Pipelining (III)

Data Hazards (cont.)
- Another way to address the data hazards is to retrieve the missing data element from internal buffers (data path) rather than waiting for it to arrive from programmer-visible register or memory. We name this solution “forwarding.”

- For example, if we have the following two instructions:
  
  ```
  ADD R1 R2 R0 # R1 + R2 => R0
  SUB R0 R3 R4 # R0 - R3 => R4
  ```
  
  - The value of R0, which is R1 + R2, used by SUB won’t be ready till ALU finish the calculation.

- If using forwarding, the pipelining for these two instructions look like
  
  ```
  add F D E W
   \ 
  sub F D E W
  ```
  
  - In this way, there is no need to stall one stage for the SUB instruction.