NC State University

Department of Electrical and Computer Engineering

ECE 463/521: Fall 2014

Project #2: Branch Prediction

by

<< SHRIRANG K. DESHPANDE >>

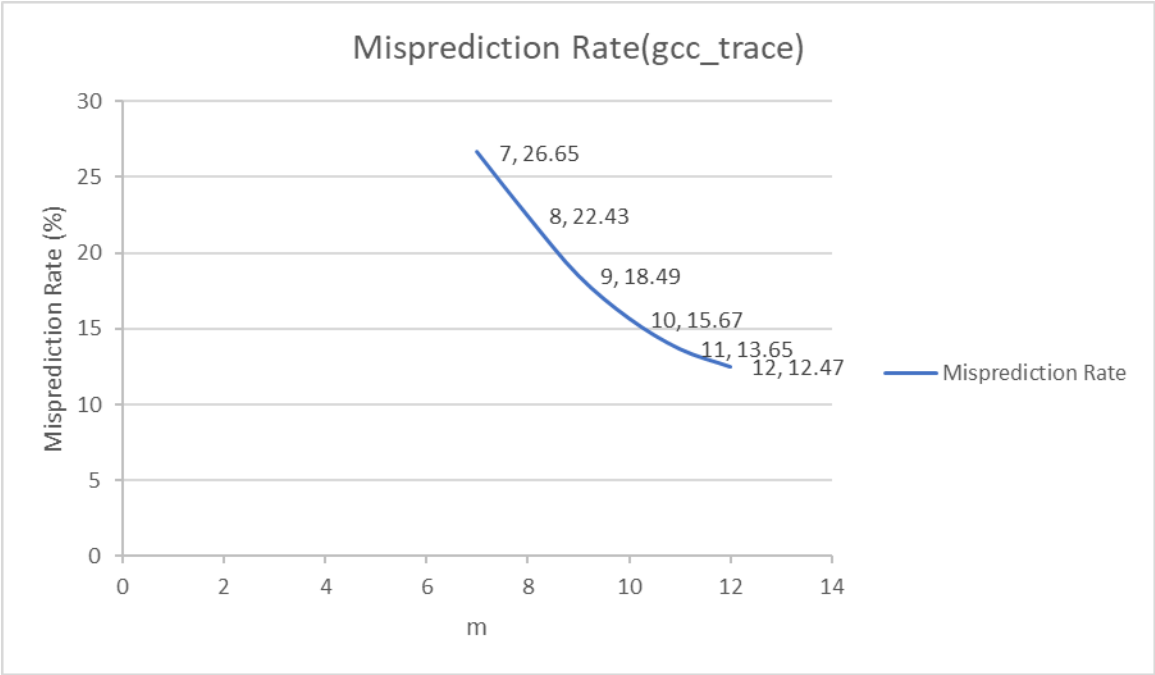
NCSU Honor Pledge: "I have neither given nor received unauthorized aid on this test or assignment."

Student's electronic signature: Shrirang Deshpande.
(sign by typing your name)

Course number: _563
(463 or 521 ?)

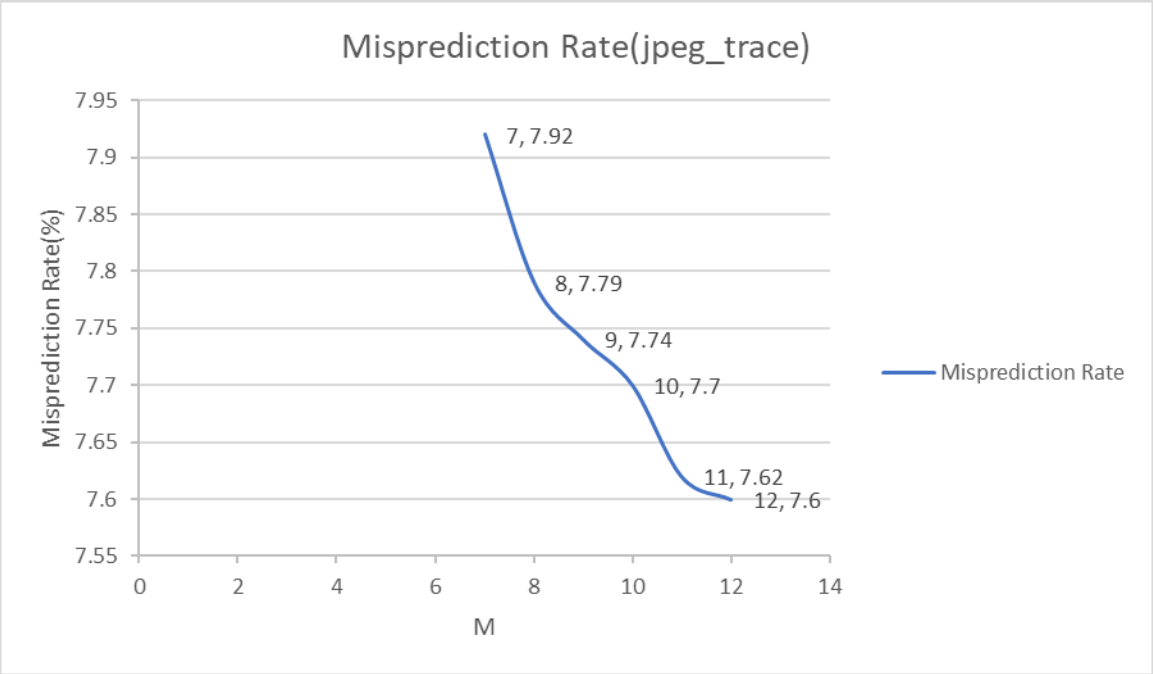
Bimodal

gcc_trace



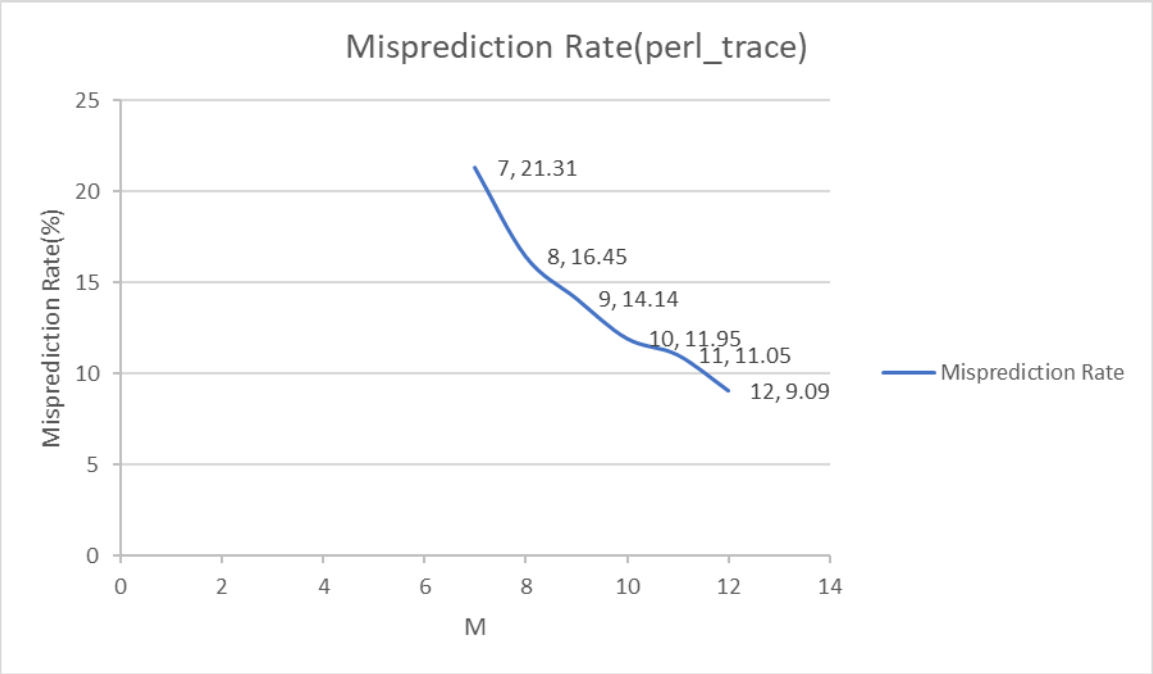
For the gcc_trace file, the prediction accuracy of bimodal branch predictor increases as M increases. As we can see from the graph above, the misprediction rete of the branch predictor decreases as from 26.65% to 12.47% as M increases from 7 to 12. As M increases the prediction table size also increases as there are 2^M cells in the prediction table which in turn facilitates more storage for unique conditional branches. The trend observed above can be explained by the stated fact, as the number of replacements from prediction table decrease as the size of prediction table increases.

