Documentation for mem_8.bin and alu_test.bin Binary Cell Matrix Files

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The binary file mem_8.bin can be loaded into the cell matrix simulator using the Load button on the control panel. This binary contains the configuration for an 8x4 memory circuit. Figure 1 shows a schematic of the circuit. Each block corresponds to a single cell within the cell matrix. The entire circuit is 15x32 cells.

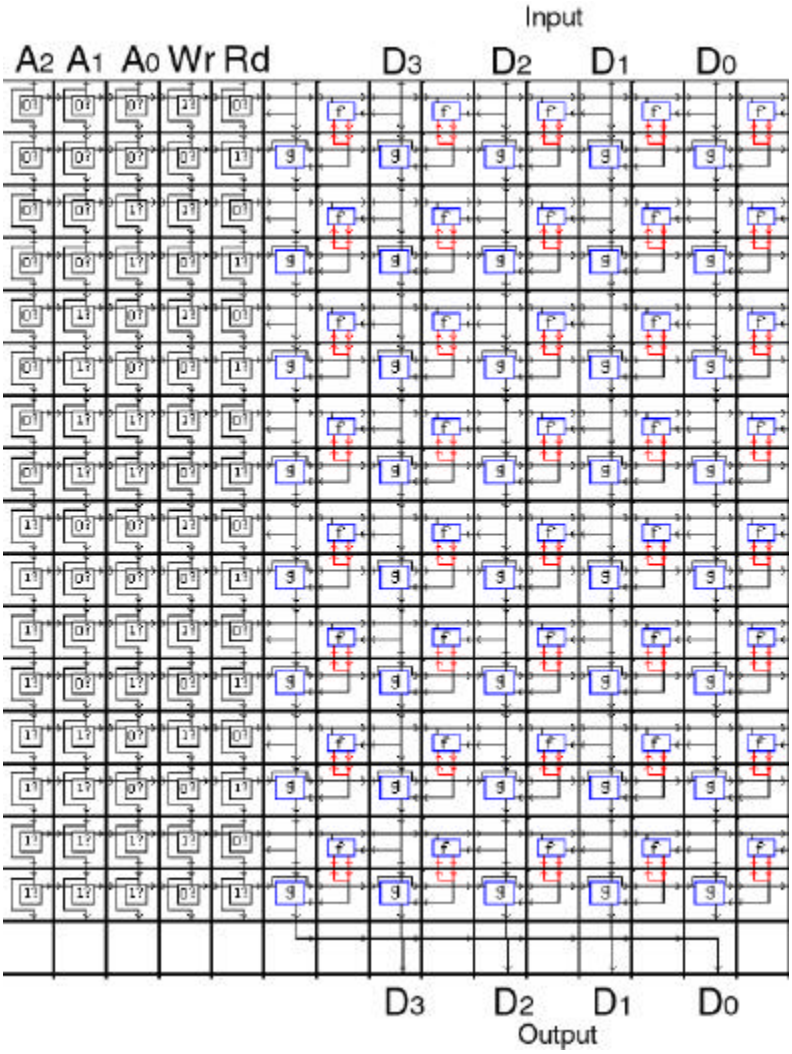

Figure 1.
Schematic Representation of 8x4 Memory
Implemented on a Cell Matrix

A2-A0 select one of eight addresses. Asserting the Rd line will cause the 4-bit number stored at location [A2-A0] to appear on the D3-D0 output lines. Asserting the Wr line will cause the 4-bit number on the D3-D0 input lines to be stored at the location given by [A2-A0].

To load this file, first run the simulator, and single-click the upper left corner of the main grid. Then click the Load button on the control panel, and select the mem_8.bin file. Your grid should

then look like Figure 2. It will probably only show the upper part of the complete circuit, so you need to enlarge the window so it contains as many cells as Figure 2.

