IC220:  
Set #13: Building a real processor!  
(Chapter 4)

The Processor: Datapath & Control

• READING: 4.1 – 4.4
• We’re ready to look at an implementation of the MIPS
• Simplified to contain only:
  – memory-reference instructions: lw, sw
  – arithmetic-logical instructions: add, sub, and, or, slt
  – control flow instructions: beq, j
• Generic Implementation:
  – use the program counter (PC) to supply instruction address
  – get the instruction from memory
  – read registers
  – use the instruction to decide exactly what to do
• All instructions use an ALU after reading the registers – why?
  memory-reference?
  arithmetic?
  control flow?
Our Timing Methodology

- An edge triggered methodology
- Typical execution:
  - read contents of some state elements,
  - send values through some combinational logic
  - write results to one or more state elements

![Diagram showing the flow of data from State element 1 through combinational logic to State element 2.]

Single Cycle Implementation

First, Datapath
Later, Control
Our Simple Implementation

- Let’s start putting our pieces together to form our single-cycle implementation.
- Our pieces include:
  - 1. Fetching the instruction
  - 2. Performing an operation (R-type)
  - 3. Loading and storing data
  - 4. Branching

- We will discuss one piece at a time.
Partial Datapath #1 – for fetching

Partial Datapath #2 – for R-type instructions
Partial Datapath #3 – for load and store (#1)

Partial Datapath #3 – for load and store (#2)
Partial Datapath #4 – for branch

How do we tie them together?

• Strategy: