COMP 222 Computer Organization
Assignment #3—Instruction-Level Parallelism

Objective:

To calculate the performance of a program with dependent register arithmetic instructions, by simulating the execution on a 5-stage pipeline processor by adding NOP's as appropriate.

The five stages are: Instruction Fetch (IF), Instruction Decode (ID), Execute Operation (EX), Memory Reference (ME), and Write Back to Register (WB).
{Note: for register arithmetic instructions, the Memory Reference cycle is unused but still included in the pipeline}

Inputs:

- Number of instructions in the program
- Set of instructions containing register arithmetic instructions, such as:
  ADD_X2,X1,X0
  where X2 is the destination register, and X1,X0 are the source registers
  {Note: to parse correctly, there should not be any space, so a "_" is added}

Outputs:

- The total cycle count for the program run on the pipeline processor
- A chart of the pipeline stages of the instructions for the pipeline processor

Specification:

The program calculates the performance of a set of register arithmetic instructions and prints out the aligned pipelined instructions based on choosing from a menu of choices, where each choice calls the appropriate procedure:

1) Enter instructions
2) Calculate and show total cycle count on a 5-stage pipeline processor (w/ NOP's)
3) Quit program

What NOT to do (any violation will result in an automatic score of 0 on the assignment):

- Do NOT modify the choice values (1, 2, 3) or input characters and then try to convert them to integers--the test script used for grading your assignment will not work correctly.
- Do NOT turn in an outdated version of the assignment downloaded from the Internet (coursehero, github, etc.) or a version that was coded by someone else (former student, tutor, etc.)
- Do NOT use any self-created or external libraries that cannot be located/utilized by zylabs
- Do NOT turn in your assignment coded in another programming language (C++, C#, Java, Python, Perl, etc.)—it will NOT compile under zyLabs C compiler.

What to turn in:

The source code as a single C file uploaded to Canvas (http://canvas.csun.edu) by the deadline of 11:59pm PST (-20% per consecutive day for late submissions, up to the 4th day—note 1 minute late counts as a day late, 1 day and 1 minute late counts as 2 days late, etc.).

Sample test run (inputs show below for running example):

```
1
3
ADD_X3,X2,X4
SUB_X1,X3,X2
ADD_X2,X1,X3
2
1
4
ADD_X2,X1,X0
SUB_X3,X5,X4
ADD_X4,X5,X2
SUB_X7,X3,X9
2
3
```

Output:

```
Instruction-level parallelism
-----------------------------
1) Enter instructions
2) Calculate total cycle count on a 5-stage pipeline processor
3) Quit program

Enter selection: 1
Enter total number of instructions: 3
ADD_X3,X2,X4
SUB_X1,X3,X2
ADD_X2,X1,X3

Instruction-level parallelism
-----------------------------
1) Enter instructions
2) Calculate total cycle count on a 5-stage pipeline processor
3) Quit program

Enter selection: 2

Total cycles: 11
ADD_X3,X2,X4:      IF        ID        EX        ME        WB
NOP         :                IF        ID        EX        ME        WB
NOP         :                          IF        ID        EX        ME        WB
SUB_X1,X3,X2:                          IF        ID        EX        ME        WB
NOP         :                                    IF        ID        EX        ME        WB
NOP         :                                              IF        ID        EX        ME        WB
ADD_X2,X1,X3:                                                        IF        ID        EX        ME        WB

Instruction-level parallelism
-----------------------------
1) Enter instructions
2) Calculate total cycle count on a 5-stage pipeline processor
3) Quit program

Enter selection: 1
Enter total number of instructions: 4
ADD_X2,X1,X0
SUB_X3,X5,X4
ADD_X4,X5,X2
SUB_X7,X3,X9

Instruction-level parallelism
-----------------------------
1) Enter instructions
2) Calculate total cycle count on a 5-stage pipeline processor
3) Quit program

Enter selection: 2
Total cycles: 9
ADD_X2,X1,X0:      IF        ID        EX        ME        WB
SUB_X3,X5,X4:                IF        ID        EX        ME        WB
NOP         :                          IF        ID        EX        ME        WB
ADD_X4,X5,X2:                          IF        ID        EX        ME        WB
SUB_X7,X3,X9:                                    IF        ID        EX        ME        WB

Instruction-level parallelism
-----------------------------
1) Enter instructions
2) Calculate total cycle count on a 5-stage pipeline processor
3) Quit program

Enter selection: 3
```