ACSL

2018-2019 **All-Star Contest**

American Computer Science League

Intermediate 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.
   - No erasures are allowed – use an additional score sheet if necessary.
   - See the form example for marking the answers.
   - 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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1. Boolean Algebra

How many ordered triples make the following Boolean expression TRUE?

$$(\overline{A}\ B + C)\ \overline{(A\ B + C)}\ (\overline{A}\ \overline{B} + C)\ (A\ \overline{B} + C)\ (A\ B + \overline{C})$$

A. 8
B. 4
C. 2
D. 0
E. None of the above

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2. Bit-String Flicking

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

```
(LCIRC-1 x) AND (RSHIFT-2 x) = 001101
```

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

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3. Recursive Functions

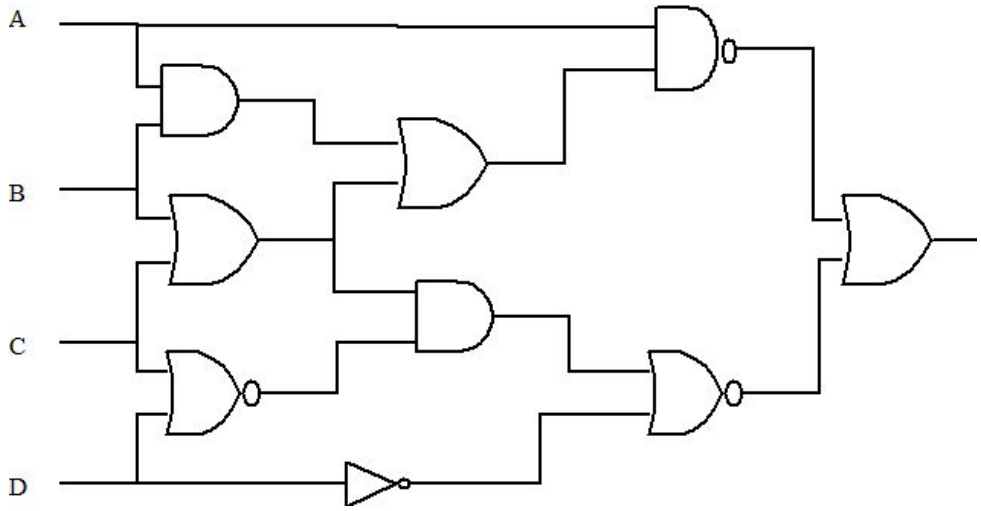
Find f (3, -1) given the function below. $[x]$ = the largest integer $\leq x$.

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

A. 9
B. 10
C. 11
D. 12
E. None of the above

4. Digital Electronics

How many ordered quadruples make the following circuit FALSE?



A. 0
B. 3
C. 9
D. 12
E. None of the above

5. Prefix-Infix-Postfix

Define the & and $ binary operators as follows:

a & b: smaller of a and b
a $ b: average of a and b

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

```
6 2 & 4 2 $ + 2 ^  4 1 + / 2 3 ^ 3 2 ^ & -
```

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

6. Computer Number Systems

In how many years from **now** would the octal representation of that year be the octal digits of 2019_{10} arranged in descending order. Express the answer in base 10.

A. 3743
B. 2560
C. 1848
D. 1767
E. None of the above

7. What Does This Program Do?

Given the following input values: 93, 18, 245, 982, 7, 500, 74, 321, 1, 653, 84, 10, 448, 8, 156, 99, 732, 0, 15, 861, 0, how many times is "yes" printed when this program is executed?

```
input n
while n != 0
  if n < 10 then
    if n/3 == int(n/3) then
      output "yes"
    end if
  else if  n < 100 then
    g  =  int(n/10)
    p  =  n - 10 * g
    f  =  g + p
    if f/3 == int(f/3) then
      output "yes"
    end if
  else
    j  =  int(n / 100)
    r  =  n - j * 100
    e  =  int(r / 10)
    x  =  r - 10 * e
    w  =  j + e + x
    if w/3 == int(w/3) then
      output "yes"
    end if
  end if
  input n
end while
```

A. 4
B. 7
C. 9
D. 13
E. None of the above

8. Data Structures

What is the internal path length of the binary search tree for:

```
LibertyandProsperity
```

Upper case letters are alphabetically before all lower case letters.

A. 62
B. 67
C. 70
D. 74
E. None of the above

9. LISP

Evaluate:

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

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

10. 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?

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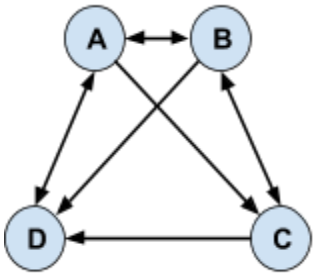
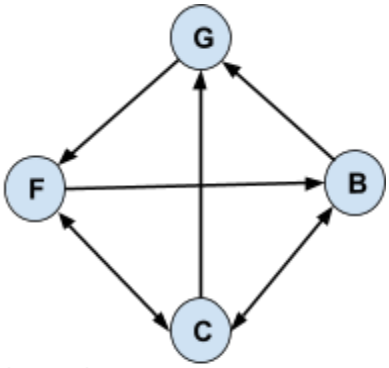


ACSL AIR



CompSci AIR

A. 4
B. 5
C. 6
D. 7
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 regular expression above?

a) `2018KCSLwasestablished.`

b) `AllStar@WayneHS`

c) `41Consecutive/yr`

d) `12Categories@shorts`

e) `Programmingischallenging&fun`

f) `ACSL.org`

A. All of the strings
B. a. d, e, f
C. a, b, e
D. a, c, e, 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