ACSL

2018-2019 **All-Star Contest**

American Computer Science League

Senior Division

Instructions for Short Round Questions

1. **MATERIALS ALLOWED**
   - Plain paper and pencils
   - No calculators, cell phones, headphones or any type of electronic device
2. **SCORE SHEETS**
   - Only use pencils to mark the answers.
   - Put your name, school name, grade and division on the back of the scoresheet.
   - See the form example for marking the answers.
   - No erasures are allowed – use an additional score sheet if necessary.
   - There will be no appeals based upon answer sheet errors.
3. **STUDENT PROCEDURES**
   - Keep your eyes on your own paper.
   - Keep answer sheet and scrap paper guarded.
   - You must stay in the room until the end of the test.
   - You can keep all materials at the end.
   - The time limit is 60 minutes.
4. **TEST ANSWERS**
   - Proctors will read the letter answers at the end of the testing period.
   - Appeals in writing must be brought to the scoring room no later than 3:30 PM. The appeal must show your detailed solution.

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Senior Division - Short Round Questions

1, Boolean Algebra

Which ordered triples make the following Boolean expression FALSE?

$$\overline{A(\overline{B}+C)+\overline{B}C} \oplus \left(\overline{B}\,\overline{(\overline{A}+C)\,(\overline{AC}+B)}\right)$$

A. (0, 0, *) (1, 0, 0)
B. (1, 1, *) (0, 1, *)
C. (0, 0, 1) (1, 1, 1)
D. (0, 0, 1) (1, 0, 1) (0, 1, 1)
E. None of the above

2. Bit-String Flicking

How many different values of **x** (a bitstring of 6 bits) solve the following equation?

```
x OR (LCIRC-4 x) AND (RSHIFT-1 x) = 001110
```

A. 1
B. 2
C. 3
D. 4
E. None of the above

3. Recursive Functions

Given the function below, find f(4, -1, 2). $[x]$ = the largest integer $\leq x$.

$$f(x, y, z) = \begin{cases} f(x-2, y+1, [y/x]) + z & \text{if } x > y \text{ and } x \neq 0 \\ x + y + z & \text{if } x = y \text{ and } x \neq 0 \\ f(x+1, y-2, y-x) - x * y & \text{if } x < y \text{ and } x \neq 0 \\ f(3, y+1, x-y) + y*z & \text{if } x = 0 \end{cases}$$

A. 1
B. 2
C. 3
D. 4
E. None of the above

4. Prefix-Infix-Postfix

Define the following binary operators:

a @ b = larger of a and b
a & b = average of a and b
a $ b = b ^ 2 - a ^ 2

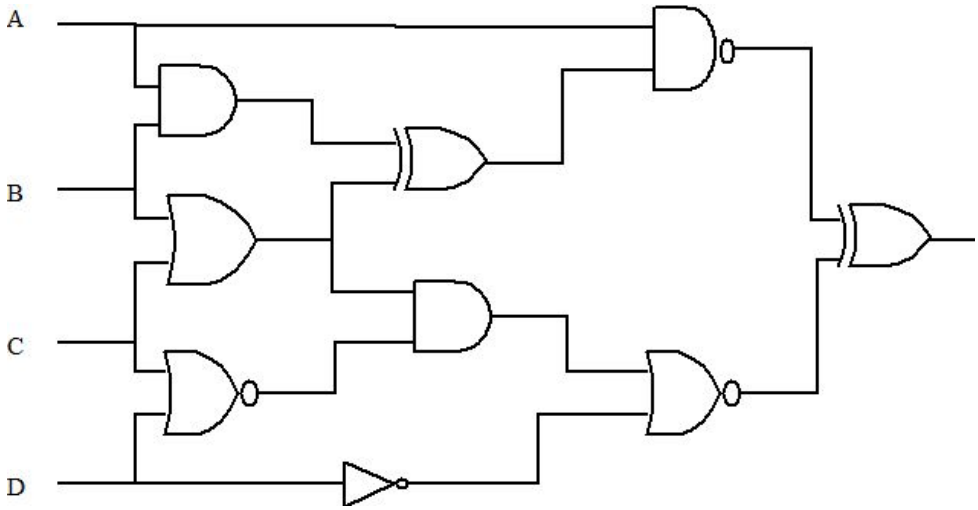
Evaluate the following prefix expression (all operands are single digit numbers):

```
$ / - ^ 5 2 * 2 2 + 1 @ 6 4 / - + ^ 3 2 * &
                        8 4 4 $ 1 2 * * @ 3 2 2 & 6 4
```

A. -8
B. -7
C. 7
D. 8
E. None of the above

5. Digital Electronics

How many ordered quadruples make this digital circuit TRUE?



