Lab 7: Finite State Machine

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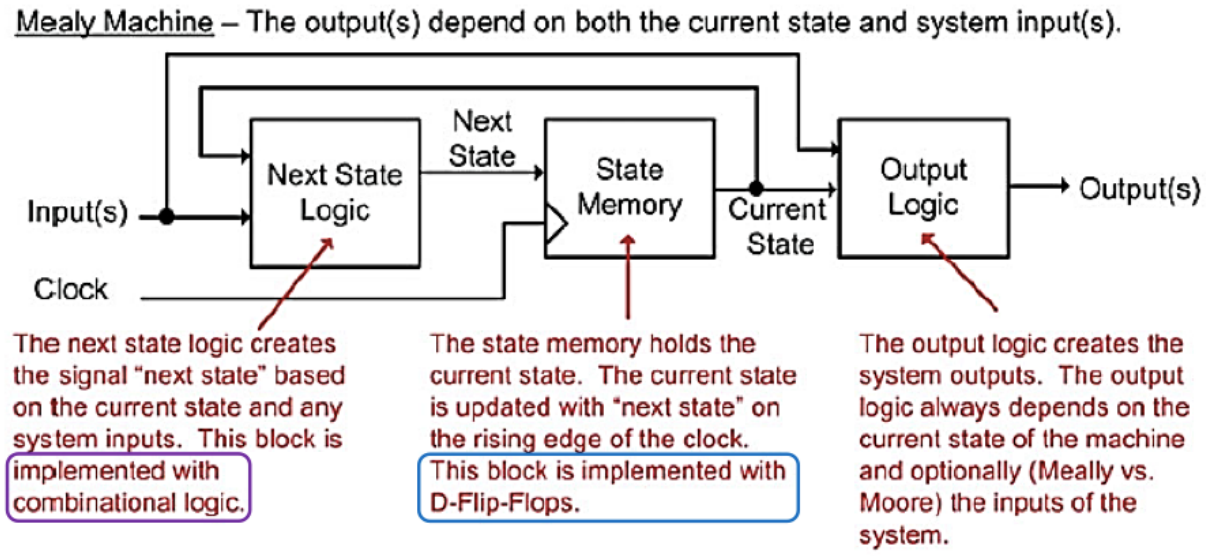
Objective:

A Finite State Machine that takes a stream of 4-bit packets as input and finds 4-bit patterns. At the positive edge (low/high) of the clock signal CLK, a 4-bit input vector from the input port x [3:0] into the machine is sampled.

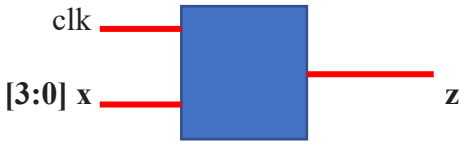
Introduction:

A Finite State Machine is a computational model that is based on a fictional machine with one or more states. At any one time, only one state of this machine can be operational. It implies that the machine must transition from one state to another to complete various tasks. Any device that stores the state of anything at a particular moment is referred to as a Finite State Machine. The state will change because of the inputs, delivering the final output for the modifications made.

Here is a diagram:

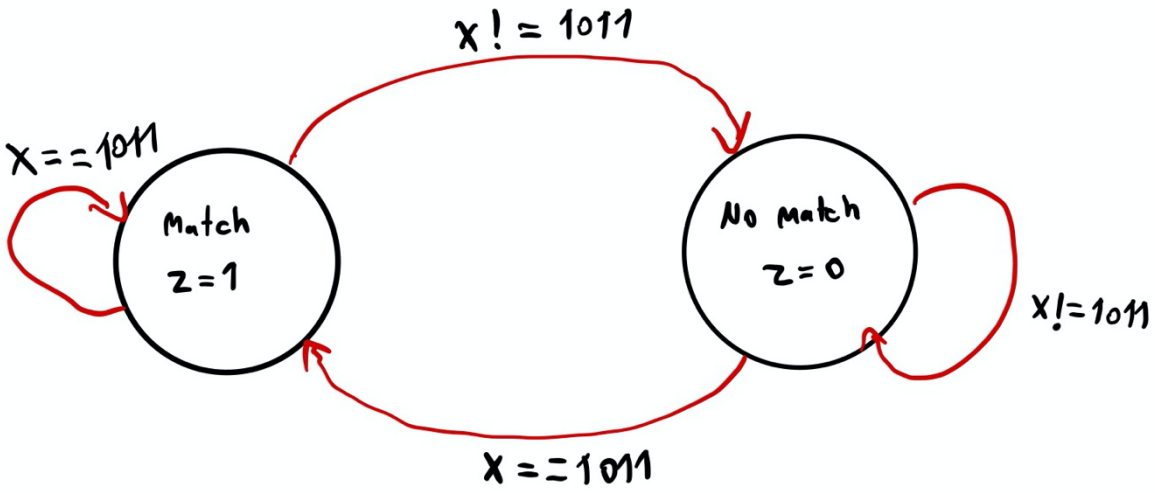


For this lab we have the following state machine:

