

American Computer Science League

2022-2023 • Contest 1: Short Problems • Intermediate Division

1. Computer Number Systems

How many 1s are there in the binary representation of the decimal numbers from 8 to 16, inclusive?

- A. 23
- B. 21
- C. 19
- D. 17
- E. 15

2. Computer Number Systems

Given the following 5 numbers:

$78B_{16}$ ACE_{16} $F4A_{16}$ $2EF_{16}$ BAD_{16}

Which one has the most odd numbers in its octal equivalent?

- A. 78B
- B. ACE
- C. F4A
- D. 2EF
- E. BAD

3. Recursive Functions

Find $f(25)$ given:

$$f(x) = \begin{cases} 2 & \text{if } x = 1 \\ 4 & \text{if } x = 2 \\ 2 \cdot f(x-1) / f(x-2) & \text{if } x \geq 3 \end{cases}$$

- A. 2
- B. 4
- C. 1
- D. 6
- E. 3

4. Recursive Functions

Find $f(f(f(9)))$ given:

$$f(x) = \begin{cases} f(x-2) + 2 & \text{if } x \text{ is a multiple of } 4 \\ & \text{and not a multiple of } 3 \\ f(x+1) - 1 & \text{if } x \text{ is a multiple of } 3 \\ & \text{and not a multiple of } 4 \\ x - 3 & \text{otherwise} \end{cases}$$

- A. 7
- B. 6
- C. 4
- D. 3
- E. 0

5. What Does This Program Do? (Branching)

Which of the following values for a, b, and c will output OBTUSE and SCALENE?

```
input a, b, c
if c >= a + b then
    output "NOT A TRIANGLE"
else
    if a ^ 2 + b ^ 2 == c ^ 2 then
        output "RIGHT"
    else if a ^ 2 + b ^ 2 > c ^ 2 then
        output "ACUTE"
    else
        output "OBTUSE"
    end if
    if a == b and a == c then
        output "EQUILATERAL"
    end if
    if a == b or a == c or b == c then
        output "ISOSCELES"
    else
        output "SCALENE"
    end if
end if
```

- A. a=3, b=6, c=9
- B. a=4, b=5, c=6
- C. a=5, b=6, c=10
- D. a=6, b=6, c=6
- E. a=6, b=6, c=10