0B

OPTIONAL: More IC Compiler™ GUI

Learning Objectives

This lab has two purposes:

1. Explore additional features of the IC Compiler GUI
2. Perform GUI-based timing analysis.

You will work with a design that has been previously placed by IC Compiler.

After completing this lab, you should be able to:

- Use the pan/zoom history features
- Configure the windows
- Create and manipulate selection lists
- Highlight layout objects
- Invoke the query tool
- Analyze timing paths
- Cross-probe between the layout and schematic

Lab Duration: 50 minutes

Instructions

Task 1. Window Configuration

1. Change your current directory to *lab0_gui* and invoke the IC Compiler GUI:

```
UNIX$ cd lab0_gui
UNIX$ icc_shell -gui
```

2. Load the ***placed*** cell from the ***risc_chip.mw*** design library:

File → Open Design … or  .

There are multiple windows within IC Compiler, for example *MainWindow* and *LayoutWindow* (there are more). These top-level windows can have multiple "views" or sub-windows in them - by default, the *LayoutWindow* contains an "Overview" (miniature cell view) window and a "View Settings" (layer visibility) panel. You can configure these sub-windows and views any way you like. The sub-windows can be undocked and can "float" anywhere on your desktop, or can be docked in another location of the window (top, bottom, left or right). We'll show you how to do this next.

3. Undock the *View Settings* panel by right clicking over the top edge of the panel (over the two horizontal lines), and selecting "**Float**". The view is now stand-alone (floating or undocked) in its own window. Left-click at the top of the floating panel and drag to move it wherever you like.

4. Dock the panel again by right clicking its top edge and selecting **Dock → Left**.

5. Move the position of the *Context* window down, below the *View Settings* panel, by left-clicking its top banner to "grab and drag" the window down. Release the mouse button when the window is below the *View Settings* panel. You can also use this method to undock and re-dock a window.

6. Close both the *Overview* and the *View Settings* windows by clicking their "Hide" icon  in the top right corner or by right-clicking the top edge and selecting "**Hide**". The windows are hidden. This gives you maximum viewing area for your layout.

7. Re-open the *Overview* and *View Settings* windows as follows: Right-click anywhere in the tool bar at the top of the *LayoutWindow* (where the pull-down menu selections are listed). A menu appears listing the available tool-bar views, followed by the four window views. Select "**Overview**". The *Overview* window appears on the left. Open the *View Settings* panel by either pressing the [F8] hot key or repeating the above step and selecting **View Settings**.

8. From the tool bar select the "**Window**" pull-down menu. Near the bottom is a list of all open windows. Selecting one brings that window to the foreground.

   You can do the same thing with [**Ctrl** `] - Control plus "back-tick" (usually below the "tilde" ~).

9. You can have multiple "layout views" displayed in one *LayoutWindow*. Open a new layout view by selecting **View → New Layout View**. The new view is displayed, along with two "tabs" at the bottom, labeled *Layout.1* and *Layout.2*. You can display the different views by selecting the tab, or by setting up "cascaded" or "tiled" views (**Window → Tile Views** or **Cascade Views**).

10. Maximize one of the two layout views. Optionally, close the other.

    Note: Your last window configuration is automatically saved by IC Compiler and will be restored during your next session. The window configuration is saved when exiting the tool in `~/.config/Synopsys/icc_shell.conf`.

Task 2. Pan and Zoom History

The *LayoutWindow* maintains a history of pan/zoom views. A view can also be saved and later recalled. This can be useful while debugging or analyzing results of large designs.

1. If the "history buttons" shown here do not already appear in the *LayoutWindow* tool bar, right-click in the tool bar and select "**Zoom and Pan History**". Three additional "history" buttons are added to the tool bar.

2. If you do not like the default location of the tool-bar buttons, you can change it. Tool-bar button "groups" can be moved to the left or right by left-clicking over the double-vertical bars and dragging and dropping in the desired area.

3. Zoom in on an area of interest [**Z**], then **[Esc]**.

4. Click on the right-most "history" button shown above  or select the menu entry **View → Zoom → Named Zoom and Pan Settings…** .

   In the dialog box enter the name "*myzoom*", click **Add** and then **Close**.

5. Return to a full view, by typing lower-case [**F**] key.

6. To retrieve the saved view, bring up the same dialog box, select "*myzoom*" and click on **Zoom To**. **Close** the dialog box.