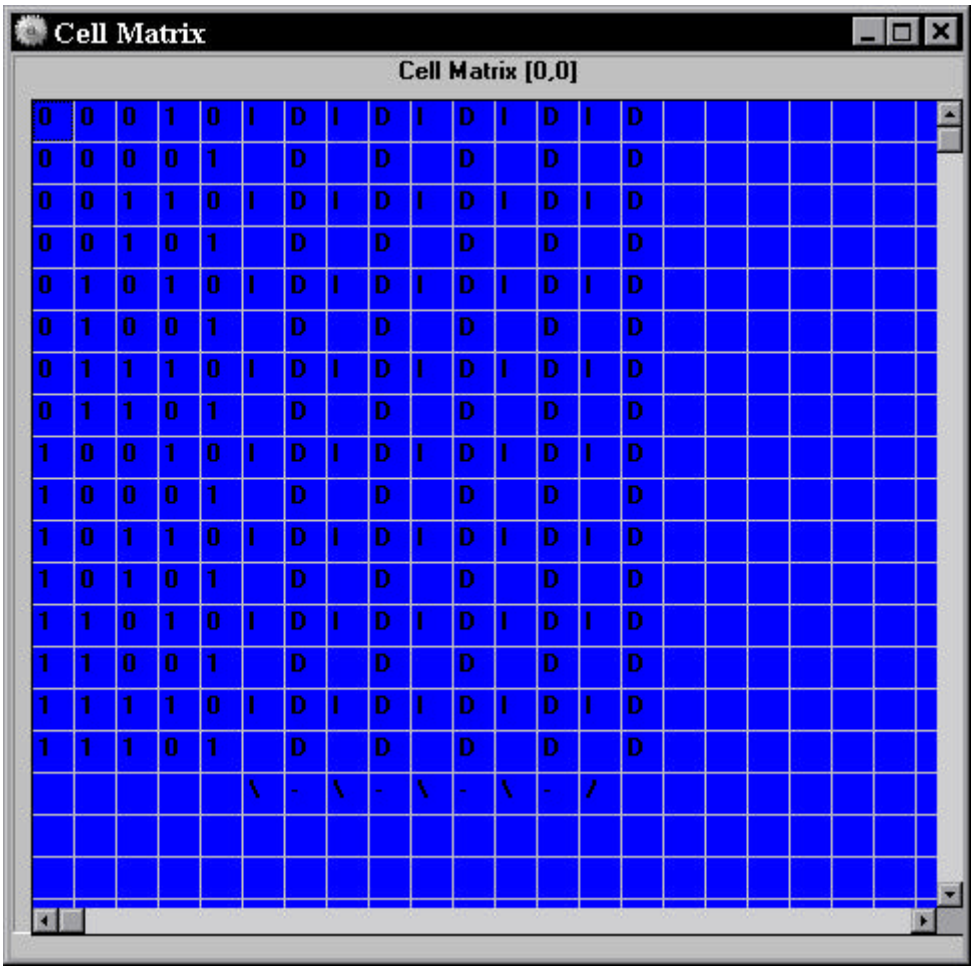

Figure 2. Main Grid display after loading mem_8.bin

To interact with the circuit, the easiest option is to load a "subgrid." To do this, single-click and hold on the upper-left corner of the main grid, then drag the mouse to the lower-right corner of the circuit and release the button. After a few seconds, you'll see a window which looks like Figure 3. Note that you may need to resize this window so it fits comfortably on your display.

This is just a different view of the cells you selected from the main window. In this view, arrows are shown between each pair of neighboring cells. A skinny arrow means D=0, while a thick arrow means D=1. Normally, arrows are black, meaning C=0. A red arrow indicates C=1. For this circuit, you will only need to deal with D-mode cells, so all the arrows should be black.

If you (left)-click on an arrow along the edge (one which is pointing to an edge cell), you will toggle the value of the D-input to that cell. Any such changes are immediately propagated throughout the matrix, so you can see their effect on the circuit. Note that the cells on the right and the bottom of the window shown in Figure 3 are **not** edge cells. Even though they are at the

edge of the window, they are still internal to the entire (nominally 75x75) matrix. Therefore, clicking on those cells has no effect.

