Homework 4: 100 Points

This Homework contains examples on the features of modern microarchitecture: Prediction, Speculation, multiple issue, dynamic scheduling, and Out-of-Order Execution.

Please submit your answers in an MS Word document and upload it in Canvas by the due date. I

Present your work neat, clear, organized, logical, and make your case; don’t leave it to our interpretation of your answer. There is 10% penalty per day for delay in submitting the homework.

1. (10 Points) Suppose the following code is within a loop reading the values of x. Assume a Branch History Table of 1-bit predictor used. Use a table to show the content of the predictor buffers as values of x: 12, 18, 23, 40, 42, 44, 46, 48, 50 are read. Assume the two predictor buffers contain 0 and 1 initially.

If (x is odd) then ;Branch B1

print “O”

if (x is even) then ;Branch B2

print “E”

Calculate the prediction accuracy of this predictor.

1. (10 Points) Answer Problem 1 using a Branch History Table of 2-bit predictor. Assume the two predictor buffers contain 10 and 10 initially.
2. (10 Points) Suppose the following loop iterates 99 times. Assume a 1-bit predictor is used. Calculate the prediction accuracy of this predictor. Assume the buffer contains 0 initially.

Loop: LD F1, 0(R1)

……

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BNEZ R2, Loop

1. (10 Points) Answer Problem 3 using a 2-bit predictor. Assume the buffer contains 00 initially.
2. (12 Points) Consider the code in Example 4, Chapter 3 slides. Assume a ten entry Branch History Table of 2-bit predictor used with initial values of 01. Show the prediction behavior if the following are read into the code via a loop:

aa=3 and bb=2, followed by aa=4 and bb=5, followed by aa=2 and bb=2

Calculate the overall prediction accuracy.

1. (12 Points) a) Display a Branch Target Buffer for the code in Example 6. Assume 1- bit predictor for branches are initially 1, 0, 1.
   1. Now assume you execute the code again and this time all three branches are taken. Display the new BTB.
2. (12 Points) State what takes place when each of the following instructions reach the top of ROB and their operands are all available:
   1. L.D F2, 0(R6)
   2. ADD.D F2, F4, F6
   3. S.D F2, 0(R2)
   4. DSUBU R3, R3, #-8
   5. BNEZ R3, target (Predicted Correctly)
   6. BEQZ R3, Loop (Mispredicted)
3. (12 Points) Exercise 3.1 of textbook.
4. (12 Points) Exercise 3.7 of textbook.