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ASS-12

Q1) L-program :- [A1] $X1 \leftarrow X_1 - 1$

$Y \leftarrow Y + 1$

IF $X1 != 0$ GOTO A1

A:- (a) Firstly we need to convert each instruction to the following format :- $\#(I) = \langle a, \langle b, c \rangle \rangle$ before calculating the integer value.

Given :- [A1] $x_1 \leftarrow x_1 - 1$

From the above instruction, we can say that $a = 1$

$x_1 \leftarrow x_1 - 1 \Rightarrow$ "TYPE-2" instruction $\therefore b = 2$

Since the variable here is x_1, whose count is $2 \Rightarrow c = 2 - 1 = 1$

$\therefore$ Instruction is $\langle a, \langle b, c \rangle \rangle$

$= \langle 1, \langle 2, 1 \rangle \rangle$

Breaking this down:-

The formulae to be used here is :- $2^x(2y+1) - 1$

Firstly, compute $\langle 2, 1 \rangle$:

So, $x = 2, y = 1$ $\therefore 2^2(2(1)+1) - 1 = 4(3) - 1 = 12 - 1 = \underline{11}$

$\therefore \langle 1, \langle 2, 1 \rangle \rangle$ breaks down to $\langle 1, 11 \rangle$

Now compute $\langle 1, 11 \rangle$:

Here, $x = 1$, $y = 11$ $\therefore 2^1(2(11)+1) - 1 = 2(22+1) - 1 = 2(23) - 1$

$= 46 - 1$

$= \underline{45}$

(b) $Y \leftarrow Y+1$

From the above instructions function, we can say that $a=0$

$Y \leftarrow Y+1$ is a TYPE-1 instruction $\Rightarrow b=1$

The count of variable (Y) is 1 $\Rightarrow c = 1-1 = 0$
(As we know)

$\therefore$ Instruction is $\langle a, \langle b, c\rangle\rangle = \langle 0, \langle 1, 0\rangle\rangle$

Breaking this down:-

formulae to be used is :- $2^x(2y+1)-1$

Firstly, compute $\langle 1, 0\rangle$

$\therefore x=1, y=0 \Rightarrow 2^1(2(0)+1)-1$

$\Rightarrow 2(1)-1 = \underline{\underline{1}}$

$\therefore$ It broke down to $\langle 0, 1\rangle$

Now, compute $\langle 0, 1\rangle$

$\therefore x=0, y=1 \Rightarrow 2^0(2(1)+1)-1$

$\Rightarrow 3-1 = \underline{\underline{2}}$

(c) IF $X \mathrel{!}= 0$ GOTO A1

Label missing $\Rightarrow a=0$ // FORMULAE OF GOTO INSTRUCTION

Given :- GOTO A1 & the value of A1 = 1 $\Rightarrow b = 1+2 = 3$

Variable here is X whose value = 2 $\Rightarrow c = 2-1 = 1$

$\therefore$ Instruction is $\langle a, \langle b, c\rangle\rangle = \langle 0, \langle 3, 1\rangle\rangle$

Breaking this down:-

Formulae to be used is :- $2^x(2y+1)-1$

Firstly compute $\langle 3, 1\rangle$

$\therefore x=3, y=1 \Rightarrow 2^3(2(1)+1)-1 \Rightarrow 8(3)-1 = 24-1 = \underline{\underline{23}}$

$\therefore$ It broke down to $\langle 0, 23\rangle$

Now, compute $\langle 0, 23\rangle$

Here $x=0, y=23 \Rightarrow 2^0(2(23)+1)-1 = (46+1)-1 = \underline{\underline{46}}$

$\therefore$ Final solution $= 2^{45} \cdot 3^{2} \cdot 5^{46} - 1$

Q2) Reverse compile 575

A:-

We need to find the PRIME FACTORIZATION of $(575+1)$
$= 576$

$$\begin{array}{r|l} 2 & 576 \\ 2 & 288 \\ 2 & 144 \\ 2 & 72 \\ 2 & 36 \\ 2 & 18 \\ 3 & 9 \\ 3 & 3 \\ & 1 \end{array}$$