You can now click on the inputs like A2-A0, Rd, Wr and D3-D0 input and observe the effect on the outputs.

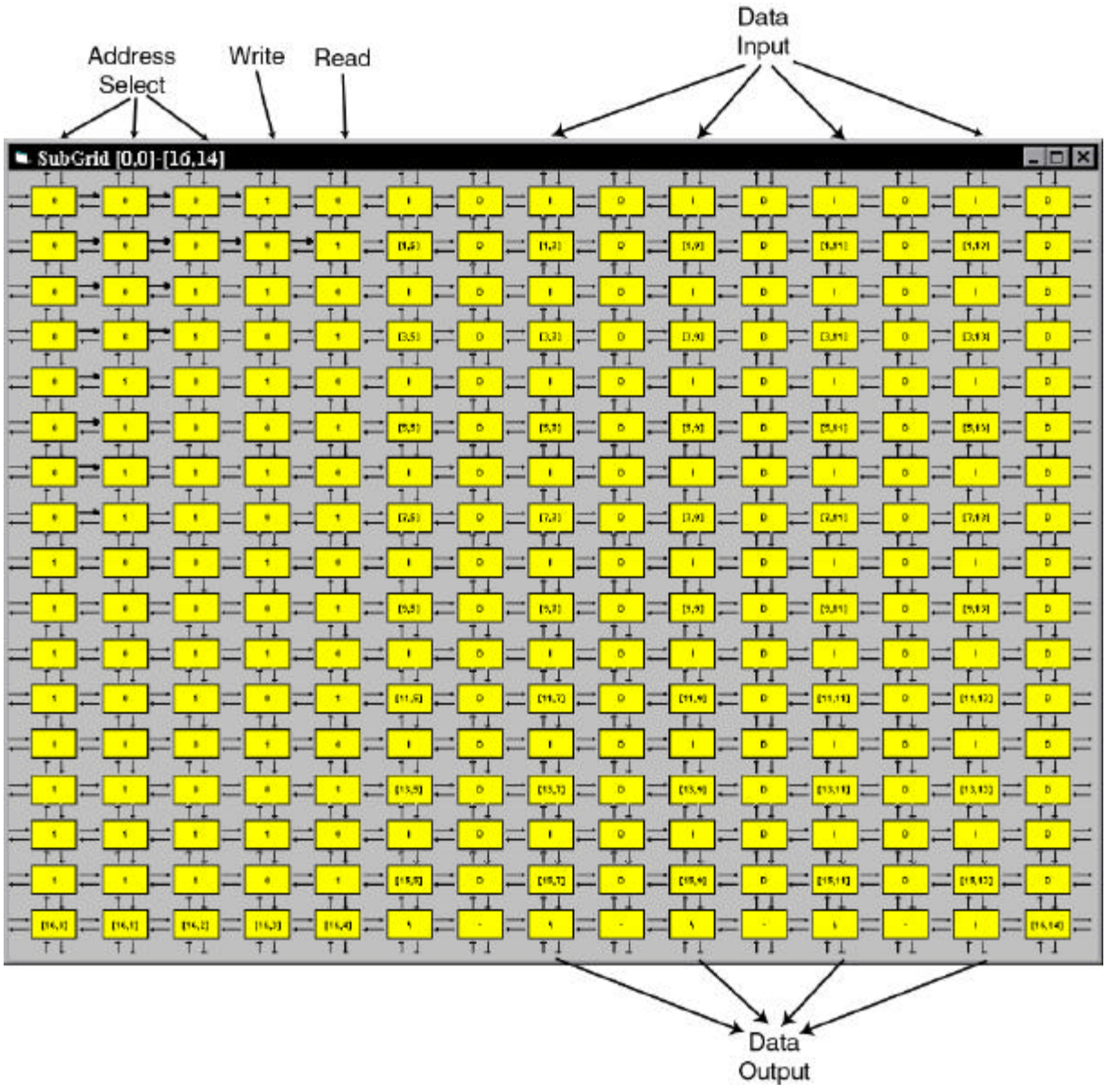

Figure 3. Subgrid display for mem_8.bin
Annotated for explanation only.

