

CS6600: COMPUTER ARCHITECTURE

SEMESTER: JUL-NOV 2024

Assignment 2 Report

Analysis of Branch Predictors

Name: Snehadeep Gayen

Roll: CS21B078

Submission Date: 23rd Oct 2024

1 Project Description

This project simulates and analyses bimodal and gshare branch predictors on various benchmark programs.

2 Results

2.1 Bimodal Predictor

(a)

The adjoining plot depicts the effect of number of bits, (m), used for prediction, on the misprediction rate for two different traces.

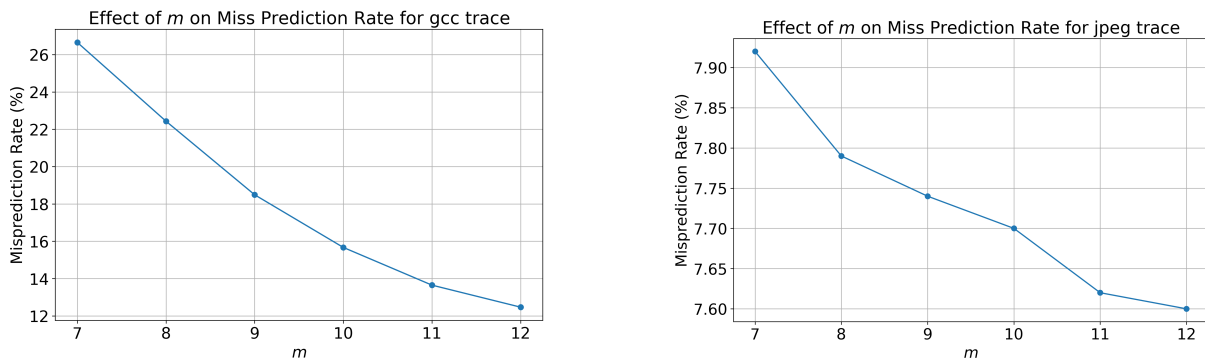


Figure 1: Miss prediction rate for varying number of prediction bits m

Some general observations and similarities between the plots is explained below:

- Clearly the misprediction rate decreases as we increase the number of bits m used for prediction. With lesser m , there are collisions that happen among different branches having identical last $m + 2$ bits. This mixes and garbles up the counters, leading to higher mispredictions. Having more number of bits decreases the number of collisions and thus, the misprediction rate.
- Clearly, there is a case of diminishing returns for both the graphs. In the left figure, we see that initially, increasing m by 2 decreases the miss prediction rate by 4%. However, at higher m , the same increase causes a decrease of less than 2% for miss prediction rate. Similarly, miss prediction decrease falls from 0.1% initially to about 0.02% at higher m .

Some differences between the two plots are:

- Firstly, it is noteworthy that the `gcc` trace has misprediction rate in the range of 10-30%, while the `jpeg` trace, has only 7-8% mispredictions. This means that the `gcc` trace inherently has more *unpredictable* branches compared to `jpeg` for the same number of prediction bits used for bimodal predictor.
- Secondly, the fractional decrease in the misprediction rate, by increasing m , is much higher in `gcc` (around 15%) than in `jpeg` (5-6%). This proves that despite having more unpredictable branches than `jpeg`, the improvement in misprediction rate with increasing m is much more for `gcc`.

(b)

2.2 Gshare Predictor

The figure below shows the misprediction rates of the Gshare branch predictor for different values of m (lookup bits from the program counter address) and n (global branch history register).

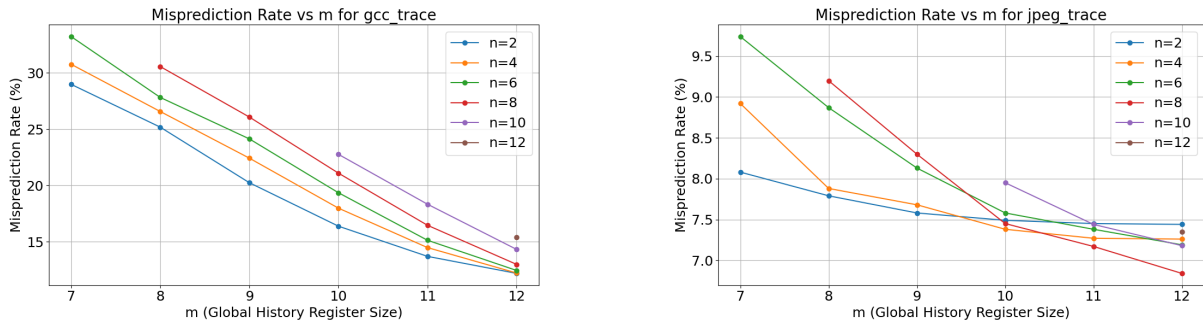


Figure 2: Miss prediction rate for varying number of prediction bits m and global branch register size n