Midterm Exam #1 for ECE/CS 250, Fall 2014

name: _____

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1. I will not lie, cheat, or steal in my academic endeavors, nor will I accept the actions of those who do.

2. I will conduct myself responsibly and honorably in all my activities as a Duke student.

Please sign your name below to acknowledge that you follow this standard:

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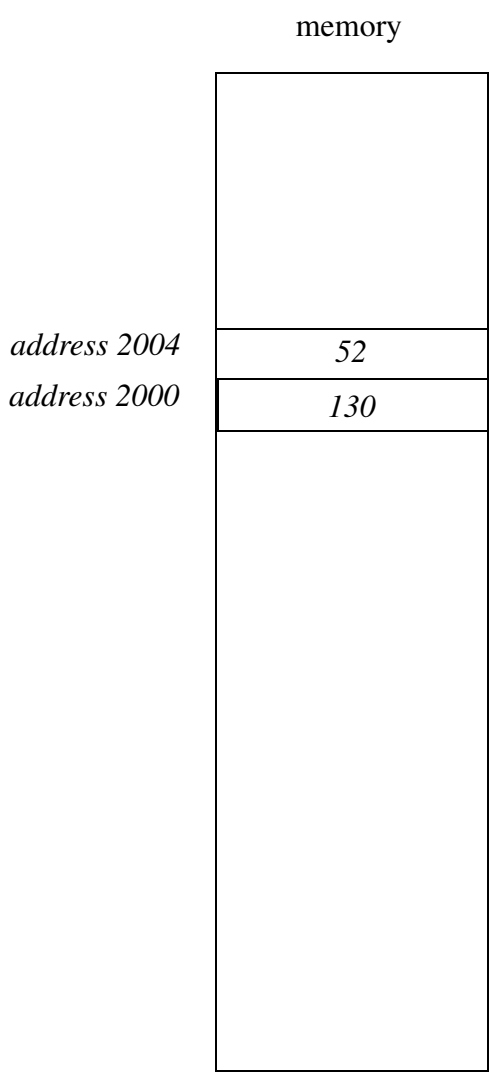
1) [10 points]

(a) Add the following base-10 numbers using **<u>6-bit</u>** 2s complement math: -3, -4. **Show your work!**

2) Assume that $2 = 2000 and $3=12. Assume that memory holds the values at the addresses shown on the left. “lw” = load word, and “sw” = store word.



(a) If the computer executes sw $3, 4($2), then what is the value of $3 after this instruction?

(b) If, after the instruction in part (a), the computer executes lw $3, 0($2), what is the value of $3 after this instruction?

(c) What single instruction could you use to write the value in $5 into address 2008?

(d) What single instruction could you use to read the word of memory at address 1996 and put the result in $8?

3) [10] The IEEE 754 floating point standard specifies that 32-bit floating point numbers have one sign bit, an 8-bit exponent (with a bias of 127), and a 23-bit significand (with an implicit “1”). Represent the number -11.75 in this format.

4) [10] The following questions are based on the following code snippet.

(a) What is *(array+7) ? Please give its datatype and its value.

(b) On a MIPS machine, how big (how many bytes) is the variable array?

(c) On a MIPS machine, how big (how many bytes) is array[2]?

(c) What is the datatype of fun?

```
int* array = (int*) malloc(42*sizeof(int));
int** fun = &array;
for (int i=0; i<42; i++){
    array[i] = i*i;
}
free (array);
```

5) [25] Convert the following C code for the function foo() into MIPS code. **Use appropriate MIPS conventions for procedure calls**, including the passing of arguments and return values, as well as the saving/restoring of registers. Assume that there are 2 argument registers ($a0-$a1), 2 return value registers ($v0-$v1), 3 general-purpose callee-saved registers ($s0-$s2), and 3 general-purpose caller-saved registers ($t0-$t2). Assume $ra is callee-saved. The C code is obviously somewhat silly and unoptimized, but YOU MAY NOT OPTIMIZE IT -- you must simply translate it as is.

```
1: int foo (int num){
2:  int temp = 0; //temp MUST be held in $t0
3:  if (num <0) {
4:      temp = num + 2;
5:  }else{
6:      temp = num - 2;
7:  }
8:  int sumA = bar(temp); // sumA MUST be held in $s0
9:  int sumB = sumA + temp + num;// sumB MUST be held in $s1
10: return (sumB + 2);
11:}

12: int bar (int arg){
```

line(s) of C	instruction(s)	what code MUST do (if not obvious from C code)
1		create stack frame large enough for callee-saved and caller-saved registers; save callee-saved registers (ONLY necessary ones)
2		
3-7		
8		save caller-saved registers (ONLY necessary ones); call bar() with appropriate arguments
after line 8		restore caller-saved registers; get value returned from bar() and put it in appropriate place
9		
10		pass return value back to whoever called foo(); restore callee-saved registers; destroy stack frame; return to caller

6) [10] Explain the von Neumann model of computers.