BABEŞ-BOLYAI UNIVERSITY
FACULTY OF MATHEMATICS AND COMPUTER SCIENCE

Admission exam – September 9th, 2026

Written Exam for Computer Science

IMPORTANT NOTE:
Unless otherwise specified:

- All arithmetic operations are performed on unlimited data types (there is no *overflow* / *underflow*).
- Arrays, matrices, and strings are indexed starting from 1.
- All restrictions apply to the values of the actual parameters at the time of the initial call.
- A subarray of an array or a string consists of elements occupying consecutive positions in the array or the string.
- If on the same row there are several consecutive assignment statements, they are separated by "; ".

1. Let the variables $a = 5$, $b = 6$, $c = 7$ and $d = 8$. We note with | bitwise **OR** operation and with & bitwise **AND** operation. What is the value of the expression $a \mid ((b + c) \,\&\, d)$?

A. 7 B. 13 C. 8 D. 9

2. Consider the algorithm `ceFace(i, j, k)`, where i, j and k are natural numbers ($0 < k \leq 10^4$, $0 \leq i, j \leq 10^4$).

```
Algorithm ceFace(i, j, k):
    If j = 0 then
        Return 1
    EndIf
    If j MOD 2 = 0 then
        x ← ceFace(i, j DIV 2, k)
        Return (x * x) MOD k
    Else
        Return ((i MOD k) * ceFace(i, j - 1, k)) MOD k
    EndIf
EndAlgorithm
```

Which of the following statements are true?

A. After the call `ceFace(2, 5, 4)`, the algorithm returns 2.
B. The algorithm always makes exactly j recursive calls.
C. For $j = 5$, the algorithm calls itself 4 times.
D. After the call `ceFace(2, 10, 9)`, the algorithm returns 7.

3. Consider the algorithm `f(n)`, where n is a natural number ($1 \leq n \leq 100$).

```
Algorithm f(n):
    x ← 1
    For j ← n, 1, -1 execute
        If j MOD 3 ≠ 0 then
            x ← j
        EndIf
        Write x, ' '
    EndFor
EndAlgorithm
```

Which of the following statements are true after the call `f(n)`?

A. If n is divisible by 3, the first value displayed is 0.
B. If $n \geq 2$, the last 2 values displayed are 2 and 1.
C. If $n = 7$, 6 distinct numbers are displayed.
D. If $n = 12$, 12 numbers are displayed.

4. Consider the algorithm `ceFace(n)`, where n is a natural number ($0 \leq n \leq 10^6$).

```
Algorithm ceFace(n):
    s ← 0
    While n ≠ 0 execute
        s ← s + (n MOD 10) MOD 2
        n ← n DIV 10
    EndWhile
    Return (s MOD 2 = 0)
EndAlgorithm
```

Which of the following statements are true?

A. After the call `ceFace(495310)` the algorithm returns *False*.
B. After the call `ceFace(79297)` the algorithm returns *True*.
C. After the call `ceFace(n)` the algorithm returns *True*, if and only if the last value of variable s is a power of 2.
D. After the call `ceFace(n)`, the algorithm returns *True* if the sum of the digits of number n is an even number.

5. Consider the algorithm `f(n, a)`, where n is a natural number ($2 \leq n \leq 10^6$) and a is an array of n integers ($-10^5 \leq a[i] \leq 10^5$, for $i = 1, 2, \ldots n$).

```
Algorithm f(n, a):
    For i ← 2, n execute
        If a[i] > a[1] then
            a[1] ← a[i] // (*)
        EndIf
    EndFor
    Return a[1]
EndAlgorithm
```

Which of the following statements are true?

A. The algorithm returns the minimum of the elements in array a.
B. If the statement marked with `(*)` is never executed, then array a is sorted descending.
C. The algorithm returns the maximum of the elements in array a.
D. After the call `f(6, [5, 6, 3, 8, 12, 5])`, the algorithm returns 12.

6. Let G be an unoriented graph with n vertices that has no isolated vertices. Let G' be an unoriented graph with the same n vertices, so that between any two vertices $n1$ and $n2$ there is an edge if and only if between the same vertices in the graph G it does not exist. **G** is known to have 10 fewer edges than G'.

Which of the following values can be the number of vertices in G?

