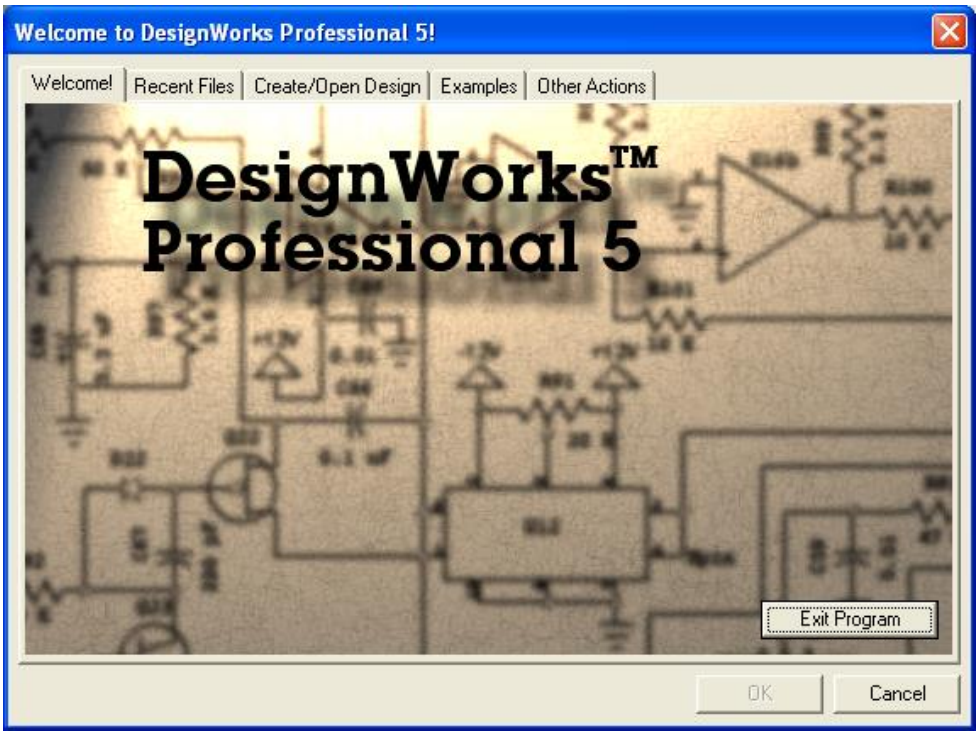
CSC 355 Lab 4 Pre-Lab Tutorial: Using DesignWorks[1] - Creating Circuits & Simulation

DesignWorks is a logical tool that can be used to create schematic circuit diagrams and simulate their operation. This tutorial gives instructions to draw a circuit for the function: $F = \overline{A\bar{B} \oplus BC}$. In particular, this function uses two AND gates, one exclusive OR gate and two inverters.

1. Locate DesignWorks on the **`Start Menu`** and open **`DesignWorks`**. The screen below appears.



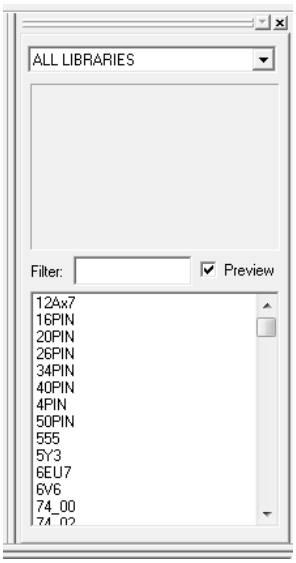
2. Click on the **`Create/Open Design`** Tab.

3. Click on the **`Generic Simulation`** in the **`Create a new design from template list`**. Then click **`ok`**.

4. The window that comes up is an empty circuit window. The top is where the circuits will be drawn (the viewport) and the lower small panel displays timing diagrams of the signals in the circuit. Both can be moved or resized.

[1] Credits to previous instructional teams (including: V.Li, S.Ganti, M.Serra) & Design Works documentation for the contents of this tutorial. Last edit by L.Jackson

5. Beside the viewport is the parts palate, which appears similar to the figure to the right. (If it is not visible, click on **`View`**, **`Parts Palette`**.)

