No E-Mail submissions will be accepted.
Submission formats and file naming:
File name : firstName_lastName_lab_6
File format: pdf or MS Word format
e.g. Donald_Trump_lab_6.pdf

Reading materials

Use the following links and write a one page summary about the movies.

How Does a Quantum Computer Work?
https://www.youtube.com/watch?v=g_IaVepNDT4&ab_channel=Veritasium

The video explains the differences between classical computers and quantum computers, noting on how quantum computing better computational power.
As we know, a classical computer processes information using bits, which can be either 0 or 1 at a time. This is the foundation of all traditional computing. A quantum computer uses qubits or quantum bits, which can have a unique property. They can exist in both 0 and 1 at the same time. This difference is what makes quantum computers able to perform certain types of calculations much faster than old computers.
The video talks about an example where researchers use the outermost electron in a phosphorous atom as a qubit. This works because electrons have a magnetic field, making them behave like tiny bar magnets. In the presence of a magnetic field, the electron will align in either a low-energy state and spin down, or 0; or a high-energy state spin up or 1.
the strange part of quantum mechanics is that before measurement, the electron can exist in both states at once. When measured, the electron changes into either 0 or 1, but before that, it holds a combination of probabilities for both states. This ability is what lets quantum computers to process information in a different way.
The video talks about multiple qubits where with two classical bits, there are four possible states and a classical computer can only store one of these four values. In a quantum computer, two qubits can exist in a superposition of all four states at once, meaning they can represent four values simultaneously, or 4 constants. If you

add a third qubit, it can hold eight values at once, and so on until you get 2^N classical bits of information.

But there's aproblem. Quantum computers don't provide better performance for everything. When qubits are measured, they collapse into a single value, meaning all the superposition information is lost. This makes quantum computing useful only for specific types of problems, where the calculations take advantage of quantum parallelism before measurement. The challenge is designing quantum algorithms that extract useful answers while maintaining the quantum advantage.

The video also makes it clear that quantum computers won't replace classical computers. They are not universally faster—they only reduce the number of operations needed for certain tasks. For stuff like if you're watching a video, browsing the internet, or writing documents, a quantum computer won't provide any benefit. But for where parallel calculations are used, quantum computers can be used.

Although quantum computing is a breakthrough, it is not a magic solution for all computing needs. It is another tool useful for specific problems where classical computing struggles.

1) The state of 8088 CPU at certain time is given by the following figure. Using this figure obtain next instruction, machine code, and the value of AX, CX, and BX before and after CPU execution.

```
AX=0100  BX=0023  CX=0123  DX=0000  SP=FFEE  BP=0000  SI=0000  DI=0000
DS=11B4  ES=11B4  SS=11B4  CS=11B4  IP=0300   NV UP EI PL NZ NA PO NC
11B4:0300 01C8          ADD     AX,CX
```

Before
AX = 0100, BX = 0023, CX = 0123
Next instruction = ADD AX,CX
Machine code = 01C8
The memory address of the next instruction = 0300

After
AX = 0223, BX = 0023, CX = 0123

2) A program consists of 8 floating point instructions and 12 integer instructions. Floating point instructions take 5 cycles and integer instructions take 2 cycles each. Assuming that the processor has a clock rate of 200.0 MHz:

a) Obtain the total cycles.

if 8 floating point instruct[ions]
and 12 integer intructions.
and it takes 5 cycles per
and 2cycles per then:

$8 \times 5 + 12 \times 2$

$= 64$ cycles total

b) Obtain the total instructions.

8 floating point and 12 integer instructions so total = 8+12=20

c) Obtain the average cycles per instruction.

$$\frac{\text{total cycles}}{\text{total instructions}} = \frac{64}{20} = 3.2$$

d) Using the total cycles Obtain the execution time.

total cycles = 64
time per cycle = 200 MHz

$$= \frac{64}{200\,\text{MHz}} = \frac{\cancel{32}}{} \times 10^{-5}\,s = 0.00000032$$

or

320 ns

e) Using the average cycles per instruction obtain the execution time.