A. 5 B. 8 C. 6 D. 7

7. George receives the following problem as homework: *Some children are getting ready to go on a trip. Their parents share* $n = 240$ *RON equally, as pocket money. Then two other cousins of theirs decide to take part in the trip. They will participate equally in the division of the money, and so each child receives* 10 *RON less than they would have received initially. How many children went on the trip in the end?*
George implemented the `solutie(n)` algorithm to find the answer.

```
Algorithm solutie(n):
    total ← 3
    While total ≤ 9 execute
        If (n DIV (total - 2) - 10) = (n DIV total) then
            Write "Solutie ", total, " "
            total ← 9
        EndIf
        total ← total + 1
    EndWhile
    Write "Solutia este mai mare decat 9 "
EndAlgorithm
```

What is displayed after the call `solutie(240)`?

A. `Solutie 8`
B. `Solutia este mai mare decat 9`
C. `Solutie 8 Solutia este mai mare decat 9`
D. `Solutie 6`

8. Consider the algorithm `f(n)`, where n is a natural number ($1 \leq n \leq 10^7$):

```
Algorithm f(n):
    If n ≤ 1 then
        Return n
    EndIf
    Return f(n DIV 2) + f(n MOD 2)
EndAlgorithm
```

Which of the following statements are true?

A. For any $n \geq 1$, the value of `f(n)` is equal to the number of digits 1 in the binary representation of n.
B. After the call `f(2026)`, the algorithm returns the value 8.
C. For any value k, $1 \leq k \leq 20$, $f(2^k) = k$.
D. The time complexity of the algorithm is $O(\log n)$.

9. Consider the algorithm `f(x, y)`, where x and y ($1 \leq x, y \leq 10^3$) are natural numbers.

```
Algorithm f(x, y):
    If x = 0 then
        Return 0, 0
    EndIf
    v, w ← f(x DIV 2, y)
    v ← 2 * v; w ← 2 * w
    If x MOD 2 ≠ 0 then
        w ← w + 1
    EndIf
    If w ≥ y then
        w ← w - y; v ← v + 1
    EndIf
    Return v, w
EndAlgorithm
```

What property do the natural numbers v and w have after the execution of the algorithm?

A. $x = w * y + v$.
B. The number v represents the quotient, and w is the remainder of the integer division of x by y.
C. The number v represents the remainder, and w is equal to the quotient of the integer division of x by y.
D. $y = v * x + w$.

10. Consider the algorithm `verific(n, x)`, where n is a natural number ($3 \leq n \leq 10^5$), and x is an array of n integer elements ($-10^5 \leq x[1], ..., x[n] \leq 10^5$):

```
Algorithm verific(n, x):
    cnt ← 0
    For i ← 2, n - 1 execute
        If x[i] > x[i - 1] AND x[i] > x[i + 1] then
            cnt ← cnt + 1
        EndIf
    EndFor
    Return cnt
EndAlgorithm
```

Which of the following statements are true?

A. There is at least one natural number $n > 10$ and at least one array x for which after the call `verific(n, x)` the value n **DIV** 2 is returned.
B. If array x is sorted strictly ascending, the algorithm returns the value n.
C. After the call `verific(5, [1, 5, 2, 8, 3])` the algorithm returns 2.
D. The algorithm returns the value 1 if the array consists only of distinct elements.

11. Consider the algorithm `mystery(n)`, where n is a natural number ($1 \leq n \leq 10^7$).

```
Algorithm mystery(n):
    s ← 0
    i ← 1
    While i ≤ n execute
        j ← i
        While j ≤ n execute
            s ← s + 1
            j ← 2 * j
        EndWhile
        i ← i + 1
    EndWhile
    Return s
EndAlgorithm
```

Which of the following statements are true?

A. If $n = 8$, the algorithm returns 21.
B. The time complexity of the algorithm is $O(n \log n)$.
C. The total number of times s is incremented is equal to the sum: $\sum_{i=1}^{n}(\lfloor \log_2(n \text{ DIV } i) \rfloor + 1)$, where the operator $\lfloor x \rfloor$ represents the largest integer less than or equal to x.
D. If in the instruction `j ← 2 * j` we replace 2 with 3, the time complexity of the algorithm is $O(\log n)$.

