

CS/COE 0447 Fall 2009

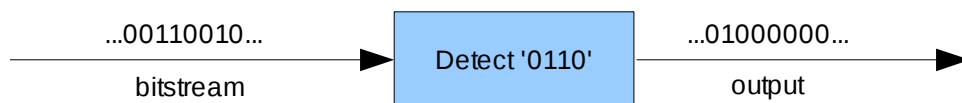
Lab 10: Sequential Logic Design

Due Date: November 19, 2009

To get started on this lab, attend recitation on 11/13. Each of you should submit your own solution, according to these instructions: <http://www.cs.pitt.edu/~sab104/teaching/cs447/submission.html>. You may collaborate with your partner, but each person must turn in their own copy of the lab, with the name of their partner. The lab is due on 11/19 at 11:59pm.

For this lab, we will use a tool for designing and simulating digital circuits. The tool is called *Logisim* and is available at <http://ozark.hendrix.edu/~burch/logisim/>.

A *bitstream* is an unstructured sequence of bits commonly used for transmitting or storing digital data. In some applications or devices, it is useful to detect a particular sequence of bits in the stream, for example to recognize the start of a data packet or file. The following figure shows an example.



An application or device might need to know when the sequence '0110' has been seen in the input. The output of the circuit is '1' when it has just seen the sequence '0110' in the input and '0' otherwise. Note that the output goes back to '0' after the next bit in the stream has been read, because the sequence that has just been read is no longer '0110'.

A sequential circuit can be used to detect sequences in a bitstream. In this lab we will build a sequential circuit that recognizes a small sequence of bits in a stream.

1) Detecting a simple sequence

First, we will construct a small circuit that detects two consecutive 1's in the bitstream.

- Draw the state diagram for a finite state machine (FSM) that detects the sequence '11'.
- Encode the states of the FSM by giving each state a different binary number, starting with 0.
- Write down the truth table for the next state function. Your truth table should have one input for every input of the circuit and for every bit of the state and one output for every bit of the state.
- Write down the truth table for the output function. Since the output of the circuit depends only on the state, the truth table should have one input and one output for every bit of the state.
- Implement the circuit in *Logisim*.

2) Detecting longer sequences

Following the steps of the previous point, implement a sequential logic circuit that detects the sequence '0110' in the input stream.