MIPS Simulation

Write a C++ program to simulate the execution of the MIPS 5-stage pipeline processor with no forwarding.

Inputs: MIPS assembly program from a text file using only the following MIPS instructions:

- add
- sub
- and
- addi
- lw
- sw
- beq
- bne
- nop (no operation)

For example, a countdown program from 5 downto 0.

```
addi $s0, $zero, 5
addi $s1, $zero, 1
sub $s0, $s0, $s1
bne $s0, $zero, -2
addi $s1, $zero, 7
```

The last addi line is for testing whether the bne works or not.

User interface inputs: Each key press will advance the clock by 1 cycle.

User interface outputs: Contents of all the registers, and contents of a small relevant section of memory after each user key press. Also show the instructions that are in the various stages of the pipeline. Organize the layout nicely so it is easy to see.

Usage: When the user presses a key, the processor will execute one clock cycle, displays the updated registers and memory contents,and show the first instruction in the IF stage. It will then wait for the next user key press. When the user presses a key again, the first instruction is now moved to the ID stage and the next instruction is in the IF stage. The program needs to handle data hazards. So if there is a data dependency between two adjacent instructions, then the appropriate number of stalls must be inserted. Note that whether any stalls are needed or not is known after the instruction is in the ID stage.

For example, after 3 clock cycles of executing the above countdown program will give the following. Notice that the sub is stalled in the IF stage and will remain there until the second addi gets to the WB stage.

```
Pipeline
IF      ID      EX      MEM     WB
sub     addi    addi
```

Extra credit:

- Add two grade steps (like going from a B to aA-)if you include an option to choose either no forwarding or with forwarding.

~~Grading:~~

- ~~add one grade step (like going from a B to a B+) to your final grade if you get it to almost work.~~
- ~~add two grade steps if it works.~~
- ~~add three grade steps if you include an option to choose either no forwarding or with forwarding.~~