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CS 383 C
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Homework 1

1.5.a.
IPS(P1) = 3 * 10^9 clocks/second * 1/1.5 instructions/clock = 2 * 10^9 instructions/second
IPS(P2) = 2.5 * 10^9 clocks/second * 1 instruction/clock = 2.5 * 10^9 instructions/second
IPS(P3) = 4.0 * 10^9 clocks/second * 1/2.2 instructions/clock = 1.8 * 10^9 instructions/second
P2 has the highest performance
b.
P1 -- 3 * 10^10 clocks, 2 * 10^10 instructions
P2 -- 2.5 * 10^10 clocks, 2.5 * 10^10 instructions
P3 -- 4.0 * 10^10 clocks, 1.8 * 10^10 instructions
c.
Execution time - 7 seconds.
P1 -- 2 * 10^10 instructions * 1.2 * 1.5/1 clocks/instruction / 7 seconds = 5.14 GHz
P2 -- 2.5 * 10^10 instructions * 1.2 * 1 clock/instruction / 7 sec= 4.29 GHz
P3 -- 1.8 * 10^10 instruction * 1.2 * 2.2 clocks/instruction / 7 sec = 6.79 GHz

1.6.
10E6 instructions the same as 10 instructions -- A - 1, B - 2, C - 5, D - 2
P1 - 1*1 + 2*2 + 3*5 + 3*2 = 26 clocks/ 1/2.5 GHz = 10.4 time units
P2 - 1*2 + 2*2 + 2*5 + 2*2 = 20 clocks / 1/3.0 GHz = 6.6 time units
P2 is faster.
a.
P1 -- 26 clocks/10 instructions = 2.6 CPI
P2 -- 20 clocks/10 instructions = 2.0 CPI
b.
P1 -- 2.6 CPI * 10E6 instructions = 2.6E6 clocks
P2 -- 2.0 CPI * 10E6 instructions = 2.0E6 clocks

1.7. -- CA = compiler A, CB = compiler B
a. Processor = 1/1E-9 = 1GHz
CA -- 1.0E9 instructions / 1.1 seconds * 1E-9 seconds/clock = 1/1.1 instructions/clock = 1.1 CPI
CB -- 1.2E9 instructions / 1.5 seconds * 1E-9 seconds/clock = 0.8 instructions/clock = 1.25 CPI
b.
CA -- 1E9 instructions / 1 second * 1.1 clocks/instruction = 1.1 GHz
CB -- 1.2E9 instructions / 1 second * 1.25 clocks/instruction = 1.5 GHz
CA/CB = 1.1/1.5 = 0.73 -- The processor running compiler A’s code is 27% slower
c.
Using a 1GHz processor --
CA -- 1E9 instructions * 1.1 clocks/instruction * 1E-9 seconds/clock = 1.1 seconds

CB -- 1E9 instructions * 1.25 CPI * 1E-9 seconds/clock = 1.5 seconds
CC -- 6E8 instructions * 1.1 CPI * 1E-9 seconds/clock = 0.66 seconds
1.1/0.66 = 1.667 -- 66% faster than CA
1.5/0.66 = 2.272 -- 127% faster than CB

1.8.1.
Cap. Load = Power/(Voltage^2 * Frequency)
Pentium -- Cap. Load = 2*90/(1.25^2 * 3.6*10E9) = 3.2*10E-8 F
Ivy Bridge -- Cap. Load = 2*40/(0.9^2 * 3.4*10E9 = 2.9*10E-8 F
2.
Pentium -- 10W / (90W + 10W) = 10/100 = 1/10, 10W/90W = 1/9
Ivy Bridge -- 30 / (30W + 40W) = 3/7, 30W/40W = 3/4
3.
Voltage should be reduced by 10%, if power is the product of voltage and current.

1.10.1.
15cm diameter die - 7.5^2 * pi = 176.71 cm^2 -- 176.71/84 = 2.10 cm^2
Yield- 1/(1+(0.020*2.1/2)) = 0.979
20cm diameter die - 10^2 * pi = 314.15 cm^2 -- 314.14/100 = 3.14cm^2
Yield - 1/(1+0.031*3.14/2)) = 0.954
2.
15cm -- 12 / (84*0.979) = 0.146 per die
20cm -- 15 / (100*0.954) = 0.157 per die
3.
15cm -- 92 dies, 0.023 defects/cm^2
Die area - 176.71/92 = 1.92 cm^2 per die
Yield - 1/(1+(0.023*1.92/2)) = 0.978
20cm -- 110 dies, 0.03565 defects/cm^2
Die area - 314.14/110 = 2.856 cm^2 per die
Yield - 1/(1+(0.03565*2.856/2)) = 0.951