NC State University

Department of Electrical and Computer Engineering

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

Project #2: Branch Prediction

By

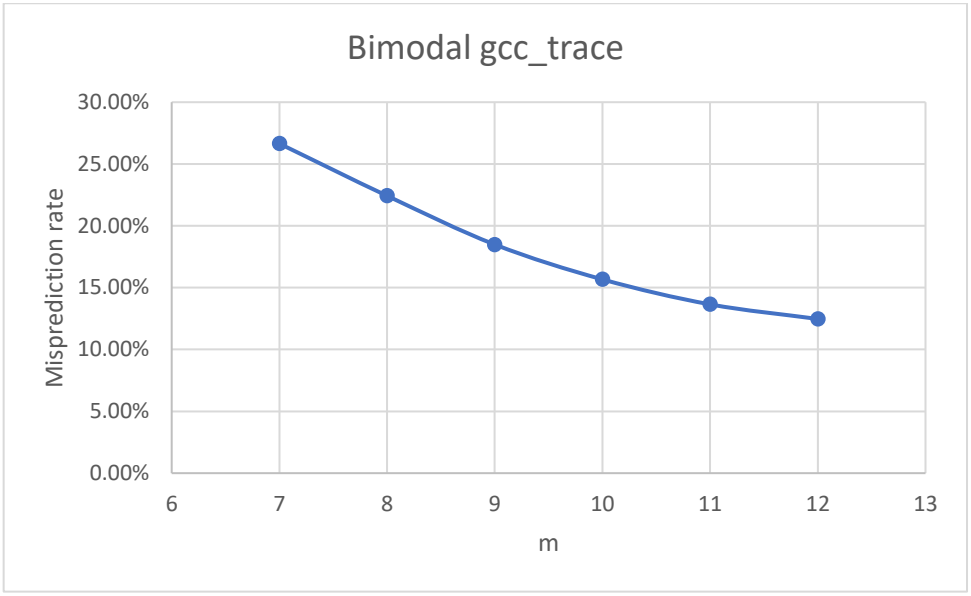
Sidharth Mehta

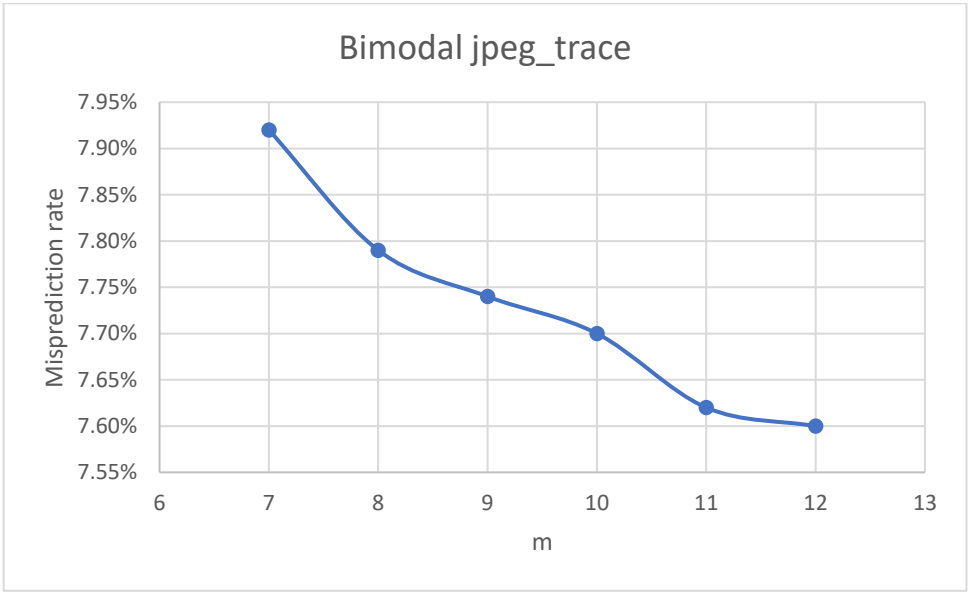
NCSU Honor Pledge: "I have neither given nor received unauthorized aid on this test or assignment."

