The State University of New York at Binghamton

Department of Computer Science

CS 520 – Spring 2019
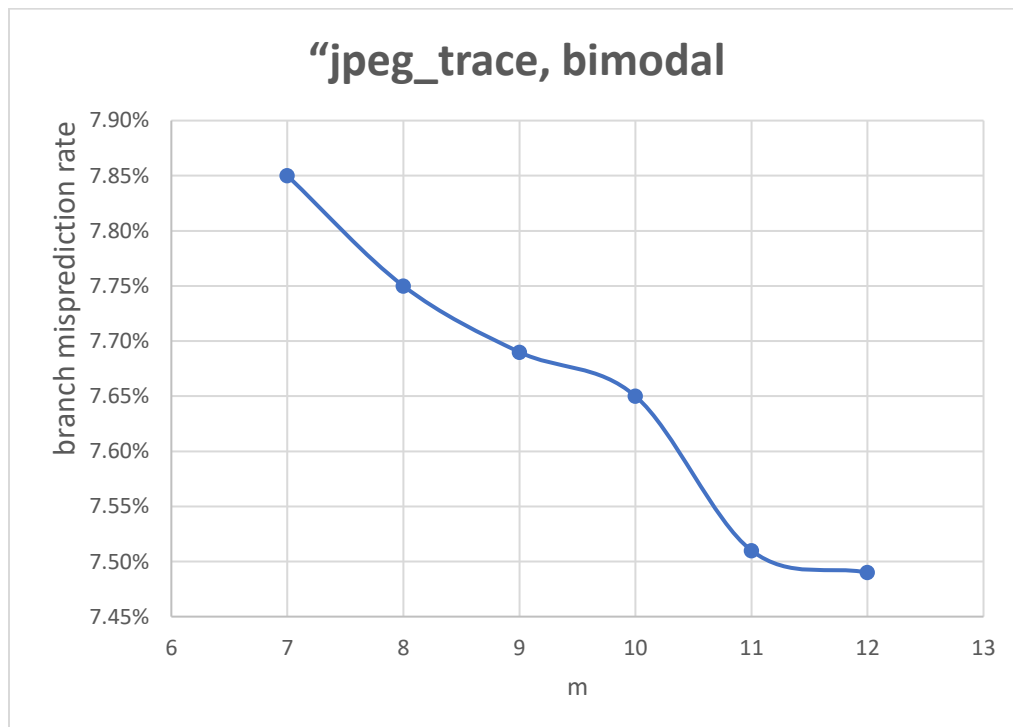