**NC State University**

**Department of Electrical and Computer Engineering**

**ECE 463/563: Fall 2019 (Dr. Huiyang Zhou)**

**Project #2: Branch Prediction**

**By**

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(Your Name)

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

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**Course Number: _____563_____**
(463 or 563?)

# Analysis of Branch Predictor

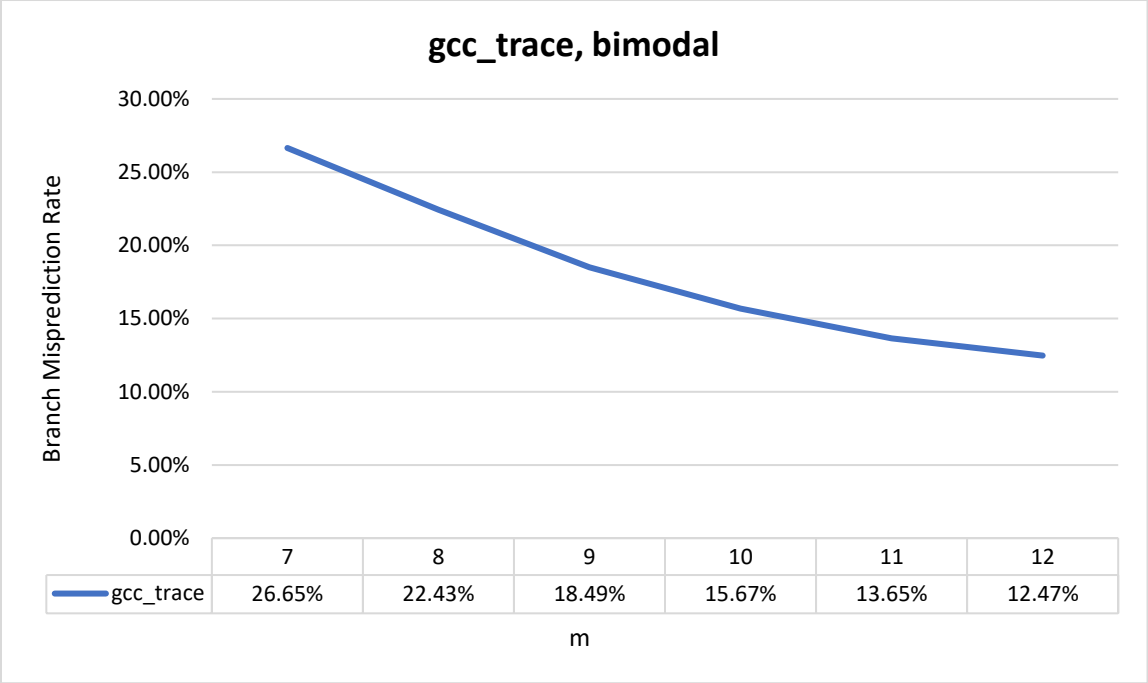
## I. BIMODAL PREDICTOR

The Bimodal predictor uses 'm' bits of the PC to index the branch history table. Here, n=0 and it is a special case of Gshare predictor.