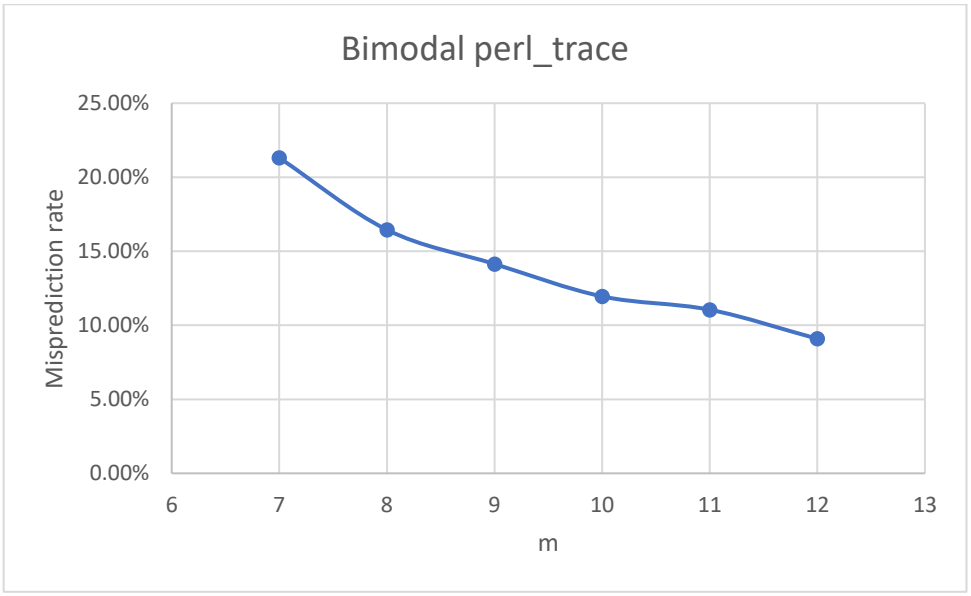
Student's Electronic Signature: Sidharth Mehta

Course Number: 563

BIMODAL PREDICTOR







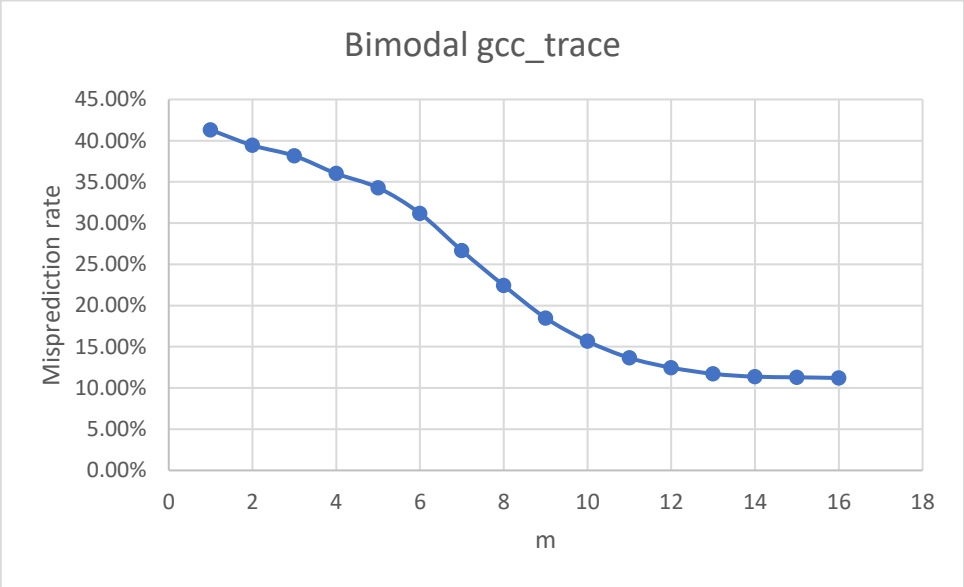
Trends and comparisons

1. With increase in no of index bits for prediction table the misprediction rate drops.
2. Misprediction rate gives diminishing returns with increase in number of index bits after a certain point.
3. gcc_trace and perl_trace have similar misprediction rate while jpeg trace has a lower misprediction rate.
4. jpeg_trace is likely to contain loops.