If you single-click inside a cell, you will see a new window with a picture of that single cell. You can then select the “Edit Cell” button to bring up the cell’s truth table and Boolean equations.

To clear the matrix, right-click on the Load button in the control panel. This will reset all cells to their initial “Nop” state.

The binary file alu_test.bin can be loaded in the same was as mem_8.bin. Figure 4 shows a schematic for this circuit.

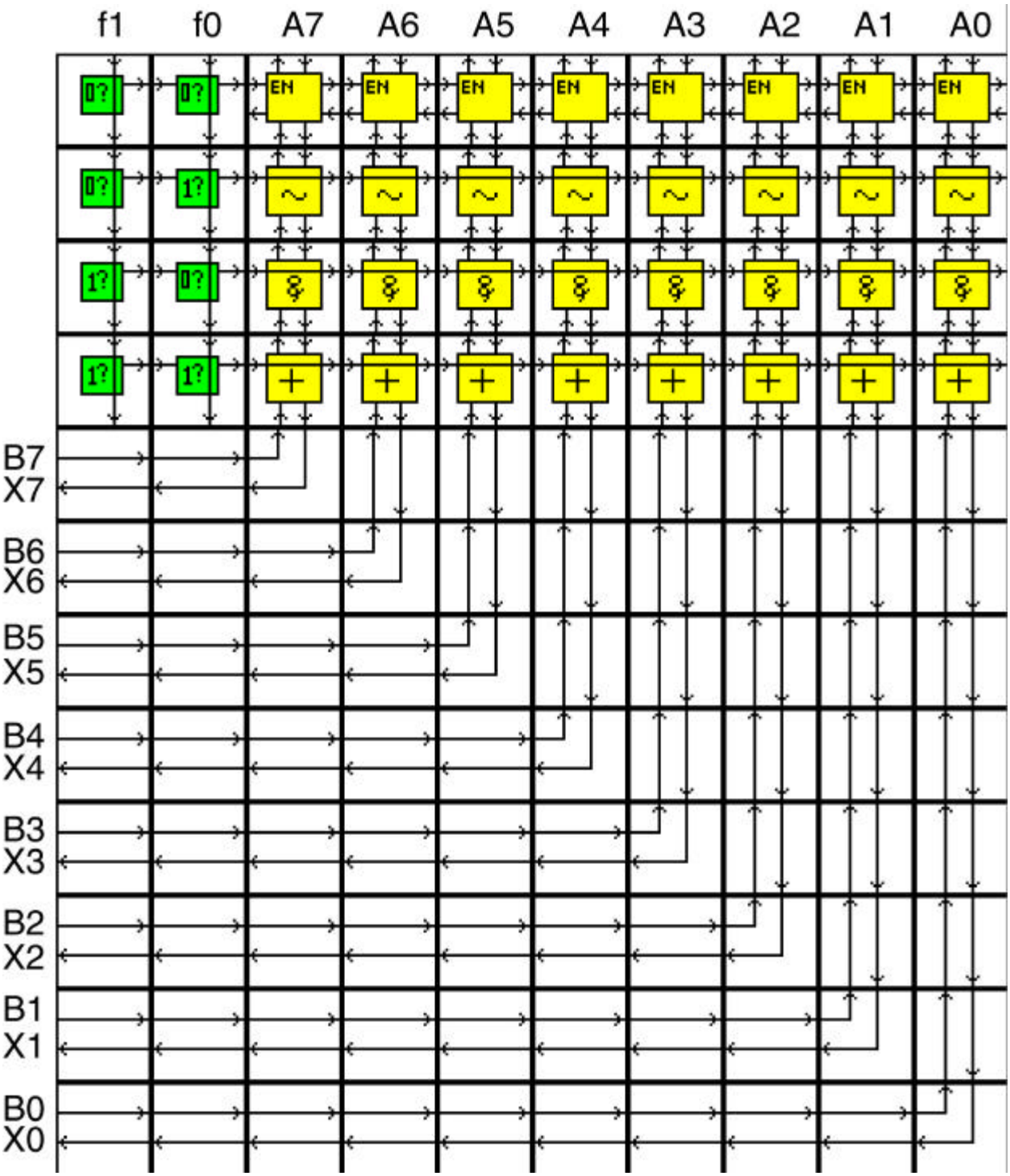

Figure 4
Schematic for 8-bit ALU from alu_test.bin

This circuit performs Arithmetic and Logical operations on a pair of 8-bit numbers A and B. The specific function is specified by the [f1,f0] pair, as shown in Table 1.

f_1	f_0	X
0	0	Sum(A,B)
0	1	Not(A)
1	0	And(A,B)
1	1	Or(A,B)

Table 1
ALU Function Selection

