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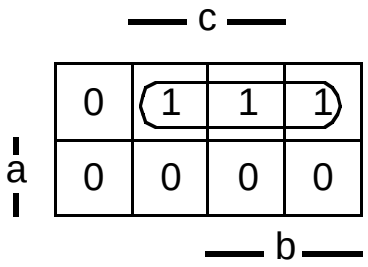
CS 33003 **Final Exam** **CompOrg**

Wednesday 16 December 1998

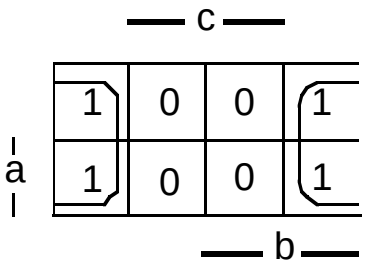
1. Convert 495.453125_{10} to base 8, showing all your work. (10 points)

2. Given the Karnaugh maps below, identify any errors, either in the way the ovals are drawn, or in the way the ovals are interpreted. If there are no errors, write "no errors". (8 points)

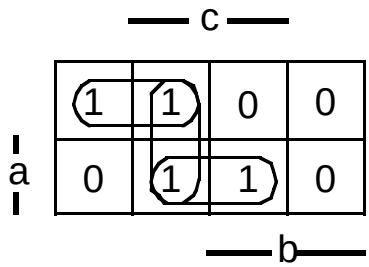
a. output = a'bc



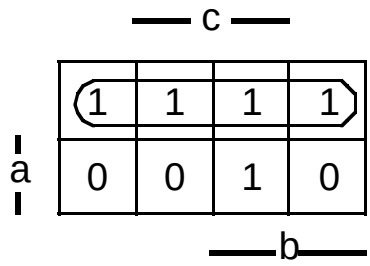
b. output = c'



c. output = a'b' + b'c + ac



d. output = a'



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3. Draw a diagram showing how a 3-bit adder can be built out of full adders and half adders (6 points)

4. Suppose a CPU is referred to as a "32-bit" CPU. (6 points)

   a. What are the implications of this with respect to the datapath?

   b. What are the implications of this with respect to the memory?

   c. If this CPU is said to have "little endian byte order", what does that mean?

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5. Suppose you need to implement a 32M (2^{25}) x 4 bit memory system. (8 points)

   a. How many 16M (2^{24}) x 1 bit memory chips would be needed?

   b. How many 4M (2^{22}) x 4 bit memory chips would be needed?

   c. In case (a.) above, how are the address lines for the memory system as a whole connected to the CS inputs of each memory chip? Explain your answer either textually, or draw a diagram. Note — you do not need to show how all the other lines are connected.

6. Write code fragments to add the values at memory locations 100 and 101 and store the sum into memory location 200, using each of the following instruction formats: (12 points)

   a. 0-operand (stack)

   b. 1-operand (accumulator)

   c. 2-operand

   d. LOAD/STORE

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7. The assembler is responsible for translating source code into object code. (8 points)

   a. In the source code, what items go in the text segment, data segment, and bss segment?

   b. How does the Location Counter differ from the Program Counter?

8. Show the **5-bit** representation of each of the decimal values below in each of the specified formats. If it is not possible to represent a particular value in a particular format, write "not possible" in that location. (9 points)

Value	Signed Magnitude	Excess 16	2's Complement
15			
2			
–16			

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9. The SPARC CPU has some “features” that may seem rather unusual at first. (9 points)

a. Register %g0 is permanently hardwired to zero. Give one example of when this is useful.

b. “inc” is a synthetic instruction that adds the constant “1” to a specified register. What is meant by “synthetic instruction”?

c. There is no multiply instruction in the instruction set. What do you do in your program if you need to multiply?

d. What is the “branch delay slot”, and why is it important to be careful what instructions are placed there?

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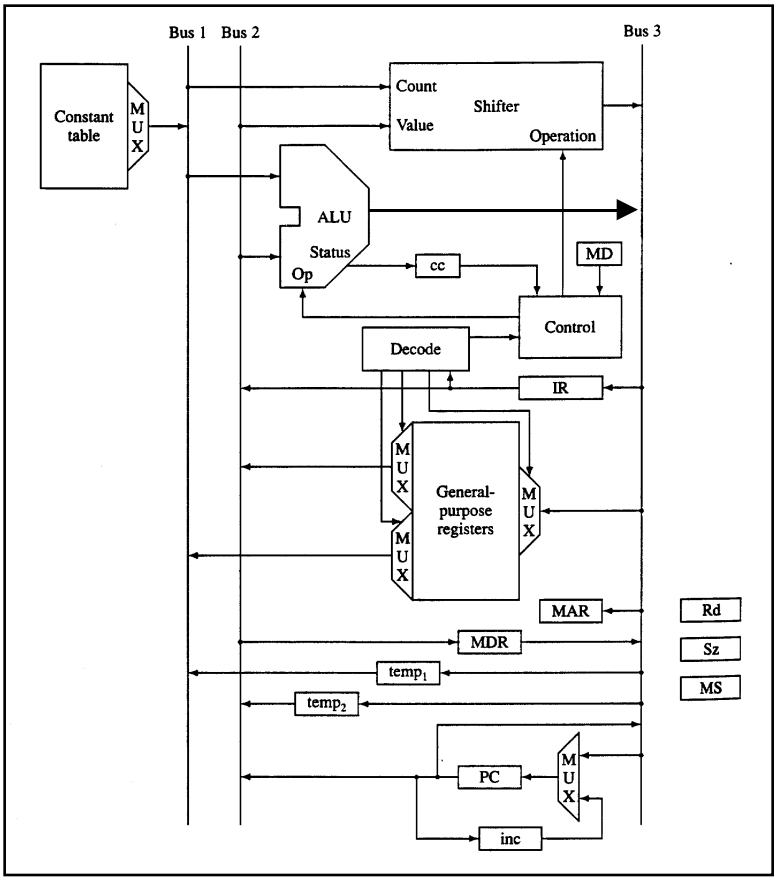
10. Consider the Chapter 9 Simple machine, shown at the right. (11 points)



a. One of the functions that can be performed by the ALU is addition, and it might be required to do this for at least three different reasons. List <u>two</u> of these reasons, or list <u>all three</u> for extra credit.

b. Why are bus 1 and bus 2 both required? Why not connect a single bus to both ALU inputs?

c. What does the "controller" (labeled "control" in the figure) control? Be specific.

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11. Almost every modern machine has at least one or more caches. (6 points)

    a. Why is it important to cache instructions?

    b. Why is it important to cache data?

12. For years, CPUs have supported interrupts. (7 points)

    a. In what way are interrupts better than using programmed I/O?

    b. What items must the interrupt handler save and restore?