Best configurations

1. gcc_trace

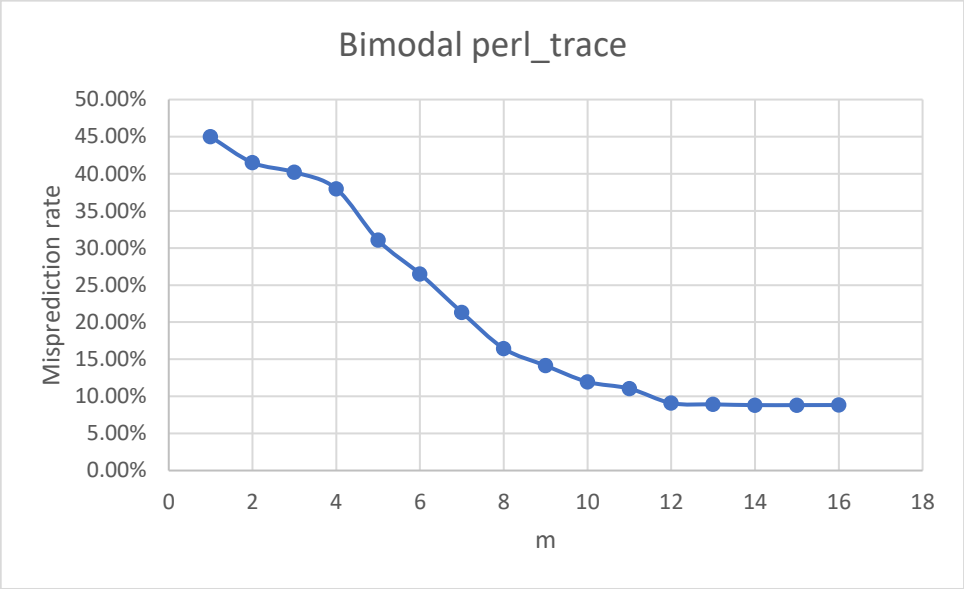
m	rate
1	41.31%
2	39.43%
3	38.16%
4	36.01%
5	34.29%
6	31.17%
7	26.65%
8	22.43%
9	18.49%
10	15.67%
11	13.65%
12	12.47%
13	11.72%
14	11.37%
15	11.30%
16	11.21%



At m = 13 the predictor gives best size to misprediction ratio after this increasing m doesn't give significant improvements.

2. perl_trace

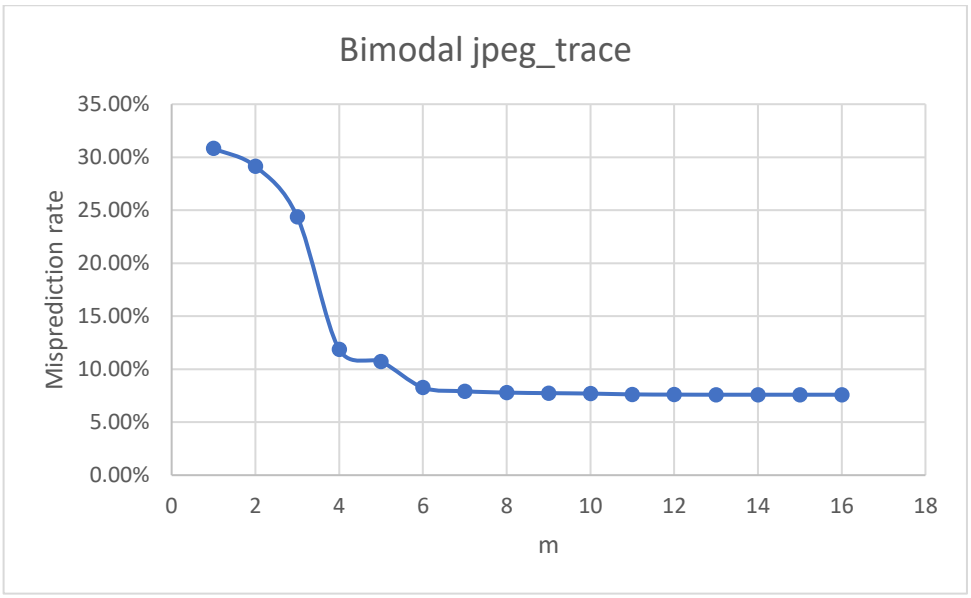
m	rate
1	44.98%
2	41.50%
3	40.22%
4	37.98%
5	31.05%
6	26.50%
7	21.31%
8	16.45%
9	14.14%
10	11.95%
11	11.05%
12	9.09%
13	8.92%
14	8.82%
15	8.82%
16	8.83%



At m = 12 the predictor gives best size to misprediction ratio after this increasing m doesn't give significant improvements.

