**Homework 3**

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1. Comparing Performance
   1. P1: 1 cycle / 1 instruction, 4,000,000,000 cycles / 1 second, so 4,000,000,000 instructions per second is the fastest it can operate at.  
        
      P2: 2 cycles / 1 instruction, 6,000,000,000 cycles / 1 second, so 3,000,000,000 instructions per second.
   2. P1 speed = 1,714,285,714 instructions / second  
      P2 speed = 2,250,000,000 instructions / second  
        
      P2 is (P2 – P1) 535,714,286 instructions / second faster than P1.
   3. C1 on I1 = 2,000,000,000 instructions / second  
      C1 on I2 = 2,500,000,000 instructions / second  
      C2 on I1 = 1,764,705,882 instructions / second  
      C2 on I2 = 2,500,000,000 instructions / second  
      C3 on I1 = 2,000,000,000 instructions / second  
      C3 on I2 = 2,666,666,667 instructions / second  
        
      Using C1 on I1 is faster than C1 on I2 by 500,000,000 instructions / second.  
      Using C2 on I2 is faster than C2 on I1 by 735,294,118 instructions / second.  
        
      If I purchased I1, I would use either C1 or C3.  
      If I purchased I2, I would use C3.  
        
      I would purchase I2 and use C3 to get the most out of my computer.
2. Amdahl’s Law
   1. Multiplication Enhancement: 29.03% speedup  
      Memory Access: 33% speedup  
      Both Improved: 90.47% speedup
   2. Mult% - (Mult% / 4) = Mem% - (Mem% / 2)  
      3Mult% / 4 = Mem% / 2  
      3/2 \* Mult% = Mem%  
        
      An example of this formula could be that Mult% = 20% and Mem% = 30%.  
      The speedup for both improvements would be 17.65%
3. Analyzing Enhancements to a Processor
   1. CPI for Mbase = 2.8  
      CPI for Mopt = 2.4
   2. Mbase runs at 2,142,857 instructions / second  
      Mopt runs at 2,916,666 instructions / second  
        
      Mopt is faster by 773,809 instructions / second
   3. The CPU spends 40% of its cycles doing multiply instructions. (If there are 100 instructions, there are 300 cycles spent on multiplication, and 450 spent on other things. 300 / 750 = 40%) Therefore, it also takes 40% of its time as well.
   4. The CPU now spends 30.77% of its cycles doing multiply instructions. But with an increase in 20% for each cycle, the CPU now spends 36.92% of its time doing multiply instructions. They should proceed with the modification.