

# INTRODUCTION TO COMPUTER ARCHITECTURE

## LAB 4

### Detecting a sequence

## 1 Building a sequence detector

We want to build a circuit that can detect whether a particular sequence of input values is being given to a sequential circuit. Specifically, for this project, we want to detect the following sequence of 1-bit values:

0, 0, 1, 1, 0, 1

A single switch will control the input value  $A$ , and a single button to provide the clock pulse  $CP$  will control when  $A$  is “entered” as the next value in the sequence. There should be a one-bit output  $Y$  that is 1 if the last six clocked values match the sequence above, and 0 otherwise.

The recommended approach is:

1. Draw the *finite state machine* that represents this problem.
2. Convert that FSM to a truth table representing the sequential logic.
3. Build the circuit that implements the sequential logic and its functions, using a ROM to store the truth table and thus implement those functions.

**Making it debuggable:** To see how the inputs affect the state, you should number the states of your FSM *in order of the progression through the sequence*. That is, the initially, the circuit should start in state 0; as each correct digit is entered, the state number should increment until the terminal state is reached. By numbering them in this way, you can connect the state number being emitted by the register to LED’s, and track that the circuit is moving correctly through the states for any given input.

## 2 How to build the circuit

Admittedly, the original plan was to program an FPGA with the logic table, and then connect that to a breadboard with a 74LS273 flip-flop chip. Unfortunately, because of voltage mismatch issues, that is not going to work...

Instead, we will build this circuit within CircuitVerse, which we used for Lab-1. There are a few new devices that we will need to use, and for which there will be a demonstration at the beginning of lab.

## 3 Submitting your work

Once you have a detector working, demonstrate the working circuit:

1. **Take a video:** Capture a video of the circuit by resetting to the initial state 0, and then moving through the following sequence of values as a test of it, resetting the circuit to state 0 before each sequence:

INPUT SEQUENCE	STATE NUMBER SEQUENCE
1	0
0, 1	1, 0
0, 0, 0	1, 2, 2
0, 0, 1, 0	1, 2, 3, 1
0, 0, 1, 1, 1	1, 2, 3, 4, 0
0, 0, 1, 1, 0, 0	1, 2, 3, 4, 5, 2
0, 0, 1, 1, 0, 1	1, 2, 3, 4, 5, <b>6</b> (terminal)

2. **Share the video:** Upload your video to your *college Google Drive account*. Then, **share the video** with me (sfkaplan@amherst.edu) and your TA (twstephens26@amherst.edu for Section 01, eleroy27@amherst.edu for Section 02). Additionally, within CircuitVerse, add those same two email address as *collaborators*.

**This assignment is due Thursday, Oct-02, at 11:59 pm.**