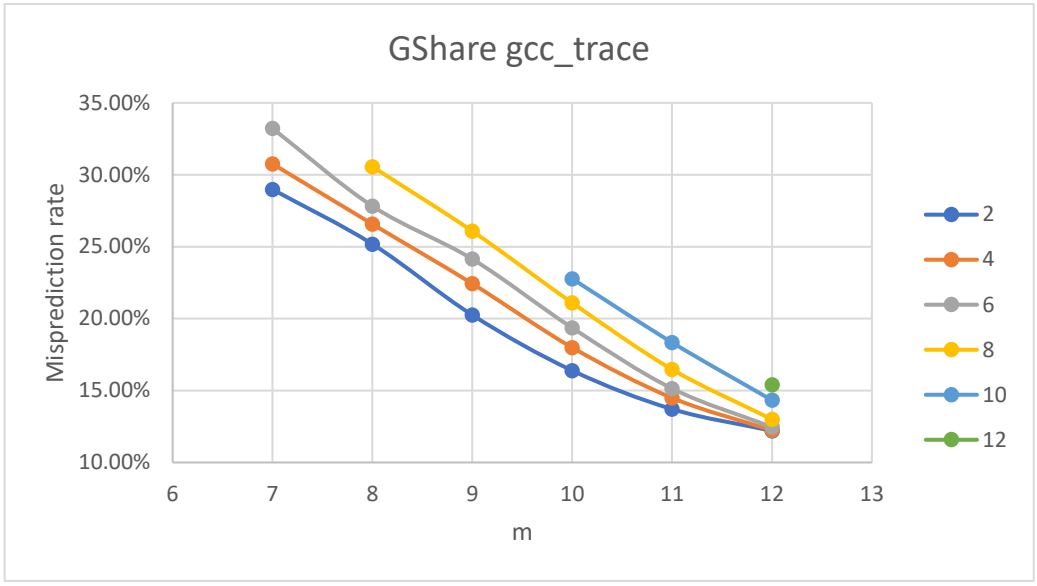
3. jpeg_trace

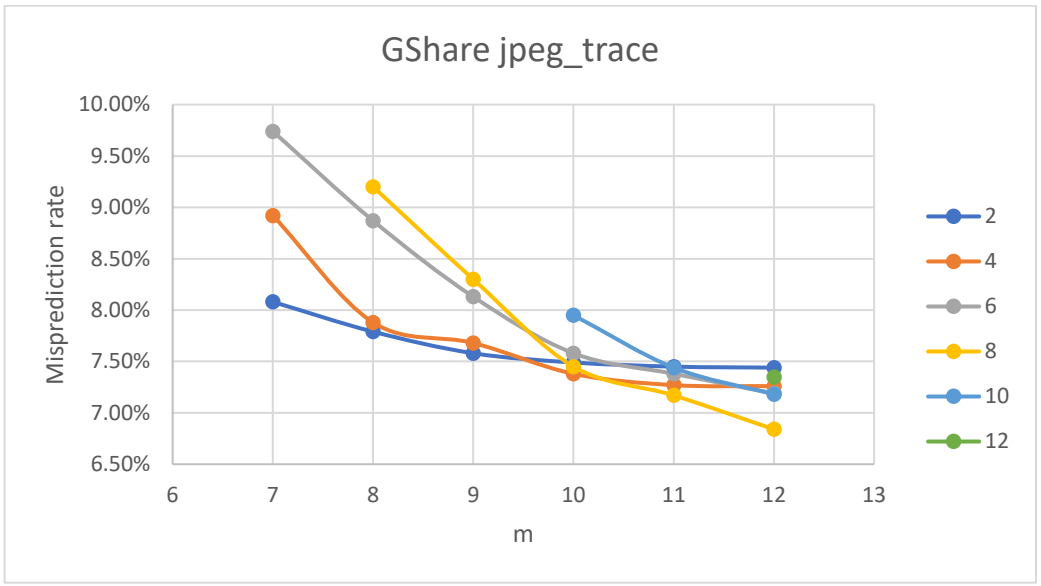
m	rate
1	30.82%
2	29.13%
3	24.38%
4	11.87%
5	10.71%
6	8.27%
7	7.92%
8	7.79%
9	7.74%
10	7.70%
11	7.62%
12	7.60%
13	7.59%
14	7.59%
15	7.59%
16	7.59%

