ECE 331 (Fall 2021) Homework #1

(Due September 14, 2021 by 11:55PM ET on Sakai "Assignment")

1. [25 points] Regarding the 6 classes of computers:
(1) Please provide one example computer for each class.
(2) Please discuss what additional features we care about in each class of computers, in addition to fast speed. (Hint: the additional features may include energy efficiency, cost, form factor, etc.).
(3) Please discuss an additional class of computers you can think of and why you think they are "computers"; alternatively, you can discuss a specific computer example, which belongs to 1 of the 6 classes but was not discussed in the lecture, and explain why you think it belongs to that class.

2. [25 points] Please answer the following questions regarding the 5-component generic computer architecture:
(1) What are the 5 components and their relationship?
(2) The textbook provided an example of disassembled smartphone. Can you please describe what parts of the smartphone are corresponding to the 5 components?
(3) In addition to the smartphone, can you please describe the 5 components for another class of computer? In that case, which of the 5 components are dramatically different from the smartphone and why?

3. [25 points] Suppose you have two processors that have the following parameters for frequency and CPI.

	Processor A	Processor B
Frequency	1 GHz	2 GHz
Average CPI for ALU Instructions	1	1.5
Average CPI for Branch Instructions	2	3
Average CPI for Memory Load	6	7

(1) If you are asked to execute a program with the following instruction mix, which processor would be faster? Please justify your answer quantitatively.
- ALU Instructions: 40%
- Branch Instructions: 20%
- Memory Load Instructions: 40%

(2) Suppose you can double the performance of branch instructions by using a dynamic branch prediction scheme for both processors. How much faster is each processor when executing the above program?

4. [25 points] Regarding the "7 great ideas in computer architecture", please note that the 1st edition of the textbook actually had the 8th great idea listed as "Designing for Moore's Law".
(1) What is Moore's law?
(2) Please comment on why the 2nd edition of the textbook removed this 8th great idea.
(3) What impacts does this new situation of Moore's Law pose on the advancements of memory and processor, and what might be the possible solutions?