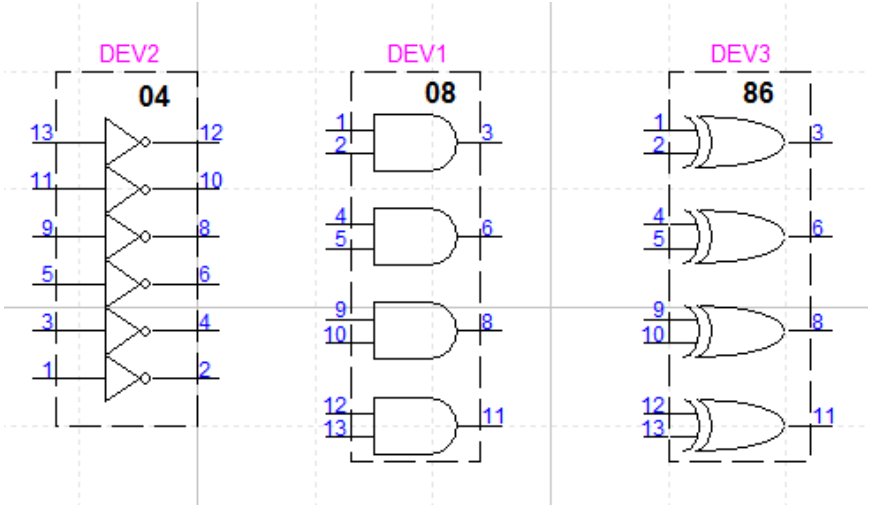


When "**`All Libraries`**" is selected the palate shows a list of all the open libraries. If you wanted to change the list of open libraries click on the **`File`** menu, **`libraries`** and **`open library`**. In the dialog box that opens choose **`libs`** and **`open`**. But for now, the default libraries are sufficient.

Observe that the numbered devices in the library, those without letters, are generic 7400-type series. Some of the other families of parts, such has High-Speed CMOS (HC), are available and include letters indicating the family in the part number. Other families can be created by adjusting the labelling and simulations characteristics.

6. Locate the 74_08, which contains four 2-input AND gates, in the parts list and double click on it. Move the cursor into the circuit window, position the image in the center of the circuit window and click. Moving the cursor to another part of the window and clicking would create more copies of the device. To return to the '**`point`**' mode, which does not make these copies, press the spacebar or click on the arrow.

7. Repeat the above step with the 74_04, which contains six inverters, and the 74_86, which contains four 2-input exclusive OR gates. Go to the lab web site on Connex and locate the data sheets for the 7408, 7486 and 7404 chips. The functionality of 74HCxx is the same as 74xx series. Ensure the pins on the devices now in the viewport correspond to the pins specified in the data sheet.



8. Signal connections (wiring the circuit):

   - Most connections are made with the pointer; position the pointer near the output of one of the gates and drag toward the input of another gate.

   - Alternatively, move two parts close together, such that the input pins of one just touch the output pins of the other.

   In either case the signal lines should flash briefly indicating a logical connection has been made. Throughout, observe the effects of ctrl and tab keys.

   Now, make signal connections that wire the function: $F = \overline{A\bar{B} \oplus \mathrm{BC}}$:

   a. Position pointer near the output of one of the inverter outputs and drag toward an input of an AND gate.
   b. Similarly, structure the circuit for function F by making connections between:
      i. The output of the AND gate (previous step) and an input of an exclusive OR gate
      ii. The output of another AND gate and the other input of the exclusive OR gate.
      iii. Finally, the output of the exclusive OR gate and the input of another inverter.

9. Input Devices:

   - The input devices are found in the Simulation IO.clf library and include such things as binary switches, binary probe.

   a. Place three Binary Switch devices on the circuit window. These will be used for the A, B and C inputs to the circuit. (If the Simulation is already running, clicking on a switch causes it to move between 0 and 1. In order to move the switch the switch to a different location, the shift key must be used.)

   b. Draw signal connections from the Binary Switches to the inputs of the inverter and AND gates as appropriate to create the function F.

10. In the **`Simulation`** menu choose **`Run`**. The *DesignWork*s simulator is now running continuously simulating the effects of the circuit, but the result are not being displayed. The simulator`s results will be displayed in the timing window that is (initially) at the bottom of the screen.

   a. Choose the **`text icon`** in the **Tool Palette**. Use the pencil to insert the name “C” on the signal line that connects the binary switch device to the C input of the AND gate. The C signal now appears in the timing window.
   b. Similarly, use the pencil to insert the names “A” and “B”.
   c. Click on the switches, causing them to change between input values 1 and 0.
   d. Use the <> and >< buttons in the simulation controls tool bar to observe how they affect the time scale of the Timing window.
   e. Examine the affect of the other buttons in that tool bar.

The step button actually advances the simulation to the next time at which there is some circuit activity, not necessarily a uniform time unit.

11. Probe Device: Allows viewing of signals that would not otherwise be shown.
    a. Place a Binary Probe in the circuit window so that it makes a signal connection with the output of the AND gate that produces $A\bar{B}$. The probe output will be updated immediately.
12. Setting Device Parameters: Selecting any device in the circuit then choosing **Simulation Params** in the **Simulate** menu allows specification and control of the device.
13. Save and Exit.