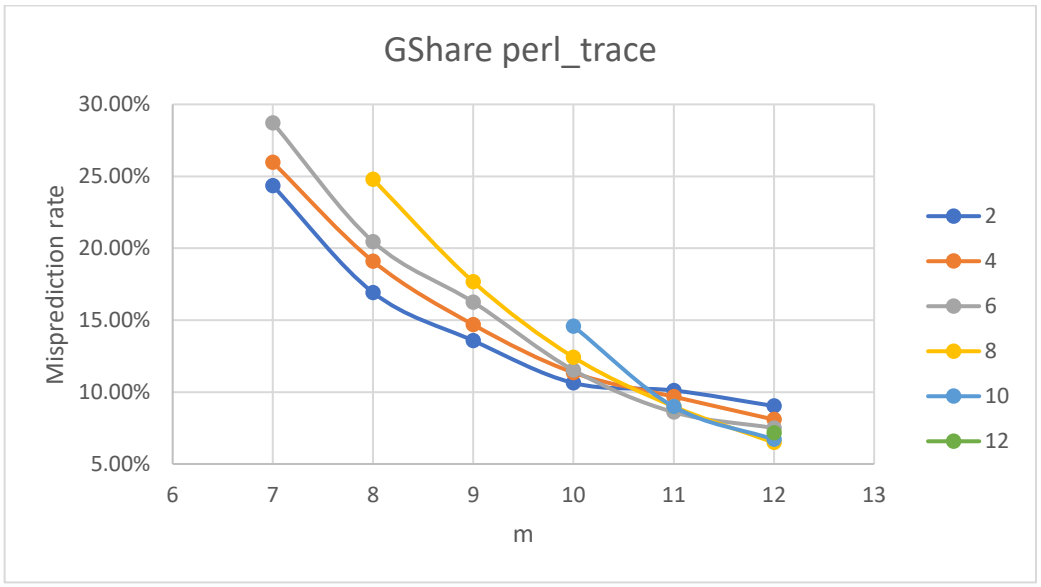


At m = 7 the predictor gives best size to misprediction ratio after this increasing m doesn't give significant improvements.

GSHARE PREDICTOR







Trends and comparisons

1. With increase in no of index bits for prediction table the misprediction rate drops.
2. Increasing the size of BHR i.e. n is beneficial after a certain value of m (9+).
3. Misprediction rate gives diminishing returns with increase in number of index bits after a certain point.
4. gcc_trace and perl_trace have similar misprediction rate while jpeg trace has a lower misprediction rate.
5. jpeg_trace is likely to contain loops.
6. Using BHR doesn't improve prediction therefore traces are less likely to contain branches in patterns.

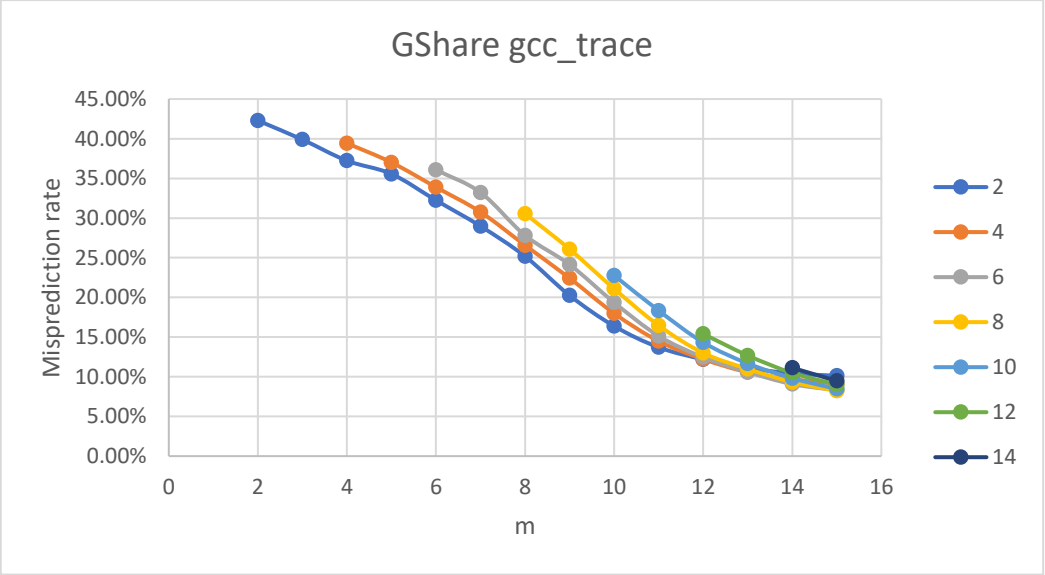
Justification for taking m as 15

Since we need to include BHR in the design max value of will be 16 to meet 16kB budget.

