Data Structures and Algorithms (GEMAK117-MA)

for Logistics Engineering Masters programme

Course load: weekly 2 + 2 (lecture + instruction)
Requirements: signature + exam, 5 credits

lecturer & instructor: Viktória Vadon, PhD

School year of 2023/24, 2nd semester

1 Planned weekly curriculum of lectures

week 1 Data, abstract data types, data structure. The algorithm. Number representations.

week 2 Pseudocode and flowchart. Qualitative description of an algorithm. Growth rate of a function, ordo notation. Fibonacci numbers, Binet-formula. Recurrence equations, the "master theorem".

week 3 Algorithms in number theory. Greatest common divider, Euclidean algorithm and its extension, linear congruence equations. Multiplicative inverse, modular powers, Fermat primse test. RSA algorithm.

week 4 Representing abstract data structures. Dynamic sets. Array, linked list, stack and queue, and their typical applications. Searching in simple structures: linear and logarithmic search. Hash tables. The "selection problem". Finding minimum and maximum. The "selection problem" in linear time.

week 5 Insertion sort. Divide and conquer. Merge sort, quicksort. Running times. Runtime theorem for all comparison sorts. Batcher-type merge sort and the related theorem.

week 6 Bubble sort, shell sort. Minimum selection sort, square time sort. Linear time sort: counting sort, radix, bucket sort. Sorting with outer memory storage and optimization.

week 7 Quick introduction to graph theory. Trees, properties of open trees, tree operations. Rooted trees and their representation, binary trees, heap. Heap sort.

week 8 *Easter, school holiday.*

week 9 Priority queue. Greedy algorithms. Huffman code. Disjoint sets. Binary trees, binomial heap. search methods. Binary search trees. Red-black trees.

week 10 Graph algorithms. Breadth first search, depth first search. Topological ordering. Strongly connected components.

week 11 Optimization problems on trees. Minimum spanning tree. Kruskal and Prim algorithm.

week 12 Single-source shortest paths, stepwise approximation. Dijkstra algorithm. Bellman-Ford algorithm. Shortest paths in directed acyclical graphs.

week 13 All-pairs shortest paths. Floyd-Warshall algorithm. Transitive closure of graphs, Warshall algorithm. Dynamic programming: principle and application to finite matrix products. Algorithmic solvability, relation of P and NP classes, examples of P and NP problems.

week 14 *Midterm retakes*

2 Course requirements

- Exit requirements: signature and (written) exam.
- To obtain signature, must attend 70% of instructions and must pass both midterms.
- Midterms: "theoretical" midterm (based on lecture material) around week 10, "practical midterm" (based on instruction material) around week 13, exact date to be discussed with class. A passing grade is 40% or higher.
- It is possible to retake either or both midterms independently on week 14. Afterwards, a combined (written) exam must be taken to obtain the signature.
- If midterm grades are high enough, a final grade may be offered without an exam. Otherwise, the final grade is determined by a written exam. Signature must be obtained first to sign up for the exam.

Miskolc, February 4, 2024

lecturer Viktória Vadon, PhD
(viktoria.vadon@uni-miskolc.hu)