Bachelor Degree Exam
2021
Computer Science - English

The evaluation of your fundamental and specialty knowledge will be done through an oral exam which will consist of:

- **6** problems (with open-ended answers):
    - 2 from the field of **Operating Systems**
    - 2 from the field of **Databases**
    - 2 from the field of **Algorithms and Programming**
        - 1 pertaining to **Algorithms**
        - 1 pertaining to **Programming**
- The time for solving the 6 problems: **20 minutes**
- The time for presenting your answer: **10 minutes**
- **Scoring** will be done as follows:
    - one score (1-10) for each field (including 1 point by default)
    - the final score will be the arithmetic mean of the scores for each of the 3 fields

Note

1. For each question there will be a score for the correct answer and a score for justifying the answer.
2. The code samples for **Algorithms and Programming** are given and required to be in the C++ programming language.

Exam Sample Paper

OPERATING SYSTEMS

a. Establish the truth value of the statements below regarding the command given. Justify your answer.

```
grep -E -i '^[aeiou]{2,3}.*[^0-9]$' a.txt
```

i. Displays from `a.txt` only the lines that start with "a" or "A"

ii. It will not display from `a.txt` any line shorter than 3 characters.

b. Establish the truth value of the statements below regarding the given code fragment. Justify your answer.

```
1 if(fork() == 0) {
2     fork();
3     fork();
4 }
```

i. Line 2 is executed by 2 processes.

ii. The IF condition is only evaluated by the parent process.

DATABASES

P1 Consider a relation with schema R[Cod1, Cod2, Cod3, C1, C2, C3, C4, C5] and the instance below. {Cod1, Cod2, Cod3} is the primary key.

Cod1	Cod2	Cod3	C1	C2	C3	C4	C5
1	1	1	10	5	2	10	1
1	1	2	10	6	3	20	1
1	1	3	20	7	2	15	2
2	1	1	20	1	4	20	1
2	1	2	30	2	5	10	1
2	2	1	30	3	5	30	2
3	1	1	40	4	5	25	2
3	1	2	40	4	5	20	1

Compute the difference between the cardinality of the first query's result set and the cardinality of the second query's result set. Justify your answer.

SELECT C1, COUNT(*), MIN(C4)
FROM R
WHERE C3 IN (2, 5)
GROUP BY C1, C2

SELECT Cod1, COUNT(*), MAX(C5)
FROM R
GROUP BY Cod1
HAVING COUNT(*) > 2

P2 Let {A, B} → {D, E} and {CodP, B} → {D} be two functional dependencies. For each dependency, state whether or not it's satisfied by the data in the relation below. Justify your answer.

CodP	CodQ	A	B	C	D	E
1	1	1	1	9	2	2
1	2	2	2	6	3	1
1	3	2	2	4	3	1
2	1	3	3	9	4	5
2	2	4	4	3	2	3
3	1	1	1	5	2	3
3	2	4	3	3	1	2

ALGORITHMS AND PROGRAMMING

P1 [ALGORITHMS] What does the recursive algorithm below compute, if called as *Computation(x, n, 1, 1, 0)*, given that $x[1]$, $x[2]$, …, $x[n]$ is a sequence of natural numbers? Justify your answer.

```
Function Computation (x, n, i, y, j) is
  If n < i then
    If j = n then
        Computation ← 0
      else
        Computation ← y * (n - j)
    EndIf
   else
     If (x[i] ≥10) and ((x[i] mod 100) mod 11 = 0) then
         Computation ← Computation(x, n, i + 1, y * x[i], j)
       else
         Computation ← Computation(x, n, i + 1, y, j + 1)
     EndIf
   EndIf
EndFunction
```

P2 [PROGRAMMING] What is the effect of the compilation and execution of the following program? Justify your answer.

```cpp
#include <iostream>
using namespace std;
class Vehicle{
    protected:
        double speed;
    public:
        Vehicle(double ms){speed=ms;}
        virtual void go(){cout<<"Vehicle going ..."<<endl;}
        void accelerate(){cout<<"Vehicle accelerating..."<<endl;}
};
class Scooter:public  Vehicle{
    public:
        Scooter(double s){ speed=s;}
        void go(){cout<<"Scooter going ..."<<endl;}
        void accelerate(int s) {cout<<"Accelerating with "<<s<<"..."<<endl;}
};
int main(){
    Scooter s(1);
    Vehicle& v=s;
    v.go();
    v.accelerate();
    return 0;
}
```