7. Pan or zoom to several different areas of interest on the layout and then try the "Go Back" and "Go Forward" buttons  to cycle through the view history.

Task 3. Selection Lists, Highlighting and Querying

1. Selection lists:

   Zoom into the blue core area of the layout and select four or five standard cells.

2. Reduce the *brightness* to **50%** to improve the contrast. The "***Brightness***" control is located at the top of the *View Settings* panel.

3. Show the selected objects in a list format: Use the **Select → Selection List** menu entry.

4. The list can be further filtered by using the **Select**/**Deselect** buttons: Using the [**Shift**] or [**Ctrl**] key, select all except the first two objects from the selection list and click the **Deselect** button to remove them from the list. Notice that only those two standard cells remain selected in the *LayoutWindow.*
   Keep the selection list open, and the standard cells selected.

5. Highlighting objects:

   In the tool bar locate the solid yellow "color" rectangle  .
   Click on the pull-down menu and select the color *red* , then click on the "pen" button to apply the highlight to the selected cells. If the selection list disappeared bring it back with [**Ctrl L**]. To see the colored highlights you must unselect the cells ([**Ctrl D**] or click an area with no objects). The objects remain highlighted in red.

   Select one other cell that is not currently highlighted.

   Question 1. Does the selection list contain the highlighted objects?

   .....

   Click the **Close** button on the *Selection List* window to close it.

   Clear the highlighted objects by clicking  or [**Ctrl M**].

6. Querying objects:

   By default, when the cursor arrow hovers over an object, the object is lightly highlighted, and a query "summary" window appears, displaying some key attributes of the object.

   To obtain a "full query", select a single standard cell, and query it by typing lower-case [**Q**] or by using the menu entry: **Select → Query Selection**. A window opens and lists all the cell's attributes and attribute values. You may need to expand the window to the left to see the values of each attribute.

7. Close the query window by clicking the "Hide" **minus sign** in its upper right corner.

8. If you do not want to change the current set of selected items, or you want to query many objects, there is an alternative method. Turn on the "Query tool" either by clicking on the  button, by pressing [**Ctrl Q**], or by using the menu item **View → Mouse Tools → Query Tool**. The cursor image changes to  .

   Now click on any object and you will see information displayed in the "Query Objects" window, without affecting the currently selected objects.

   Close the "Query Objects" window. Exit the query tool by pressing [**Esc**].

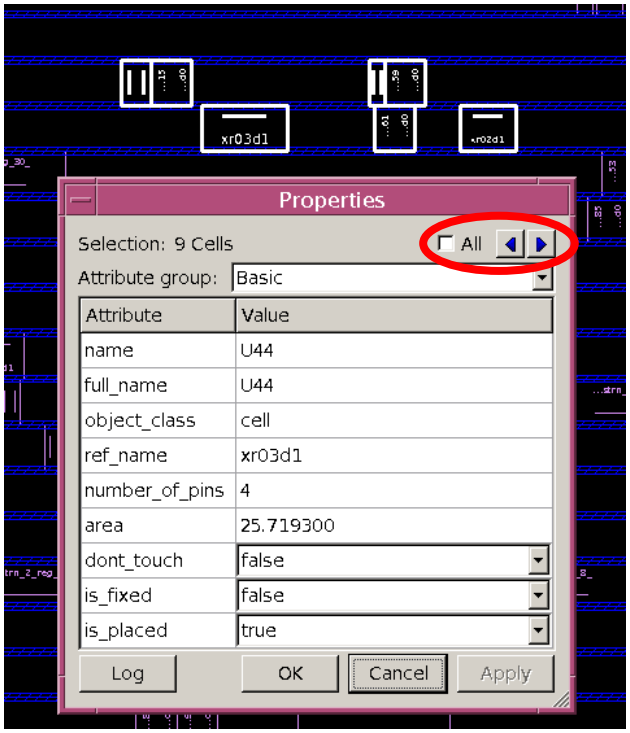
9. Select a few standard cells again. A final way to look for information in a list of selected cells is with the menu entry **Edit → Properties** or [**Ctrl R**]. This will bring up the *Properties* dialog box shown below.

   This dialog can also be used to change properties of selected objects.

   Note: You can also bring up the *Properties* dialog box by right clicking the core area and selecting **Properties** in the pop-up menu.