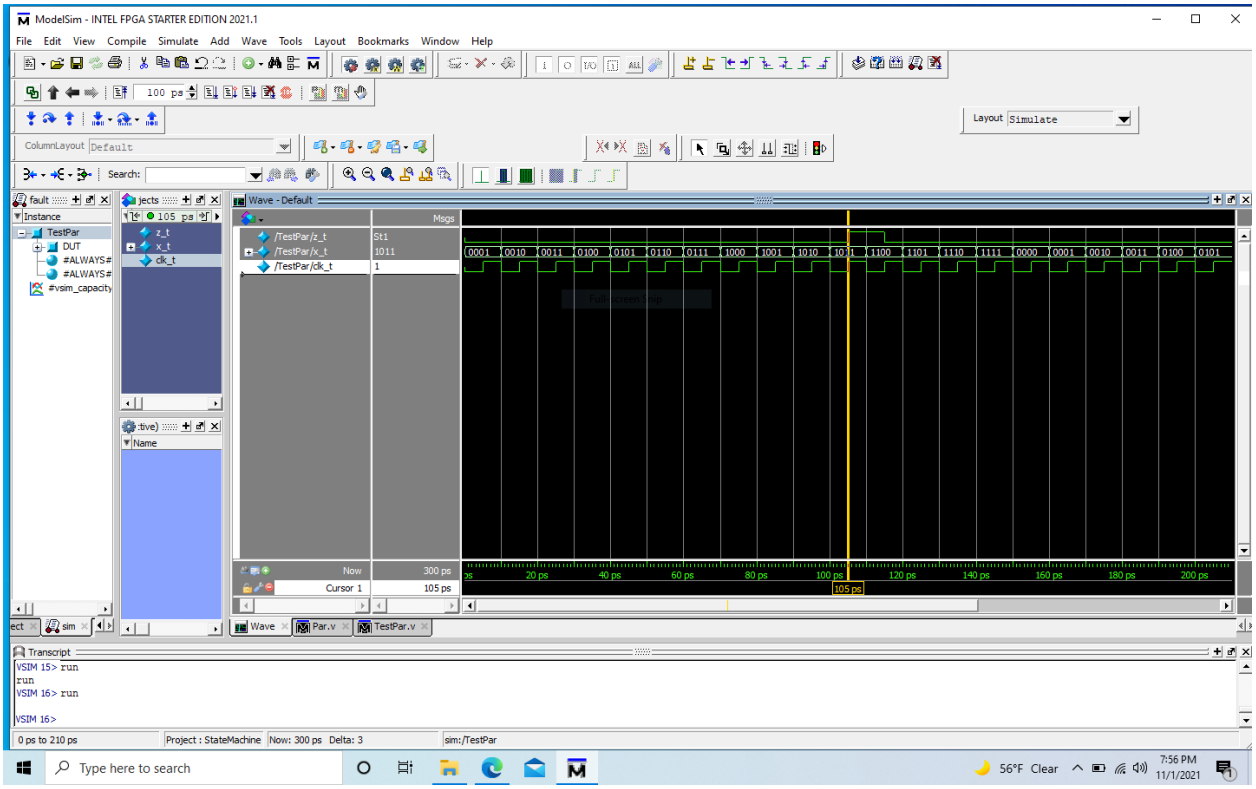


The clock and a 4-bit binary text x are our inputs, and the output is z. The clock acts as a positive triggering mechanism. The clock will update the current state at each location of the wave's edge as it moves from low to high. Every time the clock was triggered, the input [3:00] x would increment from "0000" to "1111." Will search through each state to identify the occurrence of the binary '1011'; if we find it, our output will be z=1; otherwise, z=0. (*As a side note, because we're doing a sequential search, the time complexity will be O(n); this isn't the optimal way for searching. However, because we are just looking at 4-bits, we are only looking at 0-15; however, for larger bits, we may wish to use alternative searching strategies.)

We can also construct a state diagram:



ModelSim Wave ‘1011’:



As shown in the waveform we have a change in state at the positive edge triggering of the clock. In addition, we see that every occurrence that x=”1011” the output z=1 else z=0.

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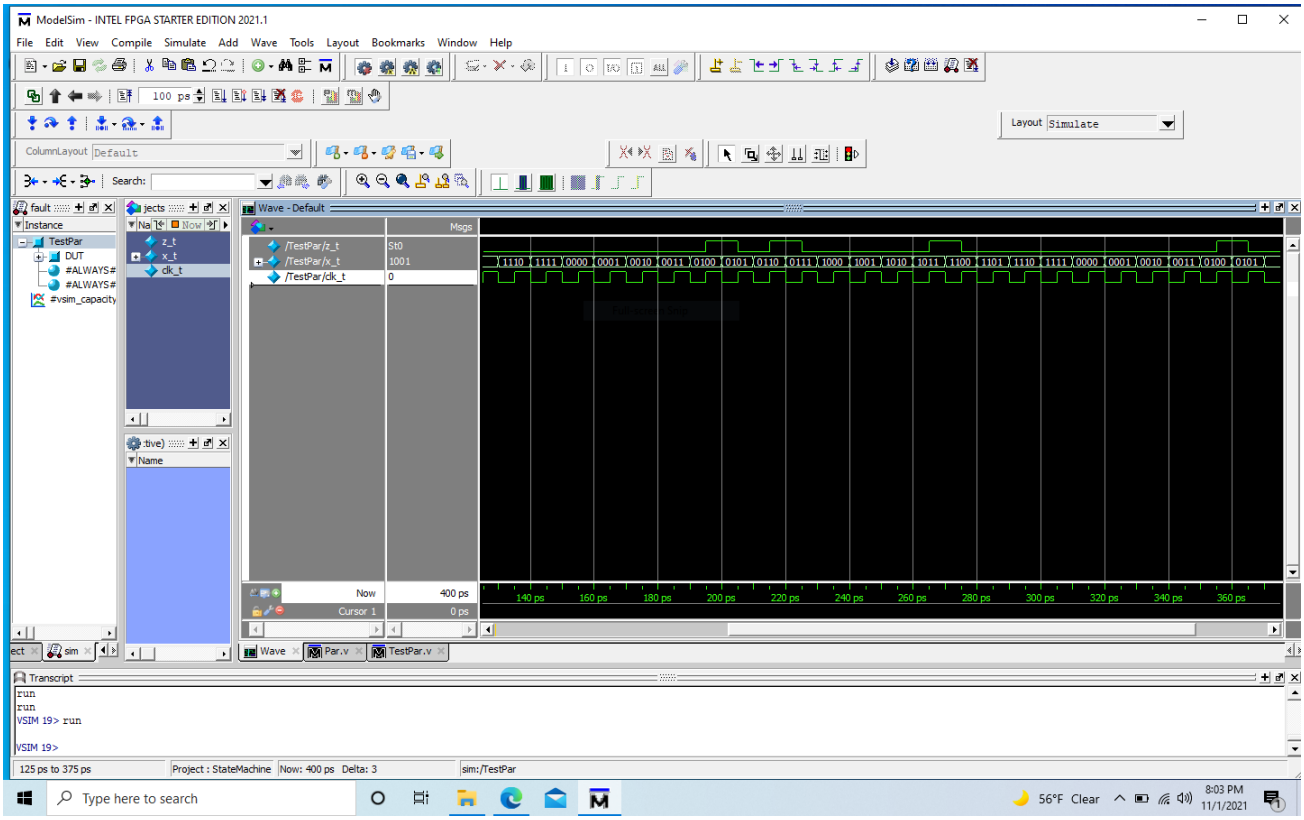
ModelSim Wave ‘1011’, ‘0110’, and ‘0100’:



