

1. What Does This Program Do? (BASIC)

What is printed when the following program is run?

```

10 A=1 : B=3 : C=1
20 if (A>B) and ((C<A) or (B<C)) then A = A+3
30 if (A<B) and (B>C) then A = A+C
40 if ((A>C) and (A>B)) or (B>C) then A = A-C
50 if A>5 then A=A+2 else A=A+5
60 print A
70 end

```

2. Computer Number Systems

How many 1's are there in the binary representation of 1996?

3. Computer Number Systems

What is the base 16 value of $FEDCBA_{16} + ABCDEF_{16}$?

4. Recursive Functions

Find $f(7)$, given the following:

$$f(x) = \begin{cases} f(x-3) + 1 & \text{if } x \geq 3 \\ f(x+2) - 3 & \text{if } 1 \leq x < 3 \\ x^2 + x + 1 & \text{otherwise} \end{cases}$$

5. Recursive Functions

Find $f(8, 5)$, given the following:

$$f(x, y) = \begin{cases} f(x-1, y+1) - 2 & \text{if } x \text{ and } y \text{ are positive,} \\ & \text{\ } x \text{ is even, and } y \text{ is odd} \\ f(y, x+1) + 1 & \text{if } x \text{ and } y \text{ are positive,} \\ & \text{\ } x \text{ is odd, and } y \text{ is even} \\ 7 & \text{if } x \text{ and } y \text{ are both zero} \\ xy & \text{otherwise} \end{cases}$$

1. The following table shows the value of variable A after each line is executed.

line	if?	A
20	false	1
30	true	4
40	true	1
50	false	6

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2. First convert 1996 to hex, $1996 = 7CC_{16}$, and then convert that to binary:

$$7CC_{16} = 0111\ 1100\ 1100$$

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3. Work from the right to the left, carrying as needed:

$$\begin{aligned} F + A &= 19 \\ \text{carry} + E + B &= 1A \\ \text{carry} + D + C &= 1A \\ \text{carry} + C + D &= 1A \\ \text{carry} + B + E &= 1A \\ \text{carry} + A + F &= 1A \end{aligned}$$

$1A\ A\ A\ A\ A\ A\ 9_{16}$

4. The evaluation is as follows:

$$\begin{aligned} f(7) &= f(4) + 1 \\ f(4) &= f(1) + 1 \\ f(1) &= f(3) - 3 \\ f(3) &= f(0) + 1 \\ f(0) &= 0^2 + 0 + 1 = 1 \end{aligned}$$

Working backwards, we have $f(3) = 2$, $f(1) = -1$, $f(4) = 0$, and $f(7) = 1$.

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5. The evaluation is as follows:

$$\begin{aligned} f(8, 5) &= f(7, 6) - 2 \\ f(7, 6) &= f(6, 8) + 1 \\ f(6, 8) &= 48 \end{aligned}$$

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Therefore, $f(7, 6) = 49$ and $f(8, 5) = 47$. Note that the evaluation of $f(x, y)$ never requires more than 3 steps for any values of x and y .