Midterm Exam for ECE 152

name: _____

1) [10 points] Explain the engineering tradeoffs between using a 2-level carry lookahead adder and using an “infinite” hardware CLA.

2) [10] The IEEE 754 floating point standard specifies that floating point numbers have one sign bit, an 8-bit exponent (with a bias of 127), and a 23-bit significand. Represent the number -17.25 in this format.

3) [10] Using Booth's algorithm (unmodified), multiply:

0010101
x
0110001

Show your work. You do NOT have to show how a computer would do this, just show how to do this by hand.

4) [25] Write MIPS assembly code for the following C/C++ code. Use the appropriate MIPS conventions for procedure calls, including the passing of arguments and return values, as well as the saving of registers that need to be saved. Assume that there are 4 argument registers ($a1-$a4), 2 return value registers ($v1-$v2), 10 callee-saved registers ($s1-$s10), and 10 temporary caller-saved registers ($t1-$t10).

```
int main (){
    int value;
    int exponent; // you can assume exponent>=1
    return power(value, exponent);
}
int power (int val, int exp){
    if (exp == 1) return val;
    else return val*power(val, exp-1);
}
```

5) [5] Give an explanation for why MIPS doesn't have an instruction that performs the power function that you just implemented in Question #4, something like:

```
power $rd, $rs, $rt
```

where $rs is the value and $rt is the exponent.

6) [15] Draw a diagram of the hardware to add four 4-bit numbers together using carry-save adders. Explain why carry-save addition is preferable to using normal (non-carry-save) addition when adding more than two numbers together.

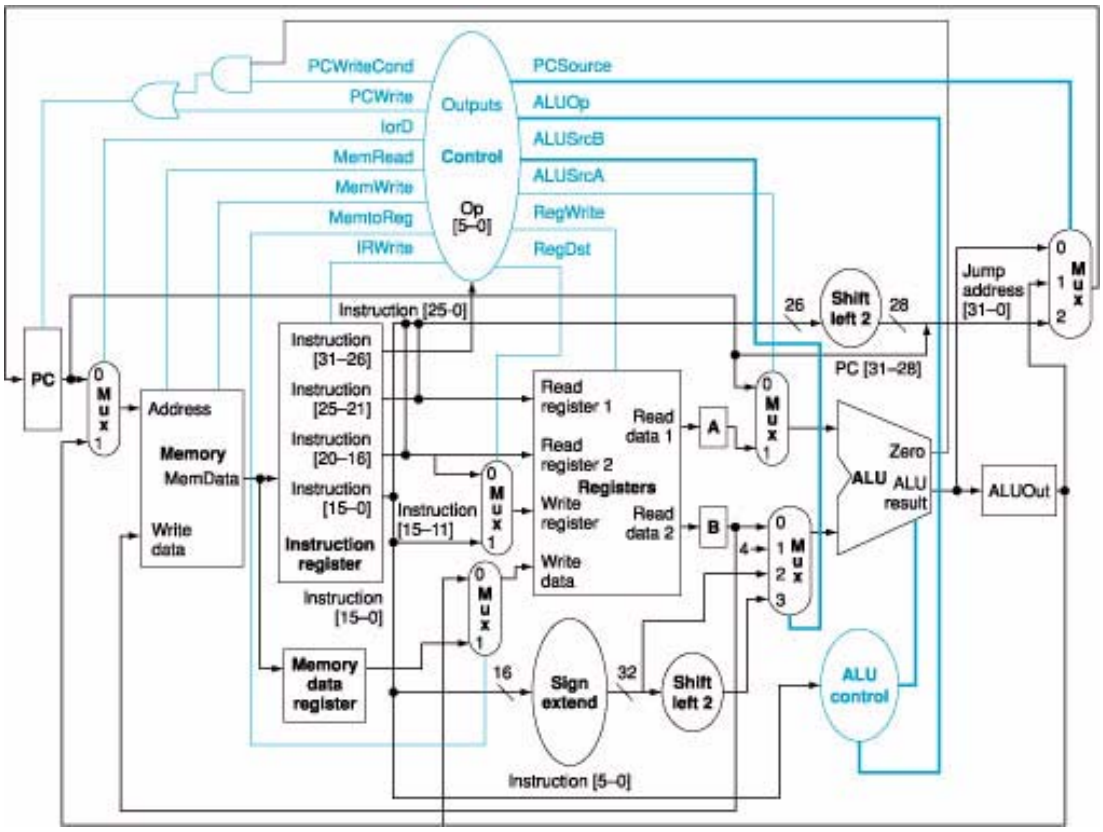

FIGURE 1. Multicycle datapath for Question #7. Note that this is NOT exactly the same datapath that we used in class.

7) [25] How would you implement the following new MIPS I-type instruction in the multi-cycle datapath shown in Figure 1?

`stringlength $rt, imm($rs)`

This instruction starts at address Mem[$rs + (SignExtended(imm)<<2)] and walks through memory looking for the NULL character (which terminates a string). When it discovers a NULL, it records the length of the string in $rt.

Discuss what new datapath elements are needed and how control would have to change to accomodate this instruction. Assume `stringlength` will take many cycles to execute. You may write on Figure 1, and you may continue your answer on the next page. Please explain your answer thoroughly, so I can more easily give partial credit.