DOCTORAL SCHOOL OF INFORMATICS
COMPLEX EXAM SUBJECT

Data structures and algorithms (recommended subject)

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1. Abstraction levels of data structures: abstract data type (ADT), algebraic and functional specification of the operations; abstract data structure (ADS), the graph of the structure, operations; level of representation: representing data by arrays and by linked lists (pointers).

2. Arrays, stack, queue, priority queue and the heap; operations, representations and applications in algorithms (e. g. polish form, graph searching, heap sort, improving the effectiveness of graph algorithms).

3. Linked lists; simple list and using sentinel record (head element), double linking, cycling by pointers; operations, representations and applications of lists.

4. Binary tree, representation by array and with pointers; tree traversal algorithms (preorder, inorder, postorder and by levels); recursive functions on trees; applications.

5. Binary search tree, operations and their efficiency. The AVL-tree; relation between the height and the number of nodes in the tree; rotations (by insertion); the cost of checking and supporting the balanced property.

6. The 2-3 tree, basic operations, efficiency; splitting by insertion and merging nodes by deletion; B-trees on the external storage devices.

7. Hash tables, hashing. Resolving the key collision by chaining. Resolution of the key conflict by open addressing; linear and quadratic probing, double hashing. Hash functions (the division method).

8. Graphs, representation by adjacency matrix and by adjacency lists, their efficiency and applications. Elementary graph algorithms: breadth-first search, shortest paths, minimum cost spanning tree; depth-first search, classification of edges, topological sort.

References:

[1] T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein: *Introduction to Algorithms*, 2nd Edition, MIT Press, 2001.
[2] N. Wirth: *Algorithms + Data Structures = Programs*. Prentice-Hall, 1976.
[3] V. Aho, J. E. Hopcroft, J. D. Ullman: *The Design and Analysis of Computer Algorithms*. Addison-Wesley, 1974.
[4] Rónyai L., Ivanyos G., Szabó R.: *Algoritmusok*. Typotex Kiadó, Budapest, 1998. (in Hungarian)