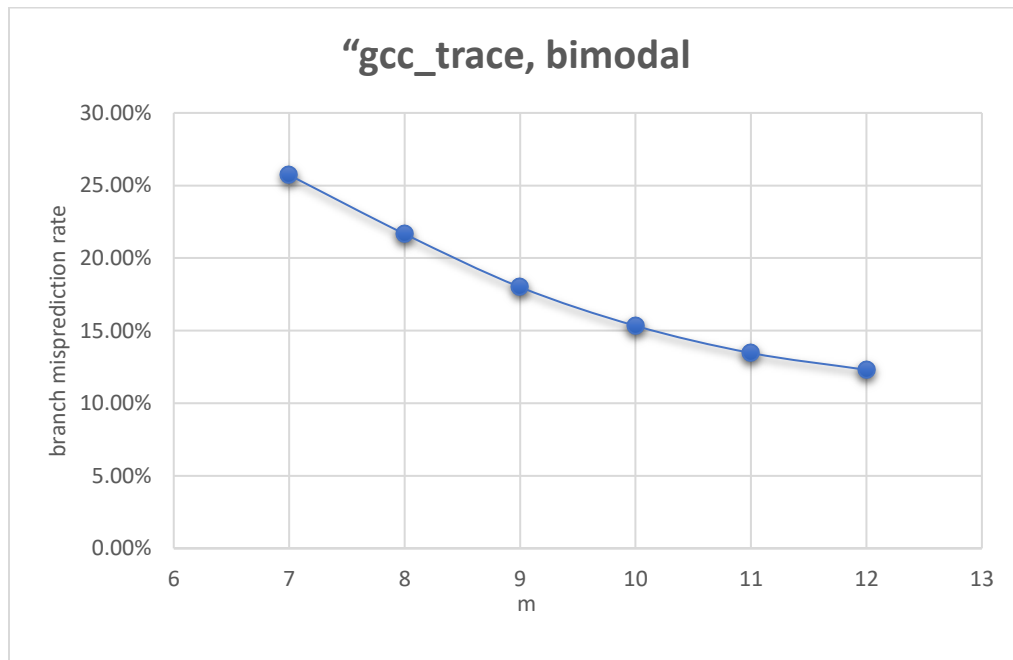
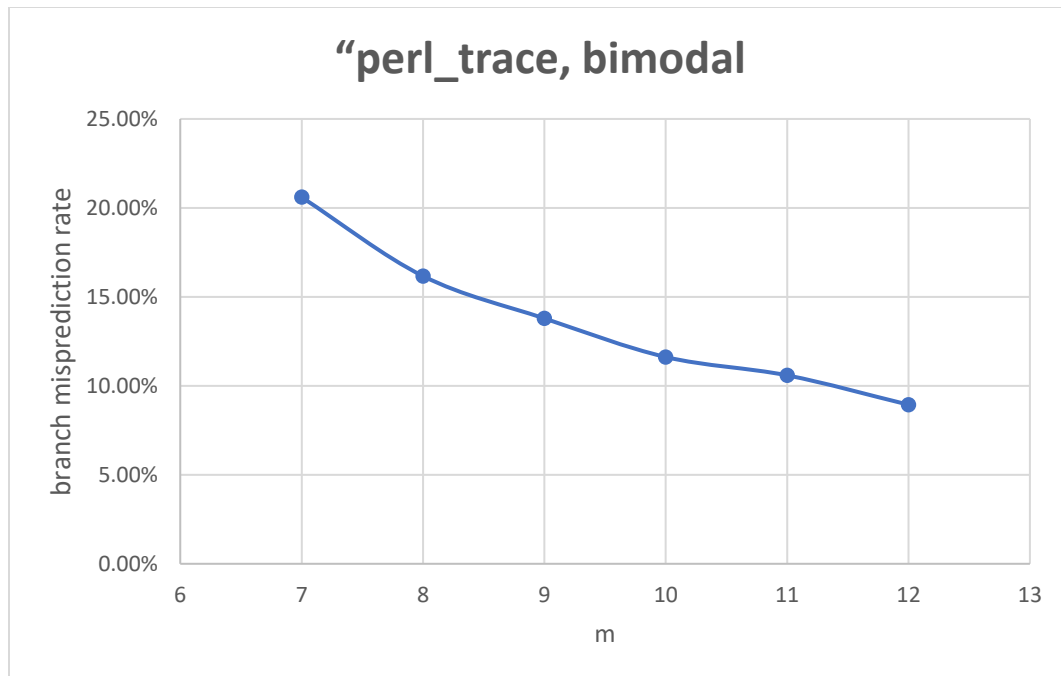# Project #1: Branch Prediction