Best configurations

1. gcc_trace

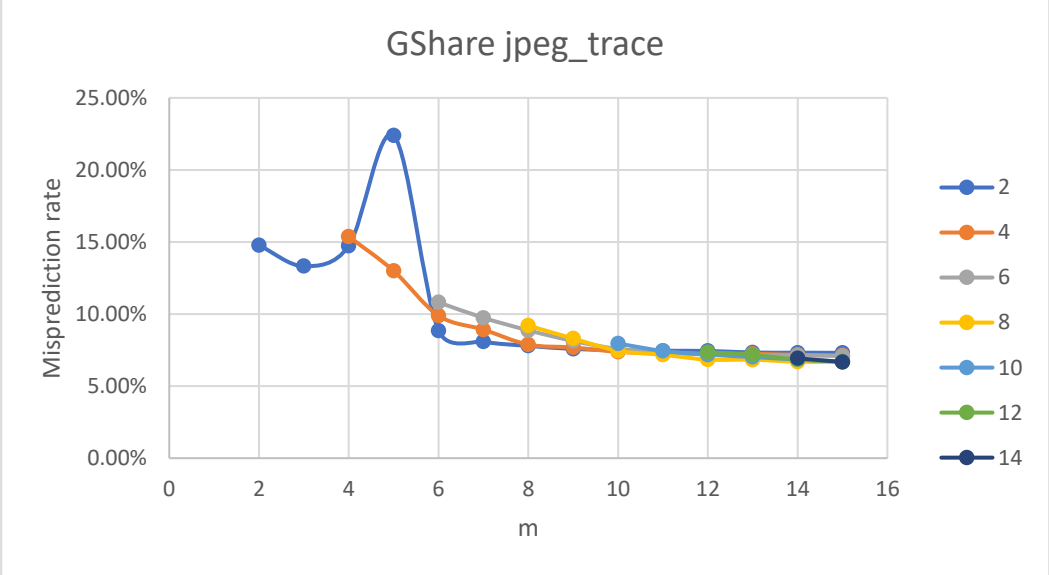
m	n	rate
2	2	42.29%
3	2	39.89%
4	2	37.23%
5	2	35.56%
6	2	32.24%
7	2	28.98%
8	2	25.18%
9	2	20.25%
10	2	16.39%
11	2	13.71%
12	2	12.20%
13	2	11.11%
14	2	10.42%
15	2	10.13%
4	4	39.43%
5	4	37.01%
6	4	33.89%
7	4	30.76%
8	4	26.57%
9	4	22.43%
10	4	17.99%
11	4	14.49%
12	4	12.23%
13	4	10.57%
14	4	9.69%
15	4	9.13%
6	6	36.08%
7	6	33.22%
8	6	27.82%
9	6	24.14%
10	6	19.36%
11	6	15.14%
12	6	12.46%
13	6	10.59%
14	6	9.08%
15	6	8.30%
8	8	30.56%
9	8	26.08%
10	8	21.10%
11	8	16.47%
12	8	13.00%
13	8	11.00%
14	8	9.34%
15	8	8.22%
10	10	22.77%
11	10	18.34%
12	10	14.33%
13	10	11.68%
14	10	9.83%
15	10	8.46%
12	12	15.40%
13	12	12.68%
14	12	10.48%
15	12	9.01%
14	14	11.13%
15	14	9.48%



At m = 13 the predictor gives best size to misprediction ratio after this increasing m doesn't give significant improvements.
For m = 13 n = 4 gives best returns.

