

## Pipeline Hazards

4-4-2003

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## Opening Discussion

- What did we talk about last class?
- Have you seen anything interesting in the news?
- Do pipeline hazards produce a fundamental change in control? If so, what is it?

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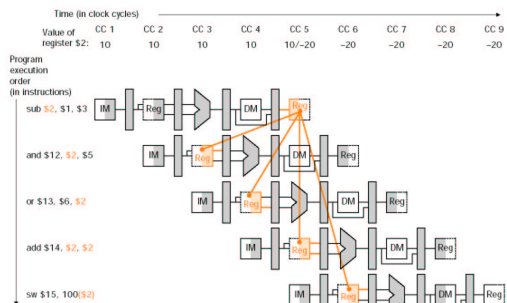
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## Example Data Hazard with Forwarding



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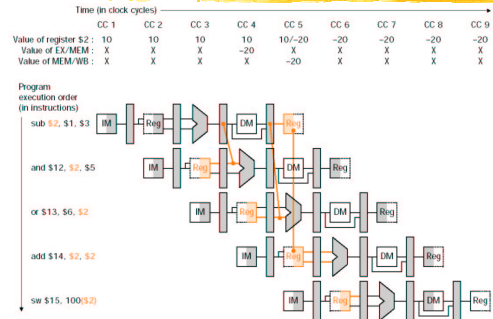
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## Fixing the Data Hazard with Forwarding




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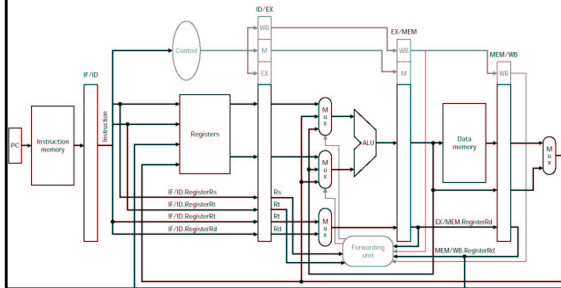
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## Simple Pipeline with Forwarding

No longer a "hazard".




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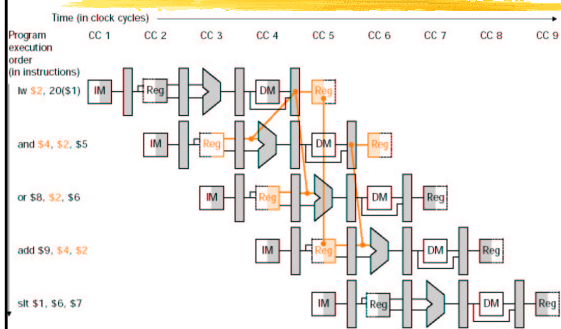
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## Example Data Hazard that Stalls




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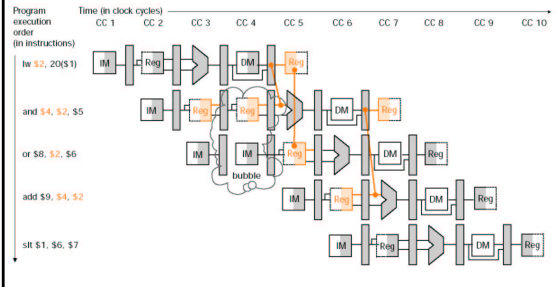
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## Fixing the Execution

Need to stall one cycle to fix this.




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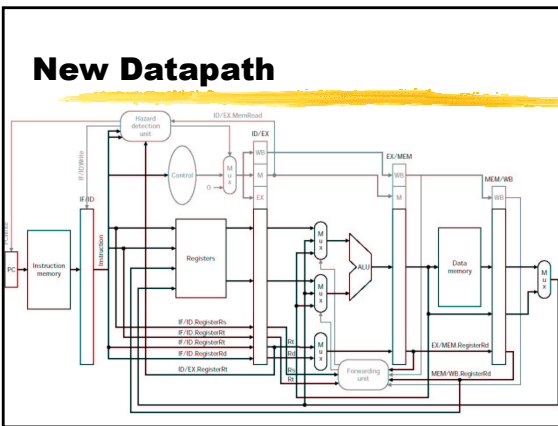
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## New Datapath




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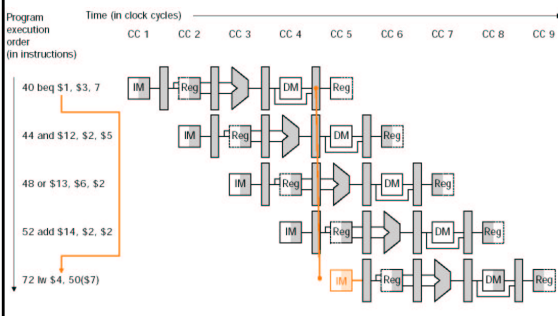
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## Example Branch Hazard




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