

## **Master's Exam Topics – Computer Science Major**

1. Real number sequences. Convergence of a sequence, Cauchy's principle.
2. Matrices. Basic matrix operations. Rank and determinant of a matrix.
3. Solving systems of linear equations.
4. Linear transformations and their relation to matrices.
5. Propositional calculus. Tautologies.
6. Mathematical induction.
7. Permutations, variations and combinations.
8. Classical definition of probability. Geometric probability.
9. Random variables and their distributions.
10. The expected value and variance of a random variable.
11. Methods of linear and nonlinear programming.
12. Logical and functional structure of a classical computer.
13. Number representations in a positional number system. Binary and hexadecimal systems and their applications.
14. Fixed-point and floating-point arithmetic. Representing numbers in a computer.
15. An operating system. Perception of the operating system by the application software layer.
16. Characteristics of a traditional Unix system.
17. Iteration, recursion and their implementation.
18. Structured programming mechanisms - conditional statements, loops.
19. Subroutines. Parameter passing.
20. Comparison between object oriented and structured programming.
21. Data encapsulation – class features (variables, methods, privacy levels).
22. Method types: constructors, destructors, selectors, queries, iterators.
23. Inheritance and dynamic polymorphism.
24. Static polymorphism – templates.
25. Lists and trees and their applications. Stacks and queues.
26. Graphs and their search methods. Applications.
27. Graph path finding algorithms.
28. Algorithm design methods (divide and conquer, dynamic programming, greedy algorithms).
29. Elementary and non-elementary sorting methods.
30. Elementary search methods. Hash-based search.
31. Computational complexity of an algorithm.
32. Notion of a database – features and capabilities.
33. Relation and its attributes in a database.
34. Referential integrity in relational databases.
35. Database normalization – normal forms.
36. Database design – relationship types, primary and foreign keys.
37. A database index – types and applications.
38. Basic SQL language constructions.
39. Neural networks in artificial intelligence. Types and applications.
40. Software life cycles.
41. The process of testing and its role in software development.
42. UML, its structure and purpose.
43. Basic project team roles and responsibilities.
44. Methods for the cost estimation in software engineering.