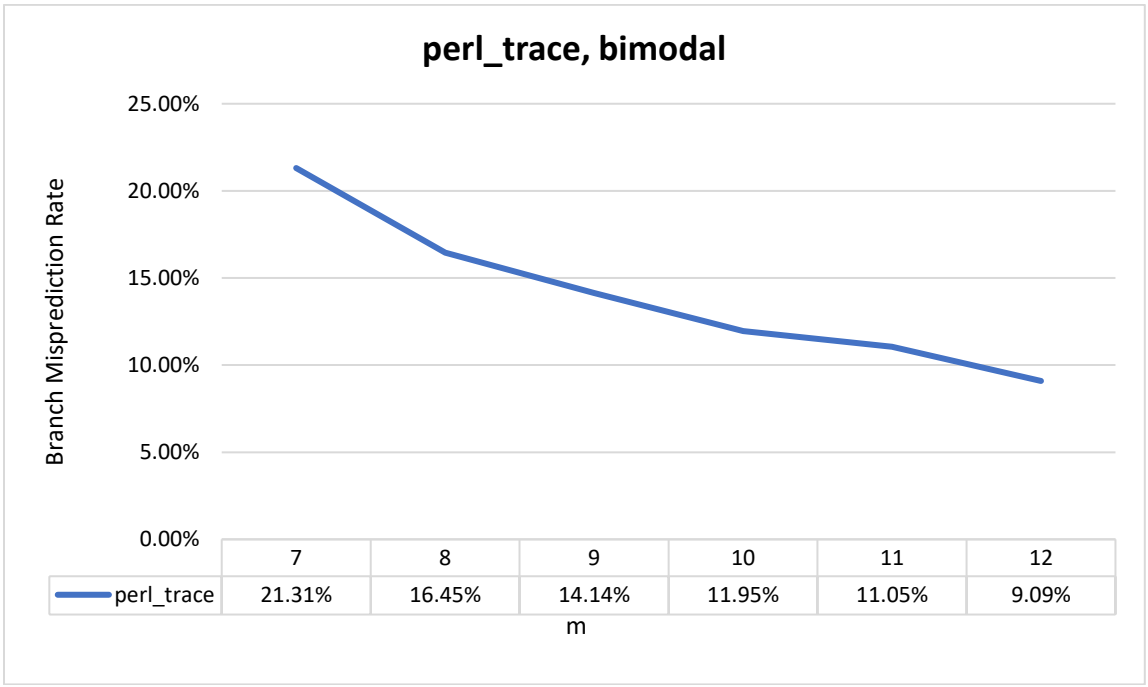
### Graphs:

The following graphs show the misprediction rate against number of index bits for the given trace files.

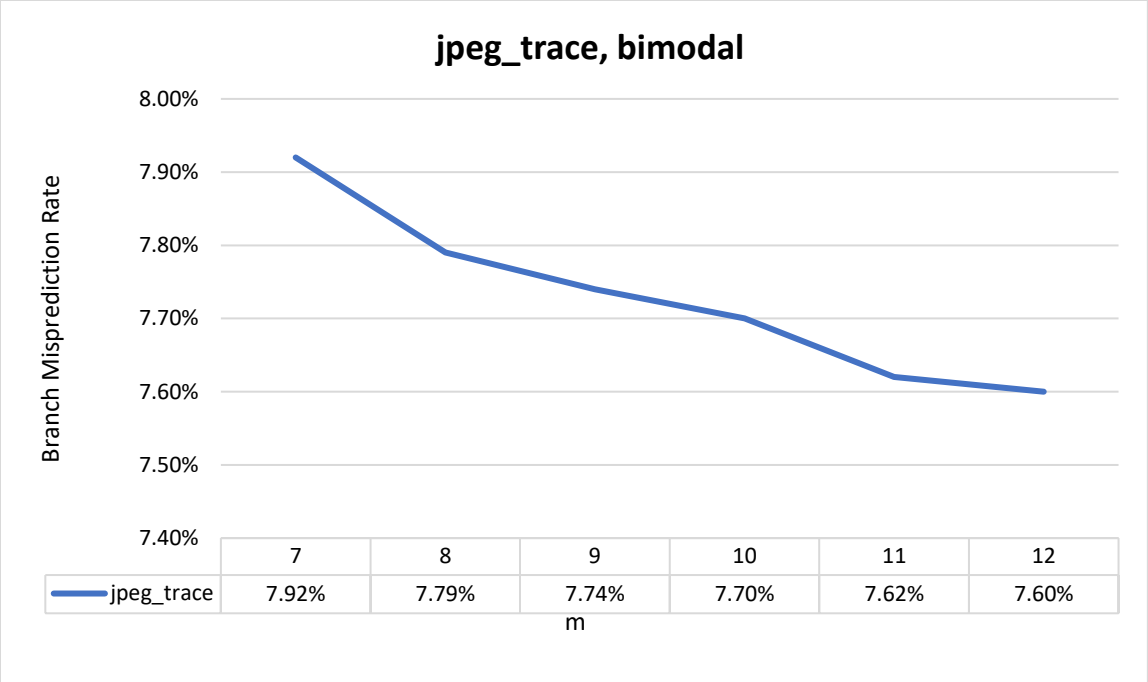
a. Gcc_trace.txt



b. Perl_trace.txt




c. Jpeg_trace.txt




## Analysis:

From the graph, we observe that the misprediction rate for all three address traces reduces as the number of PC bits used to index the branch prediction is increased.
The misprediction rate for the JPEG file trace is lower than either GCC or PERL trace.
The misprediction rate also depends upon the nature of the address trace.
gcc_trace still has the highest misprediction rate among the rest.

