NC State University

Department of Electrical and Computer Engineering

ECE 563: Fall 2017

Project #2: Branch Prediction

by

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NCSU Honor Pledge: "I have neither given nor received unauthorized aid on this test or assignment."

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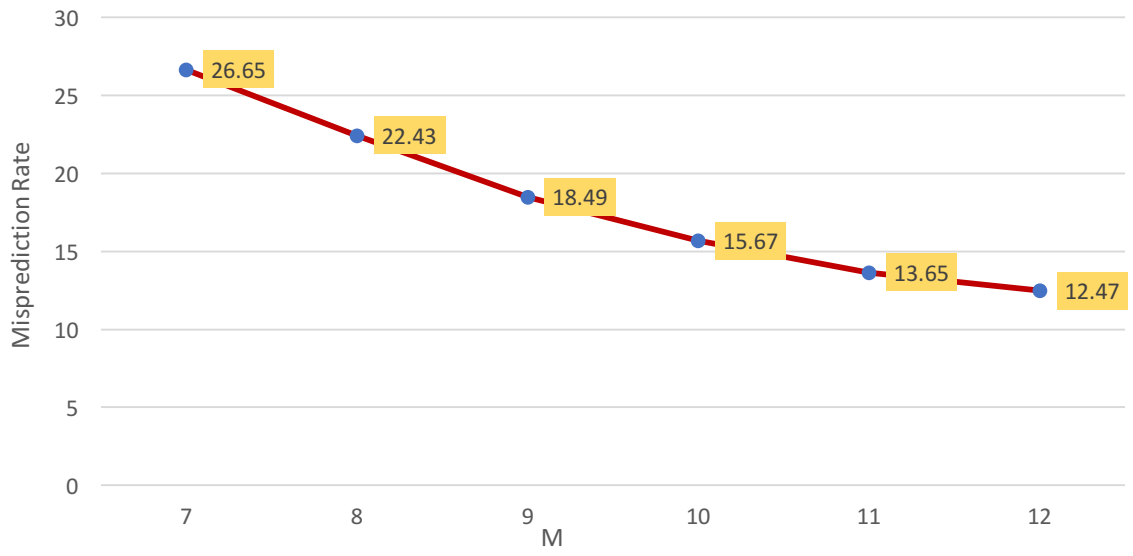
Course number: 563

Part 1: Performance of Bimodal Predictor using gcc_trace.txt

M	MISPREDICTION RATE(%)
7	26.65
8	22.43
9	18.49
10	15.67
11	13.65
12	12.47



gcc, bimodal

Analysis:

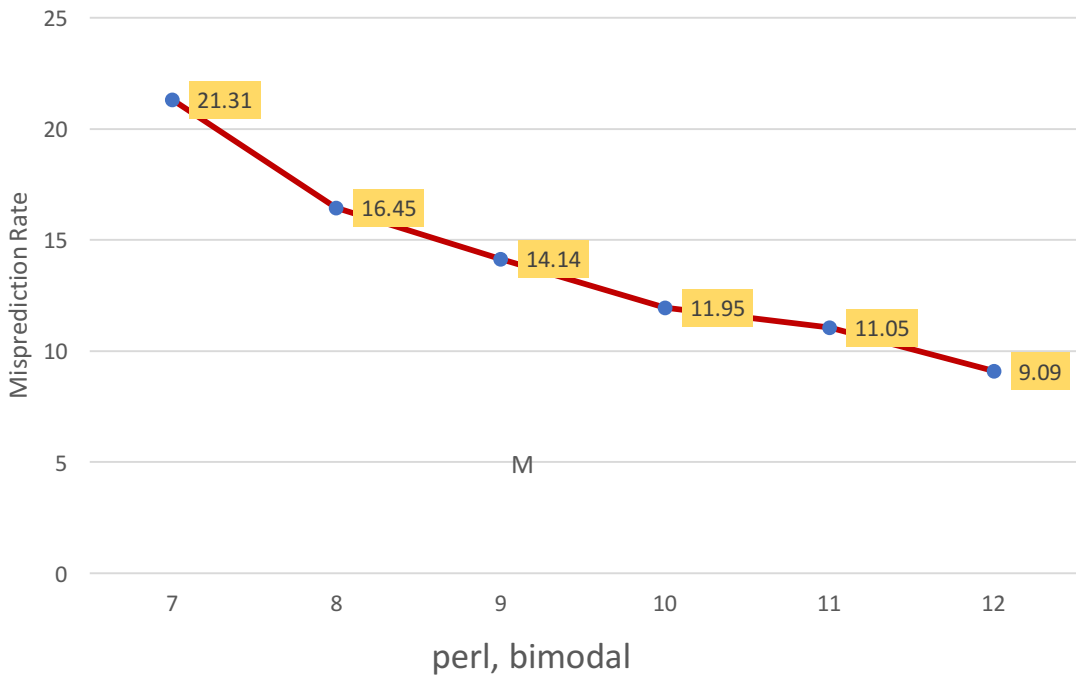
- There is a linear decrease in misprediction rate at 4% for every increase in *m* value. But increasing the *m* value after 11, the misprediction rate decreases at a slow rate of around 1%.

