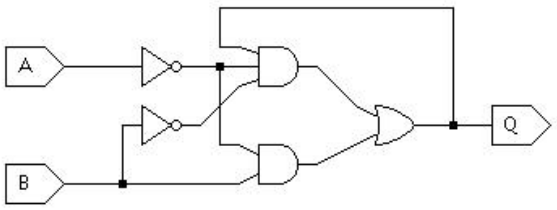
Name: _____

CIS 351 Practice Test 2

Updated March 9, 2020

1. Complete the characteristic table for the circuit shown below:

A_n	B_n	Q_n	Q_{n+1}
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	



What fundamental circuit has the same characteristic table?

2. Use Boolean Algebra to show how the circuit in problem 1 is equivalent to one of the fundamental circuits used to build CPUs.

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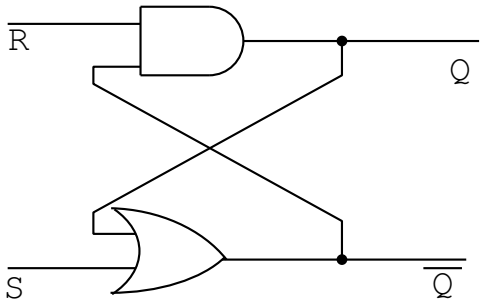
3. Complete the characteristic table for the circuit shown below: Note, there is no clock pulse here. Your answers should show the states Q and $\bar{Q}$ after they have reached a steady state given R, S, and current values of Q and $\bar{Q}$. If the given inputs will produce a non-deterministic output (i.e., the output depends on which gate changes first), write "random" in the row.

R	S	Q_{now}	$\bar{Q}_{now}$	Q_{next}	$\bar{Q}_{next}$
0	0	0	0		
0	0	0	1		
0	0	1	0		
0	0	1	1		
0	1	0	0		
0	1	0	1		
0	1	1	0		
0	1	1	1		
1	0	0	0		
1	0	0	1		
1	0	1	0		
1	0	1	1		
1	1	0	0		
1	1	0	1		
1	1	1	0		
1	1	1	1		



4. Choose a row labeled "random", and explain why the output is random.
5. Show how to build a SR latch.
6. Show how to build a D latch.
7. Show how to build a D flip-flop from two D latches.
8. Show how to add an `enable` input to a D latch or flip-flop.
9. Review the Sequential Circuits homework.
10. Design a sequential circuit to run a countdown timer. This circuit should contain two registers: One for the minutes and one for the seconds. Decrement the seconds every time the clock ticks. Stop decrementing when the timer reaches 0. This circuit should have three outputs: `minutes`, `seconds`, and a one-bit `alarm` output that will be set to 1 when the timer reaches 0.
11. What is the role of registers on the CPU?
12. What is a computer's "word size"?
13. How does a computer's word size affect its design?

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14. Convert the following line of Java code to assembly: `t0 = t1 + t2 + t3 - t4 + t5`

15. Convert the following line of Java code to assembly: `t0 = (t1 ^ t2) & (t3 | !t4)`

16. Convert the following Java code to assembly. Your answer *must* use `slt` and `beq` or `bne`. Using branching pseudoinstructions, such as `blt`, will result in partial credit.

```
if (t1 - 6 < t2) {
  t0 = t1;
} else {
   t0 = t2 + 4;
}
t1 = t1 + 7
```

17. Convert the following Java code to assembly:

```
t1 = 0;
for (int t0 = a0; t0 >= 0; t0-= a1) {
  t1 += t0;
}
return t1;
```

18. Describe in common English what the following function does. Hint: It takes three parameters, all integers.

```
mysteryFunction1:
slt $t0, $a0, $a1
slt $t1, $a1, $a2
and $v0, $t0, $t1
jr $ra
```

19. Describe in common English what the following function does. Hint: It takes two integer parameters. `sra` stands for "shift right arithmetic". It moves all the bits in the register to the right the specified amount.

```
mysteryFunction2:
add $v0, $a0, $a1
sra $v0, $v0, 1
jr $ra
```

20. Know how to convert between machine code (i.e. a binary or hex number) and assembly language. (See HW4 P1).

21. How many distinct opcodes are possible for MIPS instructions? What would change about MIPS insructions if we wanted to allow 100 distinct opcodes? What problems might this cause?