By

DEVINA SACHIN DHURI

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

Student's electronic signature: _Devina Sachin Dhuri_____

(sign by typing your name)

PART 1] BIMODAL PREDICTOR:

"gcc_trace, bimodal

"jpeg_trace, bimodal

"perl_trace, bimodal

ANALYSIS:

From the above 3 figures we have observations that the mis prediction rate decreases exponentially as the value of m increases, where m is used to index the counter.

As different branches may index the same counter entry in the prediction table (called as interference), bigger index value gives less side effect of the interference and thus the misprediction rate decreases.

But, after a certain value of m, the misprediction rate decrease slows down leading in diminishing returns.

The misprediction rate for jpeg_trace is the least followed by perl_trace. Gcc_trace has the most misprediction rate.

DESIGN:

In order to take both the misprediction rate and size in consideration we take the product of the misprediction rate and the square root of the size of the predictor.

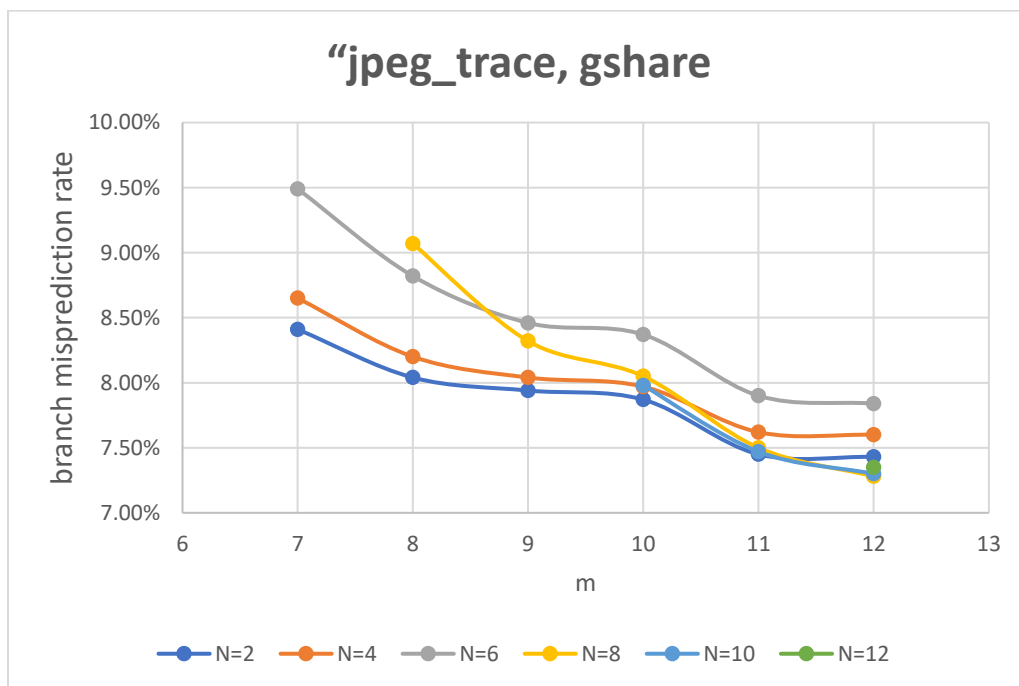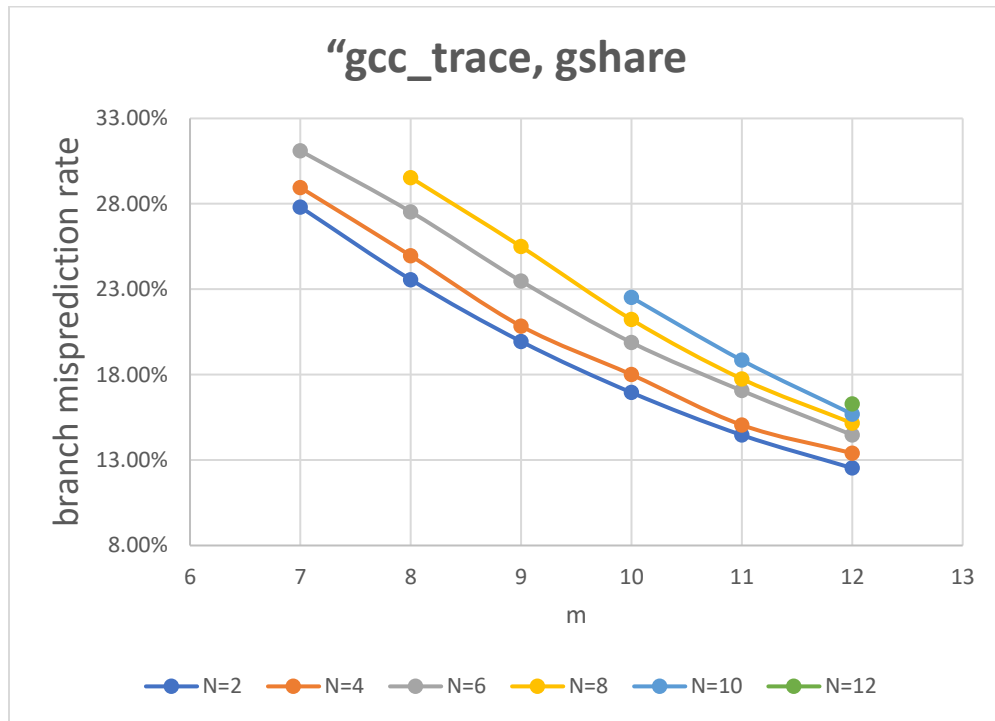Apparently, smaller the product, better the predictor.

