

Problem 1

We wish to add the instruction `jal` (jump and link) to the multicycle datapath. This instruction jumps to an address and simultaneously saves the address of the following instruction in register `$ra` (reg 31). The multicycle datapath and state machine are shown on the next page.

- Minor modifications to the datapath are needed; please show these modifications.
- The finite state machine needs to be modified to add the instruction. Please show what is needed.
- Determine the number of cycles that it would take to execute this new instruction.

Hints: * The new PC (i.e. $PC+4$) is computed in the first step (instruction fetch -IF); thus the PC register has $PC+4$ after IF.
* Instruction `jal` shares some similarities with instruction `j` (jump).



