore, your final grade for the course.
- In-class participation – answering questions, asking questions, and the like will benefit you! Coming to class and paying attention in class will help you pass the course.
- Bring your laptop if you have one.
- Do not do other course assignments during the class.

Exams
There are possibly three or up to six exams. If given during Final Exams Week, the exam is treated as a regular exam and covers only material since the last exam. **No make-ups will be given unless approved in advance or in case of a valid emergency.** In the latter case, contact the instructor immediately.

Assignments, Projects, and Quizzes

Credit for a given assignment must be submitted at the beginning of class on the announced due date. Quizzes must be submitted in class according to the given instructions.

No late assignments or projects will be accepted. For some reason, a 10% penalty will be imposed for each day an assignment or project is late; however, no late submission will be accepted after five days, and a grade of zero will be assigned for it.

All assignments and projects must be computer-printed-out, and NO handwriting is acceptable.

The instructor reserves the right to adjust the number of assignments/exams and weights throughout the semester.

Unannounced quizzes will be given at any time during the semester. Material for these quizzes will be extracted from lectures and lecture notes. No make-up quizzes will be provided. A grade of zero will be assigned for a missed quiz.

Incomplete grade (for information only)
http://catalog.pfw.edu/content.php?catoid=49&navoid=1457#grades
A grade of I may be granted to students (1) who are unable to complete specific course requirements for clearly unavoidable, nonacademic reasons (such as extended illness or relocation) and (2) whose work

has been of passing quality up to that time. A student must have completed the majority of the required coursework (as determined by the instructor) before the instructor is permitted to assign an incomplete grade. A grade of I will not be considered an alternative to an anticipated low grade in a course.

Course Policies

End-of-semester exam policies:
http://catalog.pfw.edu/content.php?catoid=49&navoid=1457#finalexaminations

> **Next-to-last week.**
> No instructor may schedule an examination-comprehensive or non-comprehensive-except for laboratory and practicum courses during the week preceding the last week of a fall or spring semester.
>
> ***Final week.***
> With the exception of courses classified as individual instruction, clinic, studio, practice teaching, or research and those offered for 0 credits, each class is expected to meet for a two-hour session during the last week of each fall or spring semester. The two-hour session is to be used for (1) a final examination, (2) a last, non-comprehensive examination, (3) submission of an out-of-class examination or assignments, or (4) a regular class meeting.

Attendance:
Class attendance is a university requirement. Generally, students are expected to attend class. Attendance will be taken and may be graded, as explained in the participation section. Students who attend regularly typically perform well. You are responsible for obtaining any course-related information or material from classes you may have missed.

Taking Notes in Classes:
Students are expected to learn to take notes in class lectures. Materials from class lectures will be part of assignments, quizzes, projects, and examinations. Students will be asked to turn in notes taken to receive proper grades.

Communication:
Students are expected to contribute to the classroom by asking questions, making suggestions, and seeking help if needed. Students are welcome to make suggestions to improve the course delivery. Your feedback can help shape the course contents and quality. Outside the classroom, the instructor will respond to emails and be available during office hours. **Please do not wait until the end of the semester to inform the instructor of your difficulties/problems.**

Academic Honesty:
Do your work. Write your solutions. Students are expected to help each other troubleshoot and solve problems in this course. However, assignments should be done individually, so you should not copy or provide your work to other students in the class. Students should not copy any materials from websites, open sources, and so on and then paste them into their work. **You will receive a zero if caught cheating or plagiarizing and will automatically fail the course if caught a second time.**

Plagiarism/academic misconduct:
http://catalog.pfw.edu/content.php?catoid=49&navoid=1457#misconduct

This includes definitions of academic misconduct and the procedures faculty must follow if such student behavior is identified.

Research and Reading Course-related Materials:
Students are expected to learn by researching course-related materials and reading them.

Lap-Top Computer in Classes
Students are welcome to use laptop computers to take class notes. However, if you use your laptop in classes for activities unrelated to the course, it will be forfeited, or you will no longer be able to use it.

Tutors:
Seek help from your instructor, Teaching Assistants, or Tutors early. But do not expect them to give you solutions.

Note to Students with Disabilities:
"If you have a disability and need assistance, special arrangements can be made to accommodate most needs. Contact the Director of Services for Students with Disabilities (Walb Union, Room 113, telephone number 481-6658) as soon as possible to work out the details. The SSD office will provide you with a Disability Accommodation Verification Card attesting to your needs for modification that you need to bring to me. For more information, please visit the website for https://www.pfw.edu/disabilities/.

Note for Free Personal Counseling Services:
PFW and the Department of Computer Science recognize that personal problems can sometimes interfere with a student's ability to progress in his/her academic program. To help students address such problems, PFW makes free personal counseling services available in Walb 210. To schedule an appointment with a PFW/PARKVIEW Student Assistance Program (SAP) counselor, call 373-8060.

Stay Connection:
Use PFW's Brightspace to access the lecture notes, assignments, exams, or any information about the course throughout this semester.

I can be reached at my email account: ngp@pfw.edu. Any correspondence between us via email (such as using your PFW's email account, your Yahoo, Hotmail, or Gmail account). You must specify your subject in your email as Subject: CS 58000.

PFW Dates to Know

August 26-September 1	Late Registration and Drop/Add
August 30	Regular Credit-to-Audit Deadline
September 1	Last Day for Full Refund
September 23	Pass/Not Pass Deadline
September 27	Last Day to Request Withdrawal (First Half-Term Classes)
October 4	Audit-to-Credit Deadline
October 25	Last Day to Request Withdrawal (Full-Term Classes)
December 16-22	Final Exams Week/Last Week of Classes

Please consult the university calendar for accurate information.

Course Evaluation
Course evaluation is an important component of the Computer Science Department's assessment plan. Data gathered from assessment surveys helps us to evaluate and improve course content and delivery. To ensure that these data reflect the experiences of all students, your participation is required in both the Student Evaluation of Instruction and the Course Learning Outcomes Assessment surveys. These surveys are distributed online via the Purdue Qualtrics system and take 2-5 minutes to complete. Approximately two weeks before the end of the semester, you will receive a link to each survey via your PFW email account. These surveys are anonymous, and no results will be released to the instructor until after the end of the semester. The CS Department expects you to complete both surveys before the final exam date. If you have difficulty accessing a survey, you should immediately notify the instructor or the CS Department Administrative Assistance (~~Mrs. Kaye Pitcher, pitcherk~~@pfw.edu, 260-481-6803).

ABET CS Program Student Outcomes
The following learning outcomes are defined by ABET, our accrediting agency, for computer science programs. According to **ABET CS Program's Criterion 3. Student Outcomes,** graduates of the program will have the ability to:

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.

2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

3. Communicate effectively in a variety of professional contexts.

4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

6. Apply computer science theory and software development fundamentals to produce computing-based solutions. [CS]

Resources for to tell students about

Math and Science Tutoring – help with math and science courses or math/science-related assignments in any course. Call 260-481-5740 or stop by Kettler Hall G19 if you do not find an available tutor on **TutorTrac.**

PFW Writing Center - is to help writers learn to use language more effectively, produce clear writing appropriate to their purposes and audiences, and develop positive attitudes about writing and themselves as writers. Located on the Second Floor of the Library.

Tutoring Center – also located on the second floor of the library offering tutoring in other subjects.

Foreign Language Lab – located in LA 258 to help students in any foreign language course.

Dean of Students (https://www.pfw.edu/offices/dean/faculty-and-staff-resources/)
Responsible for implementing the PFW Code of Student Rights, Responsibilities, and Conduct (http://catalog.pfw.edu/content.php?catoid=49&navoid=1457#code). The staff advises students about the student complaint process, grade appeals, and other concerns they may have about the university. The Dean of Students office oversees many resources for our students as part of our student wellness program: https://www.pfw.edu/offices/dean/student-wellness/

Walter E. Helmke Library
Helmke Library https://library.pfw.edu

Ask-a-Librarian https://guides.library.pfw.edu/askalibrarian
Topic Guides to get you started on your research https://guides.library.pfw.edu/home

Major Factor Link: **https://www.pfw.edu/departments/coas/news/major-factor/list.html**
Which major might be right for you than to hear from some amazing PFW College of Arts and Sciences students and recent alumni in their own words?

Important Information for Students

Balancing life and school is not always easy. At Purdue University Fort Wayne, every student matters. We are your Mastodon family, and we CARE. If you are feeling sad or depressed, have trouble sleeping, concentrating, or finishing tasks, feel anxious or fearful, or have any concerns, academic or otherwise, it can be helpful to talk with someone. Asking for help can be hard but it is an important first step.

There are several campus and community resources created to help you navigate a wide variety of challenges.

First is the CARE team. They help students create a plan to confront difficulties while providing support and the resources needed to keep them safe and successful. Any faculty or staff can help you get to the CARE Team. They can be found at https://www.pfw.edu/offices/dean-of-students/about/care-team or call the Dean of Students office at 260-481-6601 or dos@pfw.edu

The Student Assistance Program for counseling is staffed by The Bowen Center and is located on the second floor of Walb in the Health Center. The 24-hour Counseling Hotline is 800-342-5653. For more information, go to https://pfw.edu/get-support

The PFW Police Department is trained to respond to mental health/psychological emergencies; the Fort Wayne Police Department also has crisis intervention officers available 24/7. In case of emergency, call 911 (from a campus phone 9-911).

For more information or other resources, contact Project COMPASS (COMmunity Partners Against Student Suicide) at compass@pfw.edu

And for COVID-19 student-specific information:
https://www.pfw.edu/microsites/coronavirus/students/resources

Please read the following message from Ryan McCombs, Director Disability Access Center:

The Disability Access Center (formerly SSD) hopes you had a wonderful and safe winter break. We have implemented a few changes in the Disability Access Center to strengthen resources for faculty and services for students. To see more information on these changes, please check out the DAC website. A few highlighted changes are:

1) **Syllabus Statement(s):** We have developed two syllabus statements that instructors are encouraged to use in their syllabi each semester so students are aware of accommodations.
2) **Course Accessibility Letters (CAL):** We are utilizing a new accommodation letter, called a Course Accessibility Letter (CAL), that notifies instructors of a student's accommodations for their course. CALs will be sent to students via PDF, and students are encouraged to share their CALs with instructors, notifying them that an accommodation is needed for the course to have equal access. We encourage instructors who have questions or need assistance with implementing accommodations in their course(s) to reach out to us at ssd@pfw.edu.
3) **DAC Testing Center:** We have updated the process for instructors and students using the DAC Testing Center, along with new Delivery/Return methods of exams, request window for exams in the DAC, and practices for ensuring academic integrity. Please read this section on our website in its entirety as the information is very important when preparing for accommodated testing. We ask that you do not send an exam to the DAC Testing Center until we have notified that a student requested accommodated testing in the DAC.
4) **DAC Modified Attendance and Deadline Accommodations:** We have updated our Modified Attendance Policy and have provided a Modified Attendance Agreement form that instructors and students are encouraged to fill out if needed. These are resources for instructors and can be found on the DAC website under the Faculty Resource tab.

Have a great semester and please reach out to us in the Disability Access Center if you have questions.

Sincerely,

Ryan McCombs
Director
Disability Access Center
mccombsr@pfw.edu