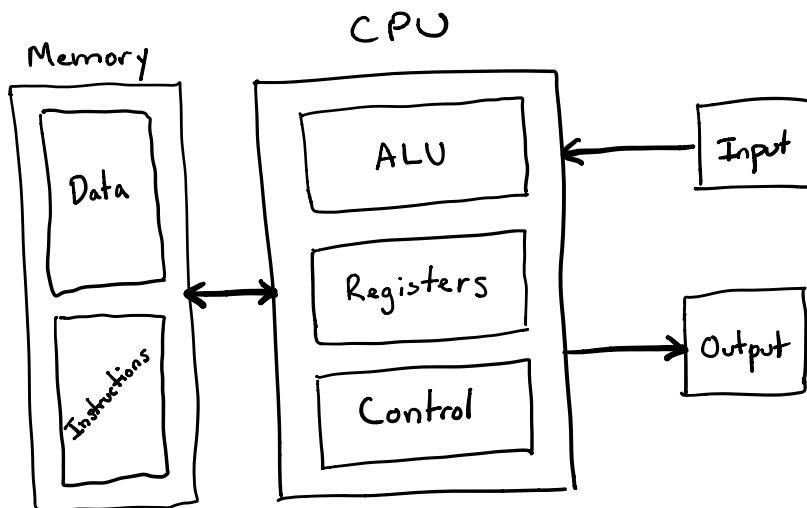


Week 5 - Computer Architecture

Von Neumann Architecture

↳ a stored program computer



Fetch - Execute Cycle

The basic loop for the CPU:

- 1) Fetch an instruction (from the program memory)
- 2) Execute that instruction

fetch the
next instruction

Address of the next instruction to fetch
is provided by the **Program Counter**.

Normally, the **PC** handles incrementing the address by 1 on each cycle. A jump is achieved by loading a new value into the **PC**.

"Executing" the instruction really means routing the control bits of the instruction to the correct place to get the hardware of the computer (like the ALU) to effect the desired operation.

{ Many computers used a shared address space for instructions and data. This means you can't fetch an instruction from the memory and a piece of data at the same time!

- Most architectures get around this by using separate + alternating fetch and execute cycles
- The Hack computer instead uses separate instruction and data memories!
 - allows fetching and executing on the same cycle!

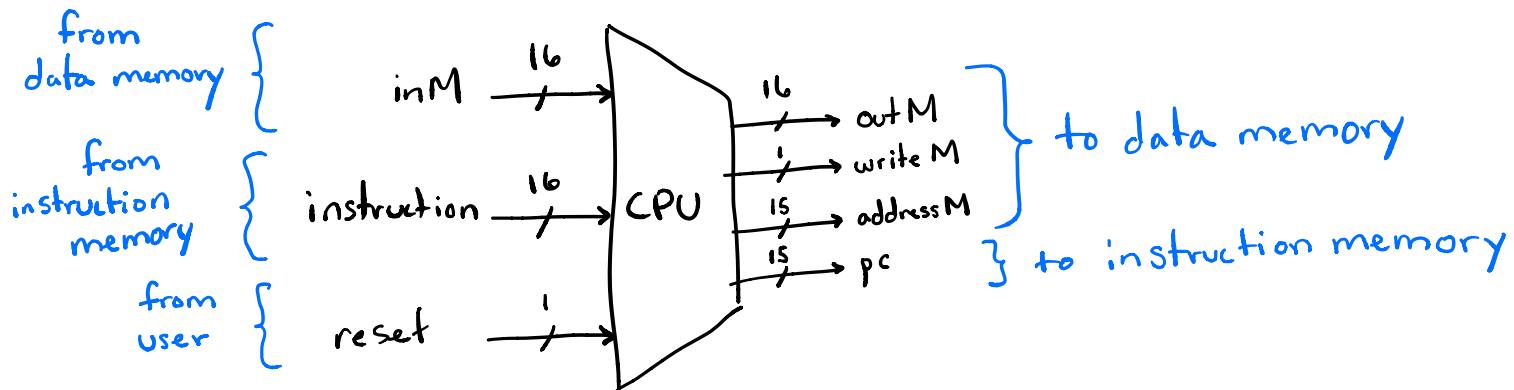
→ actually a Harvard Architecture!

↑ course describes a Harvard Architecture as a variant of a von Neumann architecture.