As shown the wave we have an output of *z*=1 when we have the following occurrence ‘1011’, ‘0110’, and ‘0100’.

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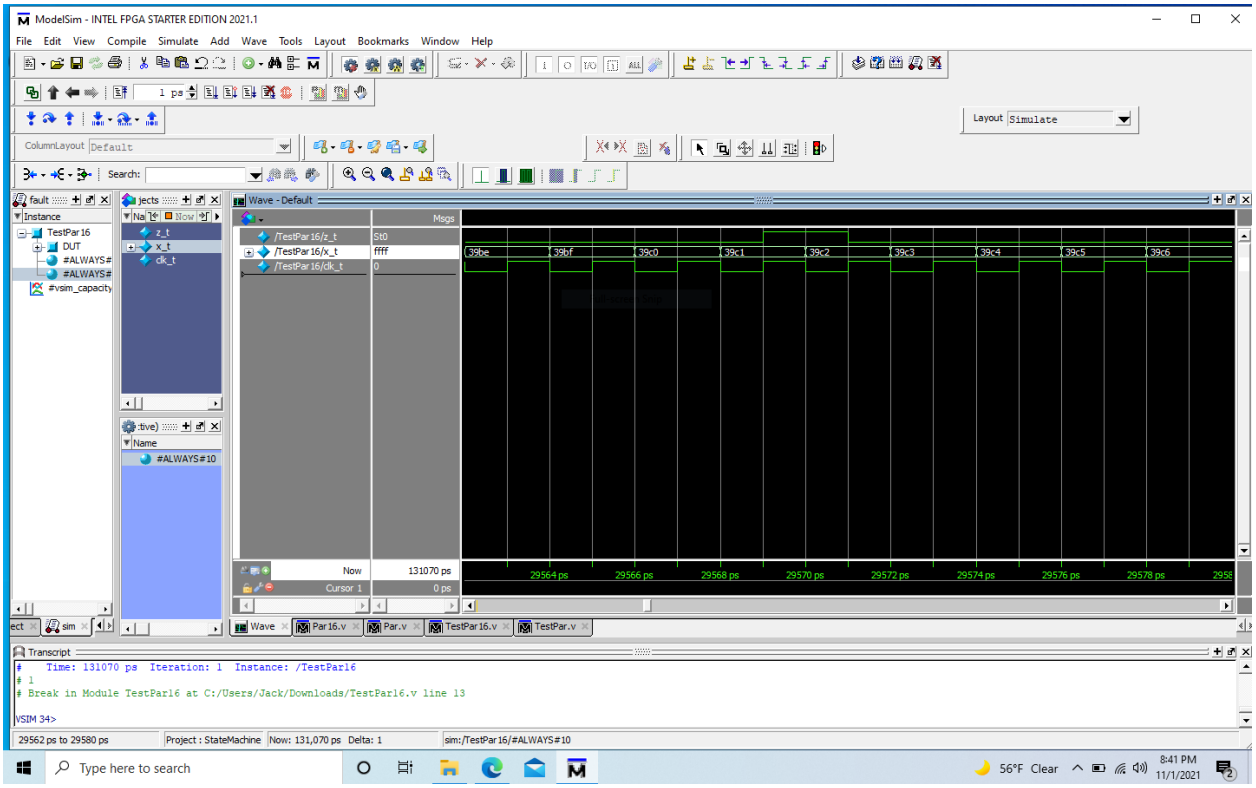
ModelSim simulate (Extra Credit):



Like the pervious waves we have transition state at every positive edge triggering. However, now we are looking for the binary ‘0011 1001 1100 0001’ z=1 else z=0. As shown z=1 at 39c1 which is the hexadecimal of ‘0011 1001 1100 0001’. Thus, the output is correct.