10. Click the right and left blue arrow buttons to cycle through the properties of each item in the selection one at a time. Check the "**All**" box to see the properties that are identical for all the selection items.

11. **Cancel** the *Properties* dialog box, unselect all objects [**Ctrl D**], and fit the layout view to the window [**F**]. Return the "brightness" to **100%**.

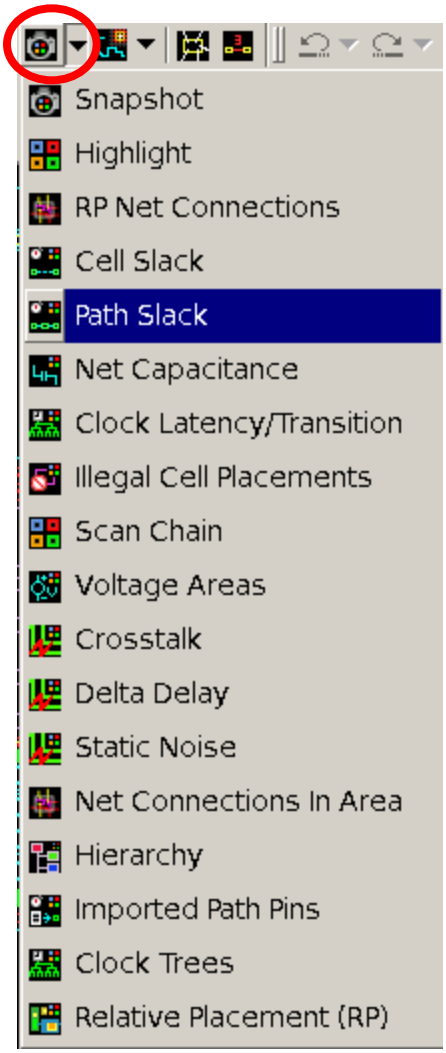


Task 4. Analyze Timing Paths

IC Compiler contains many advanced and easy to use timing analysis and visualization features. We will discuss some useful ones here.

1. Highlighting critical paths:

Select the pull-down menu shown on the right and click on **Path Slack**.



2. In the dialog that appears, click on **Reload**.

3. Click **OK** in the *Warning* box.

4. Wait a little for the *Paths Slack* dialog box to open, then click **OK**.

You should now see colored "fly-lines" in your layout window. The most critical paths (least slack) are highlighted in pink, then red, etc. The most critical path is the one that ends at the IO pad named *RESULT_DATA_iopad_0* in the lower right. **Keep the paths highlighted**.

5. Cross-probing between the layout and schematic:

Select the IO pad mentioned above, ***RESULT_DATA_iopad_0***.

6. Bring the *MainWindow* to the foreground [**Ctrl** `] and maximize it.

7. Select **Schematic → New Path Schematic View → Of Selected Logic**. A schematic window opens, showing just the selected cell – an IO pad "buffer".

8. Double click the top bar of the schematic window to enlarge the view, and fit [**F**] the schematic to the window.

If not already selected (white), select the displayed gate, then right click and select "**Next Fanin/Fanout Level**". Use [**F**] to fit the schematic to the window. You should see one additional level of fanin and fanout to/from the single gate.

Now select the new gate fanning in to our original gate. Right click and select "**Next Fanin/Fanout Level**". You will see an additional level of fanin added. Instead of selecting the gate, you can also just select one of the pins (arrows) and perform the same function. This is useful if you want to expand the path through one particular input pin of a multiple-input gate. You can also double-click the input or output pin to display the next fanin or fanout level. During actual analysis you would continue expanding the path to meet your needs.

9. Unselect all objects in the schematic by clicking in the black background, away from any object, or by pressing [**Ctrl D**]. Notice that there are no selected (white) objects in the layout view.

10. In the schematic, select the original right-most buffer ***RESULT_DATA_iopad_0***. Notice in the layout view that the same IO pad cell is selected (highlighted in white).

11. In the schematic add the fanin nets, pins and gates to your selection using either [**Ctrl**], or by dragging a left-mouse rectangle around them. Notice that these objects are also highlighted in the layout.

12. In order to see this entire critical path, select just the original gate in the schematic, right click and select **Add Logic → Paths…** In the dialog that appears, simply select **OK**. This will display the worst (critical) path to the selected logic gate.