2. jpeg_trace

m	n	rate
2	2	14.77%
3	2	13.32%
4	2	14.74%
5	2	22.39%
6	2	8.85%
7	2	8.08%
8	2	7.79%
9	2	7.58%
10	2	7.49%
11	2	7.45%
12	2	7.44%
13	2	7.33%
14	2	7.32%
15	2	7.31%
4	4	15.38%
5	4	12.99%
6	4	9.89%
7	4	8.92%
8	4	7.88%
9	4	7.68%
10	4	7.38%
11	4	7.27%
12	4	7.26%
13	4	7.24%
14	4	7.17%
15	4	7.13%
6	6	10.81%
7	6	9.74%
8	6	8.87%
9	6	8.13%
10	6	7.58%
11	6	7.38%
12	6	7.19%
13	6	7.16%
14	6	7.14%
15	6	7.09%
8	8	9.20%
9	8	8.30%
10	8	7.45%
11	8	7.17%
12	8	6.84%
13	8	6.83%
14	8	6.69%
15	8	6.69%
10	10	7.95%
11	10	7.44%
12	10	7.18%
13	10	7.02%
14	10	6.84%
15	10	6.72%
12	12	7.35%
13	12	7.17%
14	12	6.84%
15	12	6.70%
14	14	6.93%
15	14	6.67%

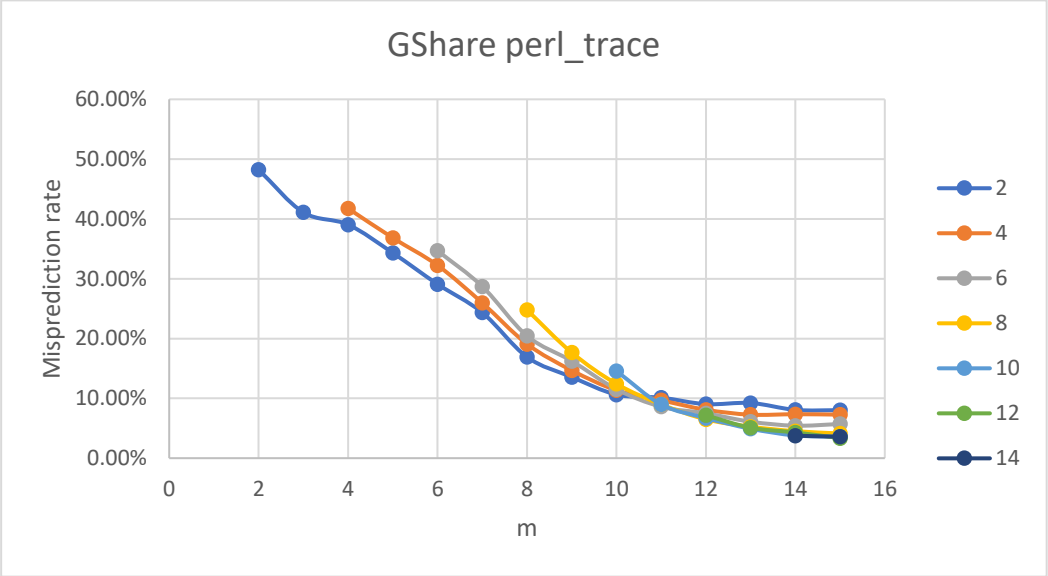


At m = 9 the predictor gives best size to misprediction ratio after this increasing m doesn't give significant improvements.

For m = 9 n = 2 gives best returns.

3. perl_trace

m	n	rate
2	2	48.23%
3	2	41.10%
4	2	39.05%
5	2	34.32%
6	2	29.09%
7	2	24.34%
8	2	16.92%
9	2	13.57%
10	2	10.63%
11	2	10.11%
12	2	9.03%
13	2	9.23%
14	2	8.07%
15	2	8.02%
4	4	41.75%
5	4	36.83%
6	4	32.24%
7	4	25.96%
8	4	19.09%
9	4	14.68%
10	4	11.35%
11	4	9.68%
12	4	8.09%
13	4	7.27%
14	4	7.35%
15	4	7.28%
6	6	34.68%
7	6	28.71%
8	6	20.45%
9	6	16.25%
10	6	11.52%
11	6	8.60%
12	6	7.50%
13	6	6.09%
14	6	5.43%
15	6	5.71%
8	8	24.79%
9	8	17.66%
10	8	12.42%
11	8	9.00%
12	8	6.49%
13	8	5.26%
14	8	4.51%
15	8	4.13%
10	10	14.57%
11	10	8.98%
12	10	6.71%
13	10	4.92%
14	10	3.80%
15	10	3.58%
12	12	7.16%
13	12	5.09%
14	12	4.30%
15	12	3.35%
14	14	3.75%
15	14	3.58%



At m = 12 the predictor gives best size to misprediction ratio after this increasing m doesn't give significant improvements.
For m = 12 n = 8 gives best returns.