ECE 429 / 629 Homework #1

1. Suppose we make an enhancement to a computer that improves the speed of accessing the stack by a factor of 10. After making this improvement, we notice that the amount of time the computer spends accessing the stack is 50% of the total execution time. (Recall that this percentage cannot be plugged directly into Amdahl's Law, which depends on the fraction of the original, unenhanced execution time.)
    a. What is the overall speedup obtained?
    b. What percentage of the original execution time has been affected by the speedup?
2. Suppose three machines named A, B, and C, execute program P1 in 1, 10, and 20 seconds, respectively. Suppose they execute program P2 in 1000, 100, and 20 seconds, respectively. Assume that each program on each machine contains 100 million floating-point operations.
    a. Calculate the MFLOPS rating of each program.
    b. Calculate the arithmetic, geometric, and harmonic means of MFLOPS for each machine. (Use computer A as the reference for the geometric mean.)
3. Show that
    a. for any two positive integers, *a* and *b*, the arithmetic mean is always greater than or equal to the geometric mean. When are the two equal?
    b. for any two positive rates, *r* and *s*, the arithmetic mean is always greater than or equal to the harmonic mean. When are the two equal?
4. From the collection of computers with reported SPEC CFP2000 benchmark results at http://www.spec.org/osg/cpu2000/results/ , choose a set of three computer models that are identical except for clock speed (use the Dell Precision Workstation 340 P4 1.5, 1.7, 1.8 GHz). Compare and contrast the clock speedup to the SPECfloat_base2000 speedup. How closely does benchmark performance track clock speed? If you buy a computer with twice the clock speed of your present computer, approximately how much speedup should you expect in the execution of your programs?

Problems adapted from Hennessy and Patterson, *Computer Architecture: A Quantitative Approach*, 3rd edition, Morgan Kaufmann, 2003. (Questions 1.3, 1.10, 1.11, 1.12, 1.21)