Topics for the Computer Science Bachelor Graduation Examination
July and September 2021

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 (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. Specification of typical operations (without implementations)
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#).

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