jpeg_trace



For the jpeg_trace file, the prediction accuracy of bimodal branch predictor increases as M increases. But the increment in the prediction accuracy is not that significant. As we can see from the graph above, the misprediction rete of the branch predictor decreases as from 7.92% to 7.6% as M increases from 7 to 12. As M increases the prediction table size also increases as there are 2^M cells in the prediction table which in turn facilitates more storage for unique conditional branches. The insignificance in the decrement in misprediction rate can be explained by the nature of the trace. It might be the case that number of unique branches are less in the jpeg_trace. The trace might follow a pattern which the predictor can't see to improve the misprediction rate.

perl_trace

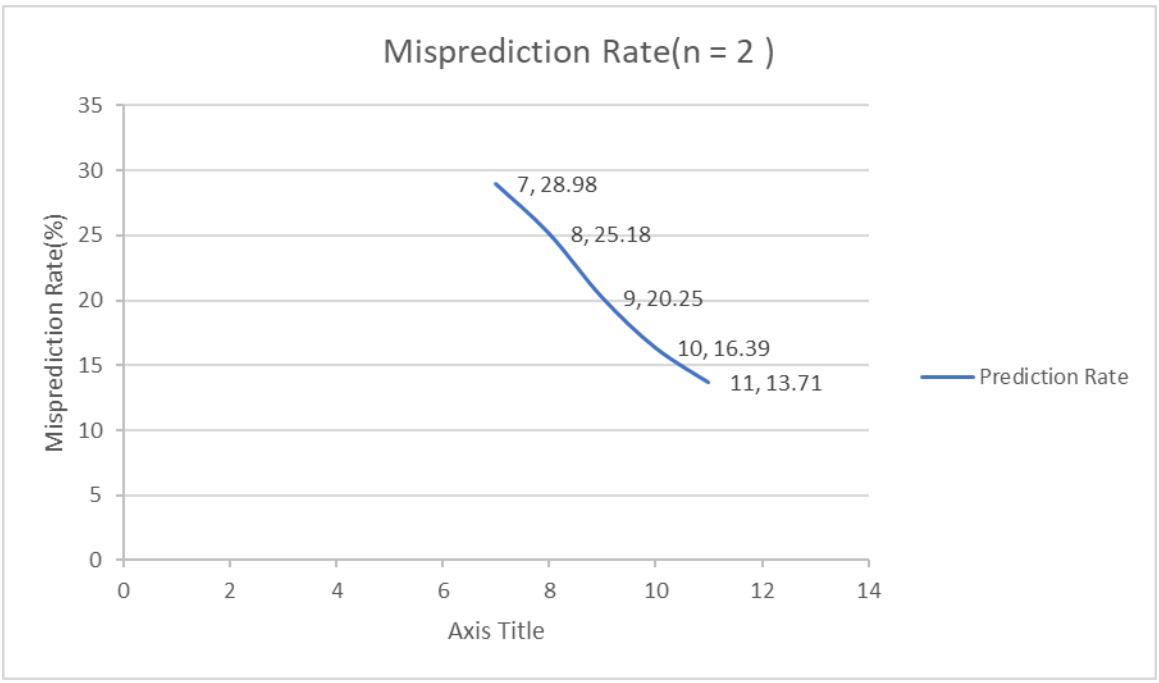


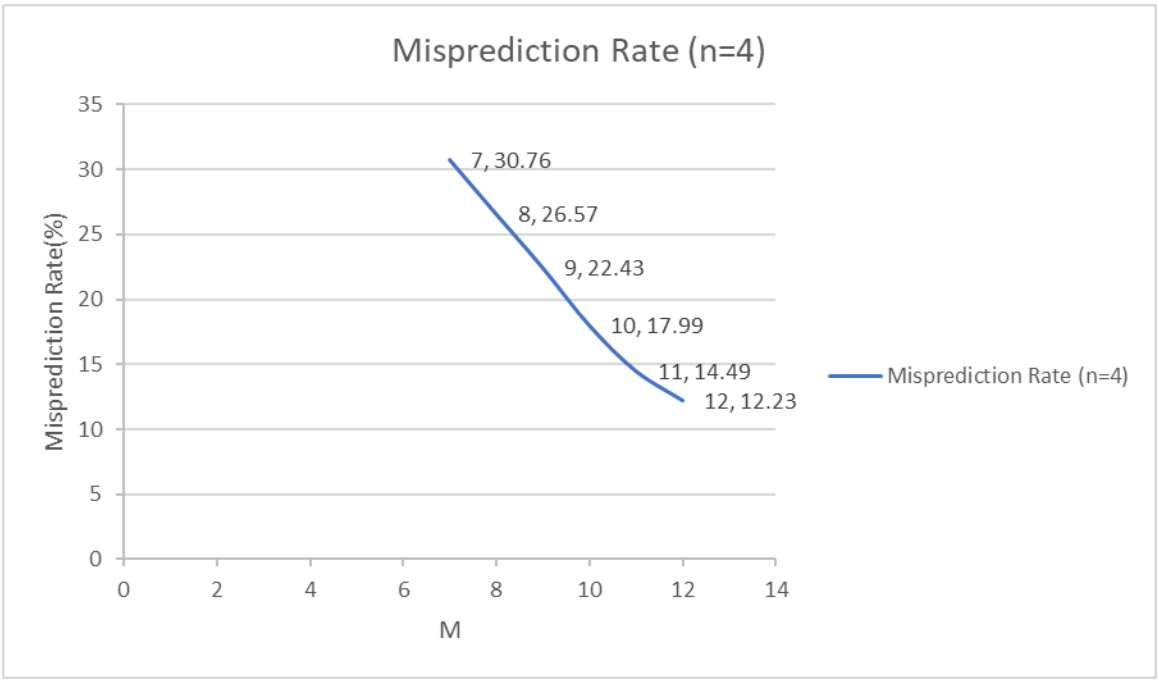
For the perl_trace file, the prediction accuracy of bimodal branch predictor increases as M increases. As we can see from the graph above, the misprediction rete of the branch predictor decreases as from 21.31% to 9.09% as M increases from 7 to 12. As M increases the prediction table size also increases as there are 2^M cells in the prediction table which in turn facilitates more storage for unique conditional branches. The trend observed above can be explained by the stated fact, as the number of replacements from prediction table decrease as the size of prediction table increases.

