Homework 1
EET 340
Introduction to Computer Organization and Architecture
Spring 2022

INSTRUCTIONS: Show the detailed steps of your calculation. The homework solution can either be typed in word or handwritten. However, convert the word or scanned (handwritten) documents to PDF and submit to Canvas.

1. Write characteristics of the six different classes of computers. (15 Points)

Personal computer: Single end user computer built for personal use.

Server: Multi-user computer built to host and serve resources over a network.

Super computer: Purpose built computer made of an array of small computer to solve complex problems.

Embedded computer: Task built computer where software interacts directly with hardware.

Personal mobile device: Portable wireless computer capable of accessing the internet as well as manipulating many types of data by use of purpose-built applications.

Cloud computing: The consolidation of many servers that provide software, infrastructure, or computing resources as a service.

2. What are the three levels of program code? Describe each level. (15 Points)

High level language: Closest to human language which are more accessible to read and write.

Low level language: Language that the computer can understand by instruction set that are not readily obvious to humans.

Machine language: Programs that are written in binary which is what high level and low level languages are reduced to before a computer can execute a program.

3. Discuss five components of a computer? Give at least two examples for each component. (10 Points)

Input: Mouse and keyboard.

Output: Monitor and speaker.

Memory: Hard disk and ram.

Control: CPU command of the data path by instruction set.

Datapath: Bus and registers.

4. State Amdahl's law. (5 Points)

Overall performance improvement gained by optimizing a single part of a system is limited by the fraction of time that the improved part is used.

5. Consider three different processors P1, P2, and P3 executing the same instruction set. If the processors each execute a program in 10 seconds, find the number of cycles and the number of instructions for each processor? (20 Points)

	P1	P2	P3
Clock Rate	3 GHZ	2.5 GHZ	4 GHZ
CPI	1.5	1	2.2

$$\text{CPU Time} = \text{CPU clock cycles} * \text{Clock cycle time} = \frac{\textit{CPU clock Cycles}}{\textit{clock rate}}$$

CPU clock cycles = instruction count * clock cycles per instruction

$$\text{CPU Time} = \text{instruction count} * \text{clock cycles per instruction} * \text{clock cycle time} = \frac{\textit{instruction count} * \textit{clock cycles per instruction}}{\textit{clock rate}}$$

PROCESSOR	CPU TIME	CPU CLOCK CYCLES [cycles = cpu time * clock rate]	CLOCK RATE	INSTRUCTION COUNT [IC = CPU time * (clock rate/ cpi)]	CLOCK CYCLES PER INSTRUCTION
P1	10	3.00E+10	3.00E+09	2.00E+10	1.5
P2	10	2.50E+10	2.50E+09	2.50E+10	1
P3	10	4.00E+10	4.00E+09	1.82E+10	2.2

6. Consider two different implementations of the same ISA. The instructions can be divided into classes as follows (Classes A, B, C, D): (35 Points)

Class	A	B	C	D
CPI (P1)	1	2	3	3
CPI (P2)	2	2	2	2

P1 and P2 have clock rate of 2.5 GHZ and 3.0 GHZ, respectively. Given a program of Dynamic Instruction count of 1.0E6 instructions divided into classes as follows: 10% class A, 20% class B, 50%class C and 20% class D.

CLASS	IC A [IC = 1.0E6 *0.1]	IC B [IC = 1.0E6 * 0.2]	IC C [IC = 1.0E6 * 0.5]	IC D [IC = 1.0E6 * 0.2]	CLOCK RATE	AVE CPI [AVE CPI = CLOCK CYCLES/INSTRUCTION COUNT]	CLOCK CYCLES [CLOCK CYCLES = $(CPI_A * IC_A) + (CPI_B * IC_B) + (CPI_C * IC_C) + (CPI_D * IC_D$
P1	100000	200000	500000	200000	2.50E+09	2.6	2600000
P2	100000	200000	500000	200000	3.00E+09	2	2000000

a. which is faster: P1 or P2?

P2 is faster with 2.0E6

b. What is the global (average) CPI for each implementation?

P1 CPI = 2.6
P2 CPI = 2

c. Find the clock cycles required in both cases.

P1 clock cycles = 2.6E6
P2 clock cycles = 2.0E6