HW#1: Performance Evaluation/Equation/Time

New Attempt

Due Sep 5 by 11:59pm **Points** 100 **Submitting** a text entry box or a file upload **File Types** doc, pdf, and txt

Assignment 1

Note, read the following carefully:

All homeworks will have to be turned in electronically on Canvas.

Plan accordingly and don't leave your submission until the last minute.

Make reasonable assumptions where necessary and clearly state them.

Feel free to discuss problems with classmates, but the only written material that you may consult while writing your solutions are the textbook, lecture notes, and lecture slides.

I am allowing you to submit HWs in groups of two at the most.

You will be able to review other people's solutions. I am allowing the reviews to appear Anonymously.

Grading Policy: I am not grading these for correctness to the decimal point but I am more interested in seeing that you understand the concepts and can apply what you have learned. Therefore, grading here will be more lenient than in Exams. But the problems are exam quality problems. I do not provide solutions to any homework but I am more than happy to solve whichever ones you want in class if asked to. The discussion and peer-review of your fellow students' solutions is part of the requirements and part of what will get graded. You actually learn from your peers sometimes more than from your instructors.

1. Examine the University and the College Cheating Policy. As stated above, it is fine to learn the material and problems in co-operation with others. But when you sit down to write your solution, be sure to do it independently while only consulting class materials.

2. **Sum of Execution Times (20 points)**

   A 4-program benchmark suite has execution times as listed below for 3 different systems. Assume that System-A is the reference machine. How does the performance of system-C compare against that of system-B? Show this comparison for all three metrics (sum of execution times, sum of weighted execution times, and GM of execution times). Report the comparison in terms of **speedup.**
   Addendum: Spet. 6: you can get the weights from the reported numbers on the reference system.

	Program A	B	C	D
Exec times on System-A (seconds)	100	300	150	50
Exec times on System-B (seconds)	50	400	200	60
Exec times on System-C (seconds)	75	450	100	40

3. **Performance Equation (20 points)**

   My new laptop has a clock speed that is 20% higher than my old laptop. I run the same three binaries on both machines. Each binary runs for roughly the same number of cycles on each machine. The IPCs of the binaries are listed in the table below. What is the **performance improvement** provided by my new laptop?

	Program A	B	C
IPCs on old laptop	1.0	0.4	1.4
IPCs on new laptop	0.9	0.3	1.5

4. **Power and Energy (30 points)**

   Consider a processor that runs at 3 GHz and 1 Volt. When running a given CPU-bound program, the processor consumes 100 W, of which 20 W is leakage. The program takes 20 seconds to execute. The processor is capable of running at different voltages and frequencies. Can you compute the following values: (i) The smallest time it takes to execute the program. (ii) The lowest power to execute the program. (iii) The lowest energy to execute the program. Assumptions: The processor is capable of executing safely at voltages between 0.8 V to 1.2 V. Voltage and frequency follow a linear relationship (i.e., if voltage doubles, frequency doubles as well).

5. **Power and Energy (30 points)**

You have a large inventory of Intel processors that run at 3 GHz and 1 Volt, and consume 100 W (of which, 20 W is leakage) when running a given CPU-bound application. This application finishes in 100 seconds on this processor. The processor is capable of DFS and DVFS, but cannot reduce its voltage under 0.9 V. A customer places an order for motherboards that have inexpensive cooling and power delivery that can only handle a processor that runs at 40 W. How will you configure your Intel processor so that it meets these specifications and consumes as little energy as possible for the same CPU-bound application? How much energy does the processor consume to finish this application on this new system?

6. Extra Credit [50 Points]: These are problems from the book.

1.9: Energy calculation
1.12: MTTF
1.13: Trade off analysis of two processors
1.16: Trade off analysis of using a FPU