

2-BIT GSHARE PREDICTOR

Project 2

ANALYSIS OF BRANCH PREDICTION

In this project, we will explore the misprediction rate of various sized tables (2^M entries) and varying size Global History Buffer (Register). We will focus on Gshare by XORing the lower M bits of the PC address with the GHB. Our table will be initialized to a value of 2 (weakly taken). Please read the README for directions on how to run the simulation.

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M set to 4, Varying N [1 – 4]

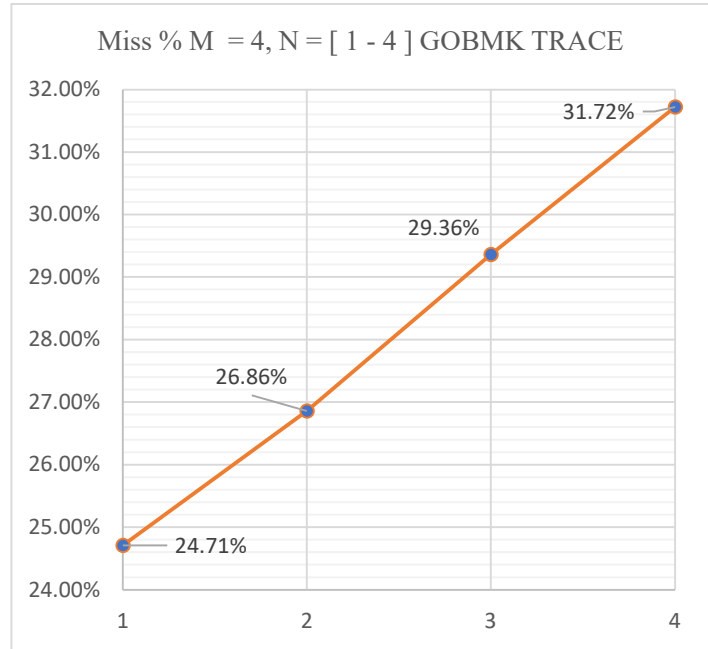
MCF TRACE

M	N	Miss %
4	1	24.71%
4	2	26.86%
4	3	29.36%
4	4	31.72%

With the number of entries held to 16, we notice a rising miss rate as we increase the size of the GHB (N). Varying N from 1 to 4 produces a standard deviation of 2.632%.

Standard Deviation calculated:
Population standard deviation

$$\sigma = \sqrt{\frac{1}{N} \sum_{i=0}^N (x_i - \mu)^2}$$

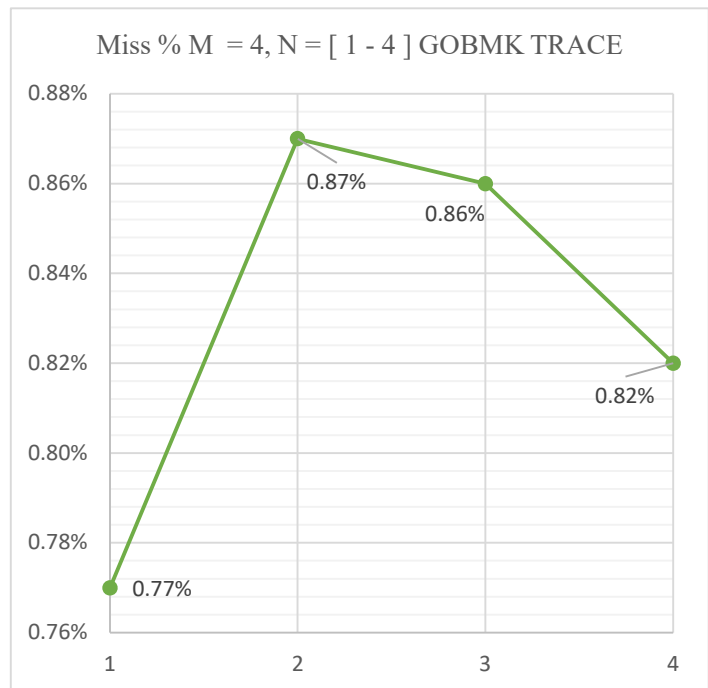


GOBMK TRACE

M	N	Miss %
4	1	0.77%
4	2	0.87%
4	3	0.86%
4	4	0.82%

. With the GOBMK trace, we notice the same pattern, an upward trend. Although the trend does fall after the change of N = 1 to N = 2, the trend is still a rising trend with the minimum misprediction at M = 4 N = 1. The standard deviation is 0.0394%

(Using the formula from part A)



