

# Topics for the Computer Science Bachelor Graduation Examination July and September 2022

## 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. Algorithms complexity.
3. OOP concepts in programming languages (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 search 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 (C++).

### 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/fin, 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