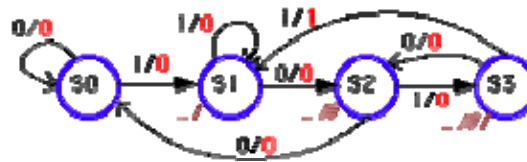
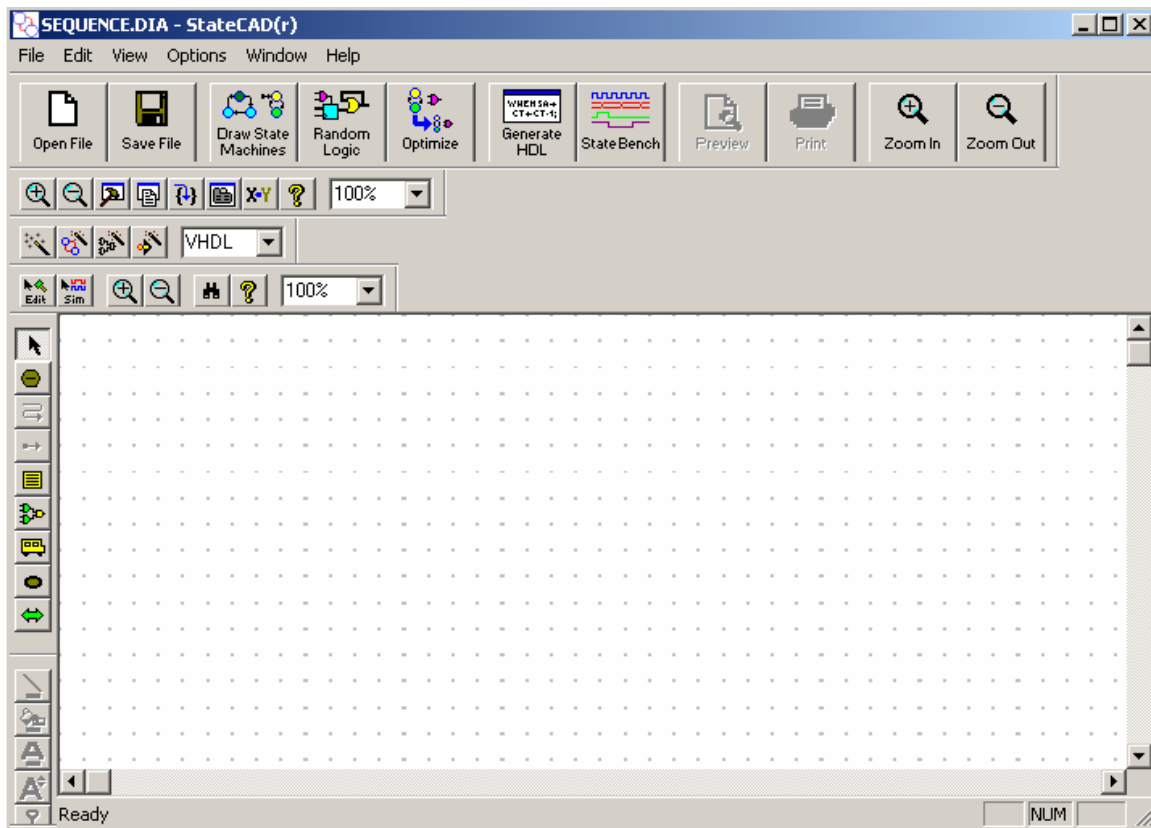


Creating a State Machine

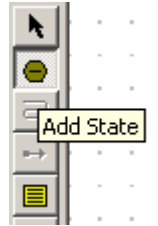
In this tutorial, we'll create a simple state machine that detects the input sequence $Y = "1011."$ The desired state machine is shown below.