The following figure shows the average product of different benchmarks.
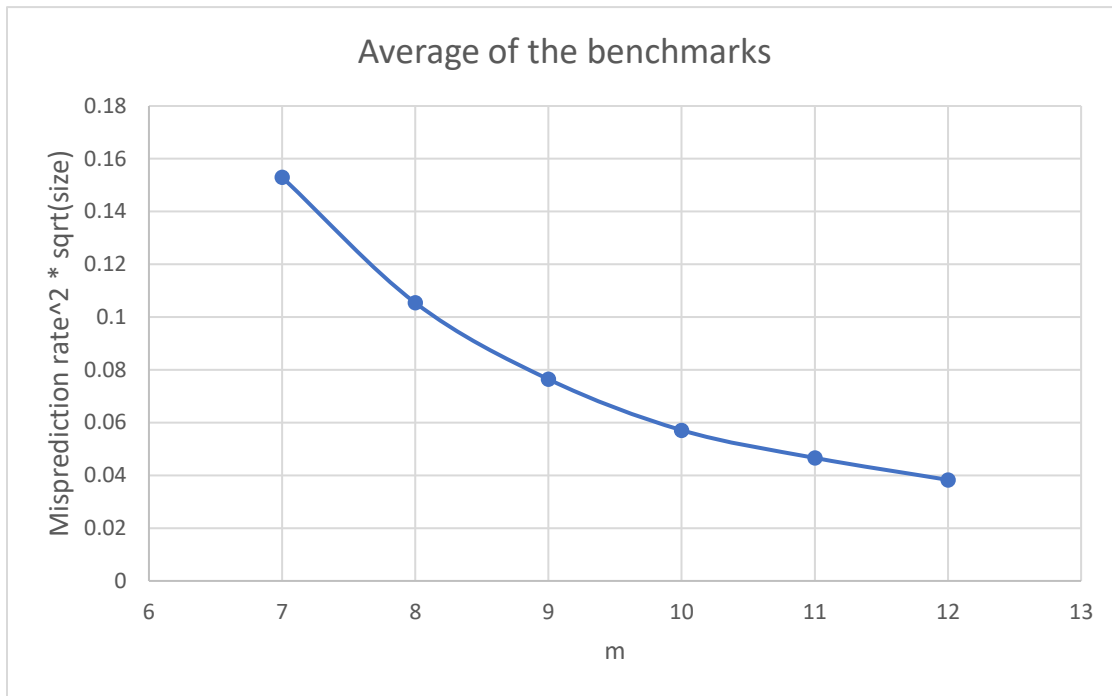
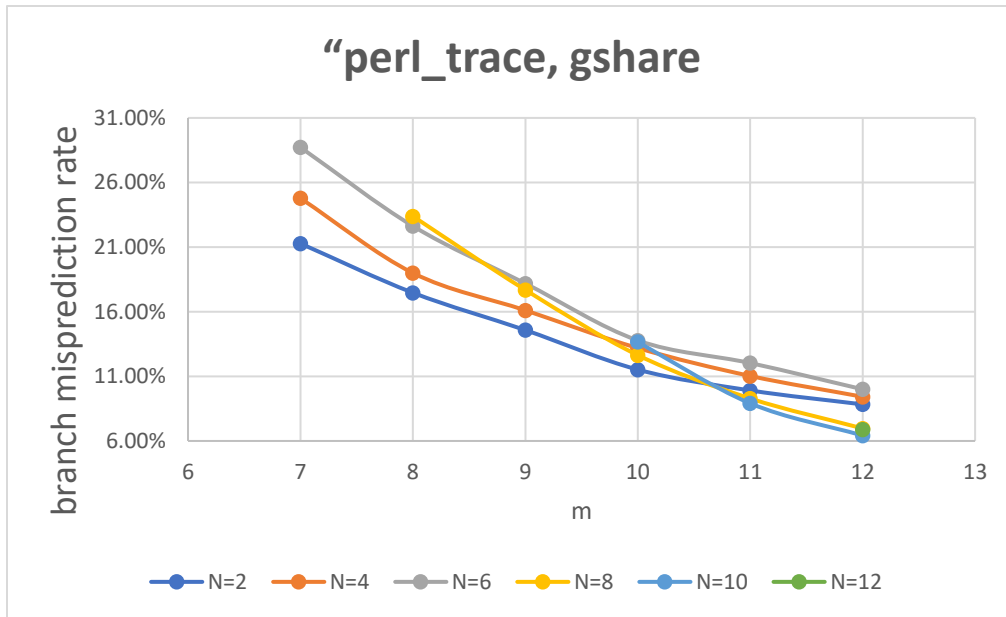
This shows that the value of the product is least for m=12 thus that is the best bimodal predictor.