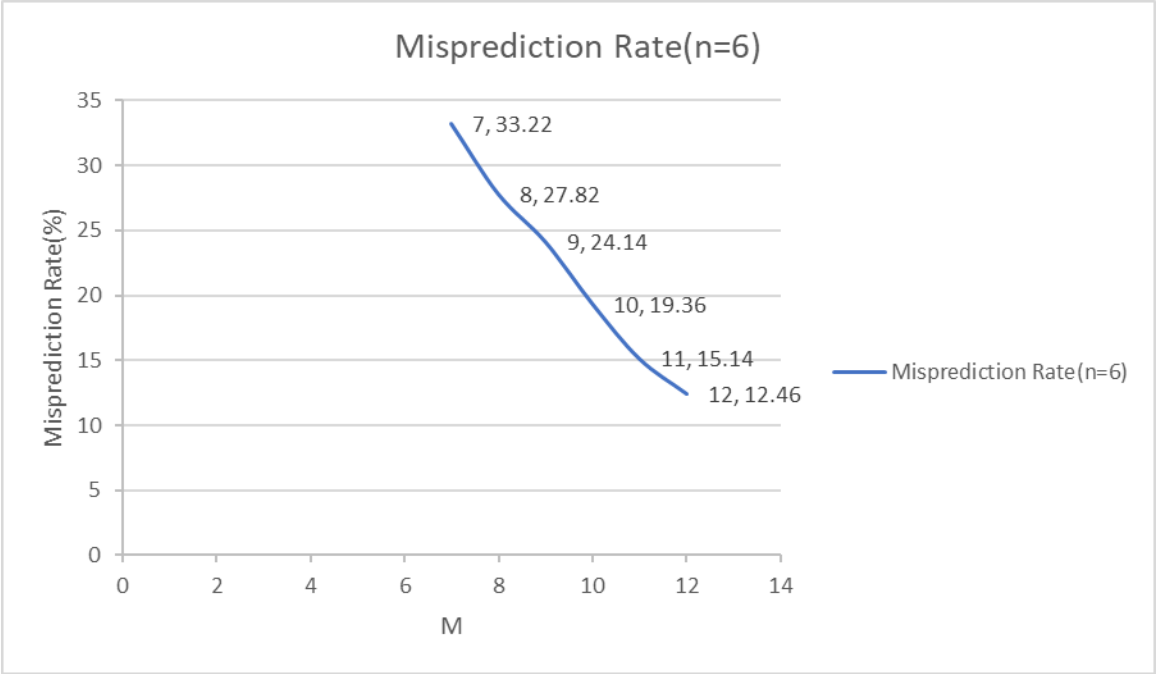
CHOOSING BEST DESIGN FOR EACH TRACE:
gcc_trace: M =11. Though M=12 has low prediction rate. The improvement is negligible compared to the cost of having M=12.
jpeg_trace: M=7. Though M=12 has low prediction rate. The improvement is negligible compared to the cost of having M=12.
perl_trace: M=10. Though M=12 has low prediction rate. The improvement is negligible compared to the cost of having M=12.