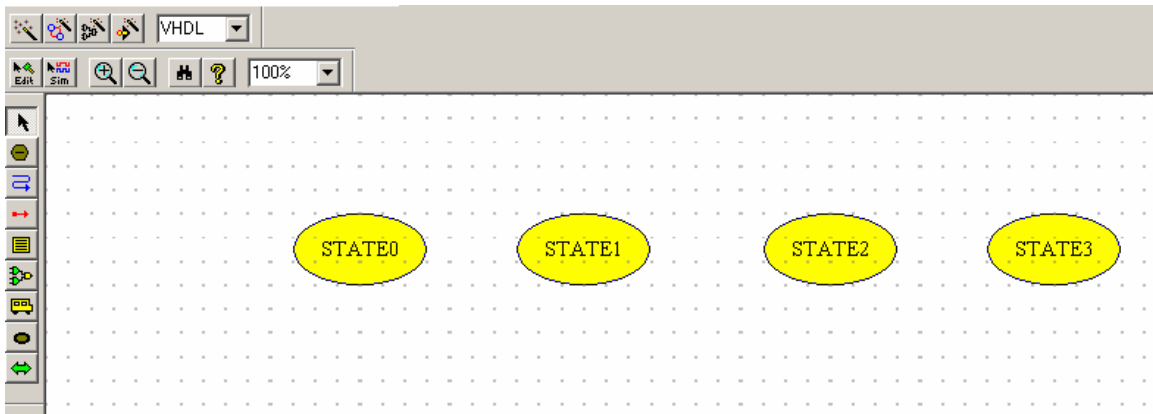
First, we need to create our state machine file. Right click on the process window and create a new source. For the source type, choose “State Diagram,” and give it an appropriate name, such as Sequence. Once you’ve clicked through the Create Source Wizard, the StateCAD wizard should open up.



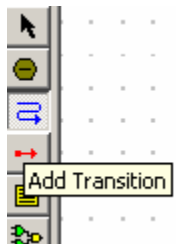
Click on the “Add State” button on the left sidebar.



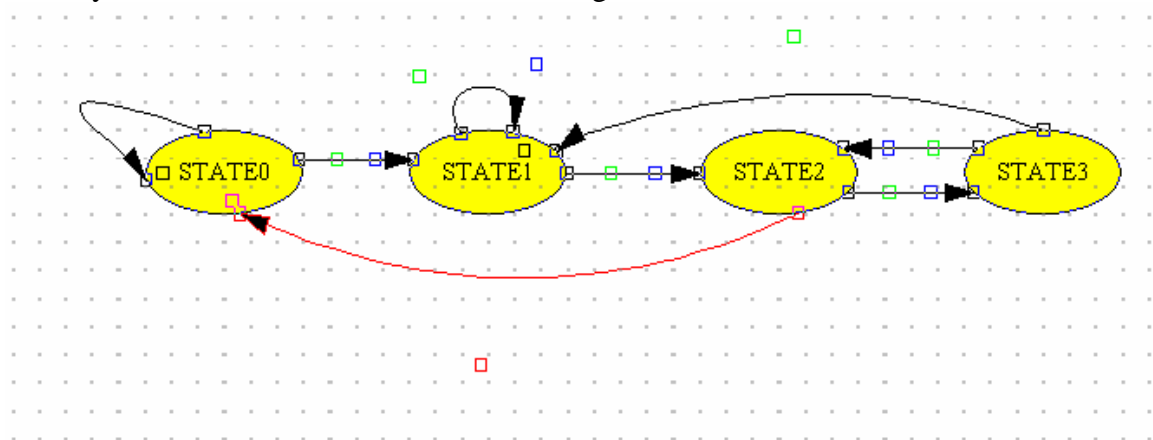
Now click once each place where you would like the four states, as shown.