## Design:

gcc_trace**:**
For m > 12, there is a small change in miss prediction rate. Thus, m=12 gives the best configuration for this benchmark.

jpeg_trace**:**
For m > 7, the miss prediction rate tends to remain the same. Thus, m=7 gives the best configuration for this benchmark.

perl_trace*:*
For m > 12, the miss prediction rate does not change much. Thus, m=12 is the best configuration.

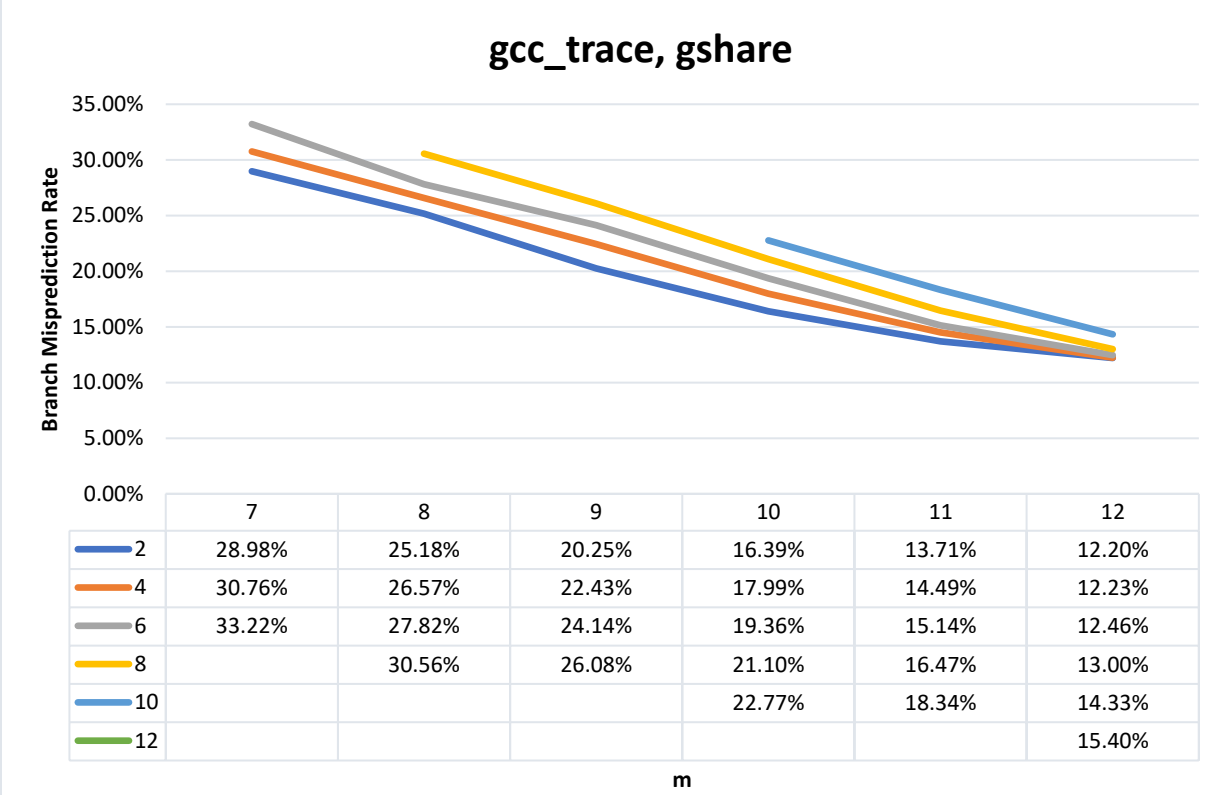
## II. GSHARE PREDICTOR

The Gshare predictor uses both the n-bit global branch history register and m bits to index the program counter.