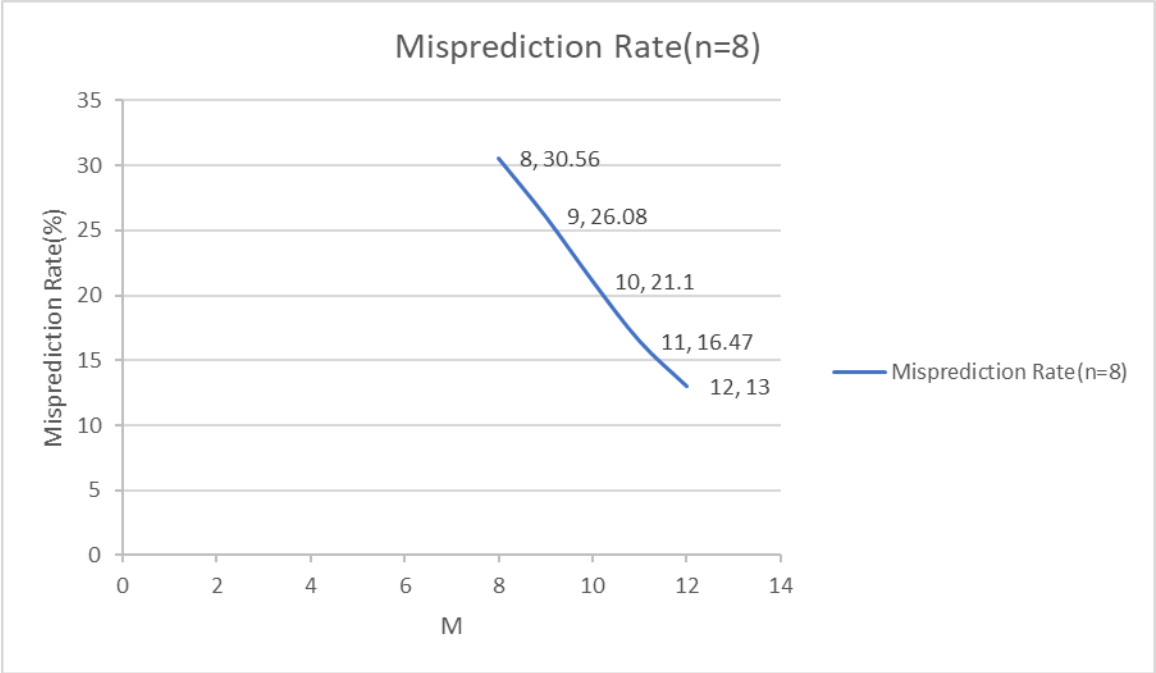
GSHARE

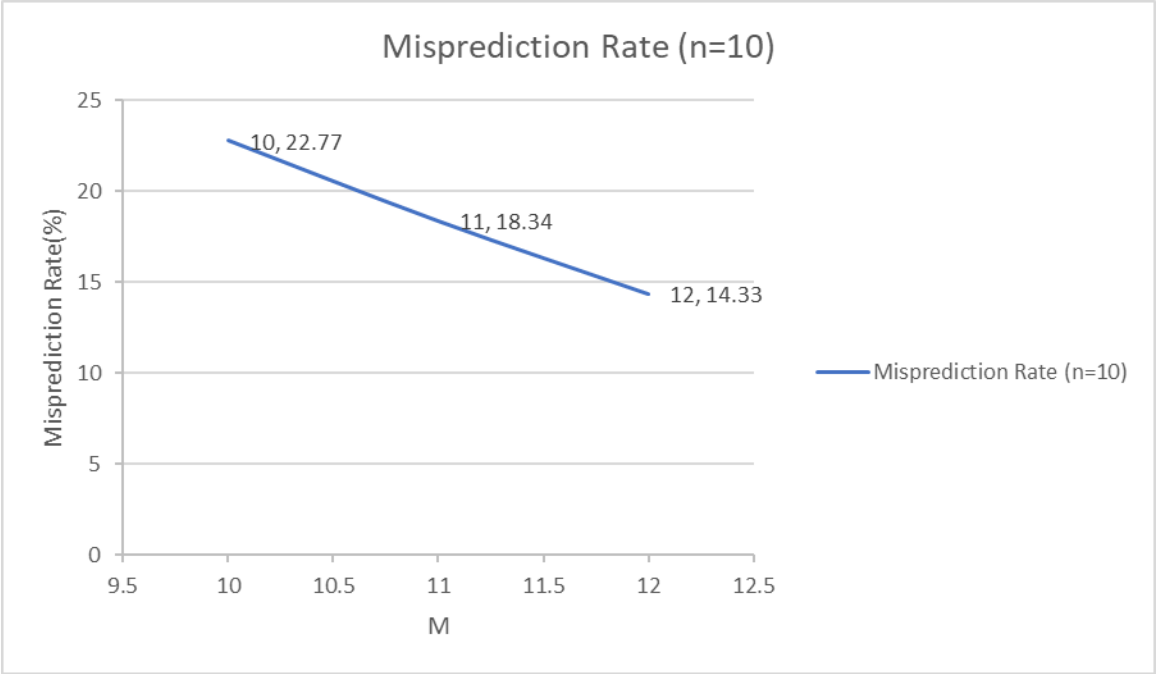
Gcc_trace

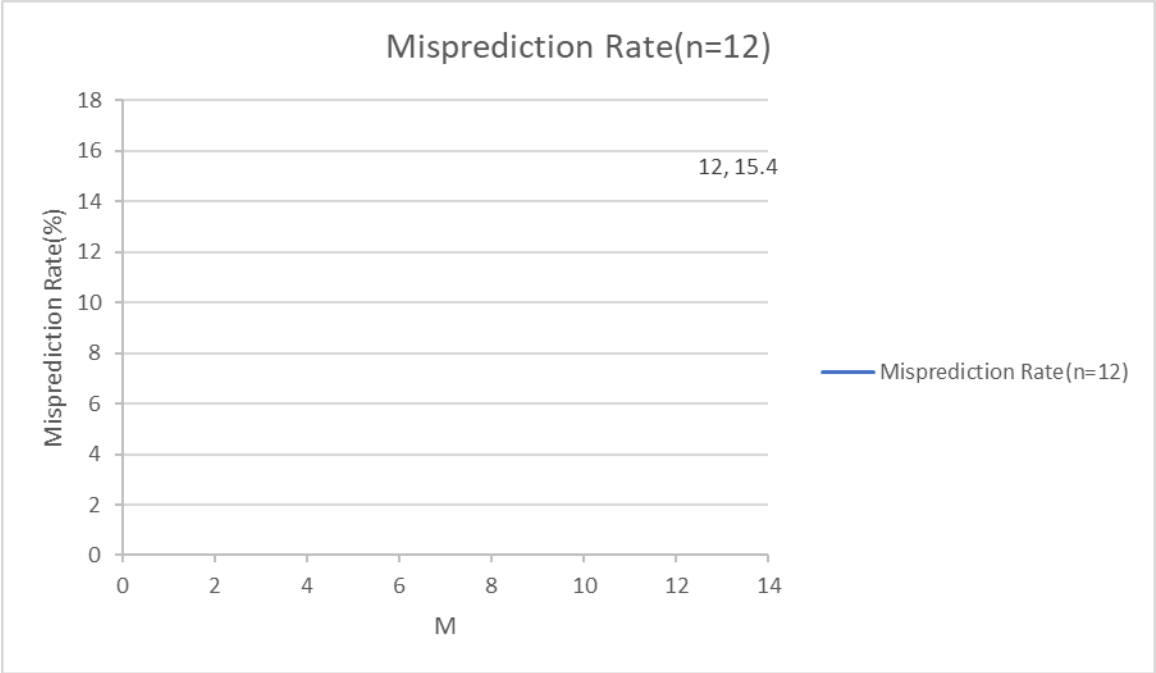

Misprediction Rate(n = 2)
Misprediction Rate(%)
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
Axis Title
7, 28.98
8, 25.18
9, 20.25
10, 16.39
11, 13.71
Prediction Rate


Misprediction Rate (n=4)
Misprediction Rate(%)
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
M
7, 30.76
8, 26.57
9, 22.43
10, 17.99
11, 14.49
12, 12.23
Misprediction Rate (n=4)


Misprediction Rate(n=6)
Misprediction Rate(%)
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
M
7, 33.22
8, 27.82
9, 24.14
10, 19.36
11, 15.14
12, 12.46
Misprediction Rate(n=6)


Misprediction Rate(n=8)
Misprediction Rate(%)
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
M
8, 30.56
9, 26.08
10, 21.1
11, 16.47
12, 13
Misprediction Rate(n=8)



