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CSCI 564: Advanced Computer Architecture (Bo Wu)
Homework 1
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1. CPI: 17.63

- CPI of ALU: (1.1 x 46%) = 0.506
- CPI of Jumps/branches: (3.0 x 20%) = 0.6
- CPI of Loads/stores: (34% x ((40% x 120) + (60% x 1))) = 16.524
- CPI of the machine: 0.506 + 0.6 + 16.524 = 17.63

2. Processor 2.

- Processor 1: 1 Ghz, CPI 1.2
- Processor 2: 2 Ghz, CPI 2
- From the latency formula, it can be concluded that processor 2 is better to build. This is because if you multiply 1/the clock speed by the average CPI, processor 2 results in a lower latency than processor 1, and therefore the performance is better.

3. The percentage of time of the original execution that was spent waiting for memory was 77.78%.

- Latencies are reduced by a factor of 3.5
- Let's say that the execution took 100 seconds (post optimization)- 50 for memory, 50 for other things
- oldLatency = 3.5 x 50 = 175 seconds
- Original execution time = 175 seconds + 50 = 225 seconds
- 175/225 = 77.78% → the amount we used to spend waiting for memory.

4. Frequency can be reduced by 30%.

- In a 60% parallelizable application: (Using Amdahl's Law: x=0.6, s=2)
- Speedup = 1/((0.6/2) + (1-0.6)) = 1/0.7 = 1.43
- To finish the same workload in same execution time:
- freqOld/freqNew = 1/speedup = 0.7/1 = 0.7
- Therefore, frequency can be reduced by 30%.