3.2 cycles per instruction
20 instructions
200 MHz

$$= \frac{3.2 \times 20}{200\,\text{MHz}} = \frac{64}{200\,\text{MHz}} = 0.00000032$$

or

320 ns

f) Compare the results obtained in parts d and e.

They are the same.

320 ns = 320 ns

3) A program consists of 50,000 instructions as follows:

Instruction Type	Instruction Count(IC)	Cycle per Instruction(CPI)
Floating point	30,000	5
Integer	16,000	2
Data transfer	4,000	6

❖ Complete the following table:

Processor	Clock Rate (MHz)	Cycle Time(CT) (nanosecond)	Execution Time (microsecond)
P1	200	5	1030
P2	300	3.3	6798
P3	500	2	412

p1 r/y

$$CR = \frac{1}{CT} \qquad CR = 200000000$$

$$CR = \frac{1}{5\,ns} \qquad CR = 200\,MHz$$

$$CR = \frac{1}{5 \times 10^{-9}}$$

P2 R2

$CR = \frac{1}{CT}$

$300MHz = \frac{1}{CT}$

$CT = 3.3 ns$

P3 R2

$CR = \frac{1}{CT}$

$500MHz = \frac{1}{CT}$

$CT = 2ns$

P1 R3

$Exectime = IC \times CPI \times CT$

$ET = 206,000 \times 5ns$ from below

$ET = 1030000 ns$

$ET = 1030 \mu s$

P2R3

$ET = IC \times CPI \times CT$

$ET = 206000 \times 3.3ns$

$ET = 679.8 \mu s$

P3R3

$ET = 206000 \times 2$

$ET = 412 \mu s$

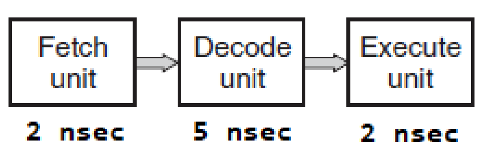
❖ Obtain the average cycles per instruction.

Find IC and CPI avg

$= (36000 \times 5) + (16000 \times 2) + (4000 \times 6)$

$= 206000$

4) A computer has a pipeline with 3 stages:



Non-pipelined processor:

A. How many instructions per second can this machine execute?

$2 + 5 + 2 = 9ns$ per instruction

$1s = \frac{1000000000 ns}{9ns} = 111,111,111.1$ instructions per sec

B. What is the latency of an instruction?

9 ns

Pipelined processor:

A. How many instructions per second can this machine execute?

$$1s = \frac{1000000000\,ns}{5ns} = 200000000$$

200,000,000 inst. per s

B. What is the latency of an instruction?

9ns for the first, 5ns after

5) The state of 8088 CPU at certain time is given by the following figures. Using this figures obtain next instruction, machine code, and the value of AX, CX, and BX before and after CPU execution. Do they have same machine codes(figures 1 and 2)?

Fig 1

```
AX=0023  BX=0777  CX=077A  DX=0000  SP=FFEE  BP=0000  SI=0000  DI=0000
DS=11B4  ES=11B4  SS=11B4  CS=11B4  IP=0300   NV UP EI PL NZ NA PO NC
11B4:0300 31D8           XOR     AX,BX
```

Before

AX = 0023, BX = 0777, CX = 077A
Next instruction = XOR AX,BX
Machine code = 31D8
The location of next instruction = 0300

After
AX = 0754, BX = 0777, CX = 077A

Fig 2

```
AX=0023 BX=0777 CX=077A DX=0000 SP=FFFE BP=0000 SI=0000 DI=0000
DS=0DB4 ES=0DB4 SS=0DB4 CS=0DB4 IP=0300 NV UP EI NG NZ NA PO NC
0DB4:0300 31D9              XOR     CX,BX
```

```
Before

AX = 0023, BX = 0777, CX = 077A
Next instruction = XOR CX,BX
Machine code     = 31D9
The location of next instruction = 0300

After
AX = 0023, BX = 0777, CX = 000D
```

No, they are not the same, they are different by 1.