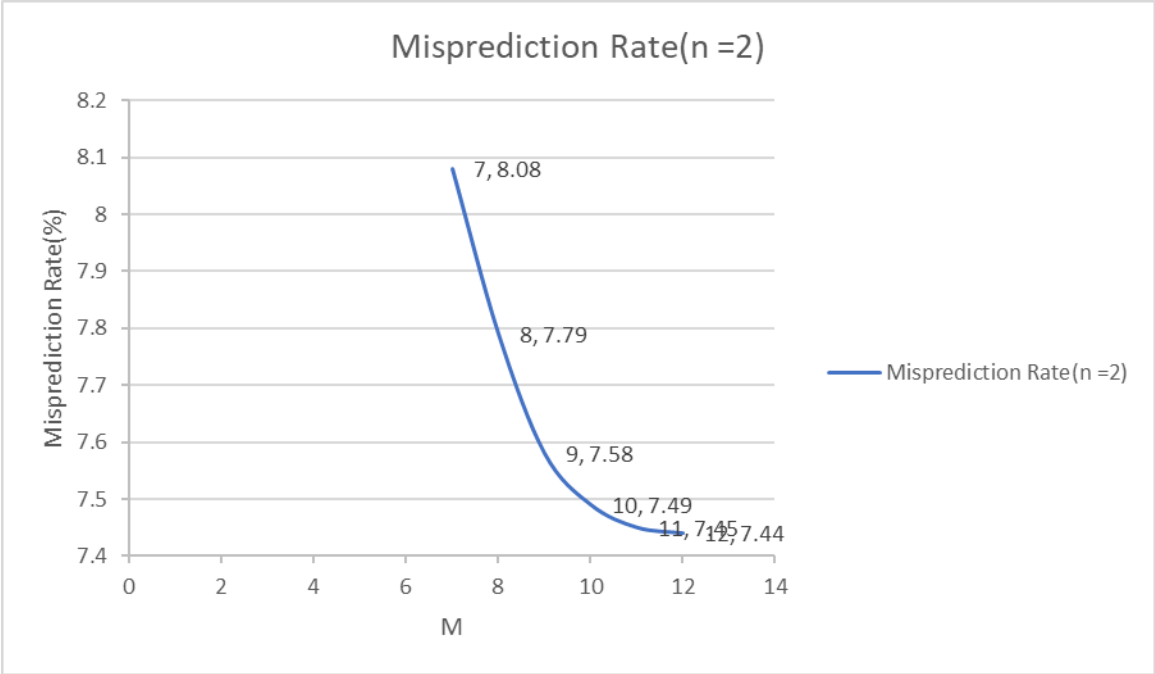


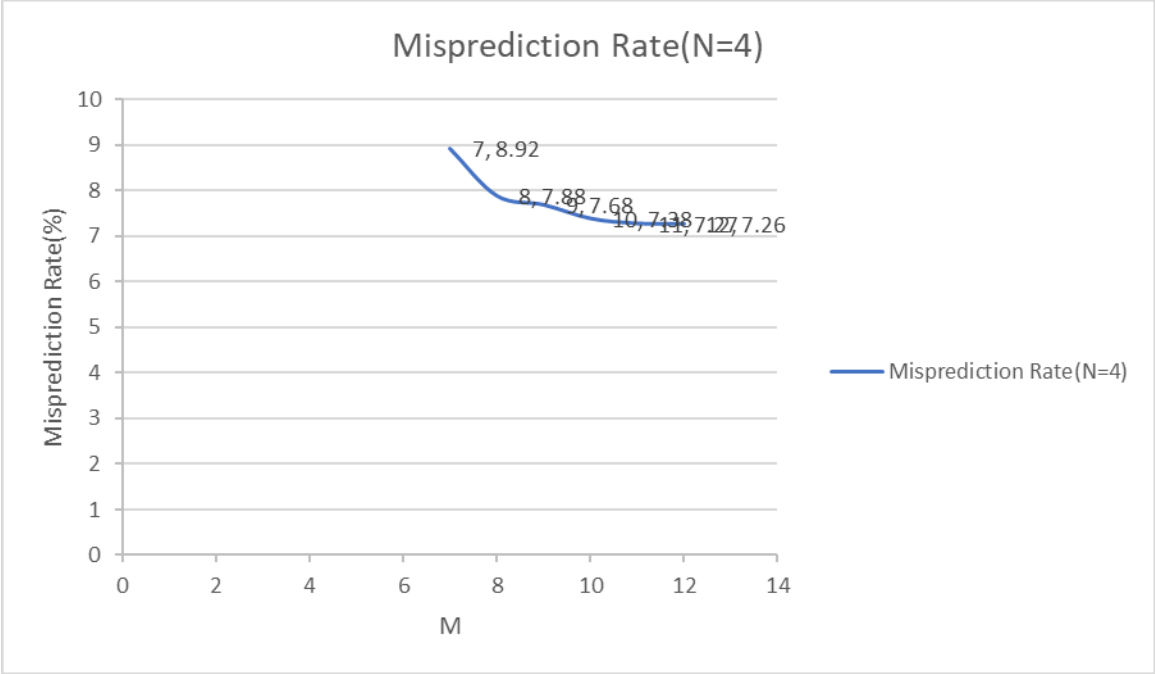
Analysis:

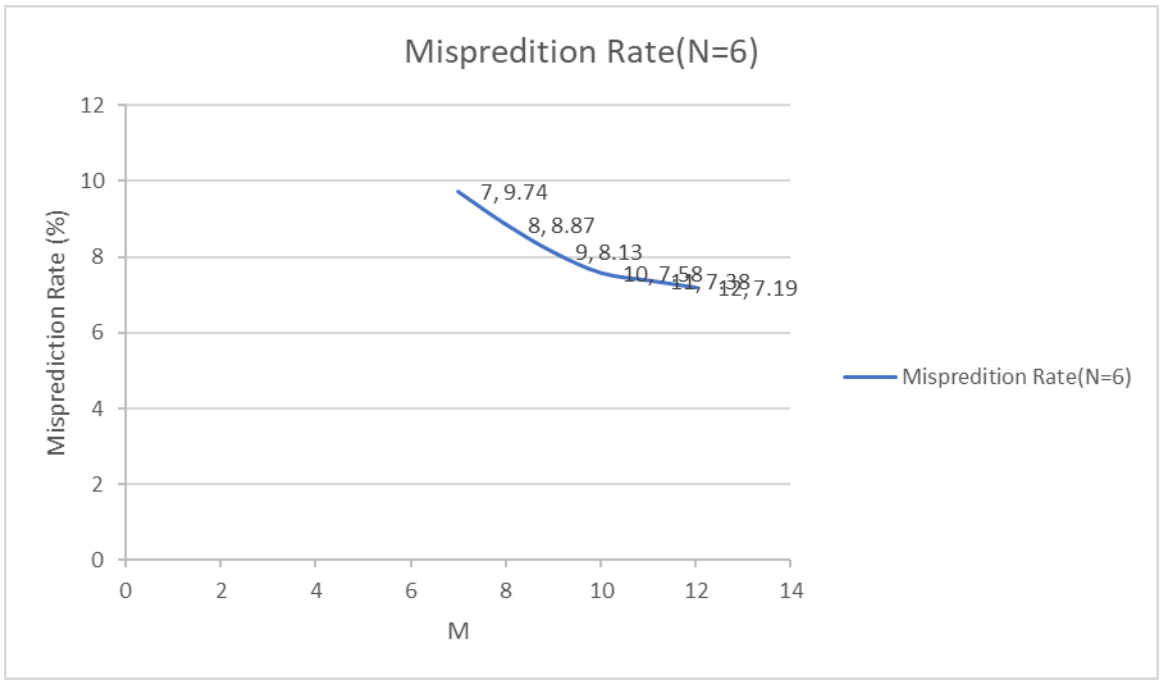
For the gcc_trace, for a fixed N, the number of mispredictions decrease as the M increases. This can be explained by the extra room the unique branches get by adding cells as M increases. Also, for a constant M, the number of misprediction loosely increase as N increases. This might be the effect of trace having a long repeating pattern which the predictor cannot completely comprehend or the branch action taken might be completely random.

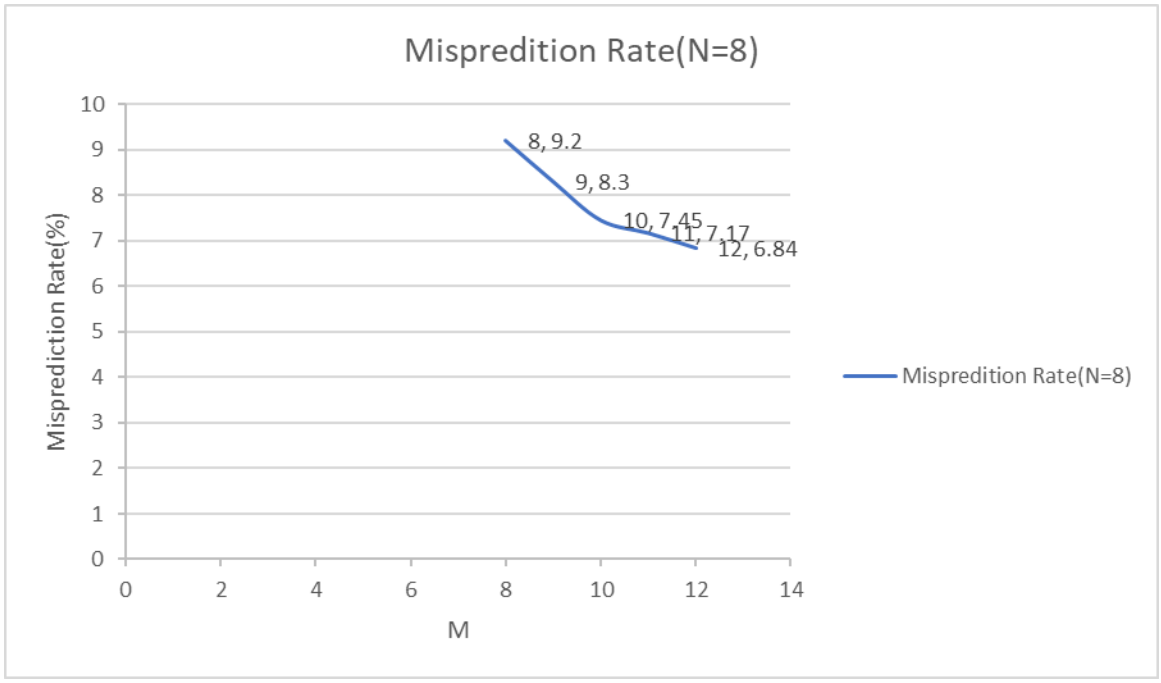
Best Design: N=4 and M=12.

