Syllabus

EN.605.621: Foundations of Algorithms Spring 2021

Virtual Live Information

Monday, 4:00-6:40 PM, ~~APL MP4-W113~~ - Virtual Live (Zoom)
Virtual Live Zoom link: https://wse.zoom.us/my/eguven2

Instructor Information

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Dr. Guven is a Data Scientist and a member of the Senior Professional Staff at the Applied Physics Laboratory. His current research includes Machine Learning applications (such as deep learning, support vector machines, random forest) to image, speech, text, and disease data. He is also active in cybersecurity research, graph analytics, optimization and generalized clustering techniques such as Latent Dirichlet Allocation. He authored and co-authored several publications studying problems in speech emotion detection, disease forecasting and cybersecurity.

Before joining JHU APL, he has been a research affiliate at The George Washington University. His research included signal processing, speech, music information retrieval, authorship attribution, plagiarism detection, swarm intelligence, statistical learning, data mining, text mining, supervised, unsupervised, reinforcement-based machine learning applications. Previously his research also included bioinformatics and working with the HG18 genome, exon sequences, and SEER medical databases, alternative splicing, motif and binding site detection problems. Previously, he had been working as a R&D engineer for Texas Instruments. He holds three U.S. patents for Voice over IP and one U.S. patent application describing a method of speech emotion detection.

I prefer that students contact me via Microsoft Teams Chat. I encourage you to post questions to the **General or Module Channels** in Microsoft Teams so that your classmates can benefit from the answer to your questions as well—your classmates might even know the answer to your question and respond to you first. To send a direct message in Microsoft Teams, select **Chat** on the left-hand menu of Teams and click the **New Chat** icon ( ) in the corner above the chat pane. Then type in the name of the instructor/student you would like to message.

If emailing, please be sure to include course number in the subject line. I will make every effort to respond to your inquiry within 24 hours or earlier.

Course Description

This follow-on course to data structures (e.g. 605.202) provides a survey of computer algorithms, examines fundamental techniques in algorithm design and analysis, and develops problem-solving skills required in all programs of study involving computer science. Topics include advanced data structures (e.g. red-black trees), recursion and mathematical induction, algorithm analysis and computational complexity (recurrence relations, big-O notation, NP-completeness), sorting and searching, design paradigms (divide and conquer, greedy heuristic, dynamic programming, amortized analysis), and graph algorithms (depth-first and breadth-first search, connectivity, minimum spanning trees, articulation points).

Most algorithms we will cover in this course will also be presented on a Jupyter Notebook with Python language for implementation. The Jupyter Notebook is an open-source web application that allows creating and sharing documents that contain live code, equations, visualizations and narrative text. Uses include data cleaning and transformation, statistical modeling, data visualization, machine learning, and more.

Prerequisites

This course is not about Python language and students are expected to be "good enough" in Python to be able to follow example algorithm implementations. Industry trends show that as a data science programming and analytics education, the Python language has more than 80% of the share according to some online polls, such as KDnuggets.

- 605.101 - Introduction to Python (highly recommended)
- 605.202 - Data Structures or equivalent
- 605.203 - Discrete Mathematics

Course Goals

Introduce algorithm design and analysis as a branch of study in computer science, including developing the necessary mathematical and computational skills, surveying the major design paradigms, and analyzing several specific algorithms. In this course, we will learn to think computationally.

Course Objectives

By the end of the course, you will be able to:

- Introduce fundamental structures and tools in computer science and mathematics used to analyze, evaluate, and design algorithms.
- Present the design heuristics and the types of problems likely to be solvable using these heuristics.
- Develop skills for analyzing computational problems and implementing algorithms to solve the problems.
- Survey application areas and apply heuristics to analyze and understand specific computational problems and develop algorithms and software.

This course emphasizes the design and analysis of algorithms. It is not a course in the semantics and syntax of a computer programming language nor is it a course in software development. Students are expected to be proficient in a high-level object-oriented language (e.g. Python, Java, C++, etc.).

Course Structure

The course materials are divided into modules, (fall and spring) one for each week of the course, and (summer) two for each week of the course. While lectures will occur in a physical/virtual classroom each week, all course materials and assignments will be housed in Blackboard and Microsoft Teams. The module content can be accessed by clicking **Course Modules** on the left menu. A module will have several sections including the overview, content, readings, discussions, and assignments. You are encouraged to preview all sections of the module before starting. Most modules run for a period of seven (7) days, exceptions are noted in the **Course Outline**. You should regularly check the **Calendar** and **Announcements** for assignment due dates.

