README FILE (Phase 3)

Group-6

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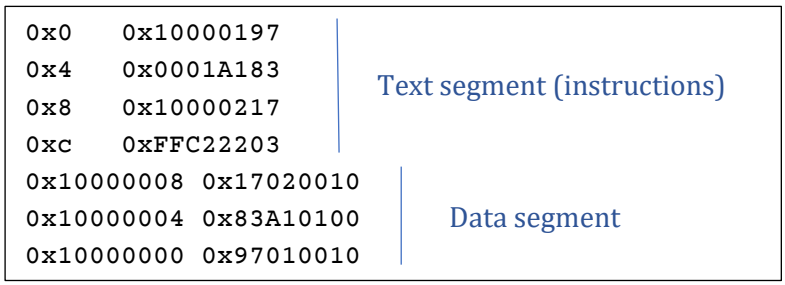
Git-Hub link to the project: https://github.com/Silent-faith/RISC-V-Simulator

Welcome to the phase 3 of the RISC-V simulator. In this phase, we have tried to incorporate Instruction Cache and Data Cache. We have built on our initial Phase 2 code.

You can either use the Non-GUI version of the code (`non_gui_phase3.py`) or use the GUI version (`phase3gui.py`)

INPUT TO CODE: A file with the machine code (here it is `code.mc`). This file has the machine code divided into two segments: data segment and text segment.



OUTPUT OF CODE:

In console: Displays the **5 step execution** of each instruction, by displaying the **fields** (*opcode, rs, rd, func3, func7, imm*) of each instruction when applicable. Also, displays the **register values** and **memory state** before and after execution. The **Instruction and Data Cache** are shown. Also displays **number of hits and misses** of the cache.

In GUI simulator window: The register states and the Instruction and Data Cache contents can also be checked using the display GUI window. (To directly go to the process to use this simulator, jump to ***HOW TO USE*** part of this document)

After execution, all the data memory is written in the `memory.mc` file before the program terminates. (additional files `console.txt, datacache.txt, instructioncache.txt` and `register.mc` are used to facilitate the GUI operation)

INSTRUCTIONS SUPPORTED BY OUR CODE:

- R format - add, and, or, sll, slt, sra, srl, sub, xor, mul, div, rem
- I format - addi, andi, ori, lb, lh, lw, jalr
- S format - sb, sw, sh
- SB format - beq, bne, bge, blt
- U format - auipc, lui
- UJ format – jal
- This code ***DOES NOT*** support any pseudo instruction.

HOW TO RUN NON-GUI VERSION?

Step 1) Run `non_gui_phase3.py` on console.

Step 2) The user is asked for **Size, Block Size** (in bytes) and **Set Associativity** of both **Data and Instruction Caches**.

Step 2) The user is given a choice to determine the method of the execution of machine code:

1 for non pipelined execution
2 for pipelined execution without data forwarding
3 for pipelined execution with data forwarding

Step 3) After user enters 1, 2 or 3, the execution begins and output is shown on console.

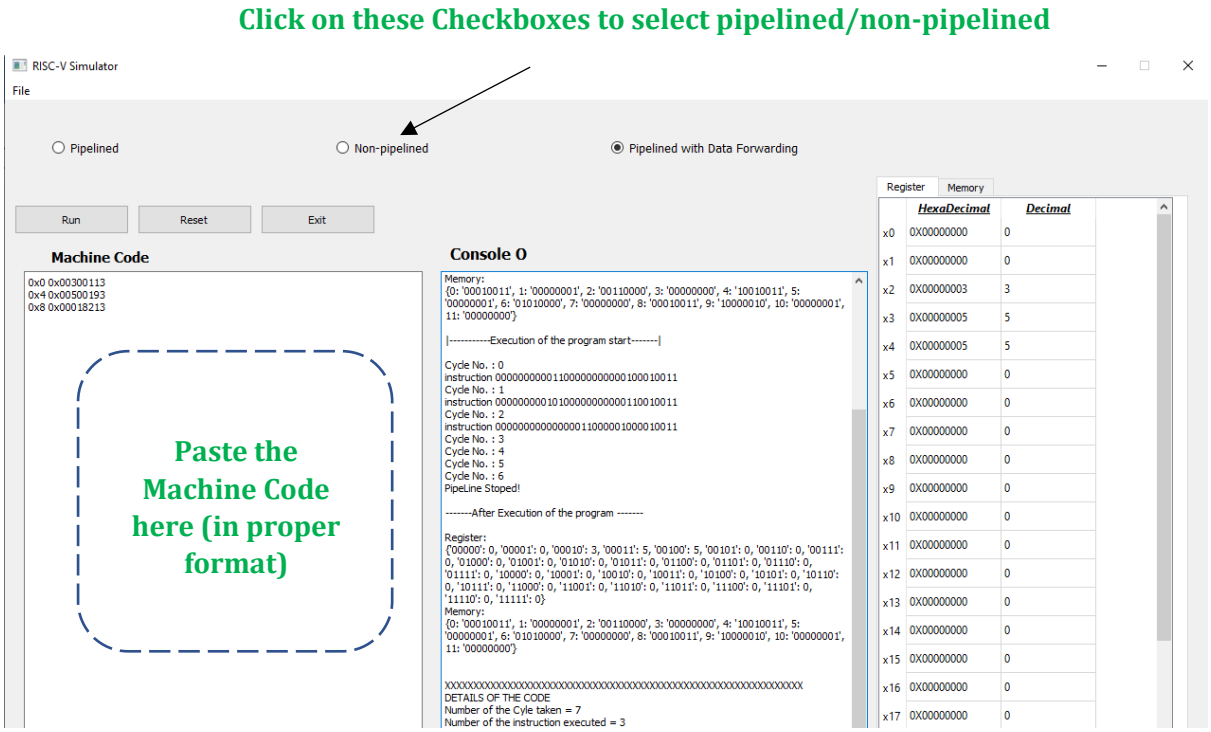
HOW TO USE THE SIMULATOR?

