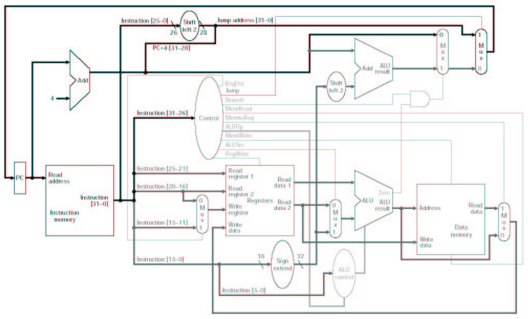
The Single Cycle Datapath



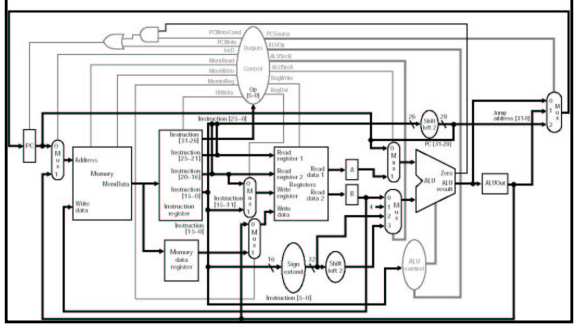
Pipelining

3-31-2003

Opening Discussion

- Do you have any questions about the quiz?
- What did we talk about last class?
- Have you seen anything interesting in the news?
- If multicycle is so much better than single cycle then why does single cycle exist?

The Multicycle Datapath



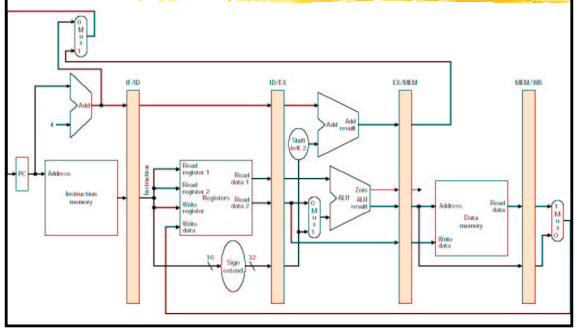
The Idea of Pipelining

- The idea is that we can do some things in parallel so that we are executing different steps of several instructions at once.
- Pipelining doesn't decrease the execution time of one instruction, but it does improve the throughput of multiple instructions. In theory the throughput increases by a factor equal to the number of pipeline stages.

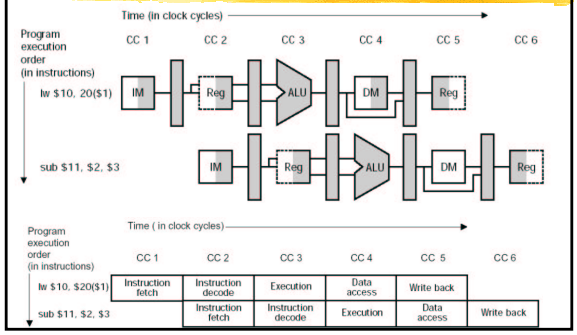
Pipeline Hazards

- Structural Hazards - hardware can't support a combination of instructions.
- Control Hazard - one instruction makes a decision that effects the next. Delayed branches can help but aren't always filled.
- Data Hazards - when a given instruction depends on the result of the previous instruction. Many can be relieved with data forwarding.

A Pipelined Datapath



Graphical Representation



Minute Essay

- How does pipelining allow us to maintain a high clock speed and a high CPI?