$\therefore 576 = 2^{6} \cdot 3^{2} \rightarrow (i)$

Now take 6:- // From (i)

$2^{x}(2y+1) - 1 = 6$

$\Rightarrow 2^{x}(2y+1) = 7$

$\Rightarrow 2^{x}(2y+1) = 7 \Rightarrow 2y+1 = \frac{7}{2^{x}}$

For $\frac{7}{2^{x}}$ to be an integer, 2^{x} should be able to divide "7"...

i.e; 2^{x} should be a multiple of 7.

$\Downarrow$

This happens ONLY when $x = 0 \Rightarrow \frac{7}{2^{0}} = 7$

$\therefore 2y+1 = 7 \Rightarrow 2y = 6 \Rightarrow y = 3$

It becomes $6 = \langle 0, 3 \rangle$

Break this even further...

$2^{x}(2y+1) - 1 = 3$

$\Rightarrow 2^{x}(2y+1) = 4$

$\Rightarrow 2y+1 = \frac{4}{2^{x}}$

$\frac{4}{2^x}$ will be an integer for $x=1$ & $x=2$
Since, the maximum should be taken.

$$\cancel{x=2}$$

$$\Rightarrow 2y+1 = \frac{4}{2^2} = \frac{4}{4} = 1$$

$$\Rightarrow 2y+1 = 1$$

$$\Rightarrow y = 0$$

$\therefore 6 = \langle 0, 3 \rangle$

& $3 = \langle 2, 0 \rangle$

$\therefore 6 = \langle 0, \langle 2, 0 \rangle \rangle \longrightarrow$ (ii)

Now take 2 :- // from (i)

$2^x (2y+1) - 1 = 2$

$\Rightarrow 2^x (2y+1) = 3$

$\Rightarrow 2y+1 = \frac{3}{2^x}$

NOTE :- $\frac{3}{2^x}$ will be an integer only when $x=0$

$$\therefore 2y+1 = \frac{3}{2^0} = 3$$

$$\Rightarrow 2y = 2 \Rightarrow y = 1$$

$\therefore 2 = \langle 0, 1 \rangle$

Break this even further

$2^x (2y+1) - 1 = 1$

$\Rightarrow 2^x (2y+1) = 2$

$\Rightarrow 2y+1 = \frac{2}{2^x}$

Now, $\frac{2}{2^x}$ will be an integer for $x = 0, 1$

$\because$ Maximum value should be taken $\Rightarrow x = 1$

$\therefore\ 2y+1 = 1$

$\Rightarrow 2y = 0$

$\Rightarrow y = 0$

$\because\ 2 = \langle 0, 1 \rangle$ and $1 = \langle 1, 0 \rangle$

$\Rightarrow\ 2 = \langle 0, \langle 1, 0 \rangle\rangle \rightarrow$ (iii)

Lets take eq^n (ii)

$6 = \langle 0, \langle 2, 0 \rangle\rangle$

Compare this with our traditional eq^n $\langle a, \langle b, c \rangle\rangle$

$\because\ a = 0 \Rightarrow$ no label

$b = 2 \Rightarrow$ TYPE-2 Instruction

Now for what value is $c = 0$?

$\Downarrow$

This is when $\boxed{\#(V) = 1}$

This implies $V = Y$

$\therefore$ Instruction is :- $Y \leftarrow Y - 1$

Lets take eq^n (iii)

$2 = \langle 0, \langle 1, 0 \rangle\rangle$

Compare this with

$\therefore\ a = 0 \Rightarrow$ no label

$b = 1 \Rightarrow$ TYPE-1 Instruction

Now for what value is $c = 0$?

$\Downarrow$

This is when $\boxed{\#(V) = 1}$ This implies $V = Y$

∴ The instruction is :- $Y \leftarrow Y + 1$