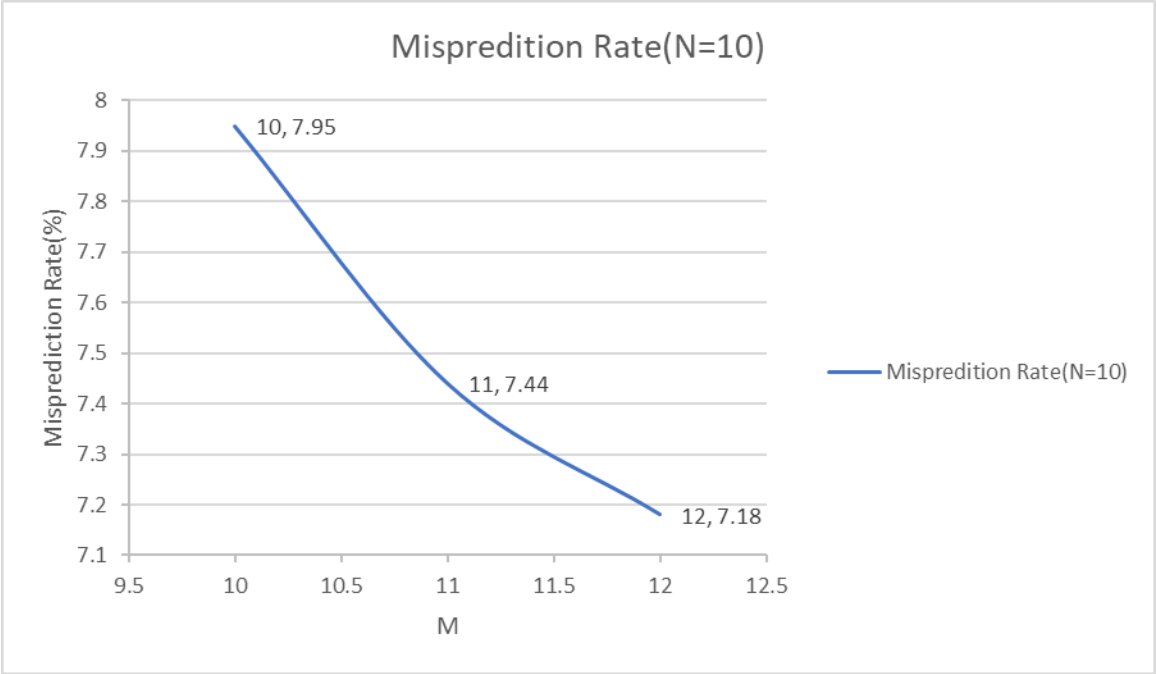
jpeg_trace

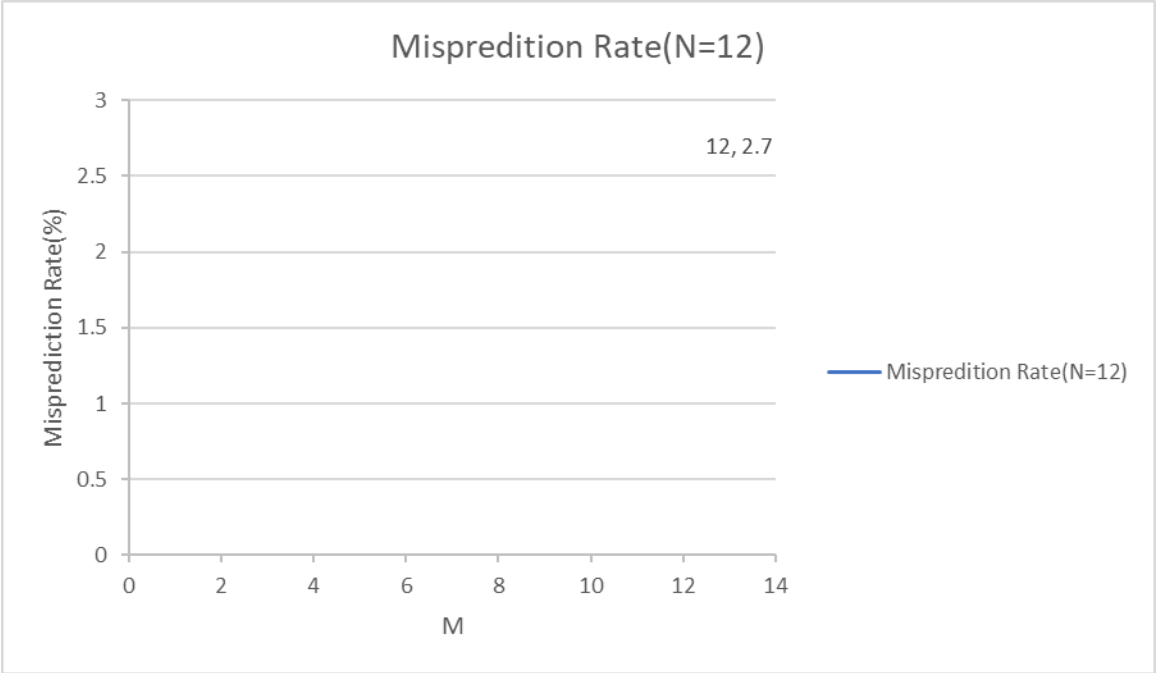

Misprediction Rate(n =2)
Misprediction Rate(%)
8.2
8.1
8
7.9
7.8
7.7
7.6
7.5
7.4
0
2
4
6
8
10
12
14
M
7, 8.08
8, 7.79
9, 7.58
10, 7.49
11, 7.45
12, 7.44
Misprediction Rate(n =2)


Misprediction Rate(N=4)
Misprediction Rate(%)
10
9
8
7
6
5
4
3
2
1
0
0
2
4
6
8
10
12
14
M
7, 8.92
8, 7.88
9, 7.68
10, 7.38
11, 7.27
12, 7.26
Misprediction Rate(N=4)


Mispredition Rate(N=6)
Misprediction Rate (%)
M
7, 9.74
8, 8.87
9, 8.13
10, 7.58
11, 7.38
12, 7.19
Mispredition Rate(N=6)


Mispredition Rate(N=8)
Misprediction Rate(%)
M
8, 9.2
9, 8.3
10, 7.45
11, 7.17
12, 6.84
Mispredition Rate(N=8)



