CSCI 2321 (Principles of Computer Design), Spring 2004

Homework 5

Assigned: March 29, 2004.

Due: April 5, 2004, at 5pm.

Credit: 30 points.

1 (Optional) figures to print

Some of the problems ask you to modify figures from the textbook, or ask you to trace through execution of instructions using one of the figures. For these problems you may find it useful to print a copy of the figure. To save you the trouble of photocopying the relevant figures or finding them on the authors' Web site, here are they are in your choice of printable formats. All figures below are copyrighted[1].

- Figure 5.19, PDF[2] or PostScript[3].
- Figure 5.20, PDF[4] or PostScript[5].
- Figure 5.29, PDF[6] or PostScript[7].

2 Problems

Do the following problems. You may write out your answers by hand or using a word processor or other program, but please submit hard copy, either in class or in my mailbox in the department office.

1. (5 points) Suppose that at the beginning of a clock cycle the following is true:

   - The program counter (PC) has a value of 4.
   - The instruction memory's location 4 contains the binary representation of the MIPS assembler instruction `add $t0, $t1, $t2`.
   - Register `$t1` contains 8.
   - Register `$t2` contains -2.

   Using Figure 5.19 (p. 360), trace through what happens during the clock cycle. (See Section 1 above for a printable version of this figure.) At the point at which values are written into state elements, what values will the following have?:

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[2] `http://www.cs.trinity.edu/~bmassing/Classes/CS2321_2004spring/Homeworks/HW05/Problems/F0519.pdf`
[3] `http://www.cs.trinity.edu/~bmassing/Classes/CS2321_2004spring/Homeworks/HW05/Problems/F0519.ps`
[4] `http://www.cs.trinity.edu/~bmassing/Classes/CS2321_2004spring/Homeworks/HW05/Problems/F0520.pdf`
[5] `http://www.cs.trinity.edu/~bmassing/Classes/CS2321_2004spring/Homeworks/HW05/Problems/F0520.ps`
[6] `http://www.cs.trinity.edu/~bmassing/Classes/CS2321_2004spring/Homeworks/HW05/Problems/F0529.pdf`
[7] `http://www.cs.trinity.edu/~bmassing/Classes/CS2321_2004spring/Homeworks/HW05/Problems/F0529.ps`

- Output of instruction memory (instruction in binary form).
- Input and output of program counter register (PC).
- Inputs and outputs of register file (read register 1, read register 2, write register, write data).
- Inputs and output of ALU.
- Outputs of control (RegDst, etc.).
- Output of ALU control.

2. (5 points) Suppose that at the beginning of a clock cycle the following is true:

   - The program counter (PC) has a value of 8.
   - The instruction memory's location 8 contains the binary representation of the MIPS assembler instruction `lw $t0, 8($t1)`.
   - Register `$t1` contains 16.
   - The 32-bit value stored starting at data memory location 24 is -10.

   Using Figure 5.19 (p. 360), trace through what happens during the clock cycle. (See Section 1 above for a printable version of this figure.) At the point at which values are written into state elements, what values will the following have?:

   - Output of instruction memory (instruction in binary form).
   - Input and output of program counter register (PC).
   - Inputs and outputs of register file (read register 1, read register 2, write register, write data).
   - Inputs and output of ALU.
   - Inputs and output of data memory (address, write data, read data).
   - Outputs of control (RegDst, etc.).
   - Output of ALU control.

3. (10 points) Do problem 5.5 on p. 427 of the textbook. (See Section 1 above if you want to print copies of the relevant figures.)

4. (10 points) Do problem 5.6 on p. 427 of the textbook. (See Section 1 above if you want to print copies of the relevant figures.)