13. Generating a schematic for the entire design:

In the *MainWindow* press [**Ctrl D**] to clear all selections, then select the menu **Schematic → New Design Schematic View**.
A new schematic window opens containing the top-level schematic of the current design, *placed*.

14. The schematic contains a single hierarchical instance *I_RISC_CORE*, plus a handful of logic gates.

Click on the rectangular *I_RISC_CORE* bounding box to select it (located in the left part of the schematic). Check that the "*Cell*" name that appears in the lower right corner confirms that *I_RISC_CORE* is selected. Double click inside the *I_RISC_CORE* boundary to traverse down the hierarchy and view its schematic.

15. Use the *Up Arrow*  and return to the top schematic level.

16. Using the *TimingWindow* for timing analysis:

Let's examine the overall timing quality of the design by displaying a list of path slacks for analysis.

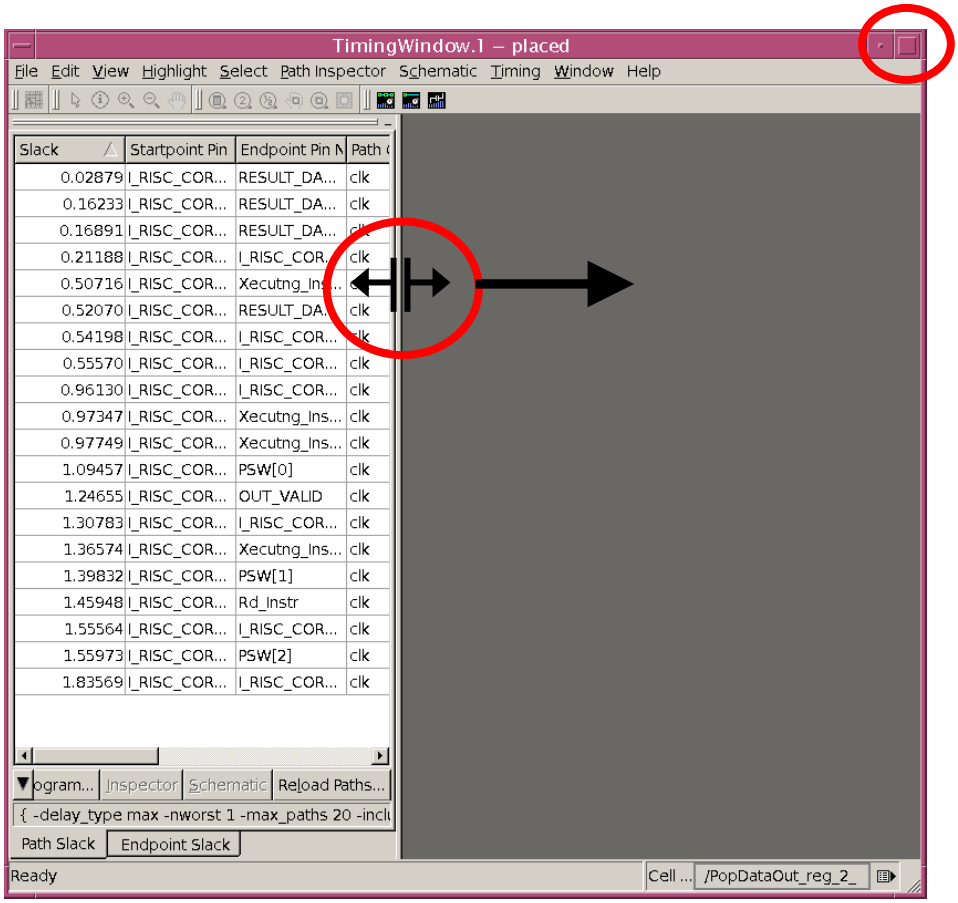
In the *MainWindow* select **Window → New Timing Analysis Window…** .

Click "**OK**" in the *Select Paths* dialog box.

A new window, labeled *TimingWindow* opens, in addition to the two windows already open.

17. Maximize the *TimingWindow* by double-clicking the title bar, or by selecting the "square" button in the upper right corner.

Expand the *slack list* window to the right by placing your cursor arrow over the right border of the window. The cursor changes shape (show below). Click the left mouse button and drag the boundary to the right.