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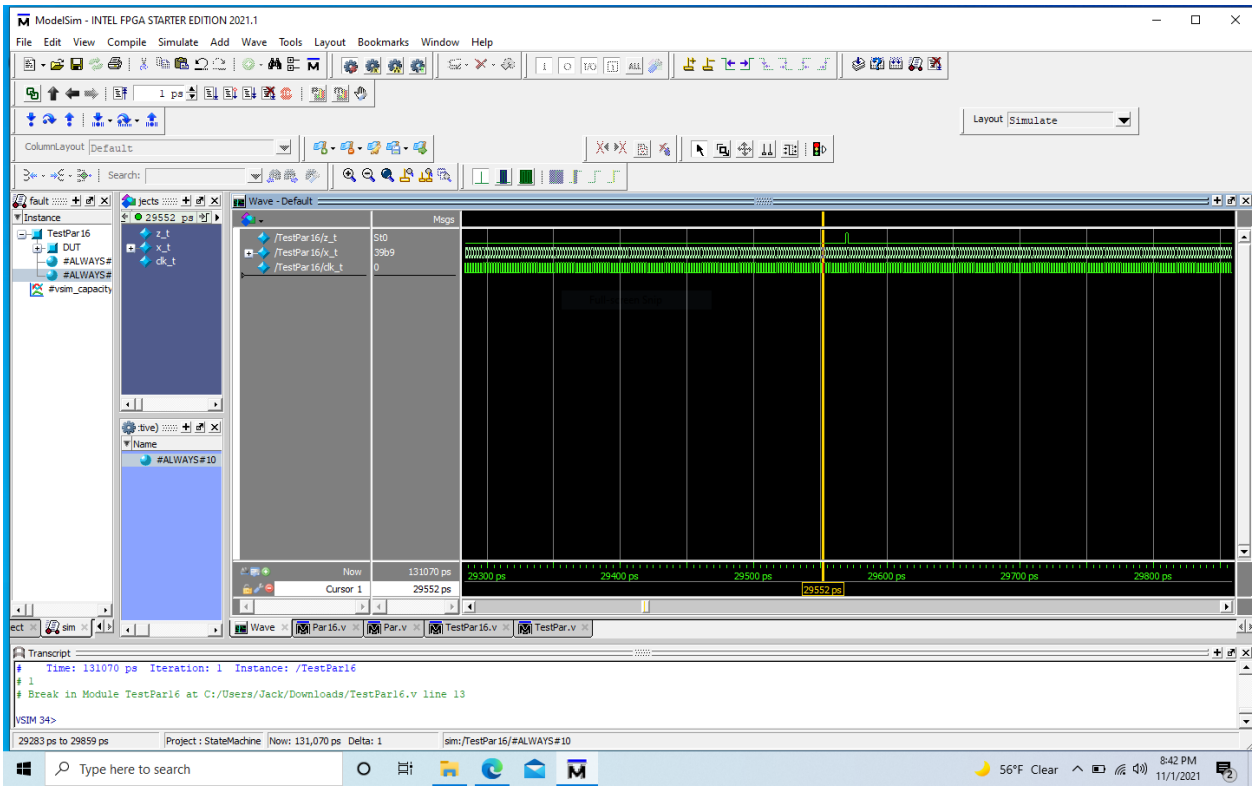

Just to show that the output z is at 1 when ‘0011 1001 1100 0001’ and not anywhere else.