12. Consider the algorithm `f(a, b, c)`, where a, b and c are natural numbers ($1 \leq a, b, c \leq 10^6$).

```
Algorithm f(a, b, c):
    If a ≤ b then
        Write "-"
    Else
        If ((a - b) MOD c) MOD 2 = 0 then
            f(a - b, c, b)
            Write "1"
        Else
            f(a - b, c, a)
            Write "2"
        EndIf
    EndIf
EndAlgorithm
```

Which of the following statements are true?

A. After the call `f(24, 13, 6)` the algorithm displays the string `"-22"`.
B. After the call `f(24, 13, 6)` the last recursive call is `f(11, 6, 24)`.
C. If $a > b$ and the remainder of the division of $a - b$ by c is an even number, then after the call `f(a, b, c)`, the algorithm displays the string `"1"`.
D. The number of characters displayed after the call `f(a, b, c)` is equal to the number of recursive calls in which $a > b$.

13. Consider the algorithm `g(a, n, k, d)`, where a, n, k and d are natural numbers ($0 < a, n, k \leq 30$, $0 \leq d \leq 30$).

```
Algorithm g(a, n, k, d):
    If d ≥ k then
        Return 1
    EndIf
    s ← 0
    For i ← a, n execute
        s ← s + g(i + 1, n, k, d + 1)
    EndFor
    Return s
EndAlgorithm
```

Which of the following statements are true?

A. After the call `g(1, 5, 3, 0)` the algorithm will return 10.
B. After the call `g(1, 10, 1, 0)` the algorithm will return 10.
C. After the call `g(1, 10, 3, 0)` the algorithm will return 121.
D. The value returned after the call `g(1, 15, 10, 0)` is equal to the value returned after the call `g(1, 15, 5, 0)`.

14. Consider the algorithm `palindrom(n)`, where ***n*** is a natural number ($1 \leq n \leq 10^9-1$).

What should the ellipsis be replaced with so that the algorithm returns *True*, if ***n*** is a palindrome?

```
Algorithm palindrom(n):
    d ← 1
    While d ≤ n execute
        d ← d * 10
    EndWhile
    While d ≥ 100 execute
        ...
    EndWhile
    Return True
EndAlgorithm
```

A.
```
d ← d DIV 10
If (n MOD 10) ≠ (n DIV d) then
    Return False
EndIf
n ← (n MOD d) DIV 10
```

B.
```
d ← d DIV 10
If (n MOD 10) ≠ (n DIV d) then
    Return False
EndIf
n ← (n MOD d) DIV 10
d ← d DIV 10
```

C.
```
d ← d DIV 100
If (n MOD 10) ≠ (n DIV d) then
    Return False
EndIf
n ← (n MOD d) DIV 10
```

D.
```
If (n MOD 10) ≠ (n DIV d) then
    Return False
EndIf
n ← (n MOD d) DIV 10
d ← d DIV 100
```

15. Consider the algorithm `inceput(n)`, where ***n*** is a natural number ($1 \leq n \leq 20$). The `zeros(n)` algorithm returns an array with ***n*** elements, all equal to 0.

```
Algorithm inceput(n):
    lim ← n DIV 2 + n MOD 2
    p ← zeros(lim)
    x ← zeros(n)
    ceface(1, n, lim, p, x)
EndAlgorithm

Algorithm ceface(k, n, lim, p, x):
    For i ← 1, lim execute
        If p[i] = 0 then
            p[i] ← 1
            x[k] ← i * 2 - 1
            If k < lim then
                ceface(k + 1, n, lim, p, x)
            Else
                afisare(n, x)
            EndIf
            p[i] ← 0
        EndIf
    EndFor
EndAlgorithm
```

```
Algorithm afisare(n, x):
    j ← 1
    For i ← 1, n execute
        If i MOD 2 = 0 then
            Write i, " "
        Else
            Write x[j], " "
            j ← j + 1
        EndIf
    EndFor
    Write new line
EndAlgorithm
```

Which of the following statements are true?

A. The third line displayed after the call `inceput(5)` is `1 2 4 3 5`.
B. After the call `inceput(n)`, all permutations of the set {1, 2, ..., ***n***} are displayed.
C. The time complexity of the `inceput(n)` algorithm is $O(n^2)$.
D. The third line displayed after the call `inceput(5)` is `3 2 1 4 5`.

