CS 473

Midterm Exam

February 28, 2003

The following exam is open book and open notes. You may feel free to use whatever additional reference material you wish, but **no calculators** are allowed. Please note the following instructions. There will be a ten point deduction for failure to comply with them:

- start each problem on a new sheet of paper
- write your social security number, but not your name, on each sheet of paper you turn in
- show your work whenever appropriate. There can be no partial credit unless I see how you arrived at your answers
- be succinct. You may lose points for facts that, while true, are not relevant to the question at hand

You have until 10:20 to finish the exam.

1. *(30 points)* Multiply the two following IEEE floating point numbers together: `41300000` × `40500000`. Express your result as an eight-digit hexadecimal number. Convert it to human-readable decimal format.

2. *(10 points)* Translate the following MIPS instructions to machine code. Expressyour answer as an eight digit hexadecimal number.

   (a) `xor $1, $2, $3`

   (b) `beq $7, $9, 0x300`

   (c) `lw $t0, 200($s1)`

3. *(10 points)* Translate the following machine code instructions to MIPS assembler. You can just use raw register numbers (like `$7`), you don't need to translate to the MIPS assembler conventions (like `$a3`). You may express constants in either decimal or hexadecimal, but please use C syntax (`0x`) to tell me if it's hexadecimal.

   (a) `0x02a72824`

   (b) `0x2d234321`

4. *(20 points)* Consider the following MIPS code fragment:

```
add  $3, $zero, $zero
lw   $1, 100($3)
sw   $1, 200($zero)
lw   $4, 400($3)
sw   $1, 100($4)
```

   (a) Draw a Gantt (timing) chart showing the execution of this code, assuming all possible forwarding and assuming loads stall instead of using a delayed load. Use arrows to show forwarding between the instructions.

   (b) Reorder the code so that it can run as fast as possible.

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5. *(30 points)* The book has a possible superscalar version of the MIPS on page 512. This superscalar machine has two pipes: one for memory instructions, and tee other for everything else. Suppose the following two instructions occur in a program:

   ```
   add $1, $2, $3
   sw  $1, 100($3)
   ```

   Assuming all possible forwarding, would it be possible to issue these instructions simultaneously? If not, why not? If so, modify the following copy of Figure 6.58 to show the forwarding that would be necessary.

   (unfortunately, the copy of this exam in my archive was the source for the exam, not the final PDF, and I don't seem to have a copy of that figure any more)