## Lecture 3:

Exercise 9:

1. Let p denote performance, and I the instruction count (multiplied by some constant so we can use the GHz unit). Then I * px = (clock rate of Px)/(CPI of Px), and so we can compare the three processors; I * p1 = 2/1.5 = 40/30, I * p2 = 1.5/1 = 45/30, I * p3 = 3/2.5 = 36/30. Meaning, compared between the three, P2 has the highest performance.

2. We get these by juggling around the various expressoins for performance terms. To be brief, in order, number of cycles: 2 * 10ˆ10, (3/2) * 10ˆ10, 3 * 10ˆ10, and number of instructions: (4/3) * 10ˆ10, (3/2) * 10ˆ10, (6/5) * 10/10.

3. By manipulating the fact that 0.7 * (CPU time) = (Instructions) * 1.2 * (CPI) / (New clock rate) we get that (New clock rate) = (12/7) * (Instructions) * (CPI)/(CPU time) = (12/7) * (Old clock rate). So to reduce the CPU time by 30% we would need to increase the clock rate by roughly 71%, so, in order, P1, P2, P3 would need to become 3.4 Ghz, 2.6 GHz and 5.1 Ghz, respectively.

Exercise 10:

1. a. 200 - 0.2 * 35 = 193s b. 210 - 0.2 * 50 = 200s 2. a. 0.2 * 85 = 17s, b. 0.2 * 80 = 16s 3. No, even if branch instructions where eliminated completely there would only be time reductions of 15% and 14% for a and b respectively.

Exercise 11:

1. Compute time ratios: [0.55, 0.51, 0.61, 0.47, 0.48], Communication time ratios: [1.18, 1.31, 1.29, 1.05, 1.13].

2. Geometric means: 0.52 and 1.19. So we would suspect getting a computation time of 0.52 * 6.5 = 3.38ms and the time for communication to be 26 * 1.19 = 30.94ms.

3. By the same extrapolation as above we can approximate the times for a single processor as 176/0.52 = 338.46ms for computation and 11/1.19 = 9.24ms for communication.

Exercise 12:

1. *Ideally*; 2500, 1250, 625 requests/sec for 4, 8, 16 CPUs/cores respectively.

2. This would mean that *everything* performed in in a ‘request’ is completely parallelizable, which is quite unlikely.