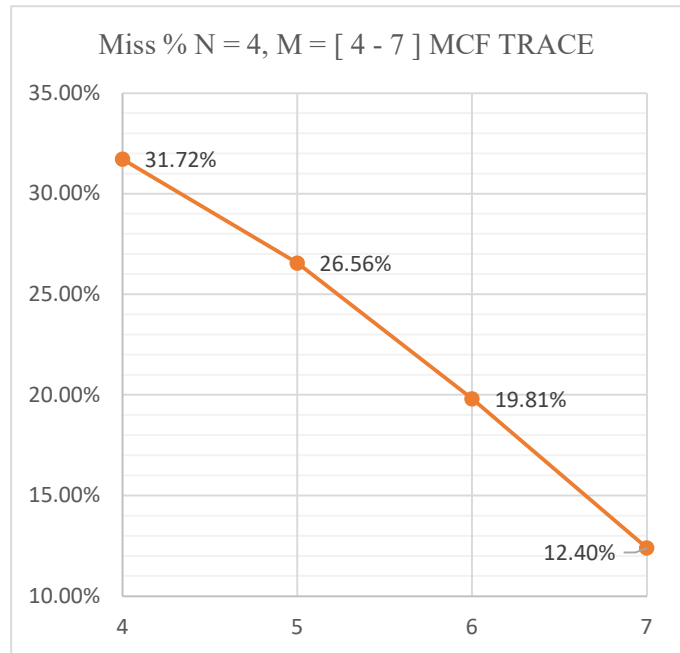
N set to 4, Varying M [4 – 7]

MCF TRACE

M	N	Miss %
4	4	31.72%
5	4	26.56%
6	4	19.81%
7	4	12.40%

Fixing N = 4, produces a lower miss rate with increasing table entry size (as M grows).

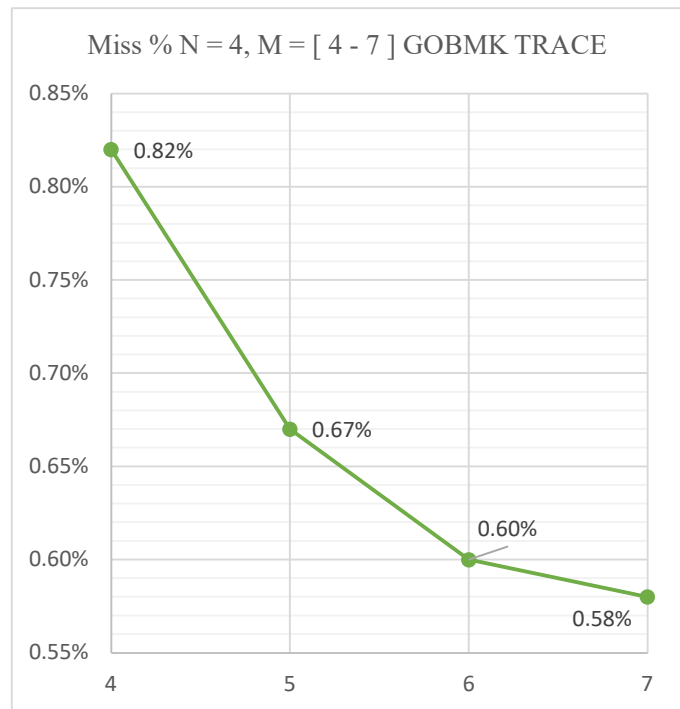
This sounds accurate as each branch prediction will become more accurate as the number of entries increase. The standard deviation is -7.26%, negative indicating decreasing; meaning a growing number of entries has a meaningful impact on the misprediction rate for this application.



GOBMK TRACE

M	N	Miss %
4	4	0.82%
5	4	0.67%
6	4	0.60%
7	4	0.58%

In the GOBMK trace, we notice that increasing the number of entries of the M table does not affect the misprediction rate that significantly since the misprediction rate was already below 1%. The standard deviation is -0.0335%, negative indicating decreasing trendline.

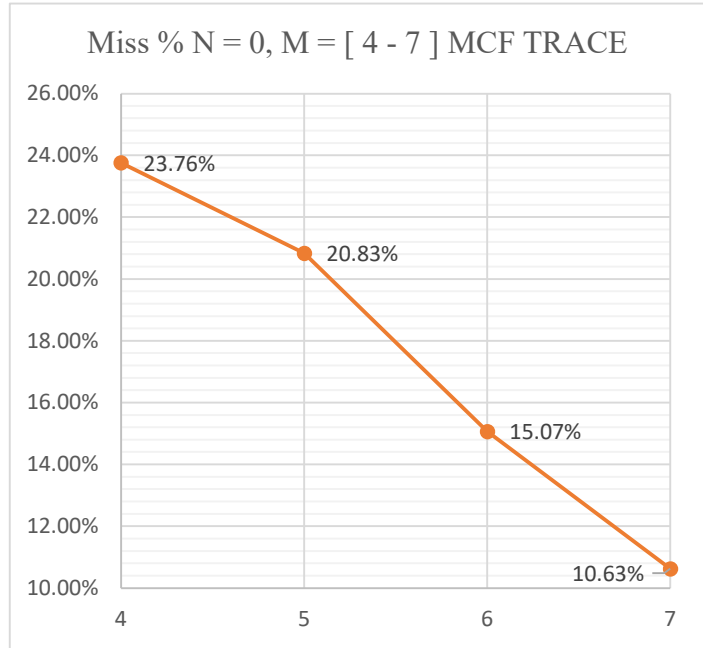


N set to 0, Varying M [4 – 7]