Note that after m=12 the product value is nearly flat and thus provides diminishing results.

PART 2] GSHARE BRANCH PREDICTOR:

"gcc_trace, gshare

"jpeg_trace, gshare

"perl_trace, gshare

ANALYSIS:

From the above 3 figures we have observations that the misprediction rate decreases exponentially as the value of m increases, where m is used to index the counter. As different branches may index the same counter entry in the prediction table (called as interference), bigger index value gives less side effect of the interference and thus the misprediction rate decreases. But, after a certain value of m, the misprediction rate decrease slows down leading in diminishing returns.

In gcc_trace, as the value of n increases the misprediction rate also increases till the diminishing results, but after the diminishing results, yields a lower misprediction rate. Also, smaller the ratio n/m lower is the misprediction rate. The speed of descending misprediction rate versus m are nearly same for different n.

In jpeg_trace, smaller ration n/m yields a lower misprediction rate. However, the speed of descending misprediction rate versus m increases as n increases.

In perl_trace, we see a combination of the previous 2 benchmarks. Smaller ration of n/m gives a less misprediction rate. Besides, the speed of descending of misprediction rate increases as n increases.

Jpeg_trace gives the least misprediction rate for lower n values but as n increases, the misprediction rate tends to fall lower for perl_trace. (Comparing values of n=10 and n=12 in perl_trace vs the same values in jpeg_trace)

DESIGN:

In order to take both the misprediction rate and size in consideration we take the product of the misprediction rate and the square root of the size of the predictor.

Apparently, smaller the product, better the predictor.

The following figure shows the average of the product of different benchmarks for different values of n.

