

EE 4363 / CSci 4203 Midterm Exam 2 – Spring, 2007
(closed book, closed notes, no calculators, no electronic devices)
Be sure to clearly show how you obtain your answers to each question.

1. Consider the following portion of a VeSPA assembly language program:

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add  r7, r8, r9      ;    instruction 1
sub  r9, r1, r8      ;    instruction 2
or   r7, r9, r1      ;    instruction 3
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(a) (15 points) Identify any flow dependences, anti-dependences and output dependences that exist amongst these instructions. (In each case, specify the register that is involved.)

(b) (15 points) Suppose that instruction 1 is in the instruction fetch (IF) stage of the 5-stage pipelined VeSPA implementation during cycle 21. Determine which cycles instructions 1, 2 and 3 will be in the write back (WB) stage of the pipeline. (Include a table that shows the instructions moving through the pipeline as part of your answer.)

2. (20 points) Consider the following parameter values: memory is byte-addressable, the virtual address is 36 bits, the page size is 16K bytes and each page table entry is 32 bits. Determine the number of bits in the virtual page number field, the number of bits in the page offset field, the number of page table entries and the total size (in Kbytes) of the page table.

3. (30 points) Here is a series of address references given as word addresses: 6, 7, 14, 12, 6, 22, 23, 15, 4, 7, 22, 20, 4, 6. Show the hits and misses and the final cache contents for a 2-way set-associative cache with one-word blocks and a total size of 16 words. Assume that LRU replacement is used.

4. (a) (10 points) Suppose that multiply instructions take 20 cycles and account for 20% of the instructions in a typical program, while the other 80% of the instructions require an average of 5 cycles for each instruction. What percentage of the time does the CPU spend doing multiplication?

(b) (10 points) Suppose that it would be possible to reduce the number of cycles required for multiplication to 10, but this would require a 25% increase in the cycle time. Nothing else would be affected by this change. How much faster or slower would the machine be if this change is made? (Give your final answer in the form “it would be A times faster” or “it would be A times slower” with a specific value given for A.)