

CSE 4010 – Homework1
Chapter1: Introduction and Performance Measures

- **Skills & Knowledge:** The purpose of this assignment is to help you practice the following skills that are essential to your success in this course in your major and professional work behind the school.
 - Perform elementary quantitative performance evaluation of computer system
 - Analyze cost performance and design trade-offs in designing and constructing a computer processor
 - Application of Performance metrics: CPU execution time, Amdahl's law, MIPS performance
- **Deliverables:** Turn in your solution through Blackboard in Softcopy (NEAT handwritten scanned, or using Word, or any other tool, and then convert to PDF).
- **You may work with classmates/group members , or share discussion in the course Discord server**

P1) (20 pts) [**Eight Great Ideas in Computer Architecture**] Consider The eight great ideas in computer architecture are similar to ideas from other fields. Match the eight ideas from computer architecture, "Design for Moore's Law", "Use Abstraction to Simplify Design", "Make the Common Case Fast", "Performance via Parallelism", "Performance via Pipelining", "Performance via Prediction", "Hierarchy of Memories", and "Dependability via Redundancy" to the following ideas from other fields: [The first one is done for you]:

- a. Assembly lines in automobile manufacturing (Ans: *Performance via Pipelining*)
- b. Suspension bridge cables
- c. Aircraft and marine navigation systems that incorporate wind information
- d. Express elevators in buildings
- e. Building self-driving cars whose control systems partially rely on existing sensor systems already installed into the base vehicle, such as lane departure systems and smart cruise control systems.
- f. Library reserve desk

P2) (30 pts) [**Performance Measure- Execution Time**] Consider three different processors P1, P2, and P3 executing the same instruction set.

P1 has a 3 GHz clock rate and a CPI of 1.5.

P2 has a 2.5 GHz clock rate and a CPI of 1.0.

P3 has a 4.0 GHz clock rate and has a CPI of 2.2.

- a. Which processor has the highest performance expressed in instructions per second?
- b. If the processors each execute a program in 10 seconds, find the number of cycles and the number of instructions.
- c. We are trying to reduce the execution time by 30% but this leads to an increase of 20% in the CPI. What clock rate should we have to get this time reduction?

P3) (30 pts) [**Amdahl's law – partial improvement**] Consider a computer running a program that requires 250 s, with 70 s spent executing FP instructions, 85 s executed L/S (Load /Store) instructions, and 40 s spent executing branch instructions.

- a. By how much is the total time reduced if the time for FP operations is reduced by 20%?
- b. By how much is the time for INT operations reduced if the total time is reduced by 20%?
- c. Can the total time be reduced by 20% by reducing only the time for branch instructions?

P4) (20 pts) [**Computer Performance**] A CSE students' team were asked to enhance the current RISC based computer system into a new machine we call it CSUSB_RISC by adding Computer Vision Support(CVS) hardware. Instructions that can be run on the new CVS hardware will execute 6 times faster than the original computer system. What the percentage of time spent on instructions that can be run on the improved hardware(CVS) is needed in order to achieve an overall speedup of 2? [*Hint: use Amdahl's law, the answer is : 60% . Show your work*]