Average of benchmarks
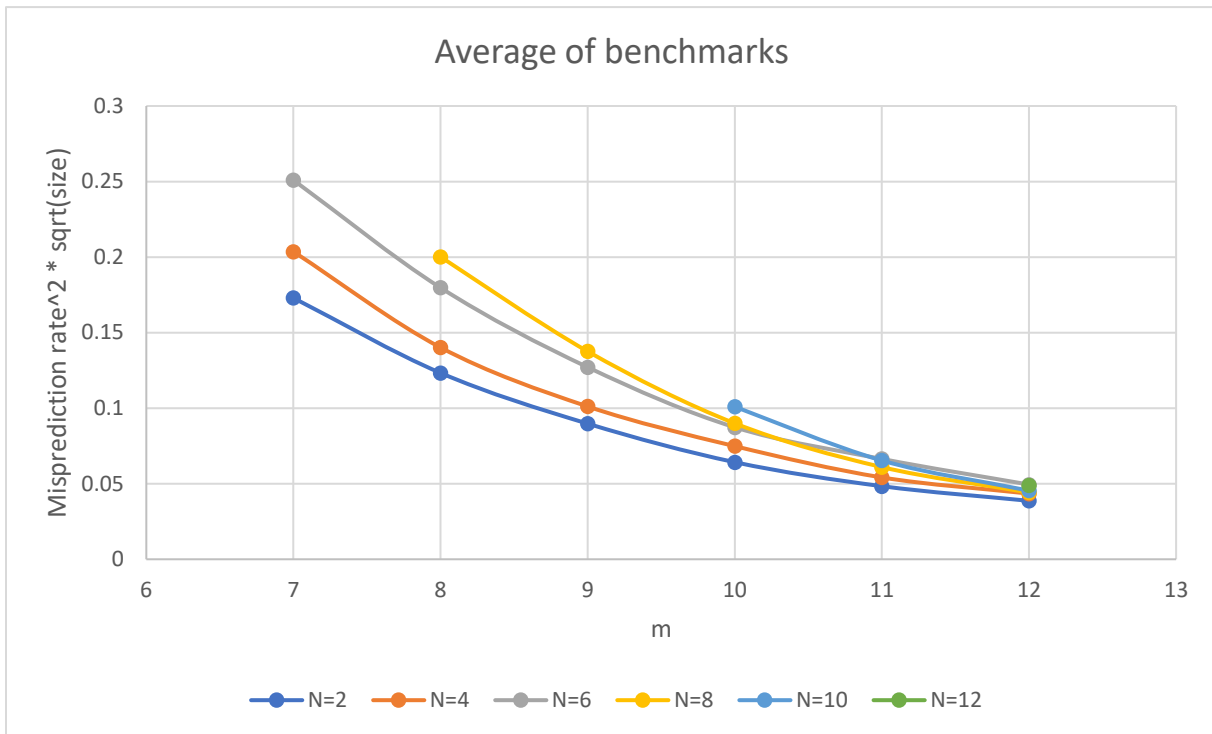
Note that after m=11 the product value is nearly flat and thus provides diminishing results.

Also, the value of n increases the misprediction rate also increases till the diminishing results, but after the diminishing results, yields a lower misprediction rate. Thus, lower the value of n better the results.

Thus the best model here would be m=11 and n=2.

PART 3] HYBRID BRANCH PREDICTOR:

