Admission testing topics for master programmes on Distributed systems and networks and Advanced computing and networks

1. Classification of constrained optimization problems and problems of computations scheduling in distributed systems.

2. Frameworks for simulated annealing, genetic and ant colony algorithms construction. General schemes of the algorithms, theorems on their properties (convergence speed, asymptotics). Application of these agorithms to solving the computations scheduling problems.

3. Notion of a simulation model. Comparison of capabilities with other model types. Main steps of simulation model development. Tools for simulation models development (examples of languages and libraries).

4. Interaction in distrubuted systems: shared memory and message passing models. Data streams. Processes and threads. Multithreaded clients and servers. Distributed transactions. Interprocess coordination.

5. Synchronization in distributed systems. Mutual exclustion of critical sections. Dekker's and Peterson's algorithms. Dijkstra's semaphores. Classical interprocess synchronization problems. Time synchronization: logical clock, global state. Voting algorithms.

6. Physical layer of the network protocol stack. Ethernet and WiFi technology. Operation algorithms, collisions, multiple access control.

7. Packet switching, packet structure. Operation and structure of a packet switch. Latency types in a computer network, approaches to latency control (priorities, weights and guaranteed flow rate). Flow control in packet switching.

8. Routing algorithms in the Internet: main approaches. Structure of the Internet, concept of an autonomous system, BGP exterior routing protocol. Congestion and main techniques to deal with it. Congestion: AIMD for single and multiple flows.

9. Emergent computer network technologies. Software-Defined Networks: structure, operation principles, OpenFlow protocol. Organization of data centers. Concepts of cloud computing, resource virtualizaton and scaling.

10. Regression models and algorithms for their construction. Perceptrons. Supervised learning. Hopfield networks. Input downscaling with prinicipal components method.

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