

1. Give and define the three types of hazards.
  1. Structural -- a hardware resource is unavailable
  2. Data -- a value is not available when and where it is needed
  3. Control -- the next instruction is not known
2. What does it mean to “stall” the pipeline?
  1. Stalling the pipeline holds instructions in the early stage of the pipeline in place. Noop instructions flow through the rest of the pipeline in their place.
3. Define “forwarding” or “bypassing”?
  1. Moving data values from where they currently are in the pipeline (i.e., not the register file) to where they are needed (i.e., the ALU).
4. Pipeline A stalls to eliminate data hazards, and has an base CPI of 1. The average stall time is 5 cycles (i.e., the total, average CPI is 6). Pipeline B is a revised version with forwarding hardware that eliminates stalling for 50% of instructions. Use Amdahl’s law to compute the speed up of processor B compared to A.
  1.  $S = 6/1; x = 0.5$
  2.  $Stot = 1/((0.5)/(6) + (1-0.5))$