

Dados de identificação*Disciplina*

Algorithms and Theory of Computation

Período Letivo

2020/2

Professor Responsável

Álvaro Freitas Moreira; Marcus Ritt

Sigla

CMP 601

Carga horária (horas)

60

Dados adicionais*Data efetiva de início*

25/01/21

Súmula

Theory of Computation: Models of computation. Limits of formal systems. Complexity theory. Algorithms: Analysis of algorithms. Main techniques for designing algorithms.

Objetivos

This course will introduce the students to the main models of computation, justifying each model and comparing them. We will also study classes of problems that can or can not be solved by computers (limits of computation) as well as how to classify the computable problems according to how efficiently they can be solved (complexity theory). Focusing on the algorithms area, we will study the main techniques for designing and analyzing algorithms. After successful completion of the course, the students are expected to: (i) understand what a model of computation is and understand the main models (ii) be able to analyze whether a problem may have an algorithmic solution or not (iii) be able to analyze algorithms using standard techniques; (iv) be able to apply the main techniques in designing algorithms; (v) know the main complexity classes.

Conteúdo Programático

Título	Conteúdo	Semana	Formato
Introduction into algorithms	Administrativa. Introduction. Representative problems. Basics of algorithm analysis.	1-2	Remote
Graph algorithms	Breadth-first, depth-first and random search, bipartite graphs, topological ordering, search in directed graphs, connected components.	2-3	Remote
Greedy algorithms	Introduction, subset systems, optimal caching, shortest paths, minimum spanning trees.	4-5	Remote

Divide-and-conquer methods	Mergesort, solving recurrences, Master theorem and Akra-Bazzi's methods, Strassen's algorithm, counting inversions, selection in linear time, closest points, the fast Fourier transform	5-6	Remote
Dynamic programming	Introduction, subset sum and knapsack, weighted interval scheduling, matrix multiplication, TSP, minimum sequence alignment with space-saving techniques.	7-8	Remote
Introduction into theory	Noncomputability, intractability and the Church-Turing thesis.	8-9	Remote
Decidability	Decidable languages, and the halting problem.	10	Remote
Time complexity	Measuring complexity, complexity classes P and NP, problem reductions, NP-complete problems.	11-13	Remote
Space complexity	Classes PSPACE, L, and NL. Savitch's theorem, PSPACE-completeness.	13-14	Remote
Exercises and exam	Exercises with question and answer, interactive sessions, review, and exam.	15	Remote
Retake exam	Retake exam.	16	Remote

Metodologia

Estratégias didáticas em atividades remotas

All classes will be offered synchronously and asynchronously. Synchronous classes will happen during regular hours using a teleconferencing software (e.g. Microsoft Teams, Zoom). For asynchronous classes, recordings of the synchronous classes will be made available on the homepage of the course. The progress of the students will be tested using quizzes, deepened with exercise lists.

Estratégias didáticas em atividades presenciais

There will be no face-to-face activities.

Recursos disponibilizados

All necessary information will be made available in Moodle, as well as on the homepage of the course. Students will be informed how to access and register in these systems. Students will have access to recorded lectures, slides, lectures notes, lists of exercises and their solutions, quizzes, and additional information such as templates, links to complementary material and complementary bibliography.

Recursos computacionais

Students need to have regular access to the Internet, and a smartphone with a microphone and optionally a camera to participate in the lectures. For the exercises it is useful, but not required, to have access to a personal computer with text editing software, and the possibility of implementing concepts to understand them better.

Carça Horária*Teórica**Prática*

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Experiências de Aprendizagem

Online and offline lectures about algorithms and theory of computation, short explanatory videos, readings, short quizzes to fix the content, exercise lists, interactive question-and-answer sessions, direct interaction with the teachers in collaborative workspaces for individual questions.

Crítérios de Avaliação

Students will be evaluated in both areas separately, and the final score will be obtained by the arithmetic mean of the scores of each area. The evaluation in each area will be by exercises lists and presentation of solutions. At the end of the semester, there will be an exam that can substitute the final score obtained. The possible grades are A, for a score in $[9,10]$, B, for a score in $[7,5,9)$, C for score in $[6,7.5)$, and D for scores less than 6. During remote teaching there is no formal attendance requirement.

Atividades de Recuperação Previstas

Each students that has obtained a score less than 6 in the regular course, can participate in a single retake exam. Students that pass the retake exam with a score of at least 6 will receive the final grade C, otherwise D.

Bibliografia

Sem alterações

Sipser M., Introduction to the Theory of Computation, Cengage Learning, 2013.

Kleinberg J., Tardos E.. Algorithm Design. Addison Wesley, 2005.