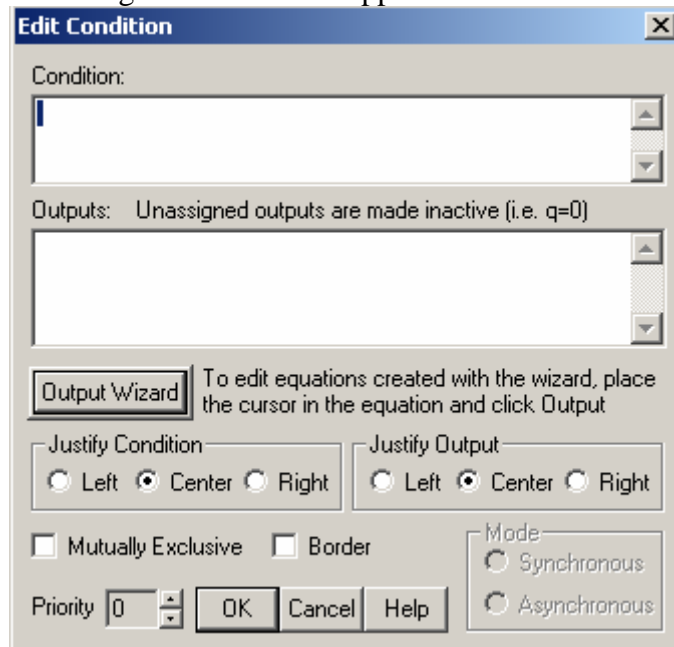
Now we would like to add transitions to the state machine. Click on the “Add Transition” button on the left sidebar.



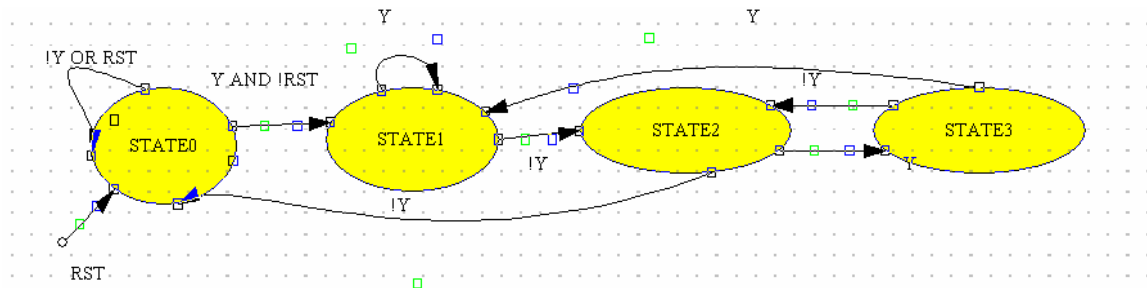
Now click once on the state where you'd like to start the transition, and once where you want the transition to end. For transitions to the same state, click on the state, then once where you want the transition to arc to, then again on the state.



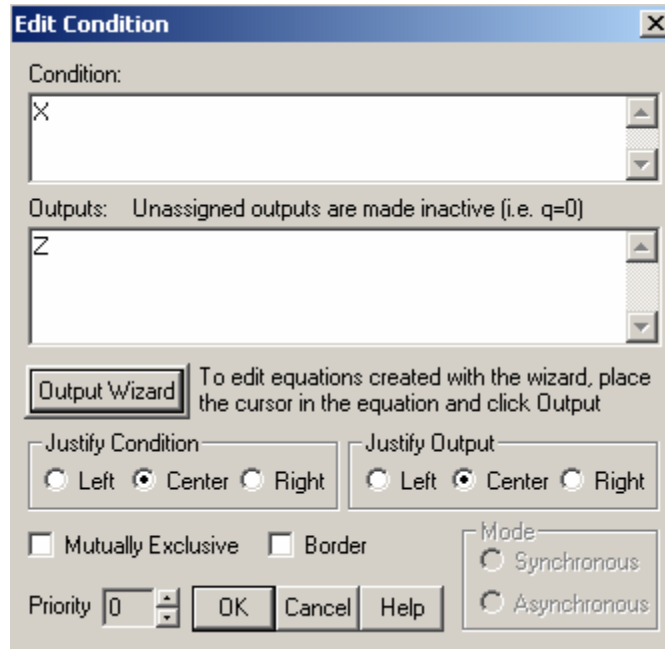
Now we need to add the conditions and outputs to the state machine. Double click on a transition, and the following window should appear.



