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Including Memory in Design Architect Schematic-Based Designs

- Esp. for ELE 405 -

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1 Introduction

In the last part of the main project (4) in ELE 405, a memory must be created and attached to the CPU to finish the computer. This document tells how to use Mentor schematic models to simulate and initialize memory chips.

2 How to Do It

There is no difference (to the user) between simulating a memory chip and any other logic device. However, to initialize the memory, special steps must be taken.

2.1 References

In Bold Browser, pp. 1-14, 1-15 and 1-34 of the "Quicksim II Advanced Training Workbook". Also, p. 4-31 (and on) of the "Digital Simulators Reference Manual".

2.2 The Memory Chip

In ELE 405 we're using the Intel 2114-AL3 static RAM chip, which has a capacity of 1K X 4 bits, and has an access time of 150 ns. Memory chips are included in schematic designs pretty much like any other component, with a few twists.

2.3 The Steps

First, invoke copies of the chip by inserting the "2114_15" model from the Mentor "sram" library. You will need 4 of these, connected in parallel, to form a 1K X 16 bit memory.

Second, create a data file for each chip, containing the initial contents of the memory. In ELE 405, this will be the test program (benchmark), encoded for your computer. This file is in ASCII, i.e., you create it with any text editor. More on this in the next section.

Third, add or modify the "Modelfile" property in each chip, making it contain the full pathname to the data file created in the second step. To add a property, select the symbol of the chip, select "Edit>Property>Add" from the drop-down menu, etc.

That's it.

3 Memory Contents Initialization File

Basically, each line of the file assigns a datum to one or more memory locations. See below.

The data assignment is with address/datum pairs, each pair followed by a semi-colon. Hex numbers are assumed, unless preceded by a "%", for binary. The entries are not case-sensitive.

Sample data file:

```
# a pound sign indicates the rest of the line is treated as a comment.

012 / f ;          # this puts the hex number ''F'' into hex
                   # memory location ''012''.

059-05B/ %1010;    # This puts hex ''A'' (binary 1010) into all
                   # three locations: 059, 05A and 05B.

* / 9 ;            # This puts ''9'' into all otherwise unprogrammed
                   # locations.

024 / %11x0 ;      # You can use ''x'' to set bit(s) to ''unknown''.
```

So for the 16-bit wide memory used in ELE 405, you'll need 4 files, each one containing one nibble (4 bits) of the data. For example, the file for the most significant nibble chip would contain all of the data for the most significant nibble.

4   Summary

So, to include memory chips in a schematic, and initialize them, 1) call up the symbol of each memory chip to be used, and place them in your schematic; 2) create the data file for the initial data; and 3) modify the "Modelfile" property of each chip to point to that chip's data file. Note that if you don't want to initialize the memory, forget steps 2 and 3. Good Luck!