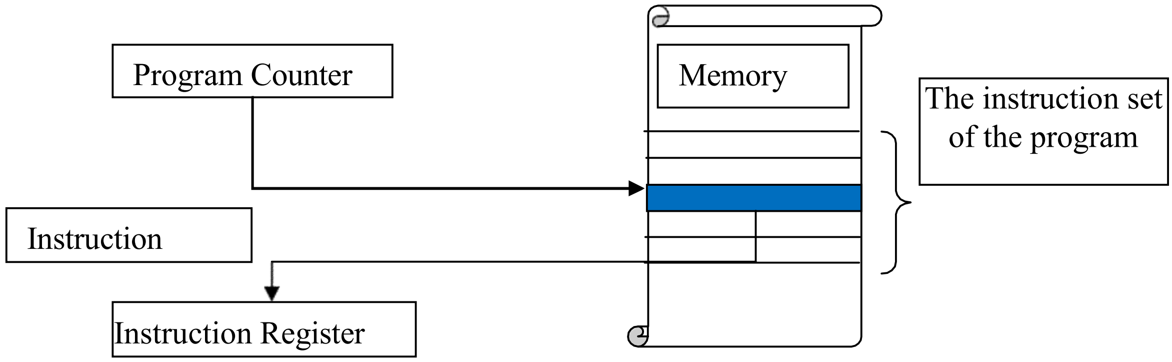
DWSolution N°03

Question01:



Question02:

Anexaminationofthefunctionsperformedbytheprocessorhighlightsthreesets: The control unit is responsible for:

1. **Fetching instructions from memory,**
2. **Decoding these instructions,**
3. **Executing the instructions.**

The processing unit mast **delivering the results of elementary arithmetic and logical operations.**
The registers **are used to store the data or results used by the processing unit.**
B- Details of the control unit operation:

Phase 1: Instruction Fetch from Memory

1. The value of the PC (Program Counter) is placed on the address bus by the control unit, which issues a read command.
2. After the memory access time, the content of the selected memory location is available on the data bus.
3. The instruction is stored in the processor's instruction register.

Phase2: Decoding and Operand Retrieval

1. Thecontrolunittransformstheinstructionintoaseriesofelementarycommandsnecessary for processing the instruction.
2. If the instruction requires data from memory ,the control unit retrieves its value from the data bus.
3. The operand is stored in the data register.

Phase3: Instruction Execution

1. The sequencer carries out the instruction.
2. Flags are set (status register).
3. The control unit up dates the PC for the next instruction.

Exercise01:

A/

1. How many cycles will the program take to execute?
   150,000 * 1 + 45,000 * 2 +55,000 * 2 + 2,000 *2 +15 * 500 = 397,500
2. What will be the execution time?
   397,500 cycles / (1.8 * 10^9), approximately220microseconds
3. Calculate the CPI (Cycles Per Instruction) of this program , defined as the ratio of the number of cycles required for its execution to the number of instructions.
   There are a total of 270,500 instructions executed, so CPI= 397,500/ 270,500 ≈1.47

B/:

Response:
We know that A is n times faster than B if Performance-A/Performance-B=nor Execution Time-B / Execution Time-A = n. The ratio is therefore 15/10

Exercise02:

Let's first determine the number of clock cycles needed for the program on A:
Time-A=Number of cycles-A/ Frequency-A10 =Number of cycles-A/ 100*106Cycles/second Number of cycles-A = 10*100*106 = 1000*106 cycles
The time for B can be obtained using the following equation: Time-B=1.2*1000*106cycles/Frequency-B
Frequency-B = 1.2*1000*106 cycles / 6 seconds = 200 MHz.

Exercise03:

A/

Sequence1 executes2+1+2=5instructions.Sequence2 executes4+1 +1=6.So, Sequence1 executes fewer instructions.

We can use the clock cycles equation based on the number of instructions and CPI to get the total clock cycles for each sequence:

Using the formula:
Number of cycles-1=21 + 12 + 23 =10cyclesNumberof cycles -2=41 + 12 +13 = 9 cycles

Sequence 2 is therefore faster, even though it executes more instructions. Since Sequence 2 overall uses fewer clock cycles but has more instructions ,it must have alower CPI. The CPI values can be calculated as:
CPI=Numberofcycles/Numberofinstructions(Asinexercise05) CPI-1
= 10/5 = 2 CPI-2 = 9/6 = 1.5

Note:
This exercise demonstrates the problem when using only one parameter (number of instructions) to gauge performance.

B/

Reminder:

Example: Size

1nanometer=1×10^{-9}m=1×10^{-3}µm1micrometer=1×10^{-6}m Frequency

One hertz isequivalent to one event per second (S^{-1} or 1/S).

A processor with a basic cycle of 0.83ns (nanoseconds) has a frequency of : $1/(0.83\times10^{-9}$ S) =1.2×10^{9} Hz= 1.2GHz.

So,the time required for one clock cycle = 1/frequency. Therefore:

Frequency= 3 GHz

Average number of cycles per instruction =4

Time for one clock cycle = $1 / (3\times10^{9}) = 0.33\times10^{-9}$ = 0.33 ns

Average execution time for one instruction=0.33ns×4=1.32ns

The number of millions of instructions that this microprocessor is capable of executing per second =3×10^{9}/ 4 = 3000×10^{6} / 4 = 750×10^{6} = 750 million instructions

C/

1: ... 8 xN ...

2: ... 8 + 3x6 =26 cycles per instruction, for a total of 26 xN.