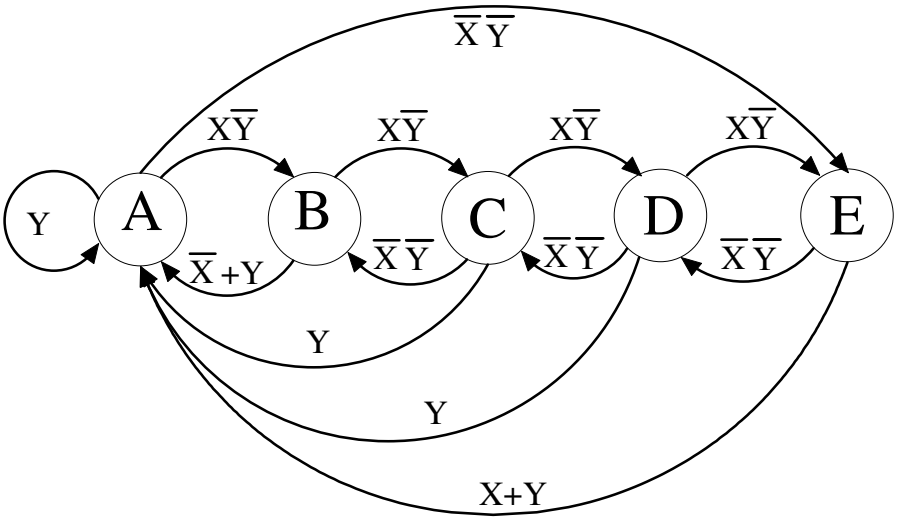
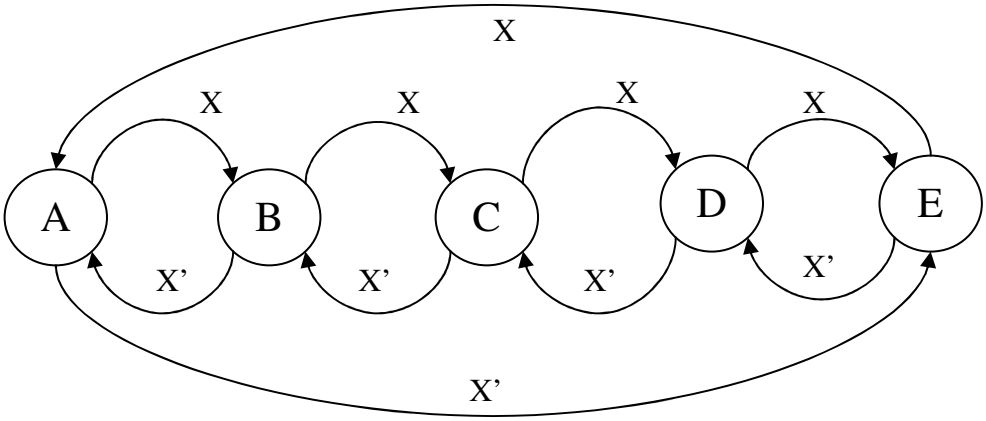
# Lab 7 – Sequential Design III ELE202 FALL2007

**Objectives**
- Modify your paper design a 3 flip-flop sequential circuit
- Build, test, and demonstrate your design in hardware

**Procedure**
In Lab 6 you did a paper design of a simple counter; this week we add two external inputs to vary the count operation, specifically, to turn it into an up/down counter with synchronous reset. We'll define the sequence ABCDEABC… as up counting and EDCBAEDC… as down. Let the input X determine up/down (X=1 for up, X=0 for down) and the input Y=1 cause the counter to return to state A on the next clock edge (Y=1 also holds the counter at A until released, Y=0 has no impact on the count). With these requirements, the state diagram becomes



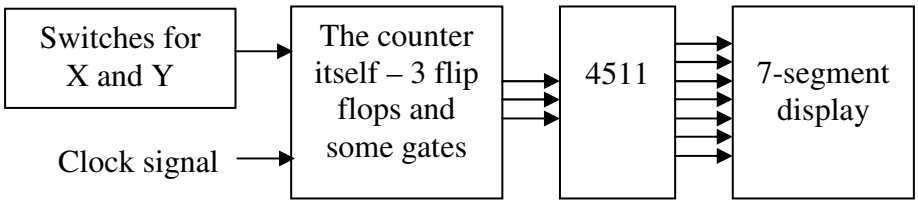

Note that I've written the labels on the state diagram branches in simplest form. For example, we go from state B to state A on a down count or a reset request. By utilizing the "Set" and "Reset" on the commercial flip flops, we can further simplify above state diagram. This is accomplished by connecting Y to the set or reset inputs of the flip flops. For example, if A=3 or 011, we want the flip flops to go to Q3=0, Q2=1 and Q1=1 when Y=1. Then, you should connect Y input to the reset of flip-flop #3, the set of flip-flop #2, and the set of flip-flop #1. Of course, the set of flip-flop #3, reset of flip-flop #2 and #1 are connected to GND or ground.



In your construction:

- Use the same ABCDE sequence as for lab 5
- Use switches for X and Y
- Display the count on a 7 segment display.
- Use a 2 Hz (approximate) clock for synchronous operation of your flip flops – using the 555 timer circuit from lab 0 is fine.

The block diagram below suggests the form of the total circuit. As in lab 4, your precise circuit will depend upon your choice of the different types of flip flops. Fully demonstrate your working circuit to the TA.




## ELE202 Report Requirement
## Lab 7 – Sequential Design III

This is a full report submission:

- The report begins with a cover page. It should include the title of the lab (include your "sequence" as part of the title), your name, your lab section, and the date the lab was submitted. Print this up ahead of time so that the instructor or TA who observes your circuit operation can sign it.
- Next, write a short abstract to summarize the lab – this should be 3 sentences or less.
- The main body of the report should be a concise, but complete description of what you did. I'm not expecting a long report, but be sure to include a discussion of your methods and results (include any references beyond the lab manual that you used). I'll be looking for the following components:
    - A clear state table
    - K-maps, algebraic expressions, and logic diagrams for each output
    - Analysis of what happens in the unused states
    - A photograph of your resulting circuit – see the TA for help in getting this

Grading will be split between the circuit working as expected, the accuracy of the information provided, report formatting (missing cover pages or necessary information, poor grammar and spelling, unlabeled and/or confusing figures, plots without units, etc. will all be penalized), and the overall quality of the report.