

**Habib University****Course: Computer Architecture****Assessment: Lab Project****Program: BS CS/ECE****Code: CS330L/EE371L****Due: 21/06/2020 23h55****Total Marks: (16% of lab grade)****Additionally, there will be a lab exam (7% of lab grade).****The task:**

This project requires you to build a 5-stage pipelined processor capable of executing a bubble sort program. Basically, you will be converting your single cycle processor to a pipelined one.

Normally the instructions you have already implemented should enable you to execute a bubble sort program with small additions i.e. you might need to implement the **bgt** instruction, or something similar, so that you know when you'd need to swap two values. This would require small modifications to the circuit.

Here's the recommended course of action:

1. You modify the single-cycle processor to be able to run the bubble sort code on it. Test and verify that it is doing the sorting correctly.
2. You then proceed to modify the said processor to make it a pipelined one (5 stages). You test and run each instruction separately to verify that the pipelined version can at least execute one instruction correctly in isolation. Test each of them instructions.
3. You introduce circuitry to detect hazards (data, control, and structural if needed) and try to handle them in hardware i.e. by forwarding, stalling, and flushing the pipeline. If this has been done correctly, then your bubble sort code should be able to function in its entirety.

The book Chapter 4 till end of section 4.8, we've covered all this in class, is there to show you how to do it all step by step.

**Submission:**

- You will submit all your codes (the .v files for modules as well as test benches + run.do files)
  - o On LMS, for individual projects
  - o On GitHub, for group projects
- You will submit a PDF containing all the codes (make a separate subsection for each code file) and explanations of how you implemented your processor, any difficulties you had and how you overcame them, and any deficiencies in your projects if there are any.
  - o On GitHub, working copy of the report
  - o On LMS, final report

**Rubric:**

Part 1: **6%** of lab grade.      Part 2: **2%** of lab grade      Part 3: **8%** of lab grade.

**Note:** any marks are conditional on your being able to explain each line of your code to the examiner during a viva.