Design:

- **M=11 i.e Predictor Size = 2048 Bytes**

Part 1: Performance of Bimodal Predictor using perl_trace.txt

M	MISPREDICTION RATE (%)
7	21.31
8	16.45
9	14.14
10	11.95
11	11.05
12	9.09



Analysis:

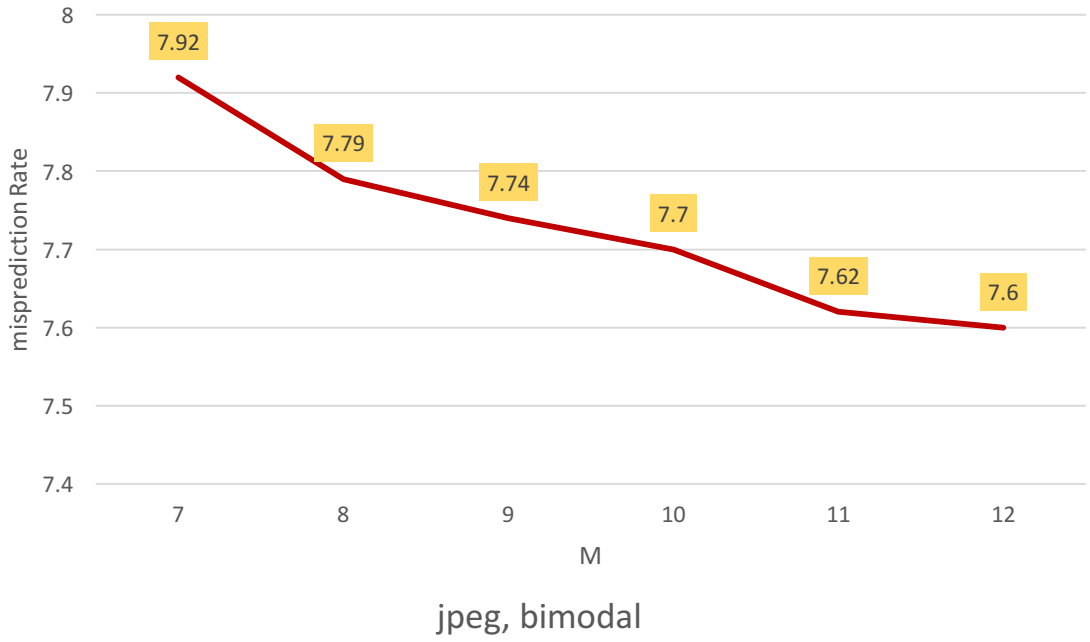
- For the *perl_trace.txt* the rate decreases linearly but later on stabilises once *m* reaches 10 and more.

Design:

- **M=10 i.e Predictor Size = 1024 Bytes**

Part 1: Performance of Bimodal Predictor using jpeg_trace.txt

M	MISPREDICTION RATE(%)
7	7.92
8	7.79
9	7.74
10	7.7
11	7.62
12	7.6



jpeg, bimodal

Analysis:

- The misprediction rate decreases at a rate of 3-4% until 9 and then starts to stabilise.

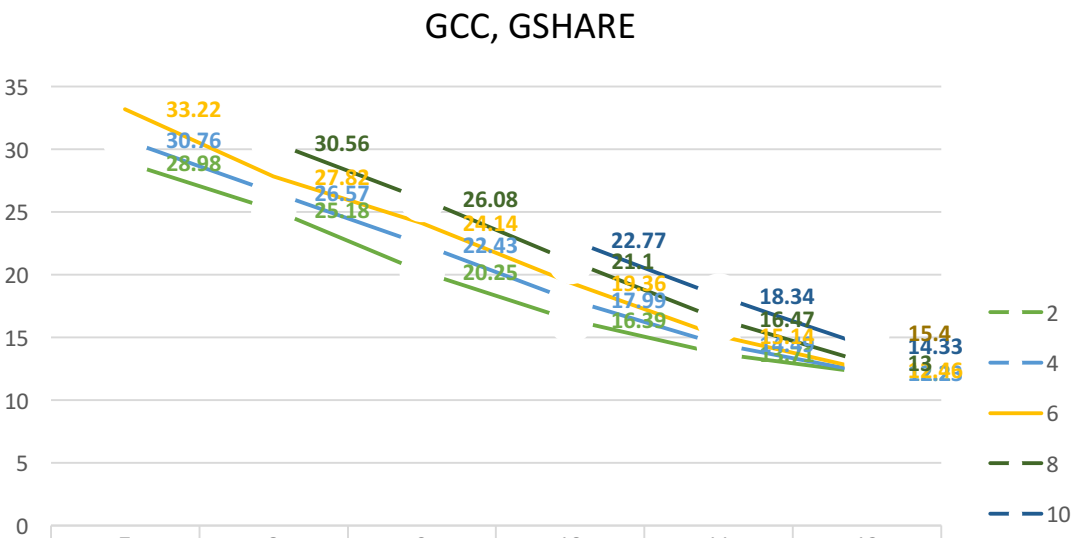
Design:

- **M=9 i.e Predictor Size = 512 Bytes.**

Part 1: Analysis

- We observe a exponential increasing trend of prediction accuracy to *m* parameter.
- Misprediction rate is inversely proportional to *m* parameter.
- Out of all the traces, *jpeg_trace.txt* has the best prediction accuracy. This indicated that the incoming PC address addresses are *taken* most of the time. It might indicate a for loop or a if loop with a true condition.
- If we increase number of bits in the predictor table, the misprediction rate decreases and it starts/ will start to level off after a size of the predictor table.

Part 2: Performance of Gshare Predictor using gcc_trace.txt



	7	8	9	10	11	12
2	28.98	25.18	20.25	16.39	13.71	12.2
4	30.76	26.57	22.43	17.99	14.49	12.23
6	33.22	27.82	24.14	19.36	15.14	12.46
8		30.56	26.08	21.1	16.47	13
10				22.77	18.34	14.33
12						15.4

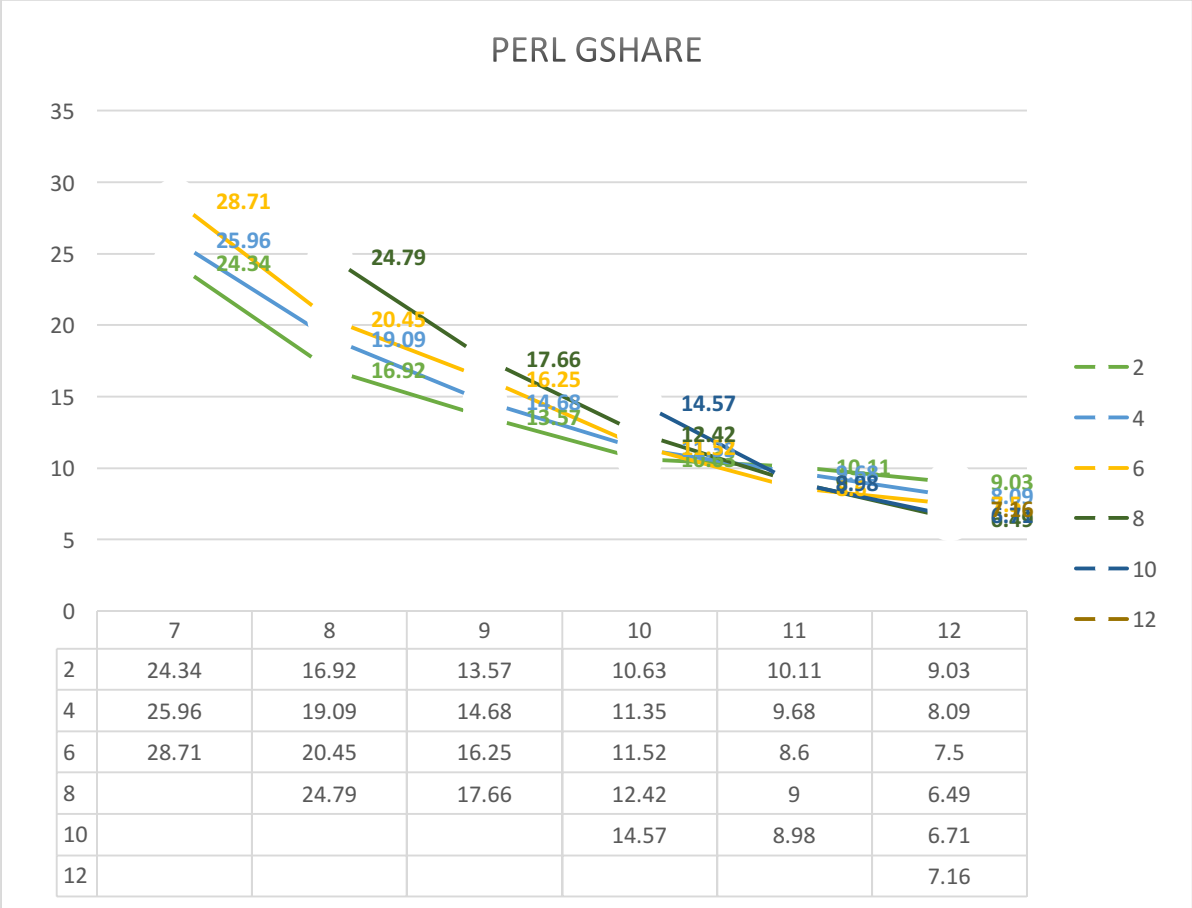
Analysis:

- The misprediction rate decreases by around 3-5% till M is increased to 11 bits. After that, the misprediction rate decreases only by 1-1.5%for each bit increased.

Design:

- **M=11 i.e. Predictor Size = 2048 Bytes**.

Part 2: Performance of Gshare Predictor using perl_trace.txt



	7	8	9	10	11	12
2	24.34	16.92	13.57	10.63	10.11	9.03
4	25.96	19.09	14.68	11.35	9.68	8.09
6	28.71	20.45	16.25	11.52	8.6	7.5
8		24.79	17.66	12.42	9	6.49
10				14.57	8.98	6.71
12						7.16

