

CSCI 4717 – Computer Arch. Fall 2012 Superscalar Exercise

Name: Brandon Buchanan

1. The figure to the right represents the execution of 6 instructions on an "in-order-issue/in-order-completion" machine.

Assume that there are two true data dependencies (write-read) in the sequence, one between I4 and I5, i.e., I5 depends on the completion of I4 before it can execute, and one between I5 and I7. As for resource dependencies, assume that any instructions that share a column in the execute stage require the same resource.

Decode	Execute	Write	Cycle
I1 I2			1
I3 I4	I1 I2		2
I3 I4	I2		3
I4	I3	I1 I2	4
I5 I6	I4		5
I7 I8	I5 I6	I3 I4	6
I7 I8	I6		7
	I7 I8	I5 I6	8
		I7 I8	9

Fill in the figure below to show how quickly an "out-of-order-issue/out-of-order-completion" machine could execute these instructions. Be sure to show which instructions are in the window too.

Decode	Window	Execute	Write	Cycle
I1 I2				1
I3 I4	I1, I2	I1 I2		2
I5 I6	I3, I4	I3 I4	I1	3
I7 I8	I5, I6 I4	I4	I2 I3	4
	I5, I7, I8	I5 I6	I4	5
	I7, I8	I7 I8	I6 I5	6
			I7 I8	7
				8
				9

2. The tables on the following page represent data collected using the high performance counter on a Dell Optiplex 780 with an Intel® Core™2 Duo CPU running at 3.33 GHz with 8.0 GB of RAM. The values represent the elapsed times for a loop to execute 2 to 12 simple additions on 2 to 12 integer values. The number of integer values updated is equivalent to the number of operations, i.e., for a loop that contained four operations, there were four integer variables updated. The page after that contains two graphs, one comparing the elapsed times for no dependencies against those with true dependencies and another showing the incremental differences in time between n-1 operations and n operations. The page after that shows a portion of the code used to generate the data. The last page shows the disassembled code for the two loops (with and without dependencies) that perform three additions on three variables.

On the D2L quiz titled, "Superscalar In-Class Exercise," write your answers to the following problems.

- Examine at the execution time and incremental differences in execution time and identify trends and/or characteristics of the data.
- Propose a minimum of two characteristics of the superscalar processor that you think are causing the characteristics you identified in the previous question.
- Examine the sample code and discuss whether or not there might be additional factors that might affect these measurements. Feel free to use the assembly language code to support your proposals.
- What other information would it have been nice to have to perform your evaluation?