MCF TRACE

M	N	Miss %
4	0	23.76%
5	0	20.83%
6	0	15.07%
7	0	10.63%

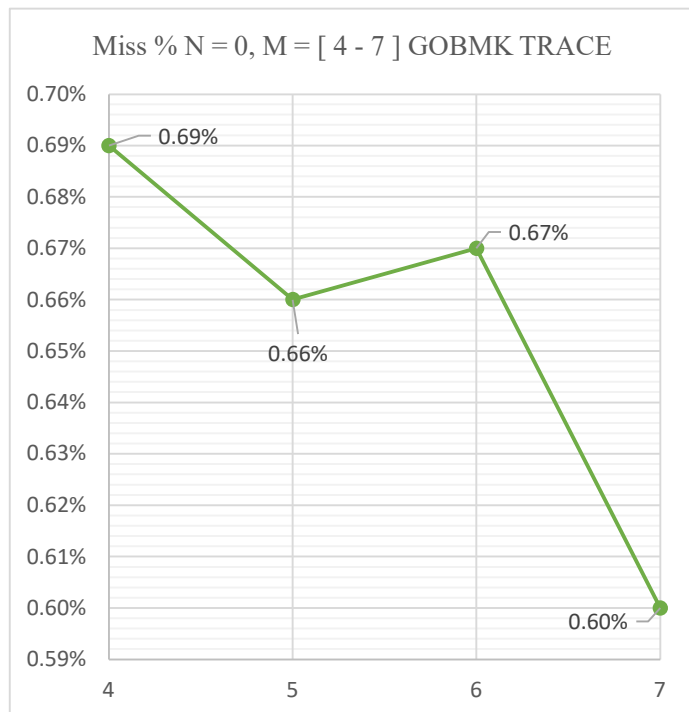
With the bimodal predictor we see a downward trend as we increase the table size. Which follows the trend from part B. MCF trace running a bimodal predictor proved to have a higher impact with a smaller table size rather than a larger one. The standard deviation is -5.08%, negative indicating decreasing trendline.



GOBMK TRACE

M	N	Miss %
4	0	0.69%
5	0	0.66%
6	0	0.67%
7	0	0.60%

If we fix N = 0 (no GHB but index directly), The trend appears to be decreasing with a larger number of entries. The trend is decreasing but has a jump between N = 5 and N = 6. There for this program (GOBMK trace) proved to have an overall lesser impact than in part B. The standard deviation is -0.0335%, negative indicating decreasing trendline.

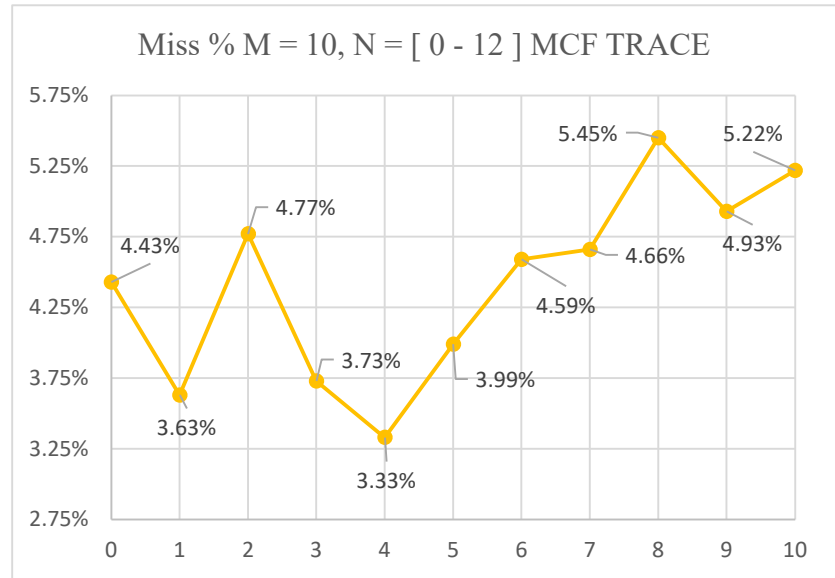


Personal analysis (Not required for project grading)

M set to 10 (1KB entries), Varying N [0 – 10]

MCF TRACE

M	N	Miss %
10	0	4.43%
10	1	3.63%
10	2	4.77%
10	3	3.73%
10	4	3.33%
10	5	3.99%
10	6	4.59%
10	7	4.66%
10	8	5.45%
10	9	4.93%
10	10	5.22%



As predicted: From our first analysis of setting $M = X$ and varying N did not make a significant impact on the outcome of the misprediction rate as we can see above.

But do notice that we are using 1KB entries and the misprediction rate fell to 5.22% which means that the standard deviation calculated in part A is actually lower than 7% since as we approach a larger table we tend to flatline to a percentage where there will be no significant change once the table size gets too large.

END REPORT