CS 203 (2019 Fall) Assignment #3

Student ID #:

Name:

1. ﻿Consider the following RISC-V instructions:  
     
   Loop: LD X1,0(X3)  
    ADD X2,X1,X4  
    MUL X1,X2,X6  
    ADD X1,X1,X5  
    ADD X7,X7,X1  
    ADDI X12,X12,-1  
    BNEZ X12,Loop  
    ADDI X16,X16,4  
    LD X3,0(X16)  
   Assume the initial value of X12 is 2. Please answer the following question.
   1. Assume the branch instruction is in the BTB and the branch is always predicted taken. Please list the instruction sequence will executed.
   2. Continued from the previous question, if you have a 5-stage RISC-V pipeline as in Figure C.25 of the textbook, can you draw the pipeline diagram that simulates the execution of the above instructions sequence? You may use the given table for the diagram.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MEM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| EX |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ID |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| IF |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LD X1,0(X3) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

1. You are asked to evaluate the performance of the following branch prediction schemes:   
   A: Static backward taken, forward not taken.   
   B: Local predictor with two-bit state machine (Saturating counter/Bimodal).   
   C: Global predictor based on 4-bit history and a 2-bit state machine associate with each entry. (4,2) correlating predictor.   
   Now, you are given the following code segment. Assume each of the branch PC never cause conflicts/alias with other branches and the predictors are initialized as all zeros. Please evaluate the branch prediction accuracy for the following code snippet with all the give prediction schemes.
   1. int i, j;   
        
      i = 0;   
      do {  
       j = 0;  
       do {  
       loop c[i][j] = a[i][j] + b[i][j];  
       } while( ++j < 5);  
      } while ( ++i < 100);
   2. int i, j;   
        
      i = 0;   
      do {  
       j = 0;  
       do {  
       loop c[i][j] = a[i][j] + b[i][j];  
       } while( ++j < 2);  
      } while ( ++i < 100);