UNIVERSITY OF CALIFORNIA, RIVERSIDE

Department of Computer Science and Engineering
Department of Electrical Engineering
CS/EE120B – Introduction to Embedded Systems
Midterm 2
August 19, 2003

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Name: Solution Key **Student ID#:** _____

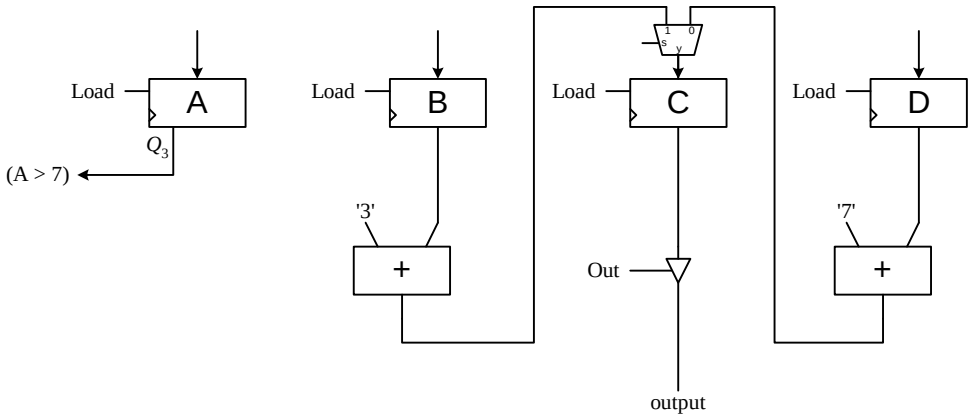
Please print legibly

(Numbers in parenthesis denote total possible points for question.)

1. Draw a 4-bit datapath that can execute the following program segment using two adders. Include all the necessary comparator circuits. Minimize the number of control signals required. How many control signals are needed? (4)

```
Input A
If A > 7 then
     C = 3 + B
Else
     C = 7 + D
End if
Output C
```

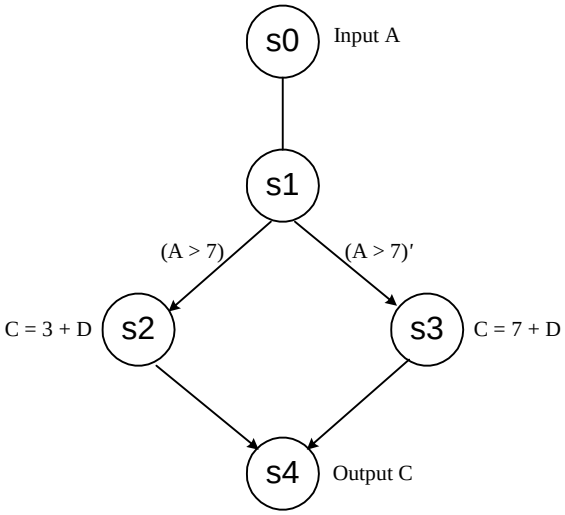
Answer



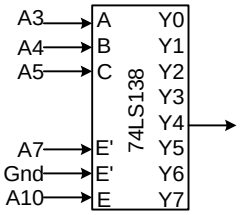
6 control signals.

2. Draw the state diagram for the program segment in question 1. Annotate the states with the instruction that is executed in that state. (4)

Answer



3. Given the 3-to-8 decoder circuit below, what is the lowest address (in hex) that will assert the output Y4? Assume that the address bus is 16 bits (A0 – A15). Pins A, B, and C are the decoder inputs. Pins E and E′ are the active high and active low enable pins respectively.



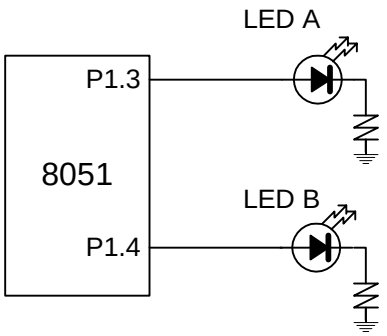
(4)

Answer

A15	A14	A13	A12	A11	**A10**	A9	A8	**A7**	A6	**A5**	**A4**	**A3**	A2	A1	A0
0	0	0	0	0	**1**	0	0	**0**	0	**1**	**0**	**0**	0	0	0

The lowest address when Y4 is asserted is 0420hex.

4. Given the following circuit, write an assembly language program that will turn on LED A at 25% of its full brightness until power is removed from the CPU. The labels P1.3 and P1.4 mean bits 3 and 4 of port 1 respectively. Write all numbers in hex. Put comments in your code to say what each line is for. Use zero (0) for all don't care values. (4)



Answer

```
Repeat
     Out P1,$08  // turn on LED A
     Out P1,$00  // turn off LED A
     Out P1,$00  // turn off LED A
     Out P1,$00  // turn off LED A
Until False
```

5. Given the circuit in question 3, write an assembly language program that will flash the two LEDs alternately until power is removed from the CPU. Write all numbers in hex. Put comments in your code to say what each line is for. Use zero (0) for all don't care values. (4)

Answer

```
Repeat
     Out P1,$08  // turn on LED A and turn off LED B
     Out P1,$10  // turn off LED A and turn on LED B
Until False
```