



American Computer Science League

2019-2020

Contest #1

SENIOR DIVISION SOLUTIONS

<p>1. Computer Number Systems</p> $42_8 = 34_{10}$ $34 * 34 = 1156 = 484_{16}$	<p>1. 484_{16} or 484</p>
<p>2. Computer Number Systems</p> <p>100 tickets @\$5.00 = \$500.00</p> $100_{10} = 1100100_2 \text{ and } 199_{10} = 11000111_2$ <p>Tickets numbered 104, 105, 106, 107, 116, 117, 122, 138, 148, 149, 154, 160 - 175 (16 #'s), 180, 181, and 186 contain the sequence "1010".</p> <p>Income = \$500 - 30 * \$5 = \$500 - \$150 = \$350.</p>	<p>2. \$ 350 or 350</p>
<p>3. Recursive Functions</p> $f(31) = f([31/2] - 5) + 4 = f(15-5) + 4 = f(10) + 4 = -15 + 4 = -11$ $f(10) = f([10/2] - 5) + 4 = f(5 - 5) + 4 = f(0) + 4 = -19 + 4 = -15$ $f(0) = f(0 + 2) - 2^0 = f(2) + 1 = -18 - 1 = -19$ $f(2) = f(2 + 2) - 2^2 = f(4) + 4 = -14 - 4 = -18$ $f(4) = f(4 + 2) - 2^4 = f(6) - 16 = 2 - 16 = -14$ $f(6) = 6 - 4 = 2$	<p>3. -11</p>
<p>4. Recursive Functions</p> $f(2, 16, 8) = f(2 + 1, 16 - 4, 8) + 2 * 8$ $= f(3, 12, 8) + 16 = 18 + 16 = 34$ $f(3, 12, 8) = f(3 + 1, 12 - 4, 8) + 3 * 8$ $= f(4, 8, 8) + 24 = -6 + 24 = 18$ $f(4, 8, 8) = f(4 + 1, 8 - 4, 8) + 4 * 8 = f(5, 4, 8) + 32 = -38 + 32 = -6$ $f(5, 4, 8) = f(5 - 2, 4 + 1, 8 - 2) - 5 * 4$ $= f(3, 5, 6) - 20 = -18 - 20 = -38$ $f(3, 5, 6) = f(3 - 2, 5 + 1, 6 - 2) - 3 * 5 = f(1, 6, 4) - 15 = -3 - 15 = -18$ $f(1, 6, 4) = f(1 - 2, 6 + 1, 4 - 2) - 1 * 6 = f(-1, 7, 2) - 6 = 3 - 6 = -3$ $f(-1, 7, 2) = f(-1 + 1, 7 - 4, 2) + (-1) * 2 = f(0, 3, 2) - 2 = 5 - 2 = 3$ $f(0, 3, 2) = 0 + 3 + 2 = 5$	<p>4. 34</p>



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5. What Does This Program Do?

5. 39

a	b	c	d	e	f	g
20	4	5				
20	4	5	1			
20	4	5	1	6		
20	4	5	1	6	1	
20	4	5	1	6	3	
20	4	5	1	6	3	
14	4	5	1	6	3	
14	4	5	1	6	0	
14	4	5	1	6	0	8

$$\begin{aligned}h &= a / (d + e) * b * g / b ^ 2 - c ^ f + 4 * ((c + d) / (e - b)) ^ (g / b) \\&= 14 / (1 + 6) * 4 * 8 / 4 ^ 2 - 5 ^ 0 + 4 * ((5 + 1) / (6 - 2)) ^ (8 / 4) \\&= 14 / 7 * 4 * 8 / 16 - 1 + 4 * (6 / 2) ^ 2 \\&= 2 * 4 * 8 / 16 - 1 + 4 * 3 ^ 2 \\&= 8 * 8 / 16 - 1 + 36 \\&= 64 / 16 - 1 + 36 \\&= 4 - 1 + 36 \\&= 39\end{aligned}$$