



American Computer Science League

2019-2020

Contest #1

JUNIOR DIVISION SOLUTIONS

1. Computer Number Systems

Convert each part to a hexadecimal number:

$$M: 5 = 5_{16}$$

$$DD: 23 = 17_{16}$$

$$YYY: 2020 = 7E4_{16}$$

$$1. 5/17/7E4$$

or

$$5_{16}/17_{16}/7E4_{16}$$

2. Computer Number Systems

$$508_{16} = 10100001000_2 = 2410_8$$

$$88A_{16} = 100010001010_2 = 4212_8$$

$$195_{16} = 110010101_2 = 625_8$$

$$348A_{16} = 11010010001010_2 = 32212_8$$

$$1050_{16} = 1000001010000_2 = 10120_8$$

$$2. 348A_8 \text{ or } 348A$$

3. Recursive Functions

$$f(90) = -1 * f(90/2) + 2 = -1 * f(45) + 2 = -1 * 33 + 2 = -31$$

$$f(45) = 2 * f(45/3) - 1 = 2 * f(15) - 1 = 2 * 17 - 1 = 33$$

$$f(15) = 2 * f(15/3) - 1 = 2 * f(5) - 1 = 2 * 9 - 1 = 17$$

$$f(5) = 5 + 4 = 9$$

$$3. -31$$



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4. Recursive Functions

4. 57

$f(6) = f(6-2) + 3 = f(4) + 3 = 6 + 3 = 9$
 $f(4) = f(4-2) + 3 = f(2) + 3 = 3 + 3 = 6$
 $f(2) = f(2-2) + 3 = f(0) + 3 = 0 + 3 = 3$
 $f(0) = 3^0 * 0^3 = 0$
 $f(9) = f(9-2) + 3 = f(7) + 3 = 12 + 3 = 15$
 $f(7) = f(7-2) + 3 = f(5) + 3 = 9 + 3 = 12$
 $f(5) = f(5-2) + 3 = f(3) + 3 = 6 + 3 = 9$
 $f(3) = f(3-1) + 3 = f(1) + 3 = 3 + 3 = 6$
 $f(1) = 3^1 * 1^3 = 3 * 1 = 3$
 $f(15) = 2 * f(15-3) - 1 = 2 * f(12) - 1 = 2 * 29 - 1 = 57$
 $f(12) = 2 * f(12-3) - 1 = 2 * f(9) - 1 = 2 * 15 - 1 = 29$
So $f(f(f(6))) = f(f(9)) = f(15) = 57$

5. What Does This Program Do? - Branching

5. -4

a	b	c	d	e
12	6	3	2	2
12	6	3	2	6
12	6	3	2	-2
-4	6	3	2	-2
2	6	3	2	-2
2	6	-4	2	-2

$x = b / a + c * e / (d + b) - (b + d) / a * a$
 $= 6 / 2 + (-4) * (-2) / (2 + 6) - (6 + 2) / 2 * 2$
 $= 3 + 8 / 8 - 8 / 2 * 2$
 $= 3 + 1 - 4 * 2 = 3 + 1 - 8 = -4$