A. 8
B. 10
C. 12
D. 14
E. None of the above

6. Computer Number Systems

How many times does the string "41" appear in the octal representations of the base 10 numbers 2000 through 2199?

A. 65
B. 66
C. 67
D. 68
E. None of the above

7. What Does This Program Do?

What is printed when this program is executed with inputs of 2, 80, 21, 36, 6, 59, 12, 28, 100, 24, 0, 15, 256, 0?

```
x=0: y=0: z=0
input n
while n != 0
  w = 0
  for i = 1 to n-1
    if n/i == int(n/i) then
      w = w + i
    next i
    if w == n then
      y = y + 1
    end if
    if w < n then
       x = x + 1
    end if
    if w > n then
      z = z + 1
    end if
    input n
end while
output x, y, z
```

A. 2 1 7
B. 4 1 5
C. 2 1 9
D. 3 2 5
E. None of the above

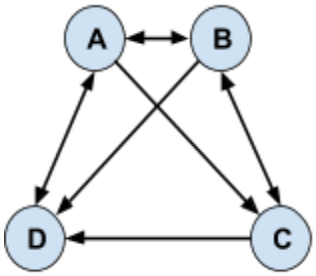
8. Data Structures

Build a min-heap from the characters **ICECREAMSUNDAE**. List the nodes at depth 2, from left to right.

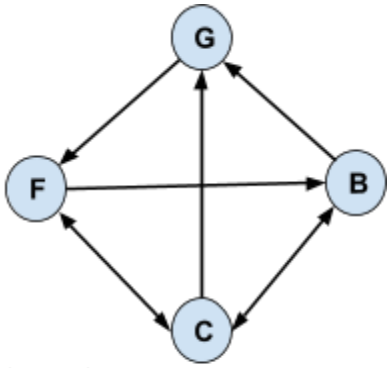
A. I, R, D, A
B. C, N, C, A
C. I, N, C, E
D. I, R, E, A
E. None of the above

9. Graph Theory

ACSL Air just merged with CompSci Air. ACSL Air's flights are shown in the directed graph on the left and CompSci Air's are on the right. How many more round trips can be taken from A after the merger without landing at the same intermediate city more than once?



ACSL AIR



CompSci AIR

A. 4
B. 5
C. 6
D. 7
E. None of the above

10. LISP

Evaluate:

```
(SETQ Y '(a (b e)(a (b(c d))(e f (g h))) f (d a)))
(CDADR (REVERSE (CDADDR Y)))
```

A. (f (g h))
B. (b (c d))
C. ((g h))
D. ((c d))
E. None of the above

11. FSAs and Regular Expressions

Given the following regular expression:

```
[0-9]*[[A-Z][a-z]*]*[&,@,/,.][^d, e, t]*
```

which string(s) match the pattern?

a) **1978RICSLwasestablished**
b) **AllStar@NJ**
c) **41Consecutive/yr**
d) **12CategorieS@SR**
e) **Programmingisfun&challenging.**
f) **ACSL.org**

A. All of the strings
B. b, c, d, e
C. b, c, e, f
D. b, c, d, f
E. None of the above

12. Assembly Language

What is printed when the following program is executed?

```
S   DC      0
X   DC      1
R   DC      2
F   LOAD    X
    SUB     R
    BL      G
    LOAD    X
    DIV     R
    STORE   A
    LOAD    R
    MULT    A
    STORE   B
    LOAD    X
    SUB     B
    BE      C
    BG      K
G   LOAD    X
    ADD     =1
    STORE   X
    SUB     =11
    BL      H
    BU      E
C   LOAD    S
    ADD     =1
    STORE   S
    LOAD    R
    ADD     =2
    STORE   R
    BU      F
H   LOAD    =2
    STORE   R
    BU      F
K   LOAD    R
    ADD     =2
    STORE   R
    BU      F
E   PRINT   S
    END
```

A. 10
B. 11
C. 17
D. 27
E. None of the above