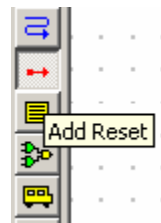
Add the conditions as shown. !Y means the transition will occur when Y is 0. In order to display how to use multiple input transitions, !Y OR RST and Y AND !RST are shown; this is not strictly necessary, as we will formally add an asynchronous reset. Your state machine should now look as shown.



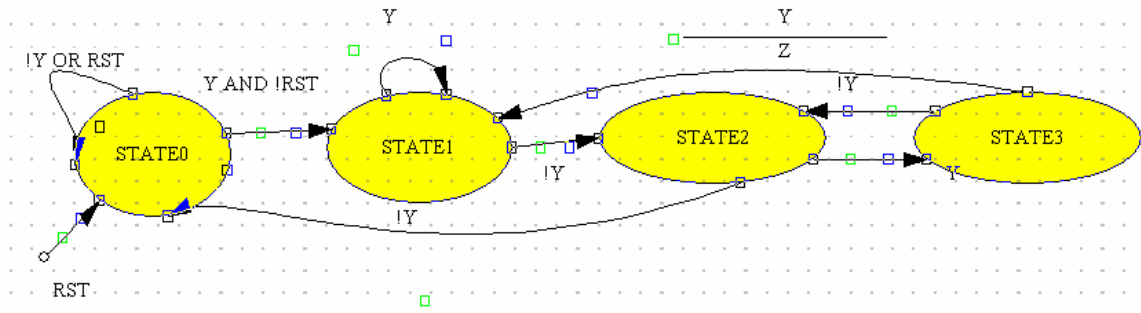
Now we need to add our output. Double click on the transition where the output should go high; now add Z to the output space in the Edit Condition window.



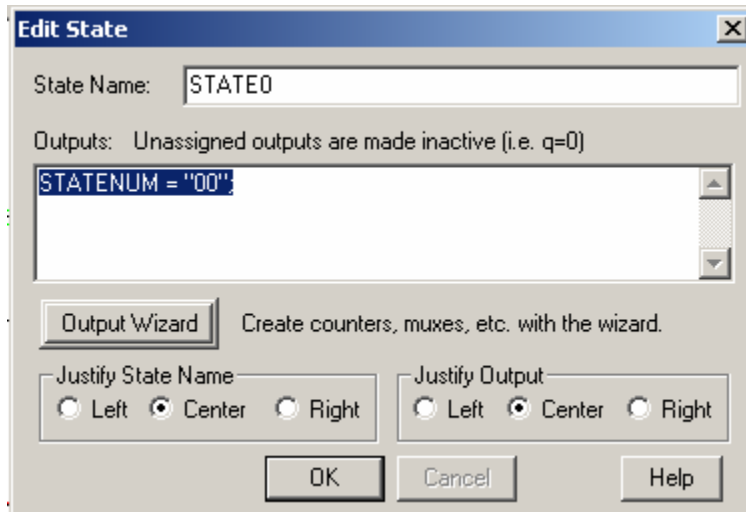
The last thing we need to add is a reset input. Click on the Add Reset button on the left sidebar.