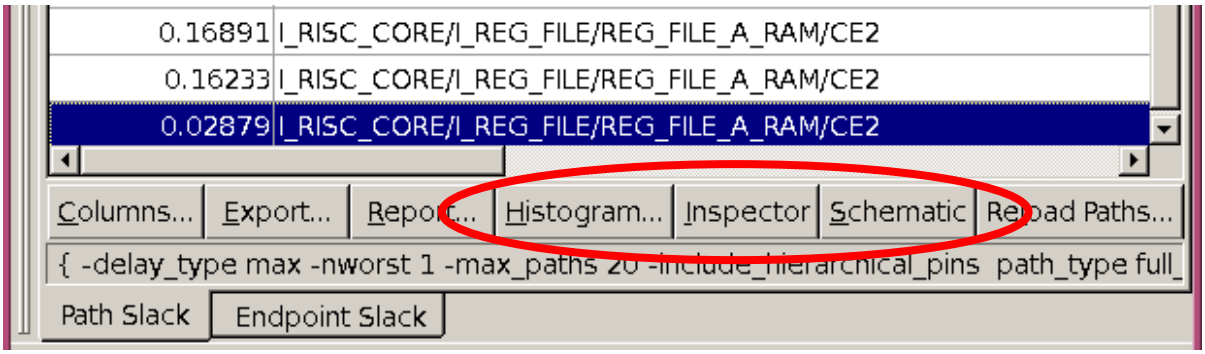


You can left click and drag the gray column header boundaries to resize the column widths if the field values are not fully displayed. You can re-arrange the order of the columns by left-clicking a column header and dragging it to the desired location. Click inside a gray column header and a *sort arrow* appears allowing you to sort the column's data.

18. Select the path with the smallest *Slack* in the list by left-clicking it. The line should highlight to a blue color.

Examine the *LayoutWindow* and *MainWindow* and observe that the path is highlighted in white.

19. There are controls for generating histograms, schematics and timing profilers at the bottom of the *TimingWindow*:

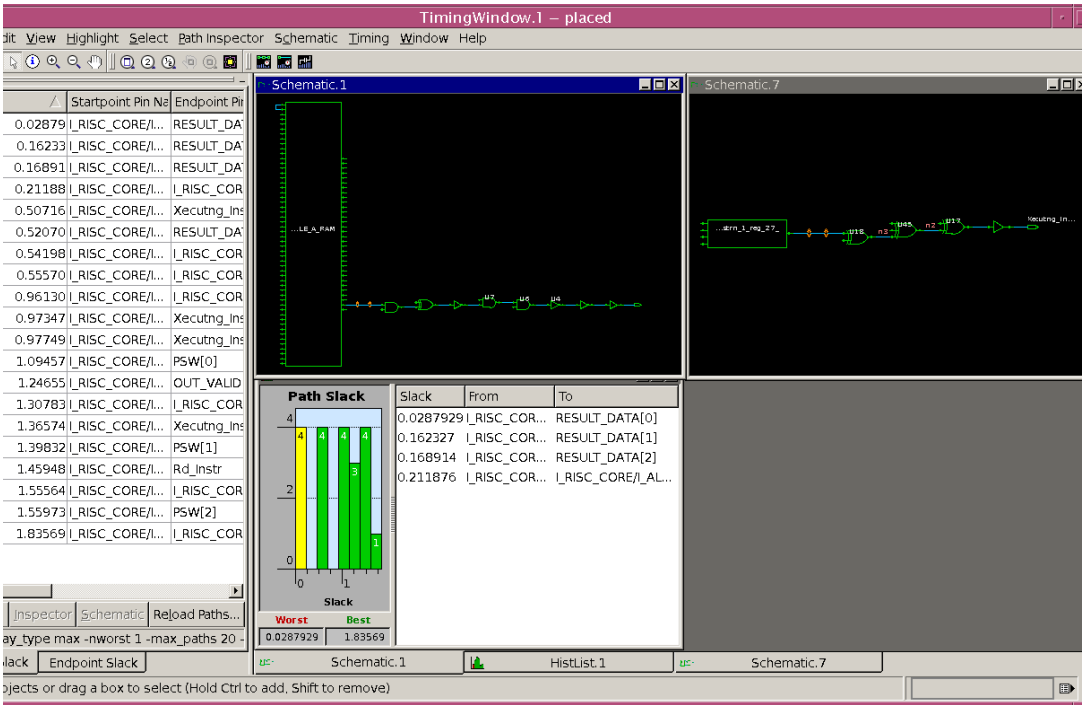


Click the ***Schematic*** button and a schematic of the highlighted path appears in a new window in the gray area of the *TimingWindow*, or in a new tab. You can select and open multiple schematic windows (two are open in the example below and have been re-arranged to fit next to each other).

