

Topics for the Computer Science Bachelor Graduation Examination July and September 2025

Computer Science Specialization

Part 1. Algorithms and Programming

Courses: Programming fundamentals, Object oriented programming, Data structures and algorithms

1. Search (sequential and binary), merging, sorting (selection sort, bubble sort, insertion sort, merge sort, quicksort). The backtracking method.
2. Algorithm description with Pseudocode. Algorithms complexity.
3. OOP concepts in programming languages (Python, C++, Java, C#): class and object, members of a class and access modifiers, constructors and destructors.
4. Derived classes and inheritance. Method overriding. Polymorphism. Dynamic binding. Abstract classes and interfaces.
5. Class diagrams in UML. Relations between classes.
6. Lists. Maps. Binary trees (excepting binary balanced search trees). Hash tables.
7. Identify data structures and data types suitable (efficient) for solving problems (only the data structures specified at 6.). The use of existing libraries for these structures (Python, Java, C++, C#).

Examination items may include source code in any of the following programming languages: Python, Java, C++, C# or Pseudocode. Solution implementation may be required in any of the following programming languages: Python, Java, C++, C# or Pseudocode.

Part 2. Databases

Course: Databases

The Relational Model

Relations

Integrity Constraints

Domain constraints

Key constraints

Foreign key constraints

SQL

DDL - CREATE, ALTER, DROP

- PRIMARY KEY, FOREIGN KEY, UNIQUE, CHECK, NULL, DEFAULT

DML - SELECT, INSERT, UPDATE, DELETE

3-valued logic

SELECT

DISTINCT, FROM, WHERE, GROUP BY, HAVING, ORDER BY, TOP

IN, EXISTS, ANY, ALL

INNER JOIN, LEFT JOIN, RIGHT JOIN, FULL JOIN

UNION [ALL], INTERSECT, EXCEPT

COUNT, SUM, AVG, MIN, MAX
Nested queries
BETWEEN, LIKE

Functional Dependencies. Normal Forms

Functional dependencies - Definition. Basic properties (reflexivity, transitivity, augmentation, union, decomposition)
1NF, 2NF, 3NF, BCNF

Relational Algebra on Sets

Selection
Projection
Cross-product
Union
Set-difference
Intersection
Condition Join (Theta Join)
Natural Join
Left Outer Join
Right Outer Join
Full Outer Join
Division
Assignment

Part 3. Operating systems

Course: Operating systems

1. The structure of UNIX file systems
2. UNIX processes: creation, and the fork, exec, exit, wait system calls. Pipe and FIFO communication
3. Unix Shell Programming
 - a. Basic concepts: variables, control structures (if/then/elif/else/fi, for/done, while/do/done, shift, break, continue), predefined variables (\$0, \$1,..., \$9, \$*, \$@, \$?), I/O redirections (|, >, >>, <, 2>, 2>>, 2>&1, the /dev/null file, back-quotes ``)
 - b. Extended regular expressions (POSIX ERE, as supported by "grep -E" and "sed -E")
 - c. Basic commands (functioning and the effect of the specified arguments): cat, chmod (-R), cp (-r), cut (-d,-f), echo, expr, file, find (-name,-type), grep (-E, -i,-q,-v), head (-n), ls (-l), mkdir (-p), mv, ps (-e,-f), pwd, read (-p), rm (-f,-r), sed (-E and only the commands d,s,y), sleep, sort (-n,-r), tail (-n), test (numerical, string and file operators), true, uniq (-c), wc (-c,-l,-w), who

Note

Algorithms and Programming, Databases, and Operating Systems exam items can be theoretical items, problem solving, multiple choice questions with/without justifications. Items from bachelor's exams in previous years, which can be found here <https://www.cs.ubbcluj.ro/studenti/examen-de-licenta-si-disertatie/manuale-si-modele-de-subiecte-pentru-examenul-de-licenta/>, can be used as exam sample items.