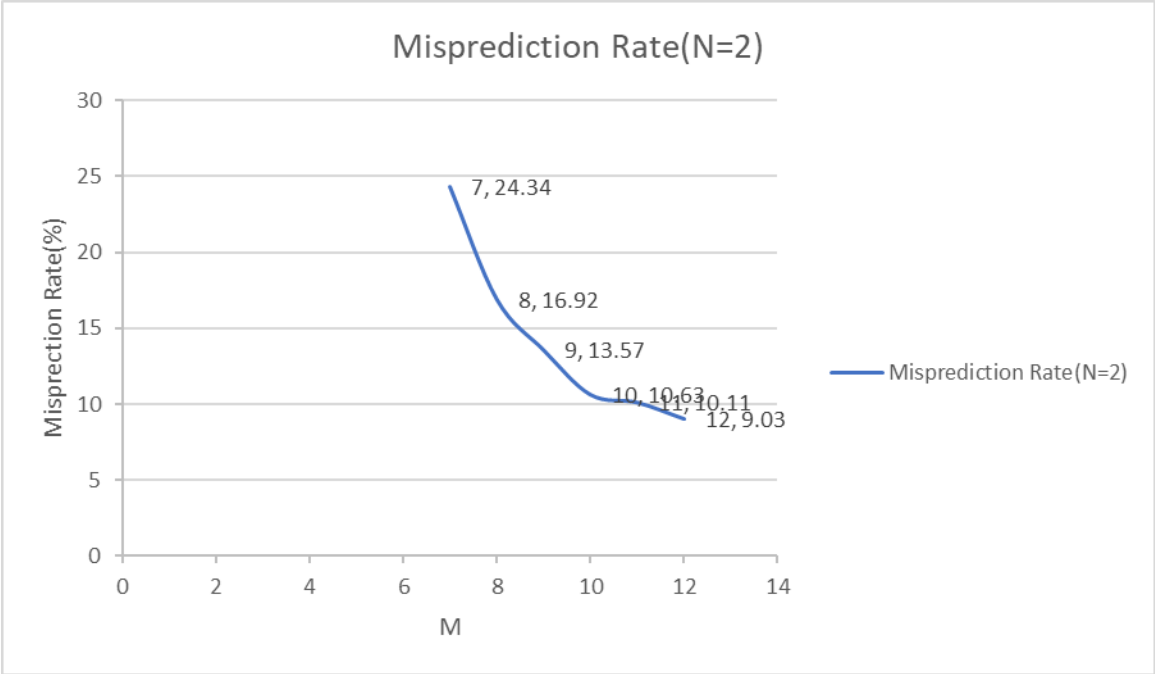


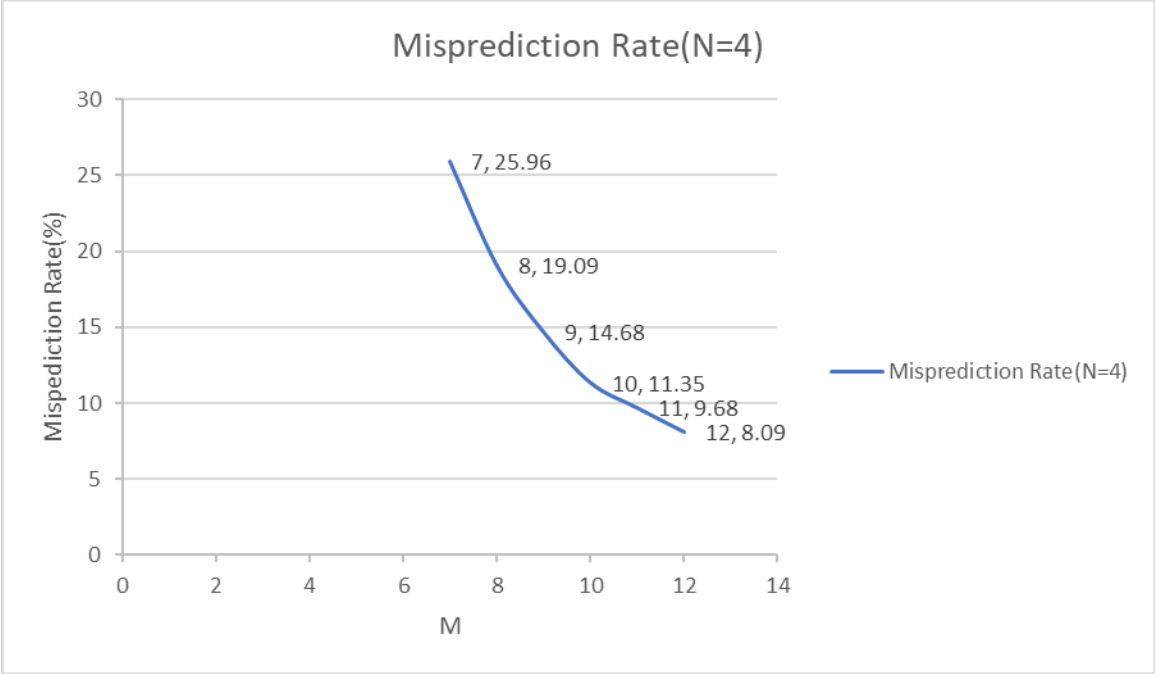
Analysis:

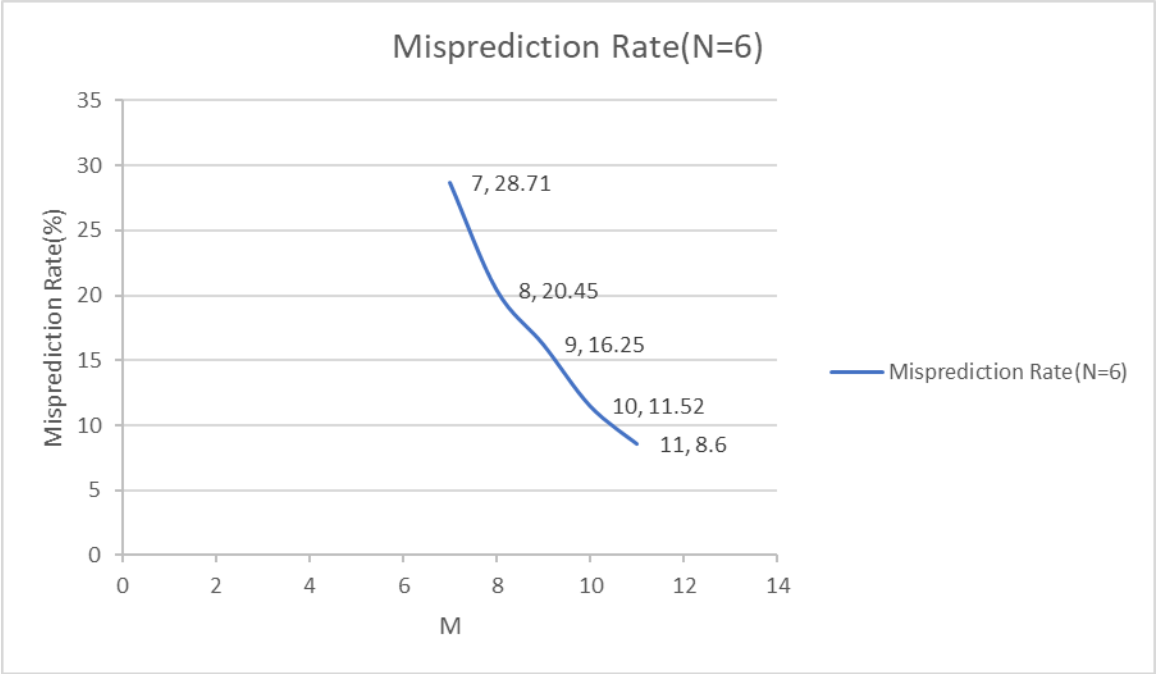
For a constant N, the mispredictions decrease as the M increases. But the improvement is not that great. Also, for a constant M, the misprediction rate very loosely depends upon the N.

