CS 441 Mid-term Exam
Fall 2004

Name:_____

You may use any resource (book, internet, notes, etc) as long as you complete this exam without help from anyone else. Turn in this exam at the DMS office (101 Chapman) by 5pm on Thursday October 14. If you are unsure how to proceed on a question, write down your assumptions and solve the problem based on those assumptions - you will be graded on your solution and how reasonable your assumptions were. Document your sources of information and evaluate their trustworthiness. Good luck.

1. How many transistors does the Intel Itanium processor have in the CPU? How many integer and floating point registers does it have? (5 points)

2. What *exactly* did Gordon Moore state that become known as Moore's Law? What was the basis for his conclusion? (10 points)

3. What applications make up the CINT2000 portion of the SPEC CPU2000 benchmarks? What are the main differences between it and the SPEC92 benchmarks? (10 points)

4. Why can't you have a 32-bit constant in a MIPS instruction? Show what is necessary to load a 32-bit constant into a register. (10 points)

5. Give a short MIPS code example to demonstrate why each of the 5 MIPS addressing modes (shown in Figure 2.24 on page 101) are needed (or makes things more convenient). (15 points)

6. Problem 3.46. While the IA-32 allows 80-bit floating-point numbers internally, only 64-bit floating-point numbers can be loaded or stored. Starting with only 64-bit numbers, how many operations are required before the full range of the 80-bit exponents are used? Give an example. (10 points)

7. Implement the following C code in MIPS assembly, assuming that `do_it()` is the first function called. Be clear on any assumptions that you make and state which registers contain variables. You many assume `0 < num <= 100`. (25 points)

```
static int count=0;
int do_it(int num) {
      int r[100];
      r[0] = 10341;
      for ( i=1 ; i<num ; i++ )
            r[i] = r[i-1] * 2851 + 1203 mod 256;
      sort_array(r, num);
      return count;
}
void sort_array(int *a, int n) {
      int i,j;
      for ( i=0 ; i<n-1 ; i++ ) {
            for ( j=0 ; j<n-1-i ; j++ ) {
                  if (a[j+1] < a[j]) {
                        tmp = a[j];
                        a[j] = a[j+1];
                        a[j+1] = tmp;
                        count ++;
                  }
            }
      }
}
```

8. Assume the following MIPS code is run on a machine with a 4 Ghz clock. What does it do? In the worst case, how many seconds will it take to execute assuming 1 cycle for `addi` and `sub` and 2 cycles for `lw`, `sw`, and `bne`? Assume that the initial value of `$t7` is `$t2+292`. (15 points)

```
loop: lw   $t1, 2000($t2)
      lw   $t3, 4000($t2)
      sub  $t5, $t3, $t1
      sw   $t5, 6000($t2)
      addi $t2, $t2, 4
      bne  $t7, $t2, loop
```