The unit accepts two inputs A and B, and produces a single output X. If, for example, f1=f0=0, then the output X=A+B, the normal arithmetic sum. If f1=0 and f0=1, then output X=Not(A), the logical compliment of A, and so on.

The circuit is designed to accept its B input from the bottom (South), but the southern-most cells of the circuit are not normally accessible to the user, since they are internal to the matrix. Therefore, the circuit also routes those southern inputs (and outputs) to cells along the left (Western) edge of the matrix. These inputs and outputs are labeled B7-B0 and X7-X0 respectively in Figure 4.

Figure 5 shows the main grid display after loading alu_test.bin via the Load button on the control panel.

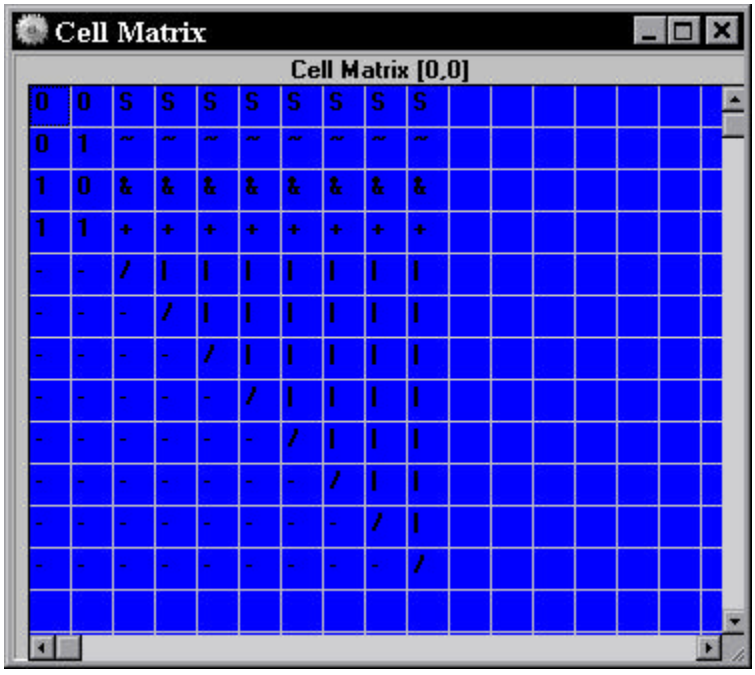

Figure 5
Main Grid Display After Loading
alu_test.bin

Again, you can select a subgrid display by left-clicking on the upper-left corner, dragging to the lower-right, and then releasing. This brings up a window as shown in Figure 6.