Textbook

Textbook information for this course is available online through the appropriate bookstore website: For online courses, search the MBS website.

Required

Cormen, et. al. (2009). *Introduction to Algorithms* (3rd ed). MIT Press. ISBN-13: 978-0262033848

Optional

N/A

Required Software

Microsoft Teams

This course will use Microsoft Teams for our Discussions and general communication. This is a platform that works in your browser, on your desktop, and has an app for tablets and phones (iOS and Android). This will allow you to participate in the Discussions and ask questions from whatever device you are most comfortable.

To access Teams, click the **Microsoft Teams** link on the course menu in Blackboard. You can also download and the desktop or mobile app. Sign in with your JHU email using **@jh.edu** (NOT @jhu.edu) and JHU password. You should see our Team listed on the left-hand side with the Team channels (discussion areas) listed below.

There are various channels for discussion, including a **General** channel that is for discussion general topics and questions related to the course assignments and content. Use your assigned **Discussion Group** channels for answering Discussion posts—you will be assigned to a different Discussion Group for each Discussion in the course. Be sure to manage your notification settings so you know when there are new posts. It's highly recommended that you be sure to subscribe to the General channel.

For more information, check out the instructions for getting started with Microsoft Teams. If you have difficulty logging in or accessing Microsoft Teams, please contact the Help Desk at ep-help-desk@jhu.edu.

Jupyter Notebook

This course will use Python as its programming language, which is deemed as the number 1 data science programming language (reference: online resources). This course will also use Jupyter Notebook, which is a document that contains both code and rich text elements, such as figures, links, and equations. A Jupyter notebook about the Jupyter Notebook itself is provided in the first module. This notebook contains how to install the Anaconda Python development environment that will be used in this course.

Technical Requirements

You should refer to **Help & Support** on the course menu for a general listing of all the course technical requirements.

Student Coursework Requirements

It is expected that each module will take approximately 10–15 hours per week to complete. **A summer course will double this estimate**. Here is an approximate breakdown:

- attending physical or Virtual Live classroom sessions (2.5 hours per week)
- reading the assigned sections of the texts (approximately 3–4 hours per week) as well as some outside reading
- listening to the audio annotated slide presentations (approximately 1 hour per week)
- participating in discussions (approximately 1 hour per week)
- and completing assignments (approximately 2–3 hours per week).

This course will consist of the following basic student requirements:

Class Participation (10% of Final Grade Calculation)

You are responsible for carefully reading all assigned material and being prepared for both the Virtual Live classroom sessions and Discussions. The majority of readings are from the course text. You will be responsible for all assigned reading material, whether we cover it in class or not, so prepare questions about parts of the readings not understood. There may also be optional readings recommended from the archival literature.

Assignments (30% of Final Grade Calculation)

Assignments will include real-world problems. Although the Assignments will usually reflect the current material, I will also give on occasion a brain-building problem that may no direct relation to the material but rather may require basic logical reasoning to solve.

Assignments are assigned more-or-less every week and can involve basic materials, further examination of concepts introduced and presented in class and in the textbook, brainteasers, and more challenging questions problems. Problems will be the basis for class discussions as well; be prepared to ask and answer questions and discuss the problems.

Any course materials prepared for evaluation for grades must be **turned in Blackboard in .ipynb format (Jupyter Notebooks).** All assignments are due according to the dates in the Calendar. If there is a legitimate reason why an assignment is going to be late and this can be known in advance (i.e., excluding illness) then the instructor must be notified of such. Illness is a legitimate excuse for lateness but please let me know as soon as possible and we can make arrangements for delivery. NO ASSIGNMENTS WILL BE ACCEPTED IF SUCH NOTIFICATION WAS NOT MADE.

Refer to the **Assignment Guidelines** for more information.

Midterm (20% of Final Grade Calculation)

The midterm examination will be given online in Blackboard system, to be completed without collaboration or use of materials other than lecture notes and the textbook. Midterm will be around 2 hours duration, can be taken only once in a time window of a determined due day.

Quizzes (10% of Final Grade Calculation)

Quizzes will be given online in Blackboard system, to be completed without collaboration or use of materials other than lecture notes and the textbook. A quiz will be around 30 minutes duration, can be taken only once in a time window of a determined due day.

Class Project (30% of Final Grade Calculation)

The class project will involve the theoretical and empirical analysis of a new algorithm that is not covered in the lectures. I will provide a list of algorithms to be selected from (not exclusively, as students may bring their own). Students are expected to develop a project, which has the introduction to the algorithm/problem, the algorithm script, canonical testing, theoretical analysis, empirical analysis, and conclusions. The script may be acquired from other sources provided that references are given and the script is "made your own". i.e. similar to writing a research paper. Please check the course Assignment Guidelines and Project Rubric.