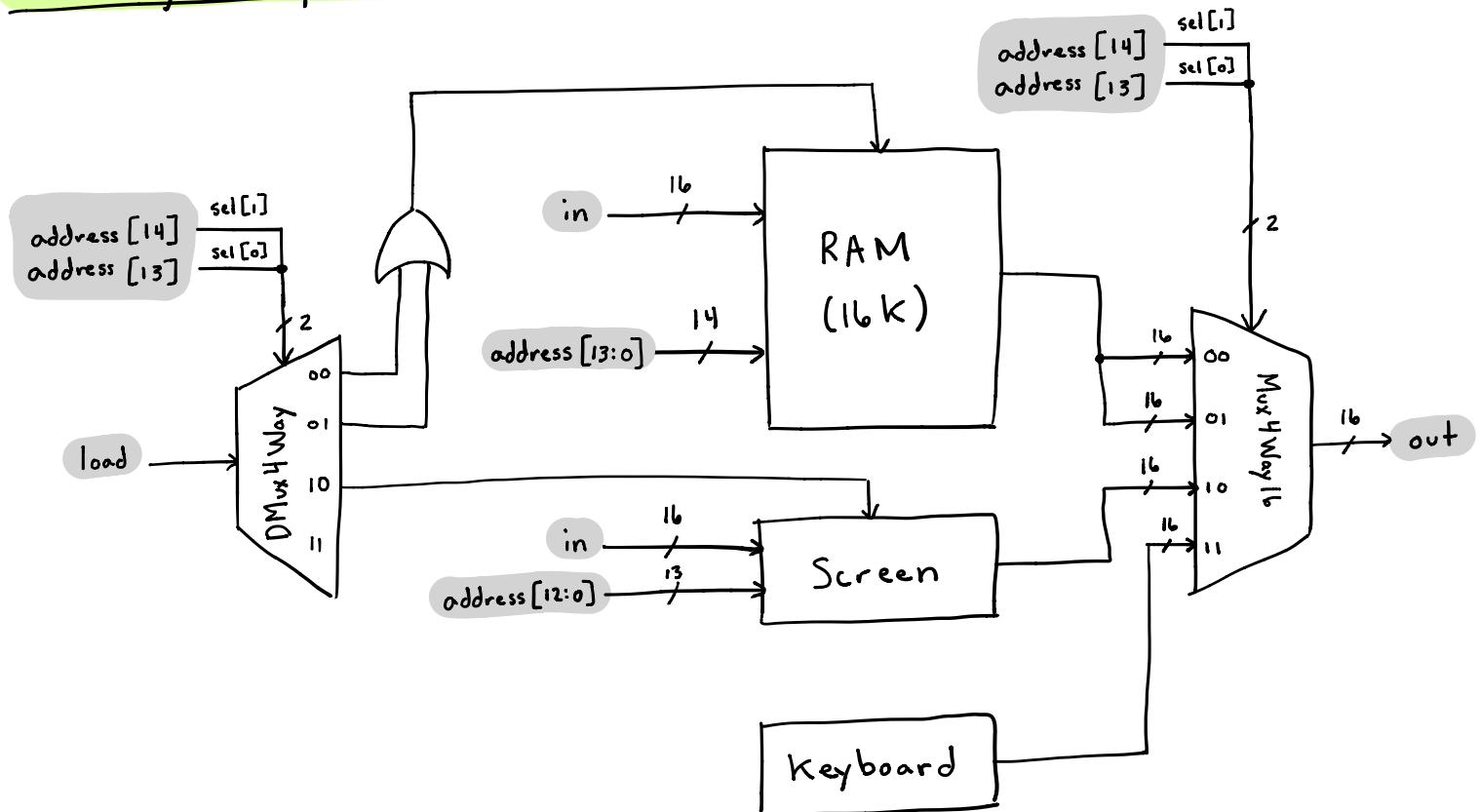
The Central Processing Unit

A 16-bit processor, designed to:

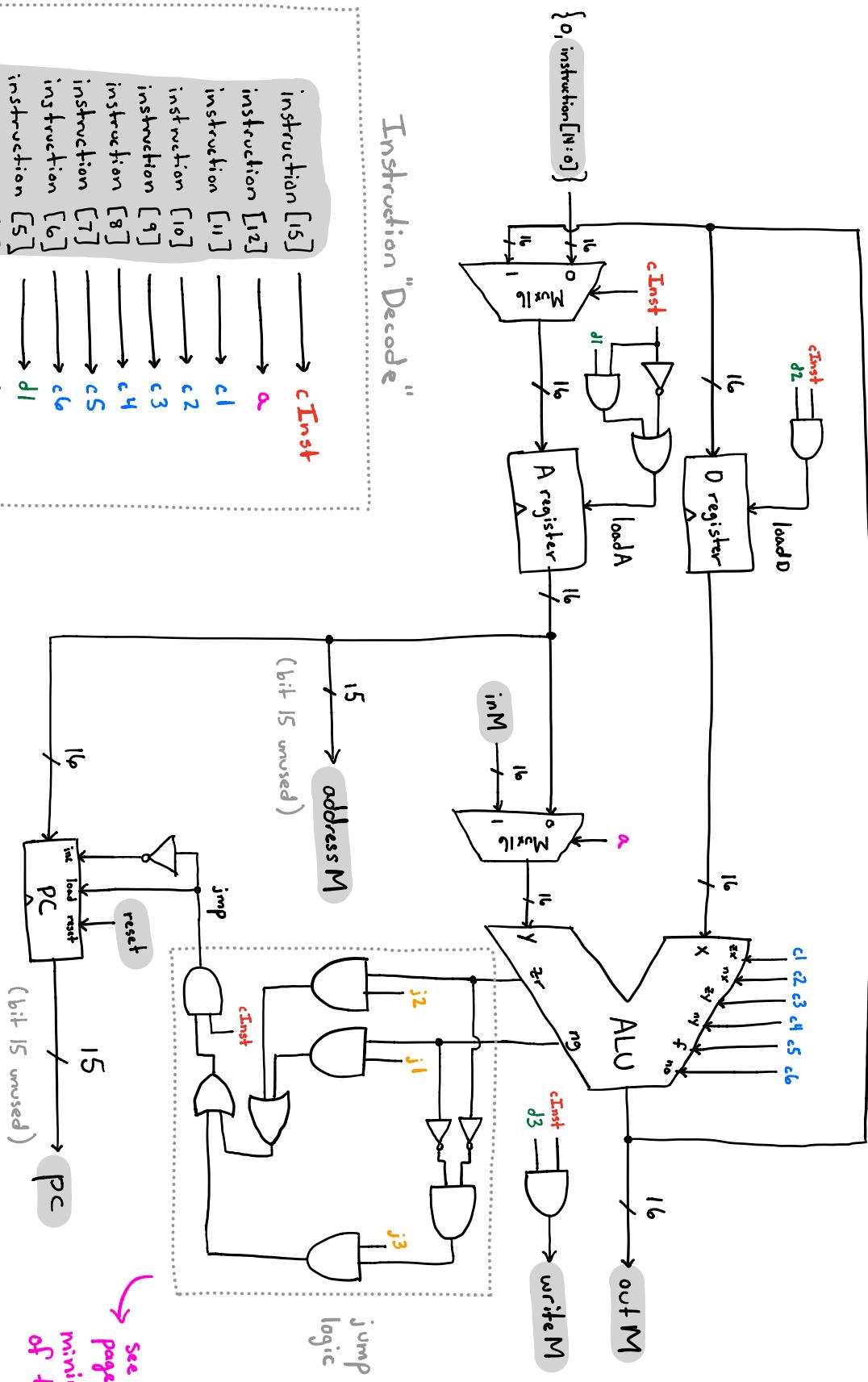
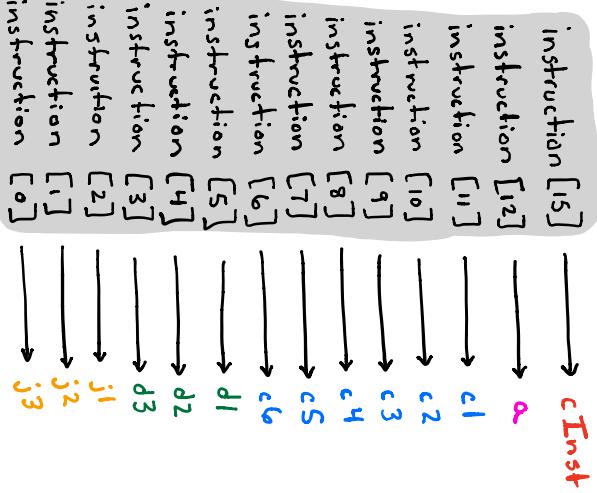
- Execute the current instruction
- Figure out which instruction to execute next.