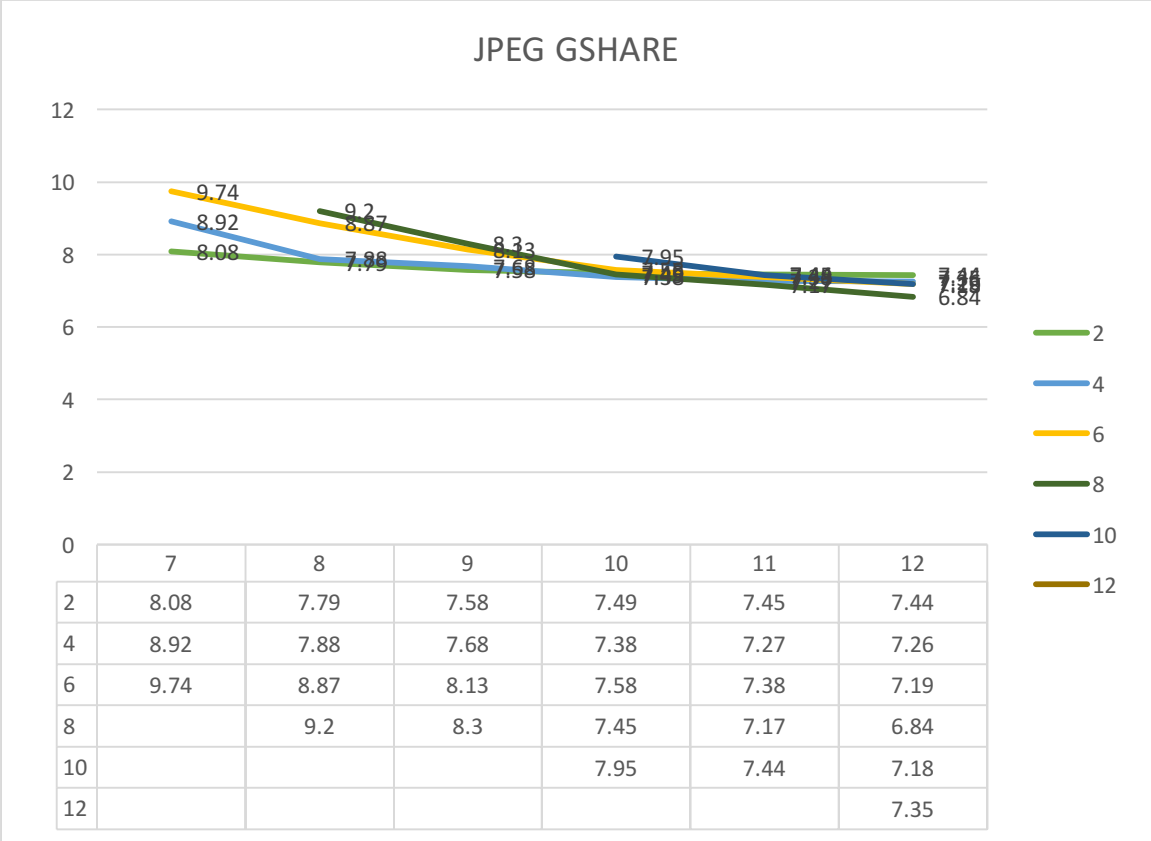
Analysis:

- For *perl_trace.txt* the misprediction rate decreases drastically for N=8. The misprediction rate decreases by around 3-8% till M is increased to 12 bits. After that, the misprediction rate decreases around1percent for each bit increased.

Design:

- **M=12 i.e. Predictor Size = 4kB, N=8.**

Part 2: Performance of Gshare Predictor using jpeg_trace.txt



	7	8	9	10	11	12
2	8.08	7.79	7.58	7.49	7.45	7.44
4	8.92	7.88	7.68	7.38	7.27	7.26
6	9.74	8.87	8.13	7.58	7.38	7.19
8		9.2	8.3	7.45	7.17	6.84
10				7.95	7.44	7.18
12						7.35

Analysis:

- For **N=8**, the misprediction rate decreases by around 0.1-0.2% till M is increased to 12bits. After that, the misprediction rate decreases only by 0.01-0.04%for each bit increased.

Design:

- **M=12 i.e. Predictor Size = 4kB**

Part 2: Analysis

- We observe a exponential increasing trend of prediction accuracy to *m* parameter.
- Misprediction rate is inversely proportional to *m* parameter.
- From the plots above, we observe that the branch misprediction rate *decreases* inversely with increase in size of the Gshare Predictor table.
- We also see that the misprediction rate, in general, *increases* with increase in the number of GHR bits (with a few minor exceptions in jpeg and perl benchmarks).
- The misprediction rate is comparatively *low for the jpeg* benchmark compared to the other two. Also the range of misprediction rate is very less for jpeg benchmark. It changes from max 9.74% to min 6.84%(range=2.9)whereas the range of misprediction rate range is around 18in gcc and perl benchmarks.