

DOCTORAL SCHOOL OF INFORMATICS  
COMPLEX EXAM SUBJECT

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**Artificial intelligence (main subject)**

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**Modeling and search.** Problem representation methods (state-space representation, problem decomposition, constraint satisfaction, logical representations) which make a problem possible to be viewed as a path-finding problem. Graph representation of a path-finding problem. AND/OR graphs. General scheme of the search system. Control strategy of search system and heuristics.

**Heuristic search.** Famous irrevocable strategies: hill-climbing search, tabu search, algorithm of simulated annealing. Tentative strategies: the backtracking algorithm and graph-search algorithms (best-first, A, A\*, A<sup>c</sup>, B algorithm). Evolutionary algorithm.

**Two-player games.** Representation of the games. The winner strategy. Sub-tree evaluations: minimax algorithm and alpha-beta pruning.

**Knowledge and reasoning.** Inference in first-order logic: resolution and rule-based reasoning. Answer extraction process. Uncertainty, Bayesian networks. Fuzzy reasoning.

**Machine learning.** Supervised learning and some examples (the k-nearest neighbor method, decision trees, deep learning). Unsupervised learning and some examples (k-mean algorithm, principal component analysis). Reinforcement learning: Markov decision problems, Bellman operator. Estimation of value functions using Monte-Carlo and temporal difference methods.

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**Bibliography:**

S. Russel, P. Norvig: Artificial Intelligence - in Modern Approach, Panem-Prentice Hall, 2003.

N. Nilsson: Principles of Artificial Intelligence, Springer-Verlag, 1982.