For this graph we choose the for gshare predictors to be have values as follows

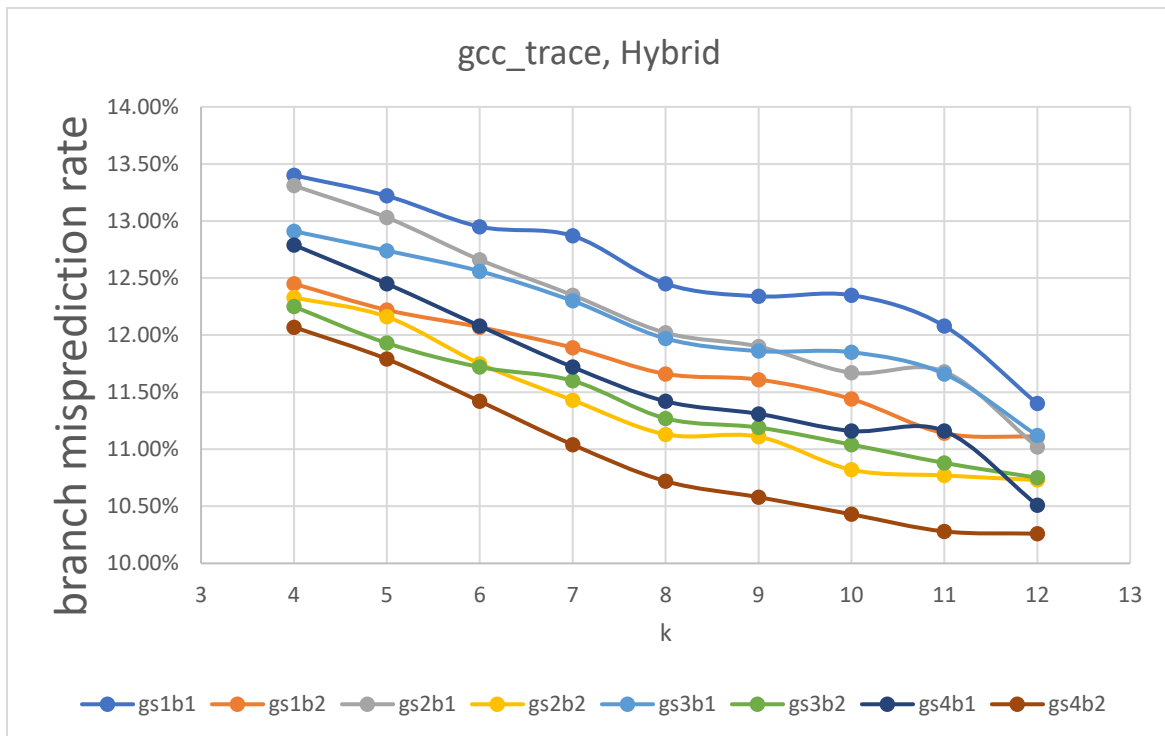a) m1=10, n=2

b) m1=10, n=4

c) m1=11, n=2

d) m1=11, n=4

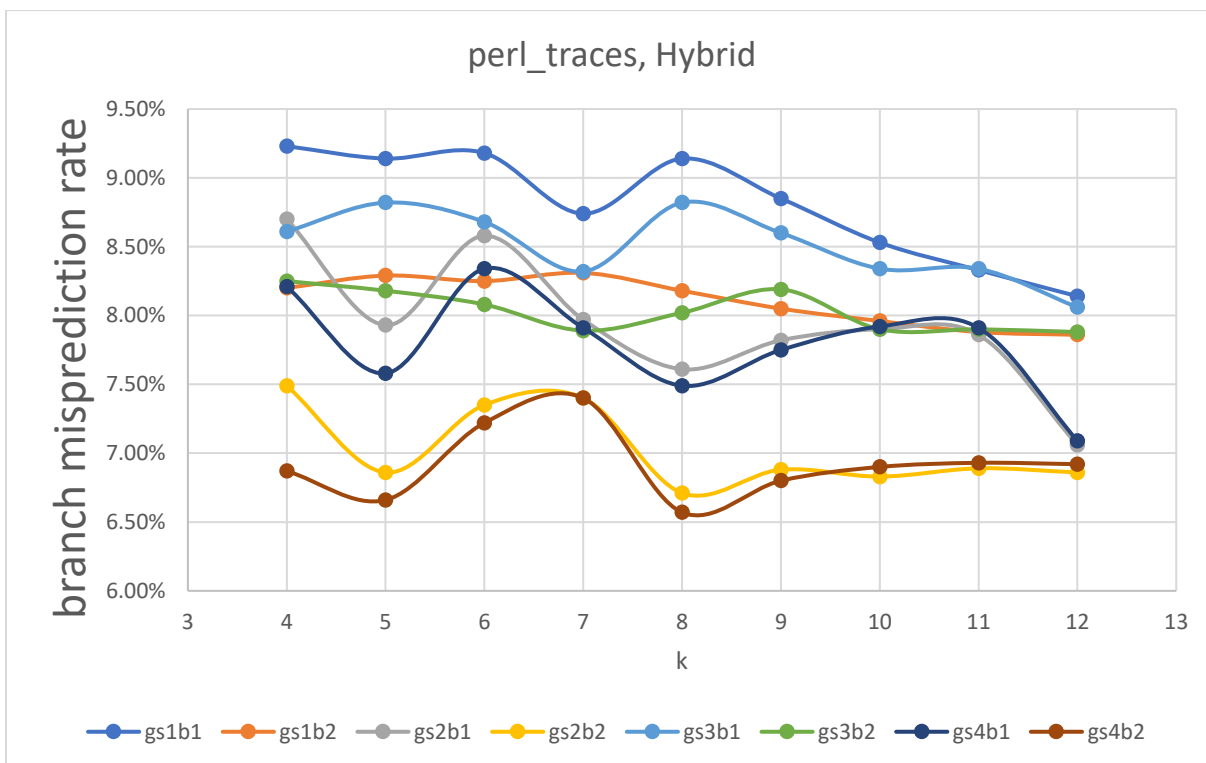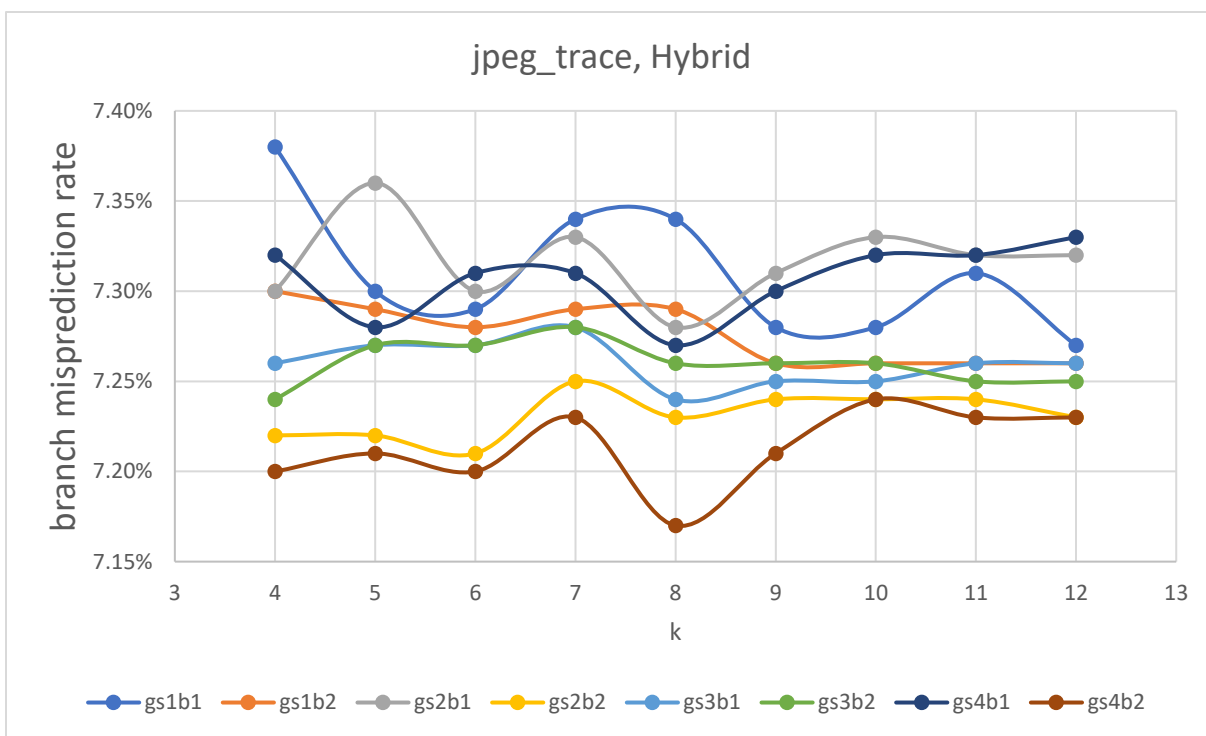and the 2 bimodal predictors have the following values:

a) m2= 11

b) m2= 12

The combinations are:

---------	Gs1b1	Gs1b2	Gs2b1	Gs2b2	Gs3b1	Gs3b2	Gs4b1	Gs4b2
M1	10	10	10	10	11	11	11	11
N	2	2	4	4	2	2	4	4
M2	11	12	11	12	11	12	11	12

jpeg_trace, Hybrid

perl_traces, Hybrid

ANALYSIS:

From the above 3 figures we have observations that the misprediction rate decreases as the value of k increases.

For gcc_trace, the value decreases exponentially

For jpeg_trace and perl_trace, the decrease us very slow. Also observe for certain values of k the misprediction rate increases and k increases.

The misprediction rate is the least for jpeg_trace followed by perl_trace and gcc_trace ha the largest misprediction rate between the 3.

Compared to bimodal and gshare, this hybrid design with the best 4 values of gshare and 2 of bimodal, has the least mis predictions.