## Graphs:

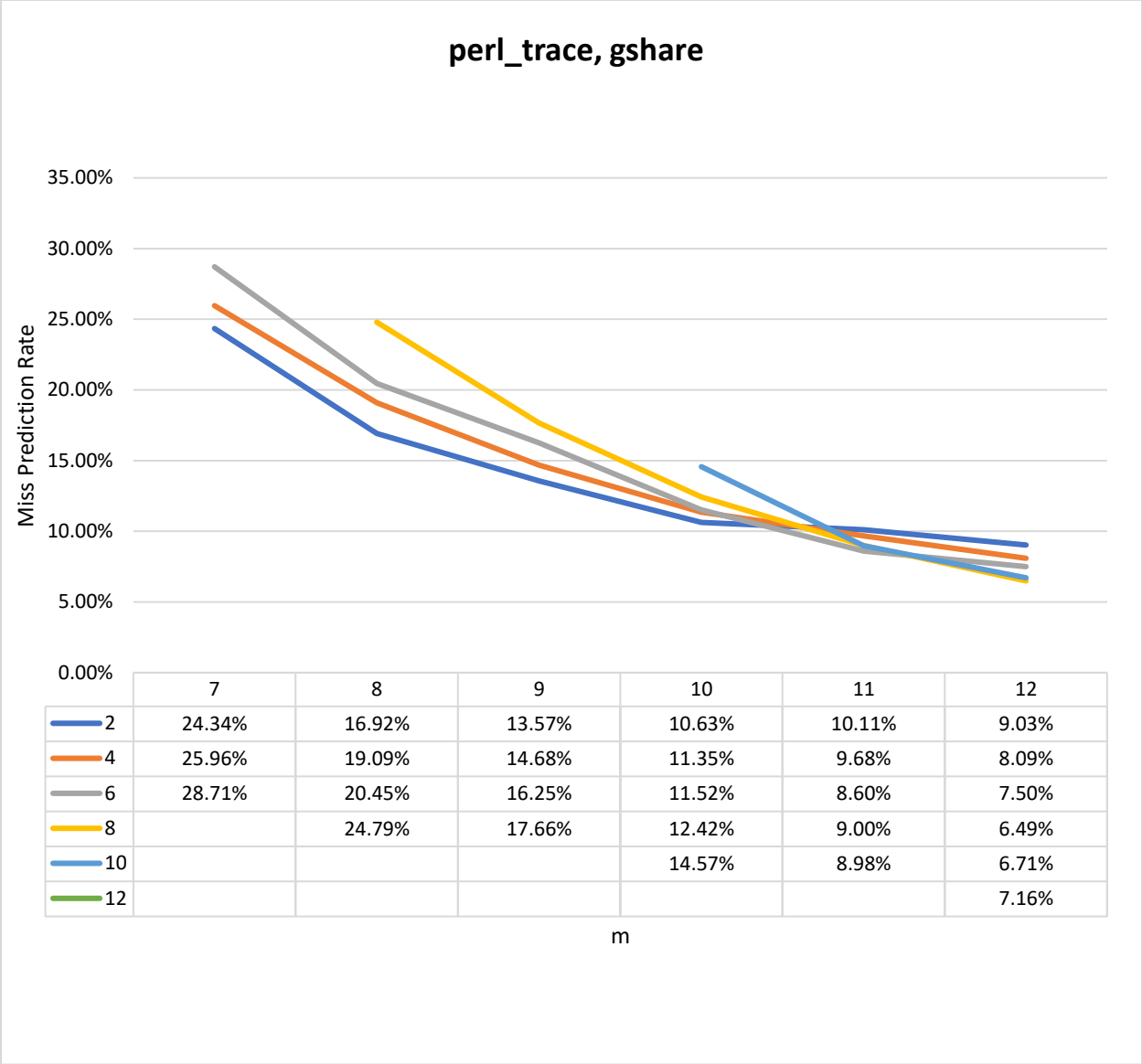
The following graphs show the misprediction rate against values of m and n bits for the given trace files.

