CPSC 3300 - Exam 1 Sample Questions

1. Matching -- technology/performance terms. Write the correct term from the list into each blank. (1 pt. each)

datapath	Dennard scaling	throughput	supercomputer
CPU time	Moore's law	bit	workload
clock frequency	CPI	byte	Whetstone

a. __________________ the observation that the number of transistors in a dense integrated circuit doubles approximately every two years

b. __________________ a computer with the highest performance and cost

c. __________________ a single binary digit (1 or 0)

d. __________________ 1/clock cycle time. Also number of clocks per second.

e. __________________ time spent processing a given job

f. __________________ measure of work done per unit time

2. Give the power of 10 associated with these prefixes. (1 pt. each)

milli ________ mega ________

exa ________ micro ________

3. For the following workload and cycle values, find the average CPI. (4 pts.)

type	freq	cycles
alu	0.70	1
ld/st	0.20	2
branch	0.10	4

CPI = ______________________________

4. Given the workload and cycle values from question 3 with an instruction count of 40 million and a clock frequency of 2 GHz, find the execution time. (8 pts.)

5. Consider the execution times of two different programs in a benchmark suite on three different computers:

	Computer A	Computer B	Computer C
Program 1	10	12	16
Program 2	10	3	4

Calculate the normalized execution times of the benchmark suite on the three computers (using geometric mean) with respect to Computer A: (8 pts.)

6. Give a circuit implementation for an XOR circuit using AND, OR, and NOT gates. (8 pts.)

```
 a  b  |    XOR
-------+-------------
 0  0  |     0
 0  1  |     1
 1  0  |     1
 1  1  |     0
```

7. Consider A + B*C = (A+B)*(A+C). Show by truth table that this is true. (10 pts.)

```
   A  B  C  |  (B*C)  |   A + B*C   |  (A+B)*(A+C)  |   A+B   |   A+C
 -----------+---------+-------------+---------------+---------+---------
```

8. For the Boolean function O1 and O2, as given in the following truth table: (6 pts. each)

Input			Output	
x	**y**	**z**	**O1**	**O2**
0	0	0	1	0
0	0	1	0	0
0	1	0	0	1
0	1	1	1	1
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	0	1

(a) List the minterms for a three-variable function with variables x, y, and z.

(b) Express O1 and O2 in sum-of-product algebraic form.

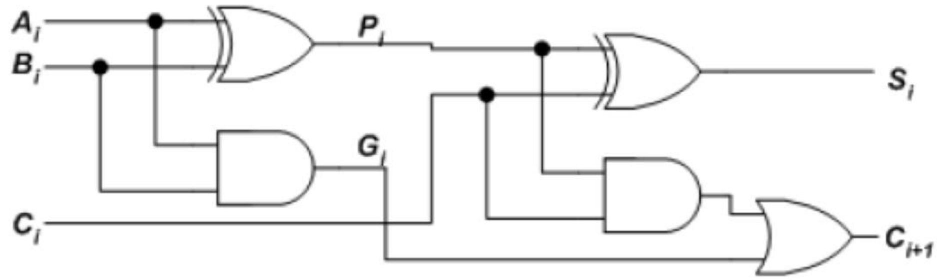
9. You are provided with NOR gates only. (4 pts. each)
   (a) draw the circuit to implement the AND function

   (b) draw the circuit to implement the OR function

10. Prove the identity of each of the following Boolean equations, using algebraic manipulation: (4 pts. each)
   (a) (~A * ~B) * (~A + B) * (~B + B) = ~A

   (b) (A * B) + (B * C) * (B + C) = B * (A + C)

11. In a carry-lookahead adder two signals are created for each bit position - P: "(carry) propagate" and G: "(carry) generate" which are used to determine the carry bit for the next (higher) bit position. (6 pts. each)



(a) Given the formula for C_{i+1} (carry bit for next position) is: $C_{i+1} = G_i + (P_i * C_i)$, write out the formulas for C_1, C_2 and C_3 in terms of C_0, P_0, G_0, P_1, G_1, P_2 and G_2.

(b) Draw the circuit diagram of a 3-bit carry-lookahead unit with inputs C_0, P_0, G_0, P_1, G_1, P_2 and G_2 and outputs C_1, C_2 and C_3.

12. Consider a mod-4 counter with input R. When R=0 the counter will increment in a loop from 00 to 11, e.g. 00->01->10->11->00... When R=1 the counter is reset to 00. (4 pts. each)
   (a) Draw the state transition diagram. Label the up transitions with '1' and the down transitions with '0'.

   (b) Give the state table using $S_1(t)$ and $S_0(t)$ for current state.

   (c) Give the logic expressions for $Q_1(t+1)$ and $Q_0(t+1)$.