Reminders: - buy DE1 for homework
- homework appointments Thurs/Fri (12 hrs advance booking req'd)
- quiz Fri

## Computing

A computer system contains 3 essential components

1 - CPU

2 - input / output

3 - memory

The datapath circuit is an example of a very basic computer

CPU - ALU, mux

I/O - switches, constants (0 and 1), hex display

Memory - register file

We are using RTN to "program" the computer

low-level: $R3 \leftarrow 1$

high-level: $R3 \leftarrow R3 + 1 \Rightarrow$ $A \leftarrow 1$, $B \leftarrow R3$, $R3 \leftarrow A + B$ } μ-ops

Each μ-op is a machine instruction.
You input instructions by setting switches
Most typical CPU instructions use 3 operands:

$C = A \text{ op } B$

C: R2 (always a register); A: R3; B: R1 + or const

written as: $R2 \leftarrow R3 + R1$ (assembly language)

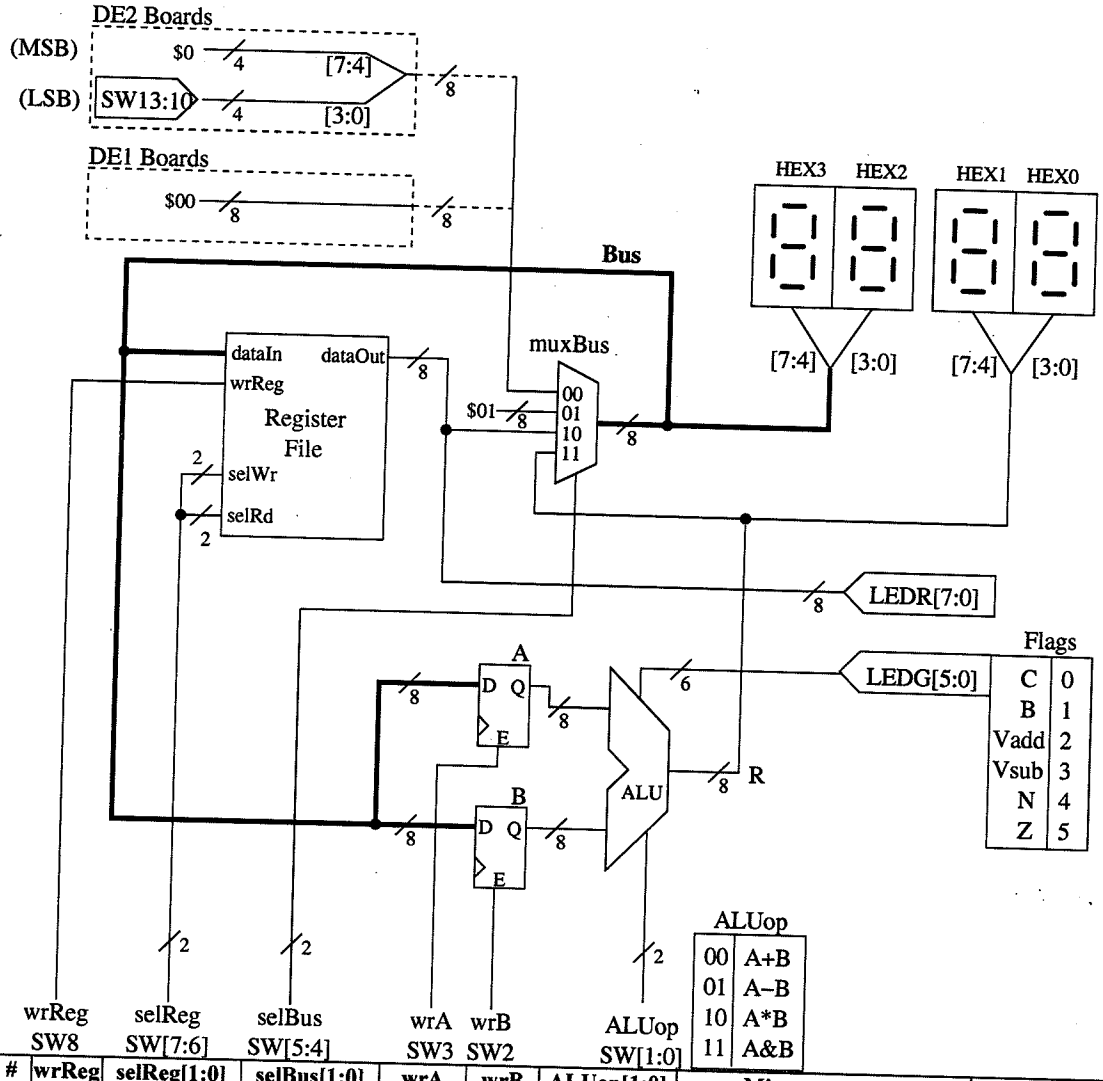
or "add R2, R3, R1"

Examples:

(3) $R2 \leftarrow R2 + R2$

(4) $R3 \leftarrow 2 + 1$

(5) $R3 \leftarrow 7 * 9$




| Cycle # | wrReg | selReg[1:0] | selBus[1:0] | wrA | wrB | ALUop[1:0] | Micro-operation | Overall Operation |
|---|---|---|---|---|---|---|---|---|
| 1. | 0 | 10 | 10 | 1 | 1 | XX | A←R2 ; B←R2 | R2←R2+R2 |
| 2. | 1 | 10 | 11 | 0 | 0 | 00 | R2 ← A+B | |
| 3. | | | | | | | | |
| 4. | 0 | XX | 01 | 1 | 1 | XX | A←1 ; B←1 | R3 ← 2+1 |
| 5. | 0 | XX | 11 | 1 | 0 | 00 | A ← A+B (1+1) | |
| 6. | 1 | 11 | 11 | 0 | 0 | 00 | R3 ← A+B (2+1) | |
| 7. | | | | | | | | |
| 8. | | | | | | | | R3 ← 7*9 |
| 9. | | | | | | | | |
| 10. | | | | | | | | |
| 11. | | | | | | | | |
| 12. | | | | | | | | |
| 13. | | | | | | | | |
| 14. | | | | | | | | |
| 15. | | | | | | | | |
| 16. | | | | | | | | |
| 17. | | | | | | | | |
| 18. | | | | | | | | |
| 19. | | | | | | | | |
| 20. | | | | | | | | |

do NOT modify R0, R1, R2

try to not modify R3 until the very end

Use A and B to hold temps