Homework 1

(Due Feb. 11, 2020, except Prob. 12 which is due Feb. 24, 2020)

1. **Read** Chapter 1 and 2 of the textbook, read the C-AMAT paper (http://www.cs.iit.edu/~scs/assets/files/SUN-ConcurrentAMAT__IEEE_May2014.pdf)

2. **Speedup**

Assume --as in the Amdahl's Law example --that we make an enhancement to a computer that improves some mode of execution by a factor of 10. Enhanced mode is used 50% of the time, measured as percentage of the execution time *when the enhanced mode is in use*. Recall that Amdahl's Law depends on the fractions of the original, *unenhanced* execution time that could make use of enhanced mode. Thus, we cannot directly use this 50% measurement to compute speedup with Amdahl's Law.

   a. <1.6>what is the speedup we have obtained from fast mode?

   b <1.6>what percentage of the original execution time has been converted to fast mode?

3. **Solve 1.2 of the text (6th edition)**

4. **Solve 1.4 of the text (6th edition)**

4. **Solve 1.7 of the text (6th edition)**

5. **Solve 1.11 of the text (5th edition)**

6. **Solve 2.1 of the text (6th edition)**

7. **Solve 2.2 of the text (6th edition)**

8. **Solve 2.19 of the text (6th edition)**

9. **Solve 2.20 of the text (6th edition)**

10. **Solve 2.21 of the text (6th edition)**

11. **How** to optimize the following code to reduce the miss rate of a memory system? Please give the optimized code and explain why briefly.

```
for (i = 0; i < N; i++) {
    A[i] = B[i] + C[i];
    }
for (i = 0; i < N; i++) {
    D[i] = B[i] + A[i];
    }
```

12. Choose any computer you like (such as desktop or laptop with multicore system) 1) Look up for CPU data manual, analyze its single core peak performance; 2) make a program to calculate matrix multiplication, try your best to approach the peak performance, give the final program and real performance in GFlops, compare it with peak performance. (4 weeks)

Some useful hints:
1. Cache size, especially L1 cache size
2. Data layout
3. Use which compiler, gcc or Intel compiler? What is compiler optimization option?
4. SIMD unit or some other float point units in pipeline?