

**Computer Architecture**

**Homework # 1**

**COVER SHEET**

**(Due: Beginning of class on 02/27/15)**

Name :

ID Number :

**Directions:** Write your answers on the sheets provided. Submit with the COVER SHEET. If you need additional sheets for any of the problem, add as many blank papers as you require. Print your name clearly. **No late homework will be accepted.** You are expected to write up your solutions *on your own*, without referring to other students' works or to solutions you may find on the web. The total score is 170 points. **This homework is due at the beginning of class on Friday, Feb 27, 2015.**

### Speedup

1. Consider two different implementations, I1 and I2, of the same instruction set. There are three classes of instructions (A, B, and C) in the instruction set. The clock rates of I1 and I2 are 6GHz and 3 GHz, respectively. The average number of cycles for each instruction class on I1 and I2 is given in the following table:

Class	CPI on I1	CPI on I2	C1 usage	C2 usage	C3 usage
A	2	1	30%	40%	60%
B	3	2	50%	20%	15%
C	5	2	20%	40%	25%

The table contains a summary of average proportion of instruction classes generated by three different compilers. C1 is a compiler produced by the makers of I1, C2 is produced by the makers of I2, and the other compiler is a third-party product. Assume that each compiler uses the same number of instructions for a given program but that the instruction mix is as described in the table.

(a) Using C1 on both I1 and I2, which machine is faster and by how much? (5)

(b) Using C2 on both I1 and I2, which machine is faster and by how much? (5)

(c) If you purchase I1, which compiler would you use? (5)

(d) If you purchase I2, which compiler would you use? (5)

2. Suppose that we support an enhancement mode to a computer by a factor of 20. Enhanced mode is used 60% of the time, measured as a percentage of the execution time when the enhanced mode is in use. Recall that Amdahl's law depends on the fraction of the original, unenhanced execution time that could make use of enhanced mode. Thus, we cannot directly use this 60% measurement to compute speedup with Amdahl's law.

a. What is the speedup obtained from the enhanced mode? (5)

b. What percentage of the original execution time has been converted to the enhanced mode? (5)

3. When parallelizing an application, the ideal speedup is speeding up by the number of processors. This is limited by two things: percentage of the application that can be parallelized and the cost of communication. Amdahl's law takes into account the former but not the latter.

a. What is the speedup with 8 processors if 90% of the application is parallelizable, ignoring the cost of communication? (5)

b. What is the speedup with 8 processors if, for every processor added, the communication overhead is 1% of the original execution time. (5)

c. What is the speedup with 8 processors if, for every time the number of processors is doubled, the communication overhead is increased by 1% of the original execution time? (5)

4. You will run two applications on this dual core, but the resource requirements are not equal. The first application requires 70% of the resources, and the other only 30% of the resources. Assume that when you parallelize a portion of the program, the speedup for that portion is 2.

a. Given that 40% of the first application is parallelizable, how much speedup would you achieve with that application if run in isolation? (5)

b. Given that 99% of the second application is parallelizable, how much speedup would this application observe if run in isolation? (5)