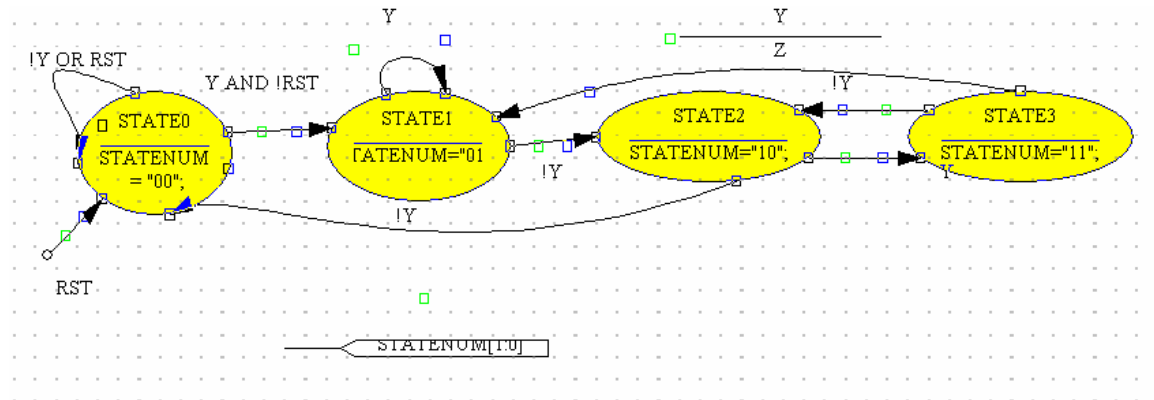
Now click in the white area beside STATE0, and then click on STATE0. The program will ask you whether you want an asynchronous or synchronous reset; choose asynchronous. The reset input will default to the name RESET; double click on it to change the name to RST, to match our other inputs. Your state machine should now look as shown.



To demonstrate how to add Moore outputs to the machine, we can now add a state number output to our finite state machine. Double click on STATE0 and the Edit State window should appear. Type in `STATENUM="00"`;



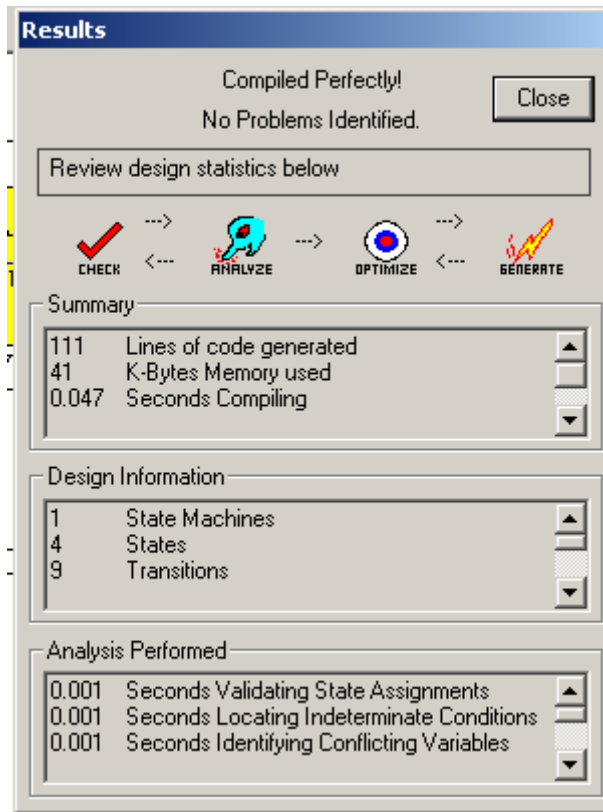
Repeat this for the other states, designating STATE1 as 01, STATE2 as 10, and STATE3 as 11. Your state machine should now look as shown.



In order to add the state machine to our project, we need to generate HDL code for the state machine. Click the “Generate HDL” button on the top toolbar.



If you’ve constructed your state machine appropriately, the following box should appear:



Otherwise, the program will notify you where your state machine does not compile properly. Click close, and the program will open the VHDL code you've created. Now we need to add our VHDL code to the project. Xilinx does not allow you to place state machine macros directly into your circuit, so we will add the Sequence.vhd code that we've just generated. Right click on the process window and select "Add Source"; now choose the file "SEQUENCE.vhd". You should now be able to simulate or create symbols from it as you would any other VHDL macro.

To simulate, create first a Test bench as explained in an earlier tutorial.

To create a schematic symbol (or macro) of the HDL file, select the SEQUENCE.vhd source file in the Sources window. In the Processes window double click on "Create Schematic Symbol" under the Design Utilities processes. This will add the symbol SEQUENCE to the library that you can now add to your schematic.