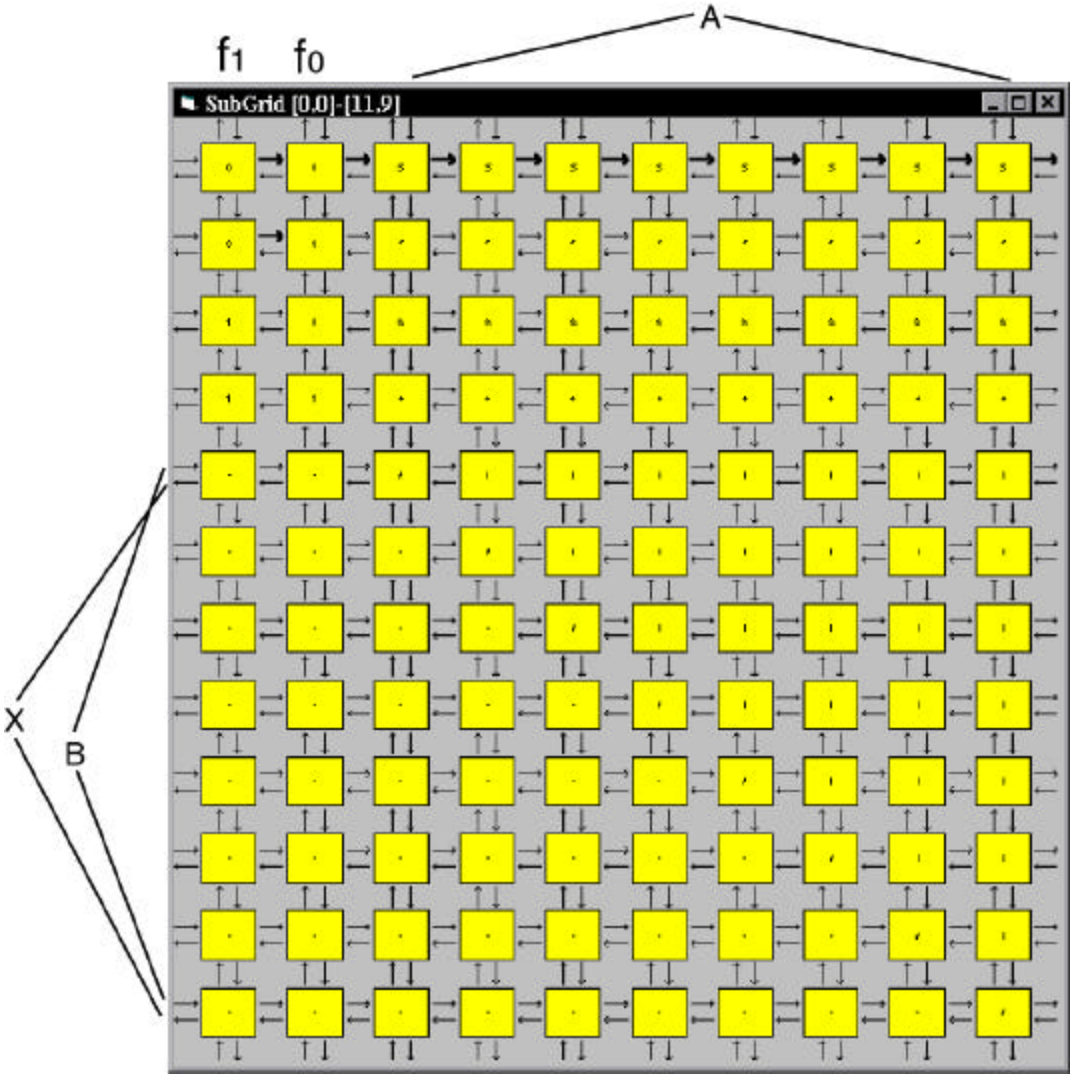

Figure 6
Subgrid Display for alu_test.bin

Again, f1 and f0 are the function select inputs, A and B are inputs for 8-bit binary numbers, and X is the 8-bit output of the circuit. You can use the mouse to change input values and see how their effect propagates throughout the matrix. You can also click inside cells and select “Edit Cell” to examine the truth table and Boolean equations of a cell.