Memory Implementation

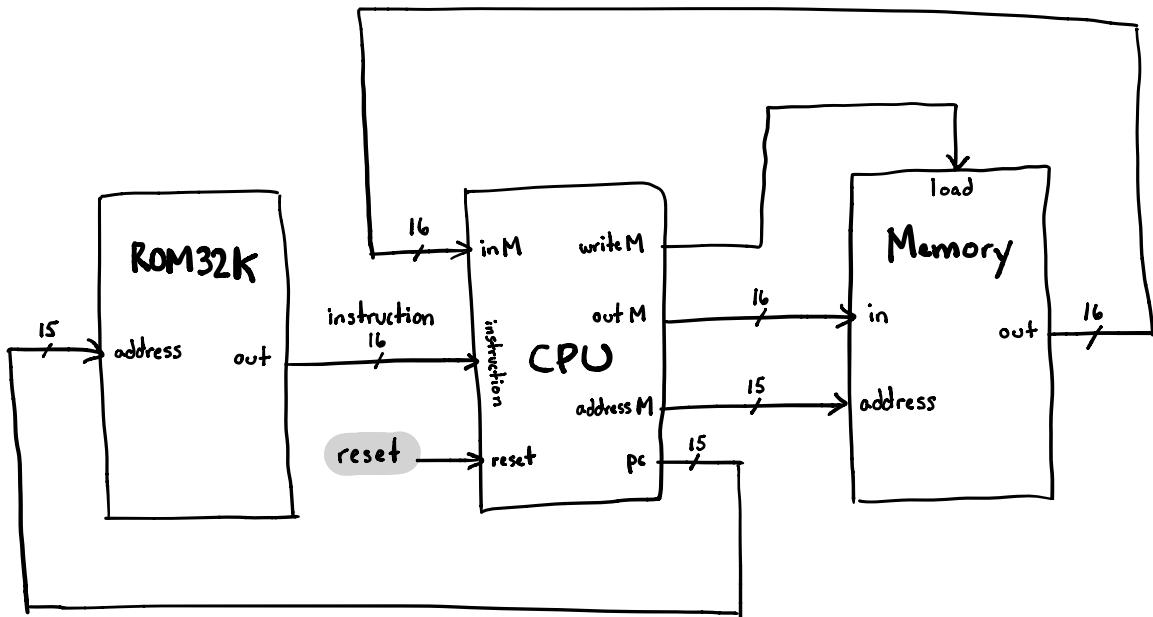


CPU Implementation

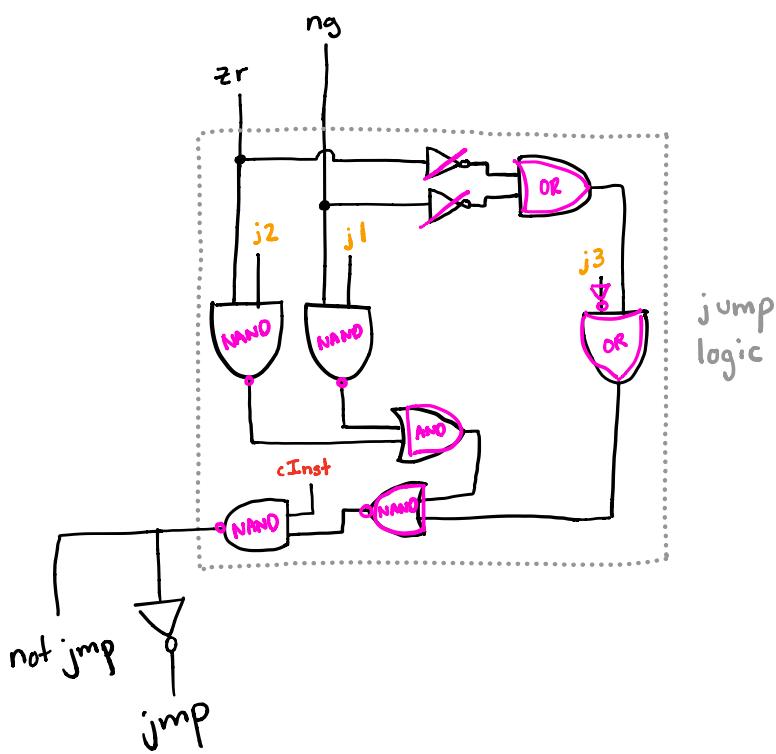


see next page for minimization of this logic

Computer Implementation



Side exercise: minimizing jump logic



Perspective

Separating data and program memories is actually a **Harvard Architecture**.

- Downside of this architecture is that you cannot change the program as it runs! You are stuck with one fixed program that must be loaded into the ROM (somehow) before power-up. The computer itself cannot change the program.

Finite State Machines are a good formal model for how to model sequential digital designs with several internal states.