16. Consider the algorithm `decide(n, b)`, where n and b are two natural numbers ($1 \leq n \leq 10^4$, $b \geq 2$).

```
Algorithm decide(n, b):
    i ← 0
    s ← 0
    While n ≠ 0 execute
        uc ← n MOD b
        If i MOD 2 = 0 then  // *
            s ← s + uc
        Else
            s ← s + 2 * uc
        EndIf               // **
        i ← i + 1
        n ← n DIV b
    EndWhile
    Return s
EndAlgorithm
```

Knowing that after the call `decide(n, b)` the value v is returned, which of the following statements are true?

A. If $b = 2$ and v is a multiple of 3, then n is a multiple of 3.
B. If $n = 8$ and $b = 3$, then $v = 6$.
C. If $b = 4$ and v is a multiple of 3, then n is a multiple of 3.
D. If the statements between the lines marked with * and with ** inclusive are replaced by the statement `s ← s + uc`, when $b = 4$ and v is a multiple of 3, then n is a multiple of 3.

17. Consider the algorithm `f(a)`, where a is a natural number ($1 < a < 10^9$).

```
Algorithm f(a):
    n ← 0
    While a > 1 execute
        b ← 1
        While b ≤ a execute
            b ← 9 * b
            n ← n + 1
        EndWhile
        a ← a DIV 9
    EndWhile
    Return n
EndAlgorithm
```

Which of the following statements are true?

A. If $a = 9^k$ ($0 < k < 10$, natural number), after the call `f(a)` the value k * (k + 3) **DIV** 2 will be returned.
B. After the call `f(729)`, the algorithm returns the value 9.
C. The values returned after the calls `f(17)` and `f(18)` are different.
D. The algorithm returns the smallest power of 9 greater than a.

18. Consider the `ceFace(x, n)` algorithm, where n is a natural number ($2 \leq n \leq 10^4$), and x is an array with n natural numbers ($x[1], x[2], ..., x[n]$, $1 \leq x[i] \leq 10^4$, for $i = 1, 2, ..., n$).

```
Algorithm ceFace(x, n):
    c ← 0
    i ← 1
    While i ≤ n - 1 execute
        If ... then //*
            c ← c + 1
        EndIf
        i ← i + 1
    EndWhile
    Return c
EndAlgorithm
```

Which of the following expressions should replace the ellipsis in the statement marked with *, so that the `ceFace(x, n)` algorithm determines the number of pairs of consecutive elements of the array x ($x[i], x[i + 1]$, where $i = 1, 2, ..., n - 1$) where each element is divisible by 2 or is divisible by 3?

A. `NOT ((x[i] MOD 2 ≠ 0) OR (x[i] MOD 3 ≠ 0) OR (x[i + 1] MOD 2 ≠ 0) OR (x[i + 1] MOD 3 ≠ 0))`
B. `(x[i] MOD 2 * x[i] MOD 3 = 0) AND (x[i + 1] MOD 2 * x[i + 1] MOD 3 = 0)`
C. `NOT ((x[i] MOD 6 = 1) OR (x[i] MOD 6 = 5) OR (x[i + 1] MOD 6 = 1) OR (x[i + 1] MOD 6 = 5))`
D. `(x[i] * x[i + 1]) MOD 6 = 0`

19. The first 5 numbers in the interval [10, 3000] which, represented in base 2, contain the digits 0 and 1 alternately are: 10, 21, 42, 85, 170. *Example*: for $10_{(10)}$ we have $1010_{(2)}$, where the digits 0 and 1 appear alternately, but in $11_{(10)} = 1011_{(2)}$ they do not.

Which are the next 3 numbers with this property?

A. 340, 680, 1360
B. 341, 682, 1365
C. 341, 680, 1361
D. 340, 681, 1363

20. Consider the algorithm `test(n)`, where n is a natural number ($1 \leq n \leq 10^4$).

```
Algorithm test(n):
    c1 ← 0
    c2 ← 0
    While n > 1 execute
        If n MOD 2 = 0 then
            n ← n DIV 2
            c1 ← c1 + 1
        Else
            n ← n – 1
            c2 ← c2 + 1
        EndIf
    EndWhile
    Return c1, c2
EndAlgorithm
```

Which of the following statements are true?

