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CS 33003 | **Exam #2** | **CompOrg**

Friday 16 October 1998

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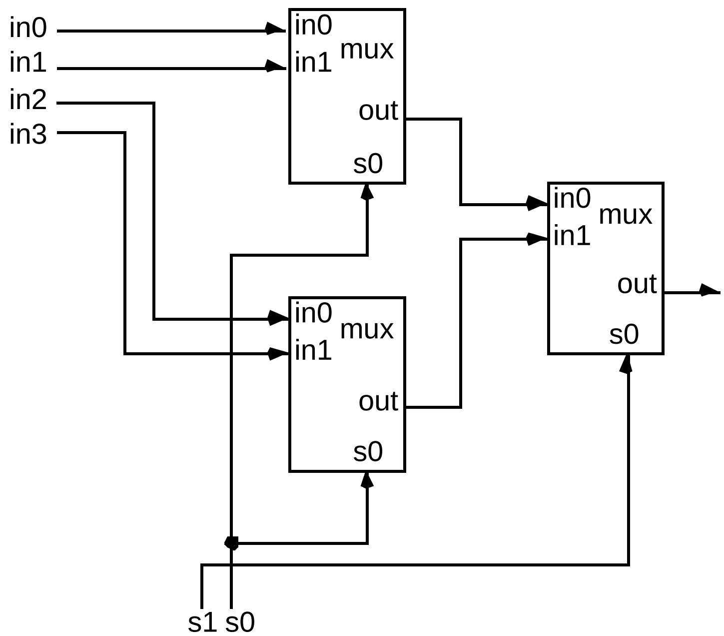
1. Explain the difference between a D flip-flop and a D latch. (10 points)

With a D latch, the output Q changes to match the D input anytime CK is high.

With a D flip-flop, the output Q changes to match the D only on the rising edge of CK (when it changes from low to high).

2. Draw a diagram showing how a 4-input multiplexer (with inputs i3–i0 and select lines s1–s0) can be built from 2-input multiplexers. (15 points)



3. How does a PLA compare to a field-programmable logic device (FPLD)? (10 points)

Both are "programmable" in the field by the designer, but a PLA can be programmed only once, while a FPLD can be programmed many times

A PLA contains an AND-OR structure; a FPLD is essentially an array of PLAs (so it's bigger). Also, a FPLD usually includes registers, RAM, and other components not on a PLA.

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4. For each of the following registers, give the full name of the register, and briefly describe what it is used for: (3 points each = 12 points)

a. PC

Program Counter — holds address of next instruction to be executed

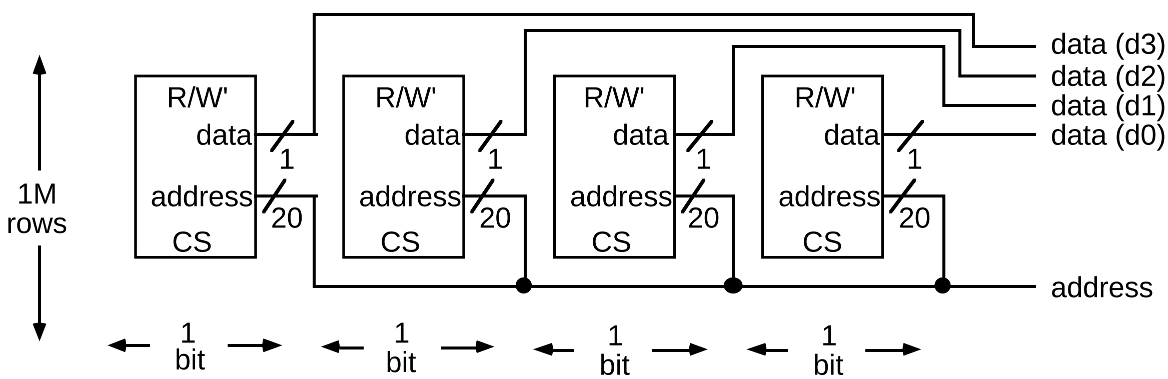
b. IR

Instruction Register — holds current instruction being executed

c. MAR

Memory Address Register — holds address being passed to memory (specifies location to be read from or written to)

5. Draw a diagram showing how a 1M (2^{20}) x 4 bit memory system can be built using 1M x 1 bit memory chips. Clearly show the address and data lines that connect to each chip. For simplicity, don't show the R/W' and CS lines connecting to the chips unless the connections are different for some chips. (15 points)



6. For a disk system, explain how the terms "platter", "surface", "track", and "sector" are related. (8 points)

A platter is a disk of magnetic material; it has two surfaces. Each surface is divided into rings called tracks, and each track is divided into fixed-size sections called sectors.

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7. For an <u>accumulator</u> machine, write code to execute the statement "D=AD – BC", assuming A is stored at memory location 20, B at location 21, C at location 22, and D at location 23. Do not destroy the contents of any variable except D, which should receive the final value of the computation. (15 points)

```
LOAD    21    ; B
MPY     22    ; BC
STORE   24    ; TEMP = BC
LOAD    20    ; A
MPY     23    ; AD
SUB     24    ; AD – BC
STORE   23    ; D = AD – BC
```

8. For an <u>LOAD/STORE</u> machine, write code to execute the statement "D=AD – BC", assuming A is stored at memory location 20, B at location 21, C at location 22, and D at location 23. Do not destroy the contents of any variable except D, which should receive the final value of the computation. (15 points)

```
LOAD    R0,20       ; A
LOAD    R1,21       ; B
LOAD    R2,22       ; C
LOAD    R3,23       ; D
MPY     R0,R0,R3    ; AD
MPY     R1,R1,R2    ; BC
SUB     R0,R0,R1    ; AD – BC
STORE   23,R1       ; D = AB – BC
```