

ACSL

2016 - 2017

American Computer Science League

Contest #1

Senior Division Solutions

1. Recursive Functions

$$\begin{aligned}
 f(28) &= f(28/2)+1 = f(14)+1 = -4 + 1 = -3 \\
 &= f(14/2)+1 = f(7)+1 = -5 + 1 = -4 \\
 &= f(\lceil 7/2 \rceil) - 3 = f(3) - 3 = -2 - 3 = -5 \\
 &= f(\lceil 3/2 \rceil) - 3 = f(1) - 3 = 1 - 3 = -2 \\
 &= f(\lceil 1/2 \rceil) - 3 = f(0) - 3 = 4 - 3 = 1 \\
 &= f(0) = 3*0 + 4 = 4
 \end{aligned}$$

1. -3

2. Recursive Functions

$$\begin{aligned}
 f(20, 10) &= f(17, 9) + 1 = 5 + 1 = 6 \\
 f(17, 9) &= f(14, 8) + 1 = 4 + 1 = 5 \\
 f(14, 8) &= f(11, 7) + 1 = 3 + 1 = 4 \\
 f(11, 7) &= f(8, 6) + 1 = 2 + 1 = 3 \\
 f(8, 6) &= f(5, 5) + 1 = 1 + 1 = 2 \\
 f(5, 5) &= f(4, 5) - 2 = 3 - 2 = 1 \\
 f(4, 5) &= 2*4 - 5 = 3 \quad \text{Now substitute backwards.}
 \end{aligned}$$

2. 6

3. Computer Number Systems

- A. $A_{16} + 1011_2 + 73_8 = 10 + 11 + 59 = 80 = 1010000_2$
 - B. $23_8 + F_{16} - 111_2 + 11_8 = 19 + 15 - 7 + 9 = 36 = 100100_2$
 - C. $2A_{16} + 75_8 - 31_{10} = 42 + 61 - 31 = 72 = 1001000_2$
 - D. $F_{16} - 1E_{16} + 67_8 - 35_8 = 15 - 30 + 55 - 29 = 11 = 1011_2$
- D has the most 1's at 3.

3. D

4. Computer Number Systems

2016 = 3740₈ which is not a palindrome.
 Next one in octal which is will be 3773₈ = 2043.
 Next one in hex which is will be 7E7₁₆ = 2023.
 The difference is 2043 - 2023 = 20

4. 20

5. What Does This Program Do?

The table contains the values of a, b, c, d and e after each line.

a	b	c	d	e
20	5	2	80	4
20	6	2	60	5
20	7	3	40	5
20	8	4	20	5

So $4*(a/e+b/c)-a/(b+2)+d^2/a*2 = 4*(20/5+8/4)-20/(8+2)+20^2/20*2$
 $= 4*(4+2)-20/10+400/20*2 = 4*6-2+20*2 = 24-2+40 = 62$

5. 62