CSE340: Computer Architecture

Assignment 1

Chapter 1 (Computer Abstractions and Technology)

Question - 1:

What do you understand by "**Dependability via Redundancy**" in terms of computer architecture? Why is it important to keep redundancy while designing a system?

Question - 2:

X is an IC manufacturing company. They have an order for 9900 IC chips. They started their manufacturing process with 10 silicon ingots each with a radius of 7 cm. Each die should have an area of 1.55 cm^2.

- **A.** What is the area of the wafers they are making and how many dies can they make per wafer?
- **B.** During manufacturing, they discovered that the wafers had 0.035 defects/cm^2. Find out the value of yield and comment on it according to the definition of yield.
- **C.** Find out the cost per die if one wafer costs 13 units. Find out the total number of dies if they can make 10 wafers per ingot and the total cost of making 9900 dies.
- **D.** Can they fulfill their order? Explain why or why not.

Question - 3:

a. Explain Amdahl's Law in your own words.
b. Can you relate/connect Amdahl's law with any of the design principles, mentioned below? Explain the reason with an example.

	Design Principle
1	Performance via Prediction
2	Performance via Pipelining
3	Make the common case faster
4	Use Abstraction to Simplify Design

Question - 4:

Description	Name	Instruction Count x 10^9	CPI	Clock cycle time (seconds x 10^{-9})	Execution Time (seconds)	Reference Time (seconds)	SPECratio
Interpreted string processing	perl	2252	0.60	0.376	508	9770	19.2
Block-sorting compression	bzip2	2390	0.70	0.376	629	9650	15.4
GNU C compiler	gcc	794	1.20	0.376	358	8050	22.5
Combinatorial optimization	mcf	221	2.66	0.376	221	9120	41.2
Go game (AI)	go	1274	1.10	0.376	527	10490	19.9
Search gene sequence	hmmer	2616	0.60	0.376	590	9330	15.8
Chess game (AI)	sjeng	1948	0.80	0.376	586	12100	20.7
Quantum computer simulation	libquantum	659	0.44	0.376	109	20720	190.0
Video compression	h264avc	3793	0.50	0.376	713	22130	31.0
Discrete event simulation library	omnetpp	367	2.10	0.376	290	6250	21.5
Games/path finding	astar	1250	1.00	0.376	470	7020	14.9
XML parsing	xalancbmk	1045	0.70	0.376	275	6900	25.1
Geometric mean	–	–	–	–	–	–	25.7

To calculate the **benchmark** of a system, why do we take the **geometric mean** instead of only taking the **average** of the individual spec ratios?

Question - 5:

We are building a calculator. Below is the program of the calculator app converted to assembly language,

Line No.	Instruction	Line No.	Instruction
1	add	10	sub .....
2	add	11	mul .....
3	add	12	sub .....
4	add	13	sub .....
5	mul	14	add .....
6	addi	15	addi .....
7	add	16	sub .....
8	add	17	mul .....
9	add	18	sub .....

CPI for add, sub, mul, and addi instructions are respectively 2, 3, 4, and 5. The duration of a clock cycle is 3s.

a. What is the total number of instructions in the above-mentioned program?

b. What is the execution time of this program?

c. What is the Clock rate?

d. If you want to make the system faster and you can only speed up one type of instruction, which instruction would you choose and why?

e. Suppose you want to reduce the current execution time by 1.2 times. What improvement factor would be required for the chosen instruction in question d?