Lab 4: Branch Prediction

ECE 6913

Assigned: 12/1/2021

Due: 12/20/2021 11:59 PM

In this lab you will simulate a simple branch predictor with a 2-bit saturating counter. You are provided with a text file containing a trace of branch instructions consisting of the PC at which each branch occurs, and whether the branch is Taken or Not Taken.

Your goal is write code to evaluate the performance of a 2-bit saturating counter based branch predictor on this trace. Your output file indicates, for each branch in the trace, whether it was predicted as Taken or Not Taken.

Branch Predictor Architecture

Your design must consist of 2^m 2-bit saturating counters indexed using m LSBs of each branch instruction. Each 2-bit saturating predictor starts in the 11 (Predict Taken with High Confidence) state and is updated as per the finite state machine discussed in Lecture 11. The value of m is specified in a config file config.txt.

Config File

The config file config.txt contains a single line with the value of m. A sample file for m=12 is provided. The largest value of m is 32 (for 32 bit PCs), but we will not input an m larger than 20.

Trace File

The trace file, trace.txt, contains one branch per line. Each line has the PC for the corresponding branch (in hex format) followed by a single bit indicating Taken (1) or Not Taken (0). A sample trace file is provided.

Output Format

The output from your simulator should be a file trace.txt.out that has one line per branch. Each line has a single bit that indicates whether that branch was predicted as Taken (1) or Not Taken (0).

What to Submit

a) **Code**

1. Your source code. On compilation, we should be able to execute your simulator with the following command

    ./branchsimulator.out config.txt trace.txt

    Your simulator should output a file trace.txt.out in the same directory.

2. A Makefile that will compile the code. You must use a Makefile, any special instructions must be included in a readme.txt with instructions on how to compile your code (only if necessary, please keep it simple).

b) **Analysis**

For the provided trace.txt, plot a graph of the branch misprediction rate as a function of m with m varying from 10 to 20 in increments of 1.

Submit your plot as a PDF file in the same folder as your source code.