# CIS 351 Practice Test 2

## Updated October 3, 2022

1. Explain **specifically** what makes a carry-lookahead adder faster than a ripple-carry adder of the same size.

2. Draw a nine-bit carry-select adder with 3-adder blocks. How many adders and muxes are required to build your circuit? Give the propagation delay for all of the sum bits (not just the final ones).

3. Build a 4:1 mux using logic gates.

4. Show how to build an `AND` gate and an `OR` gate out of a mux.

5. Use a Karnaugh map to simplify the following Boolean expression:

   `A'B'C'D' + A'B'C'D + A'B'CD' + A'BC'D' + A'BC'D + AB'C'D' + AB'C'D + ABCD' + ABCD`

   Remember: it should be easy to write out the truth table for an expression that is already in sum-of-products form.

6. 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 | |
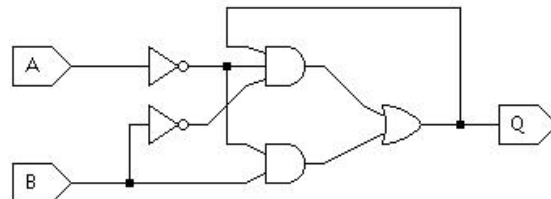


What fundamental circuit has the same characteristic table?

7. 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 | | |
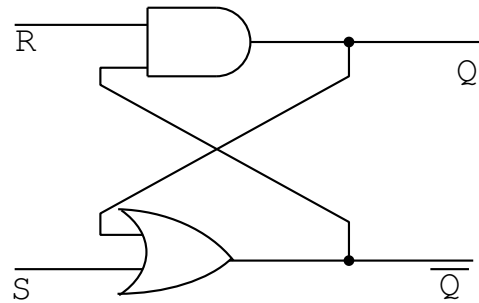


8. Choose a row labeled "random", and explain why the output is random.

9. Review the Sequential Circuits homework.

10. Review the "golfer" example from Week 5 activities – there were several questions related to this example. (You should review the activities in general, but these ones test several skills you will need on the exam.)

11. 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.