The Simulator has an in-built GUI feature to make the code more user-friendly. (Please install `bitstring module` and `PyQt5 module` in Python before running this code)
The following steps will show how to use the simulator.

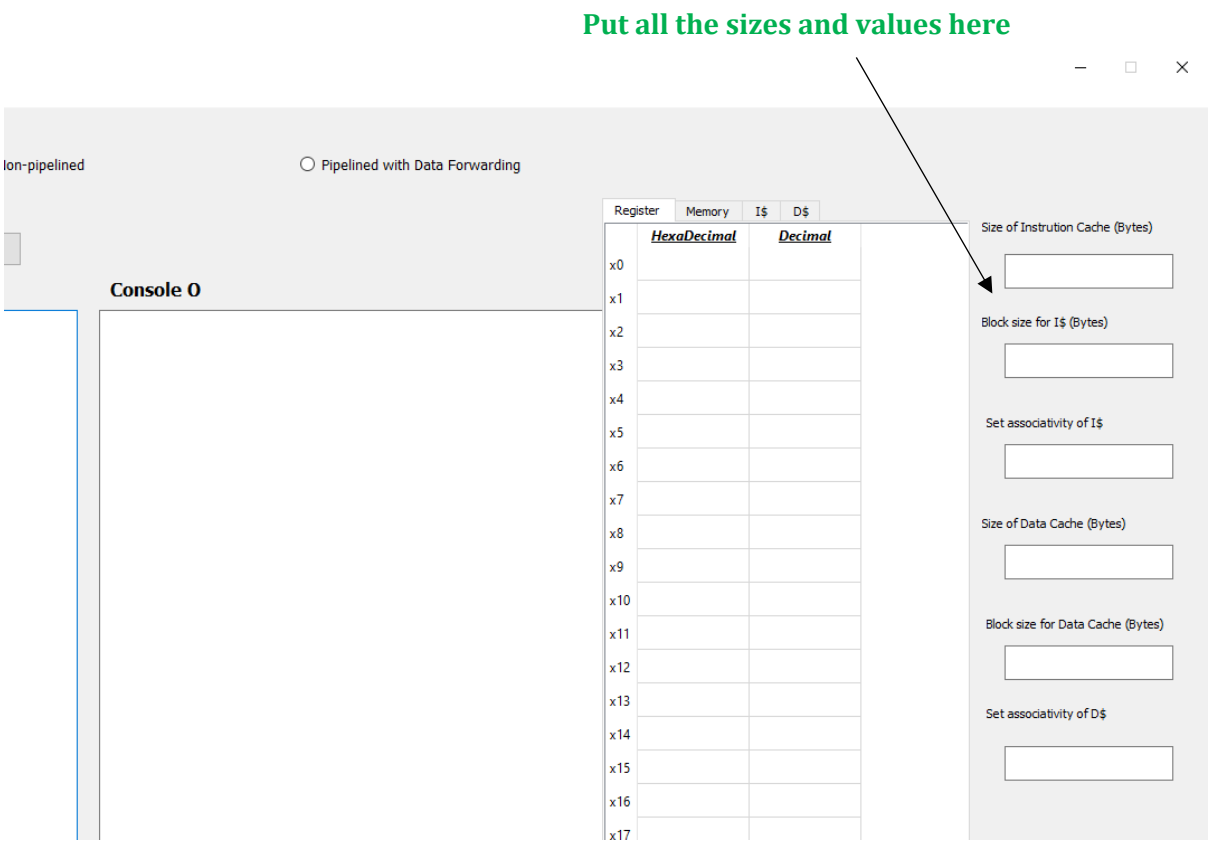
Step 1) Run `phase3gui.py` on the console. A GUI window will pop-up automatically.

Step 2) Paste the machine code from `code.mc` into the 'Machine Code' text field.

Step 3) Select appropriate checkbox for **Pipelined, Non-pipelined, Pipelined with Data Forwarding**.



Step 4) Put the **Size of Cache, Block Size** (in bytes) and **Set Associativity** of both **Data and Instruction Caches** in the text boxes.



Step 5) **Double click** on RUN button to start execution.

Step 6) The Console text field will show the console output. The tables of **Register** and **Memory** will also show required values. The tables of **Instruction and Data caches** (**I$ and D$**) shows the current stages of Instruction and Data Cache.

Please Note: The first column of cache is the tag array (the block addresses). The next columns are the block values byte wise. Each ROW represents a BLOCK.

I$ and D$ shown here