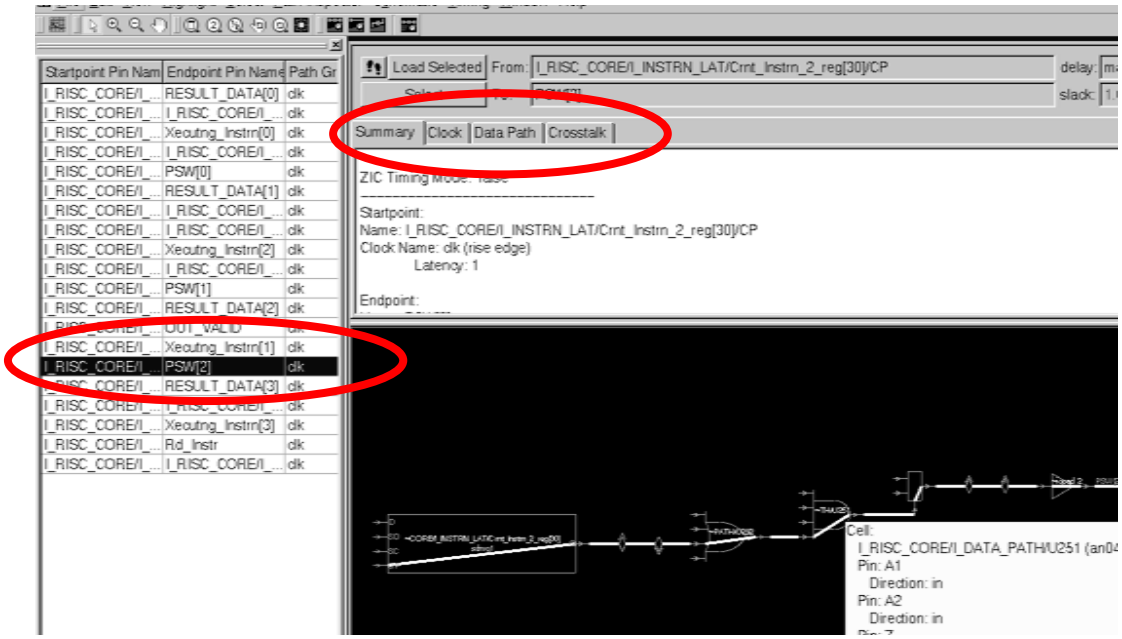
Click the ***Histogram*** button and "**OK**" the dialog box. A set of timing slack histogram bars appears. Select one of the histogram bars and the list window populates with all the paths in that bar. Selecting one of these paths updates the selection in the master path slack list and the path display in the *LayoutWindow*.

Note: The histogram tool is similar to that available from the Design Compiler and PrimeTime GUIs.

Note: To clear a highlighted path, select [**Ctrl D**] as usual.



The *path inspector* can be started by pressing the "**Inspector**" button at the bottom of the *TimingWindow.*
Note: You must first select a path that you wish to "inspect" from the list on the left.



This also opens a schematic window, along with another window that can display details about the path (by selecting the appropriate tab): The *Clock* tab lists details about the launching and capturing clock of the path; *Data Path* lists timing and additional details along the entire path; Crosstalk lists related delay and parasitic information.

Task 5. Window Management

1. A final note on window management: It is possible to have multiple *MainWindows*, *LayoutWindows* and *TimingWindows* open at the same time. You can also open multiple designs at the same time, and switch between them.

If you have not already done so, try the [**Ctrl** `] (control back-tic) sequence to cycle through these windows, similar to an ALT-TAB in an *MS Windows* interface.

If you have multiple tabs (or views) within a window, you can cycle through them using [**Ctrl Tab**].

If you have problems with windows disappearing, e.g. a *Properties* window that vanishes under a *LayoutWindow*, check the controls in your Linux/Unix window manager. Find a control to keep "Secondary windows" on top.

2. From the *MainWindow* or *LayoutWindow* use **File → Exit → Discard All** to exit IC Compiler.

You have completed the optional GUI lab.

Answers / Solutions

Question 1. Does the selection list contain the highlighted objects?

The list tracks what is selected at any time, not the highlighted objects.