a. Gcc_trace.txt



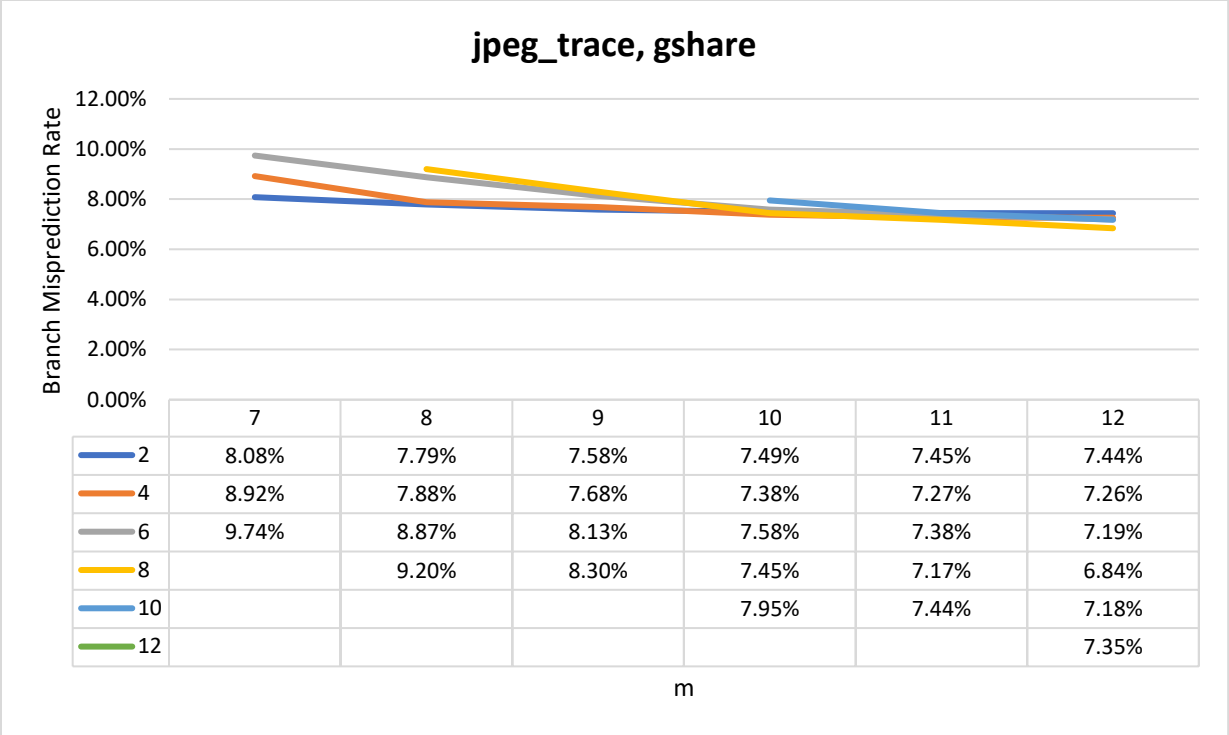

| | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|
| 2 | 28.98% | 25.18% | 20.25% | 16.39% | 13.71% | 12.20% |
| 4 | 30.76% | 26.57% | 22.43% | 17.99% | 14.49% | 12.23% |
| 6 | 33.22% | 27.82% | 24.14% | 19.36% | 15.14% | 12.46% |
| 8 | | 30.56% | 26.08% | 21.10% | 16.47% | 13.00% |
| 10 | | | | 22.77% | 18.34% | 14.33% |
| 12 | | | | | | 15.40% |

b. 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% | 8.60% | 7.50% |
| 8 | | 24.79% | 17.66% | 12.42% | 9.00% | 6.49% |
| 10 | | | | 14.57% | 8.98% | 6.71% |
| 12 | | | | | | 7.16% |

c. 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 | | 9.20% | 8.30% | 7.45% | 7.17% | 6.84% |
| 10 | | | | 7.95% | 7.44% | 7.18% |
| 12 | | | | | | 7.35% |

## Analysis:

We observe that the GCC benchmark has a higher misprediction rate compared to JPEG and PERL. This observation is similar to the Bimodal predictor.

In Gshare, the minimum achieved misprediction rate is lower than the minimum achieved in Bimodal. This is due to the better indexing strategy employed in Gshare.

For the three benchmarks, the miss prediction rate decreases on increasing PC bits.

## Design:

gcc_trace**:**
For m=12 and n=2, we can achieve the least miss prediction rate.

jpeg_trace**:**
For m=10 and n=4 , we can achieve the least miss prediction rate.

perl_trace*:*
For m=12 and n=2, we can achieve the least miss prediction rate.