
LANGUAGES & DATA STRUCTURES in Fall 2020 (CS2071)

Course Code	CS2071	Professor(s)	Georgi Stojanov
Prerequisites	None	Office Number	PL107
Class Schedule	F: 18:10-19:45 in Q-604 T: 12:40-14:15 in Q-604	Office Hours	by appointment
Credits	4	Email	gstojanov@aup.edu
Semester	Fall 2020	Office Tel. Ext.	NA

Course Description

After the Introduction to programming courses (the prerequisite for this course) the objective of this course is to introduce most of the deeper theoretical concepts from Computer Science and the Theory of Computation in general. The course opens with a brief overview of the history of computing. Then, the students will be presented with different ways of formalizing the notion of computing: from finite automata to Turing machines. Pseudocode is introduced as an informal notation of writing the essence of an algorithm. Tools for estimating spatial and temporal complexity of algorithms will be presented.

The notion of Abstract Data Type (ADT) and its role in algorithm design will be explained.

Most important classes of ADTs and the properties of commonly used algorithms will be studied: stacks, queues,

Finally, as case studies, we will explore the best practices of algorithms used for graph traversals and search as well as sorting algorithms.

Course Learning Outcomes

Have deep understanding of abstract computing machines; and overall understanding of theory of computation.

Have solid knowledge in algorithm design and analysis.

Be able to use algorithm complexity analysis tools.

Be able to recognize algorithm design patterns as well as most important ADTs.

Be familiar with several classes of most widely used algorithms for tree traversals, sorting, and operations on graphs.

General Education

Course Outline

Course Outline [The course schedule is subject to evolve in light of class engagement & interests.]

Course assignments and reading links will be posted on a weekly basis within the course site

Week & Dates

Week 1

Fri Sept 25

Topic

Theory of Computation: An Introduction to the Course

History of Computation;

Intro to Final State Machines (FSM)

Formal systems for writing algorithms

Regular Expressions (RE);

FSM to RE conversion;

Kleene's Theorem

Week 2

Tue Sept 29

Fri Oct 2

Week 3

Tue Oct 6

Exercises

More formalisms

Formal Grammars;

Types of grammars

Regular Grammars (Type 3);

Exercises;

Context Free Grammars (Type 2)

Exercises;

Summary of Context Free Grammars;

Context Dependent Grammars (Type 1);

Fri Oct 9

Week 4	Exercises;
Tue Oct 12	Universal Computing
	Turing Machines and universal computing;
	Exercises;
Fri Oct 15	Formal Systems in Mathematics;
	Algorithmically unsolvable problems;
	Goedel's undecidability theorem;
Week 5	The Halting problem;
Tue Oct 20	Practice week
Fri Oct 23	In class exercises;
Week 6	Short tests;
Tue Oct 26	Intro to pseudocode and complexity analysis
	Writing algorithms in pseudo—code;
Fri Oct 29	Algorithm complexity analysis;
	Big-O notation; Asymptotic behavior analysis;
Week 7	Exercises;
Tue Nov	Recursion
	Recursion;
	Analysis of recursive algorithms;
Fri Nov 8	Exercises
	Introducing to Abstract Data Types (ADTs);
	Stacks, Queues, Double queues;
Week 8	Exercises
Fri Nov 10	Implementation ADTs;
	Implementations of ADTs;
	Efficient usage of ADTs;
Fri Nov 14	Exercises;
Week 9	Hierarchical Structures
Fri Nov 17	General and Binary Trees; Tree traversals;
	Exercises;

Fri Nov 20

Week 10

Tue Nov 24

General vs Binary trees; Trees
implementations;
More Tree Types
Binary search trees;

Priority queues; Sorting, Heaps;

Fri Nov 28

Week 11

Fri Nov 30

Exercises;
Maps, Hash Tables;
Classic Algorithms
Sorting;

Theoretical limits on comparison based
sorting algorithms;

Fri Dec 3

Week 12

Fri Dec 7

Fri Dec 10

Final Exam Weeks

Dec 17 5 :30

Exercises;
Graph based ADTs
Practice and work on Final Projects
Practice
Practice

FINAL EXAM PERIOD – Presentations of
papers & projects

Textbooks

This course doesn't have any textbook.

Attendance Policy

ATTENDANCE POLICY:

Students studying at The American University of Paris are expected to attend ALL scheduled classes, and in case of absence, should contact their professors to explain the situation. It is the student's responsibility to be aware of any specific attendance policy that a faculty member might have set in the course syllabus. The French Department, for example, has its own attendance policy, and students are responsible for

compliance. Academic Affairs will excuse an absence for students' participation in study trips related to their courses.

Covid-19 temporary amendments:

Students studying at The American University of Paris are **STILL EXPECTED TO ATTEND ALL** scheduled classes. Due to the Covid-19 pandemic, students will have the option of attending classes remotely when special circumstances apply. For example when students are placed under quarantine by the French authorities or by their doctor, or when students present symptoms of Covid-19 and are directed, by their doctor or the AUP Health Office, to remain home. It is still the student's responsibility to be aware of any specific attendance policy that their professor might have set in the course syllabus. In particular, Students attending remotely from distant Time Zones should check with their professors about the specific attendance policy for remote learners.

Attendance at all exams is mandatory.

In all cases of missed course meetings, the responsibility for communication with the professor, and for arranging to make up missed work, rests solely with the student.

Whether an absence is excused or not is **ALWAYS** up to the discretion of the professor or the department. Unexcused absences can result in a low or failing participation grade. In the case of excessive absences, it is up to the professor or the department to decide if the student will receive an "F" for the course. An instructor may also recommend that a student withdraw, if absences have made it impossible to continue in the course at a satisfactory level.

Students must be mindful of this policy when making their travel arrangements, and especially during the Drop/Add and Exam Periods.

ENGLISH LANGUAGE PROFICIENCY STATEMENT: As an Anglophone university, The American University of Paris is strongly committed to effective English language mastery at the undergraduate level. Most courses require scholarly research and formal written and oral presentations in English, and AUP students are expected to strive to achieve excellence in these domains as part of their course work. To that end, professors include English proficiency among the criteria in student evaluation, often referring students to the university Writing Lab where they may obtain help on specific academic assignments. Proficiency in English is monitored at various points throughout the student's academic career, most notably during the admissions and advising processes, while the student is completing general education requirements, and during the accomplishment of degree program courses and senior theses.

Grading Policy

Assessment Components:

Homework assignments: (30%)

Laboratory work and presentations (20%)

Mid-term examination (20%)

Final examination: (30%) [Possibility for extra projects for better grade]

Grade Scales:

[A+, A, A-] = [95, 93, 90] %

[B+, B, B-] = [86, 82, 78] %

[C+, C, C-] = [72, 63-71, 57-62] %

[D+, D, D-] = [56, 52, 48] %

[F] = [47 or below] %

There is always a possibility to get a better grade by working on extra projects. Be curious! Be proactive!

Other

Selected portions from: Harry Lewis and Christos Papadimitiou “Elements of the theory of computation”, second edition, Prentice Hall, 1998;

All supporting materials for the course will also be available at the following web address: <http://blackboard.aup.edu>;

There is no mandatory textbook for this course

