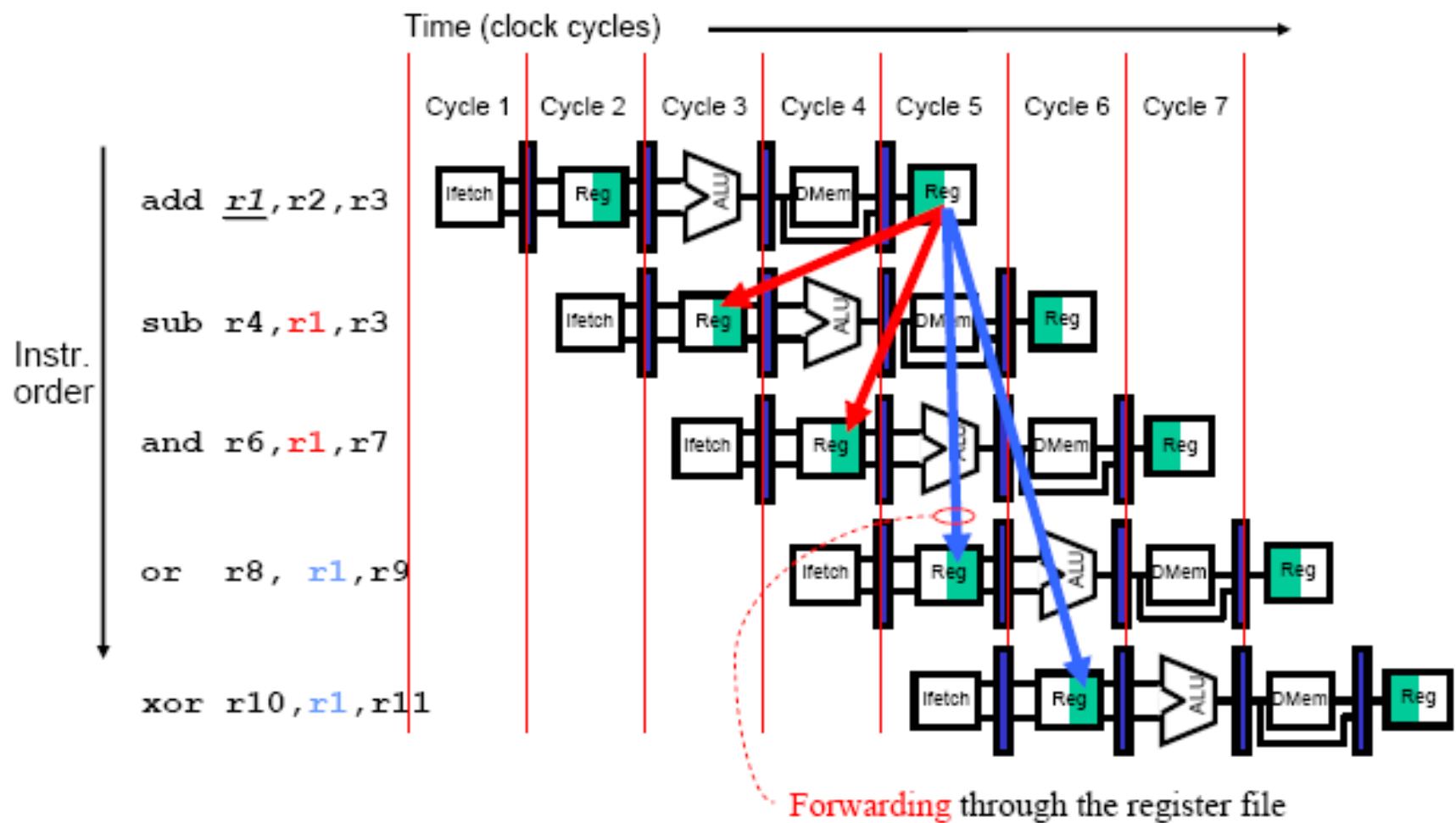


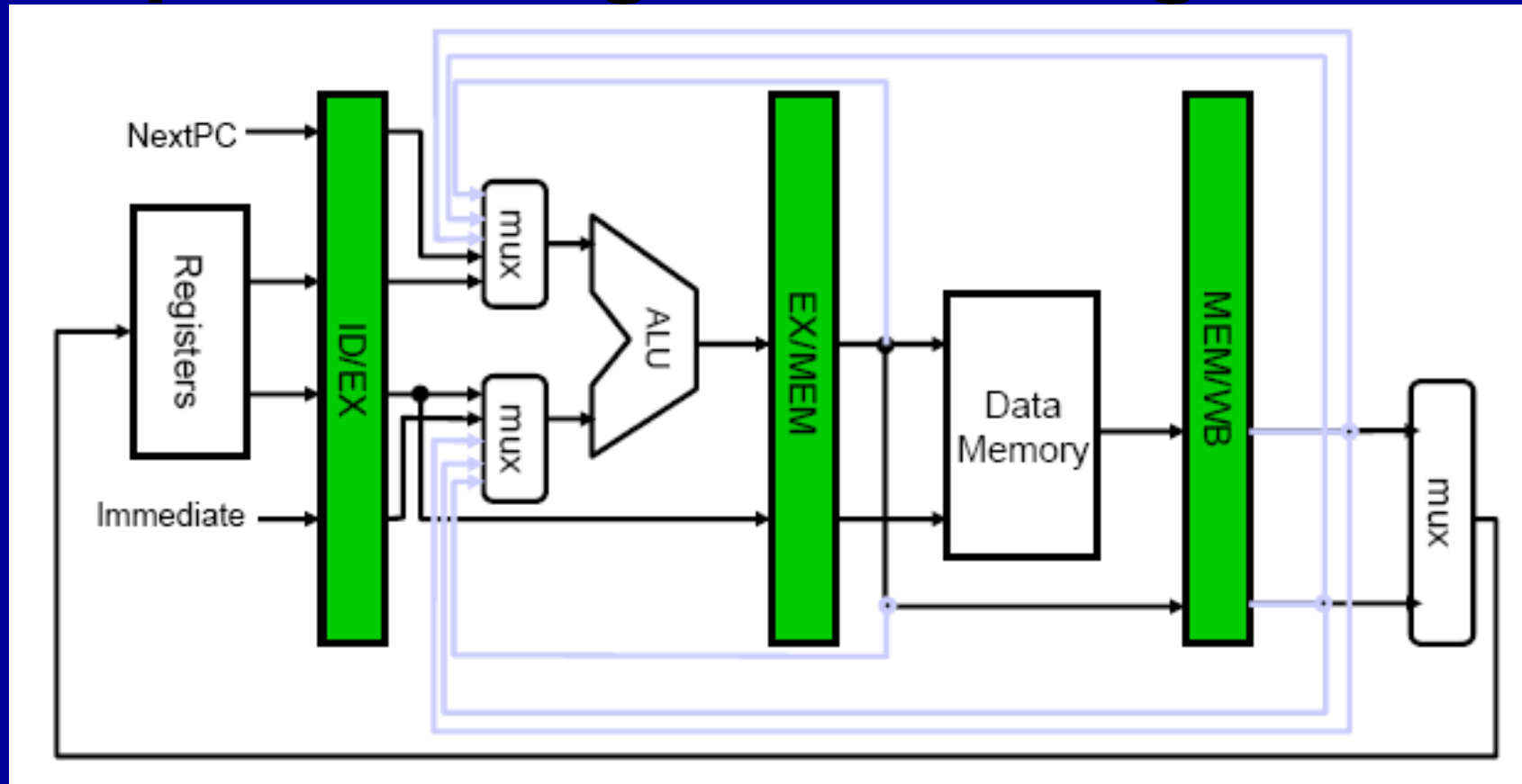
Data Hazard Example



Techniques to Reduce Data Hazards

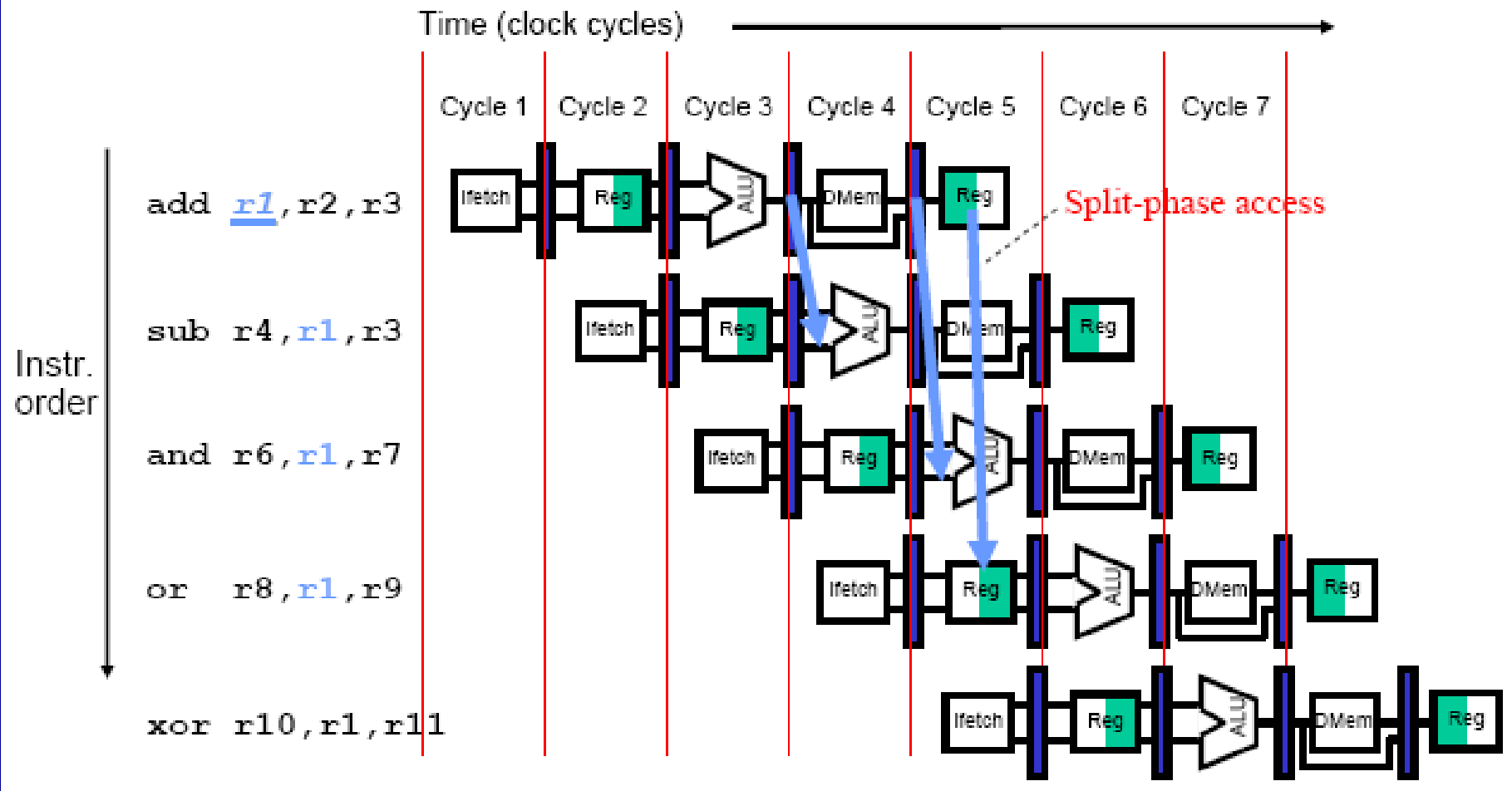
- Forwarding and bypassing
- Basic compiler pipeline scheduling
- Basic dynamic scheduling
- Dynamic scheduling with renaming
- Hardware speculation

Implementing Forwarding in HW



- To support data forwarding, additional hardware is required; **multiplexers** to allow data to be transferred back and **control logic** for the multiplexers

Avoidance of Data Hazards using Forwarding



An Unavoidable Stall