The project will be accepted in a Jupyter notebook format similar to the Assignments. More details about the project and expectations are provided in the Project Rubric.

Grading

Assignments are due according to the dates posted in your Blackboard course site. You may check these due dates in the **Course Calendar**, Course Outline, or the Assignments in the corresponding modules. I will post grades one week after assignment due dates.

We generally do not directly grade spelling and grammar. However, egregious violations of the rules of the English language will be noted without comment. Consistently poor performance in either spelling or grammar is taken as an indication of poor written communication ability that may detract from your grade.

A grade of A indicates achievement of consistent excellence and distinction throughout the course—that is, conspicuous excellence in all aspects of assignments and discussion in every week.

A grade of B indicates work that meets all course requirements on a level appropriate for graduate academic work. These criteria apply to both undergraduates and graduate students taking the course.

EP uses a +/- grading system (see “Grading System”, *Graduate Programs* catalog, p. 10).

100-98 = A+
97-94 = A
93-90 = A−
89-87 = B+
86-83 = B
82-80 = B−
79-77 = C+
76-73 = C
72-70 = C−
69-67 = D+
66-63 = D
<63 = F

Final grades will be determined by the following weighting:

Item	% of Grade
Class Participation	10%
Assignments	30%
Midterm	20%
Quizzes	10%
Class Project	30%

Help & Support

You should refer to **Help & Support** on the left menu for a listing of all the student services and support available.

Policies and Guidelines

I use the student email addresses as listed in the SIS system and will use Microsoft Teams and email to send such things as last minute class information, answers to homework questions, data for projects, etc. If you prefer an email different than that (which is the official one given by you to the University) it is your responsibility to get it to me; otherwise, I will assume that you check your official email regularly.

Academic Integrity

Academic Misconduct Policy

All students are required to read, know, and comply with the Johns Hopkins University Krieger School of Arts and Sciences (KSAS) / Whiting School of Engineering (WSE) Procedures for Handling Allegations of Misconduct by Full-Time and Part-Time Graduate Students.

This policy prohibits academic misconduct, including but not limited to the following: cheating or facilitating cheating; plagiarism; reuse of assignments; unauthorized collaboration; alteration of graded assignments; and unfair competition. You may request a paper copy of this policy at this by contacting jhep@jhu.edu.

Policy on Disability Services

Johns Hopkins University (JHU) is committed to creating a welcoming and inclusive environment for students, faculty, staff and visitors with disabilities. The University does not discriminate on the basis of race, color, sex, religion, sexual orientation, national or ethnic origin, age, disability or veteran status in any student program or activity, or with regard to admission or employment. JHU works to ensure that students, employees and visitors with disabilities have equal access to university programs, facilities, technology and websites.

Under Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act (ADA) of 1990 and the ADA Amendments Act of 2008, a person is considered to have a disability if c (1) he or she has a physical or mental impairment that substantially limits one or more major life activities (such as hearing, seeing, speaking, breathing, performing manual tasks, walking, caring for oneself, learning, or concentrating); (2) has a record of having such an impairment; or (3) is regarded as having such an impairment class. The University provides reasonable and appropriate accommodations to students and employees with disabilities. In most cases, JHU will require documentation of the disability and the need for the specific requested accommodation.

The Disability Services program within the Office of Institutional Equity oversees the coordination of reasonable accommodations for students and employees with disabilities, and serves as the central point of contact for information on physical and programmatic access at the University. More information on this policy may be found at the Disabilities Services website or by contacting (410) 516-8075.

Disability Services

Johns Hopkins Engineering for Professionals is committed to providing reasonable and appropriate accommodations to students with disabilities.

Students requiring accommodations are encouraged to contact Disability Services at least four weeks before the start of the academic term or as soon as possible. Although requests can be made at any time, students should understand that there may be a delay of up to two weeks for implementation depending on the nature of the accommodations requested.

Requesting Accommodation

New students must submit a Disability Services Graduate Registration Form along with supporting documentation from a qualified diagnostician that:

- Identifies the type of disability
- Describes the current level of functioning in an academic setting
- Lists recommended accommodations

Questions about disability resources and requests for accommodation at Johns Hopkins Engineering for Professionals should be directed to:

EP Disability Services
Phone: 410-516-2306
Fax: 410-579-8049
E-mail: ep-disability-svcs@jhu.edu