A. If, after the call `test(n)`, the product of the two returned numbers is equal to zero, then n is a power of 2.
B. The algorithm `test(n)` has time complexity $O(\log n)$.
C. After the call `test(n)` the first returned value is always greater than or equal to the second returned value.
D. In the interval [100, 200] there are 2 numbers n for which, after the call `test(n)` the values $c1$ and $c2$ are returned such that $c1 = c2$.

21. Consider the sequence $X = (1, 2, 2, 2, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 5, 5, 5, 5, 5, 5, 5, 5, 5, 6, \ldots)$.

Considering that the first element in the sequence is at position 1, in which of the following subarrays of X does the value 9 appear at least 9 times?

A. $X[64], X[65], ..., X[75]$
B. $X[70], X[71], ..., X[82]$
C. $X[75], X[76], ..., X[90]$
D. $X[60], X[61], ..., X[70]$

22. Consider the algorithm `a(n)`, where n is a natural number ($1 \leq n \leq 10^9$).

```
Algorithm a(n):
    If n MOD 2 = 0 then
        Return n + a(n DIV 2)
    EndIf
    Return n
EndAlgorithm
```

Which of the following statements are true?

A. The number of self-calls for `a(n)` is equal to the number of 0 bits in the base 2 representation of n.
B. In the interval [100, 200] there exists a single value n for which, after the call `a(n)`, the algorithm returns an even number.
C. There exist two distinct numbers n and m, such that `a(n) = a(m)`.
D. After the call `a(20)`, the algorithm returns 35.

23. Consider the algorithm `calculeaza(x, y)`, where x and y are natural numbers ($1 \leq x, y \leq 10^4$).

```
Algorithm calculeaza(x, y):
    p ← 1
    i ← 1
    While i ≤ x OR i ≤ y execute
        If i ≤ x then
            p ← (p * 2) MOD 10
        EndIf
        If i ≤ y then
            p ← (p * 3) MOD 10
        EndIf
        i ← i + 1
    EndWhile
    Return p
EndAlgorithm
```

Which of the values of the following expressions have the same last digit as the number returned by the algorithm after the call `calculeaza(x, y)`?

A. 6^{x+y}
B. $2^{\max(x,y)} * 3^{\max(x,y)}$
C. $2^x * 3^y$
D. $6^{\min(x,y)}$

24. Consider the algorithm `f(n, x)`, where n is a natural number ($3 \leq n \leq 10^4$), and x is an array of n natural numbers ($x[1], x[2], ..., x[n]$, $1 \leq x[i] \leq 10^4$, for $i = 1, 2, ..., n$).

```
Algorithm f(n, x):
    If x[1] > x[2] then
        Return False
    EndIf
    k ← 0
    For i ← 1, n - 1 execute
        If k = 0 then
            If x[i] = x[i + 1] then
                Return False
            EndIf
            If x[i] > x[i + 1] then
                k ← 1
            EndIf
        EndIf
        If k = 1 then
            If x[i] ≤ x[i + 1] then
                Return False
            EndIf
        EndIf
     EndFor
     Return k = 1
EndAlgorithm
```

Which of the following statements are true?

A. After the call `f(6, [5, 8, 23, 22, 4, 2])`, the algorithm returns *True*.
B. After the call `f(6, [1, 4, 6, 2, 3, 5])`, the algorithm returns *True*.
C. For any 4 distinct values, $1 \leq v_1, v_2, v_3, v_4 \leq 10^4$, there exist 6 distinct arrays x that contain these values, and for which, after the call `f(4, x)` the algorithm returns *True*.
D. If, after the call `f(n, x)`, the algorithm returns *True*, then the array x contains only distinct values.

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GRADING AND SOLUTIONS

DEFAULT: 10 points

1	B	3.75 points
2	CD	3.75 points
3	BD	3.75 points
4	BD	3.75 points
5	CD	3.75 points
6	B	3.75 points
7	C	3.75 points
8	ABD	3.75 points
9	B	3.75 points
10	AC	3.75 points
11	BC	3.75 points
12	A	3.75 points
13	ABD	3.75 points
14	B	3.75 points
15	D	3.75 points
16	ABD	3.75 points
17	ABC	3.75 points
18	BC	3.75 points
19	B	3.75 points
20	ABC	3.75 points
21	AB	3.75 points
22	CD	3.75 points
23	C	3.75 points
24	AC	3.75 points