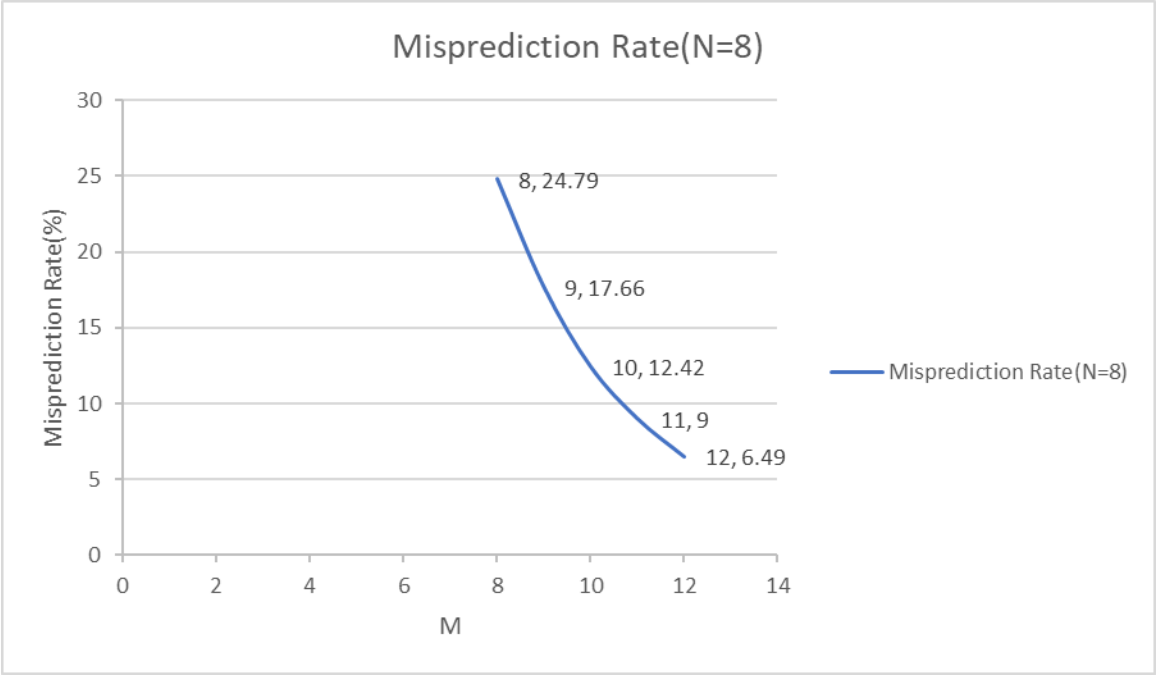
Best Design: N=2, M=10.

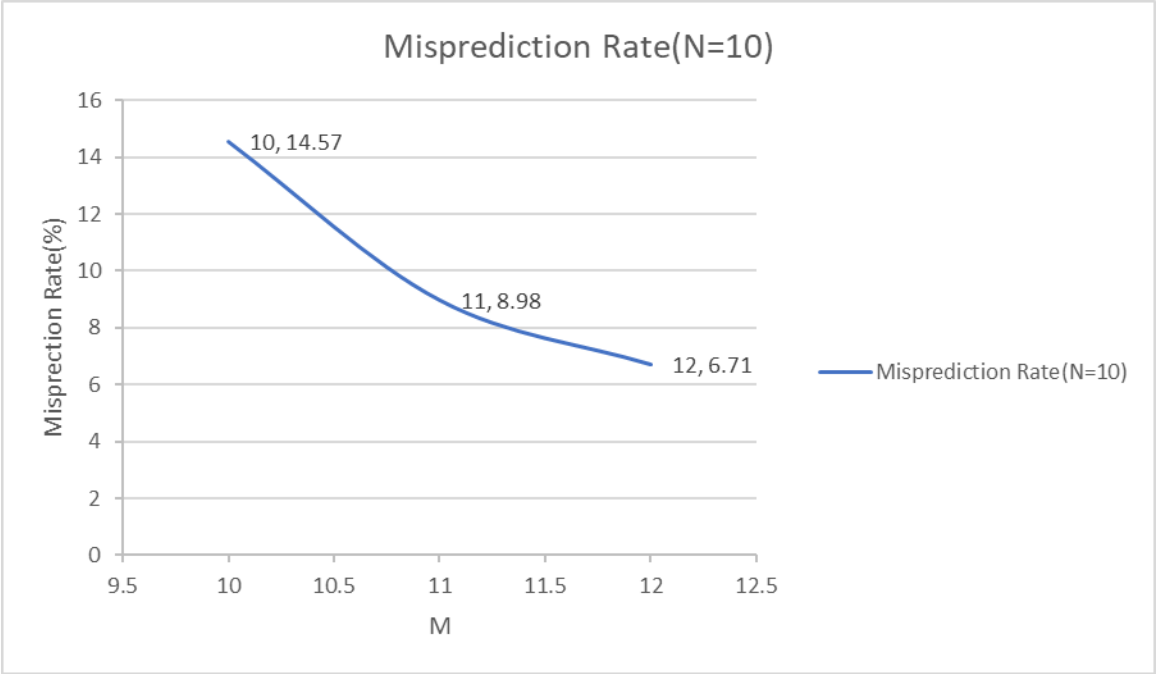
Perl_trace

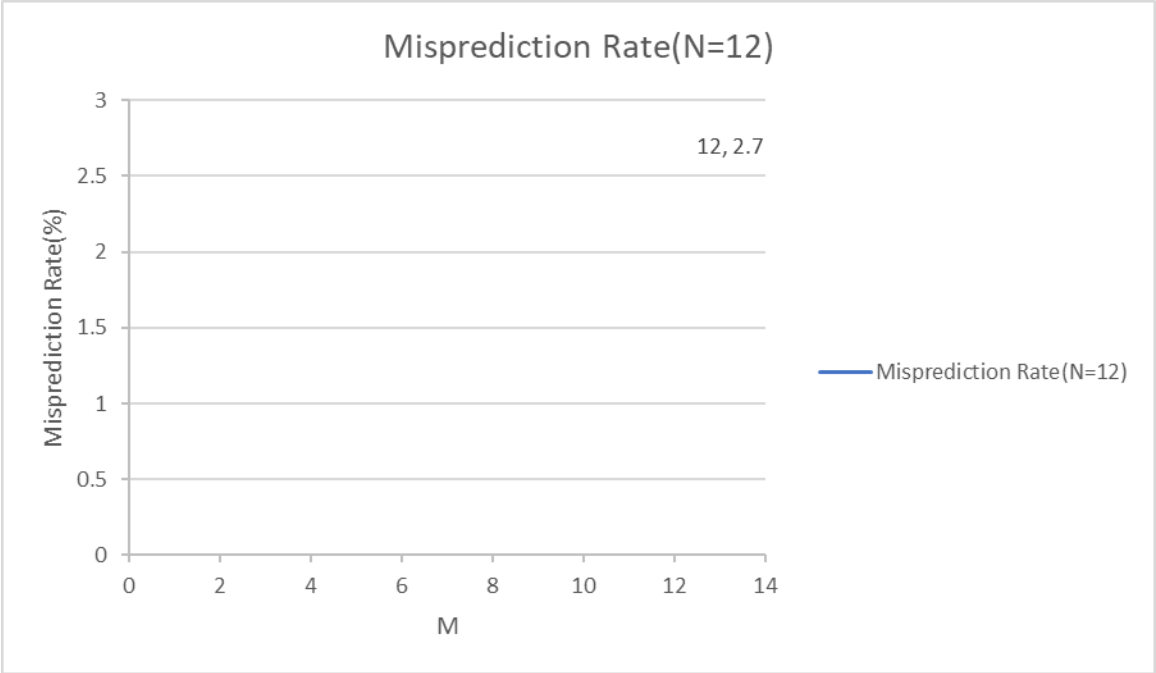

Misprediction Rate(N=2)
Misprection Rate(%)
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
M
7, 24.34
8, 16.92
9, 13.57
10, 10.63
11, 10.11
12, 9.03
Misprediction Rate(N=2)


Misprediction Rate(N=4)
Mispediction Rate(%)
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
M
7, 25.96
8, 19.09
9, 14.68
10, 11.35
11, 9.68
12, 8.09
Misprediction Rate(N=4)


Misprediction Rate(N=6)
Misprediction Rate(%)
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
M
7, 28.71
8, 20.45
9, 16.25
10, 11.52
11, 8.6
Misprediction Rate(N=6)


Misprediction Rate(N=8)
Misprediction Rate(%)
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
M
8, 24.79
9, 17.66
10, 12.42
11, 9
12, 6.49
Misprediction Rate(N=8)





Analysis:

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Best Design: N=4 and M=12.