# ECE 429 / 629 Homework #2

This homework covers Sections 1.8-1.9 of the textbook.

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. Calculate the SPEC ratings for B and C, assuming A is the reference.
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 CFP2006 benchmark results at http://www.spec.org/osg/cpu2006/results/ , choose two computer models that are identical except for clock speed. Compare the clock speedup to the performance 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 would you expect in the execution of your programs?
5. Suppose you have a program with three non-overlapping parts. I.e., E = t + u + v, where E is the total execution time and t, u, and v are the three parts. Two of these parts, u and v, are sped up by factors s_u and s_v, respectively.
    a. Write the equation for the total speedup as a function of the two individual speedups.
    b. Suppose t, u, and v take up 20%, 60%, and 20%, respectively, of the processor time before speedup. Suppose u is sped up by 10x and v by 20x. What is the total speedup?

Textbook: Hennessy and Patterson, *Computer Architecture: A Quantitative Approach*, 4th edition, Morgan Kaufmann, 2007.