CS4342 Advanced Computer Architecture

Take Home Lab2

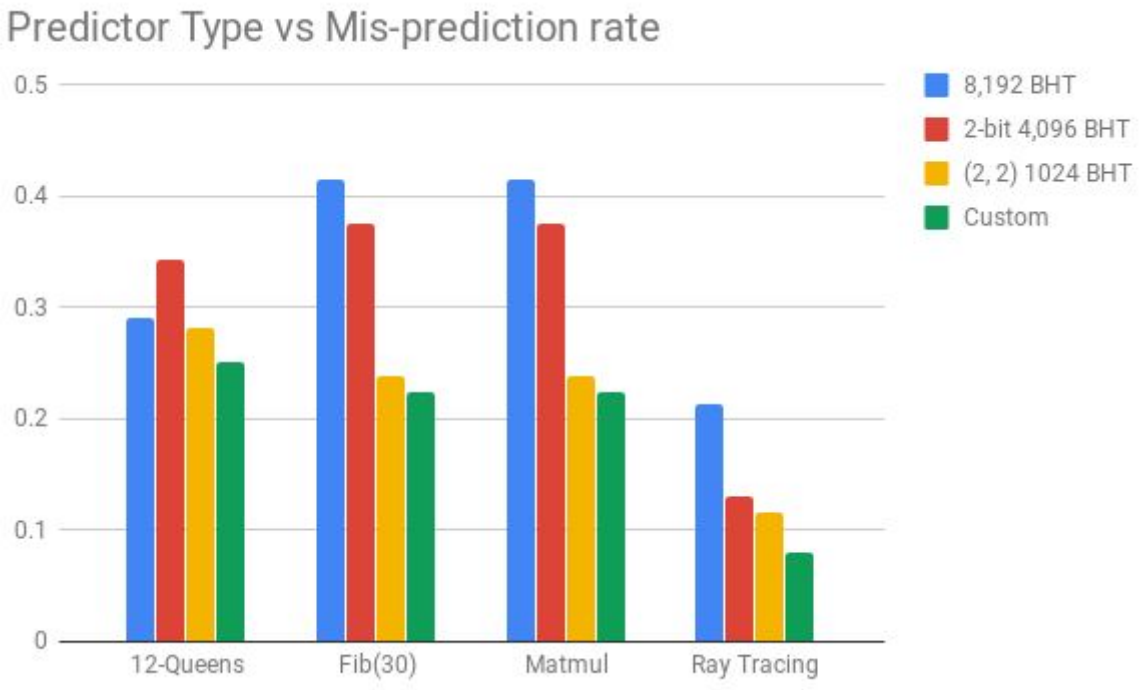
Name: P.D.I.T.S.K. Perera
Index: 140462E

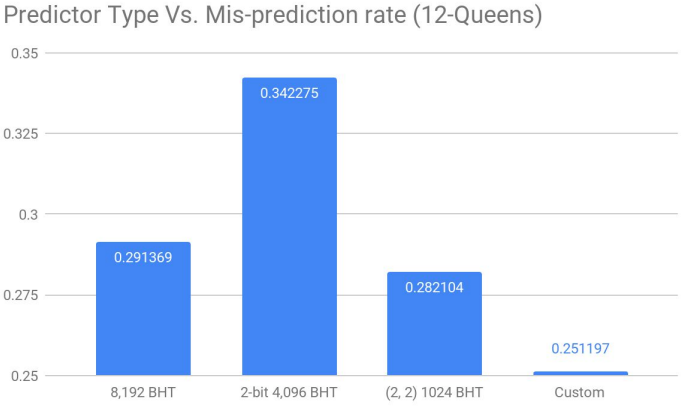
Step 6:

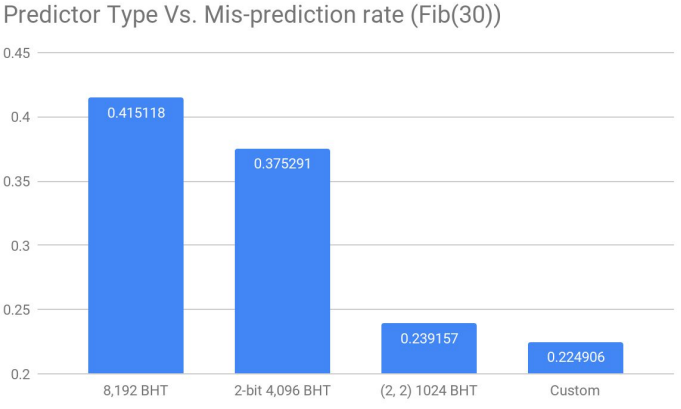
12-Queens				
	8,192 BHT	2-bit 4,096 BHT	(2, 2) 1024 BHT	Custom
Total no of branches:	2727424	2727424	2727424	2727424
No of unique branches:	768	768	768	768
No of branches correctly predicted:	1932736	1793895	1958007	2042302
No of branches incorrectly predicted:	794688	933529	769417	685122
Mis-prediction rate:	0.291369	0.342275	0.282104	0.251197
Fib(30)				
	8,192 BHT	2-bit 4,096 BHT	(2, 2) 1024 BHT	Custom
Total no of branches:	4241389	4241389	4241389	4241389
No of unique branches:	491	491	491	491
No of branches correctly predicted:	2480712	2649632	3227031	3287475
No of branches incorrectly predicted:	1760677	1591757	1014358	953914
Mis-prediction rate:	0.415118	0.375291	0.239157	0.224906
Matmul				
	8,192 BHT	2-bit 4,096 BHT	(2, 2) 1024 BHT	Custom
Total no of branches:	838802	838802	838802	838802
No of unique branches:	1001	1001	1001	1001
No of branches correctly predicted:	698674	705694	715419	760087
No of branches incorrectly predicted:	140128	133108	123383	78715

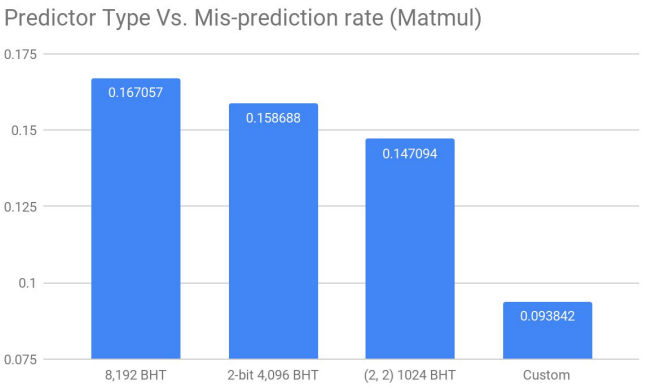
Mis-prediction rate:	0.167057	0.158688	0.147094	0.093842
Ray Tracing				
	8,192 BHT	2-bit 4,096 BHT	(2, 2) 1024 BHT	Custom
Total no of branches:	42400131	42400131	42400131	42400131
No of unique branches:	797	797	797	797
No of branches correctly predicted:	33324767	36873124	37486476	38973074
No of branches incorrectly predicted:	9075364	5527007	4913655	3427057
Mis-prediction rate:	0.214041	0.130354	0.115888	0.080827

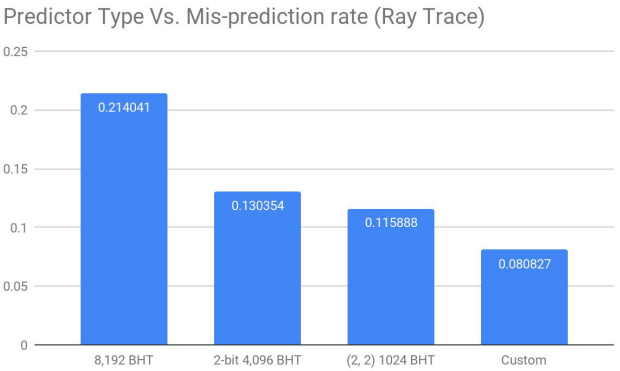
Step 7:











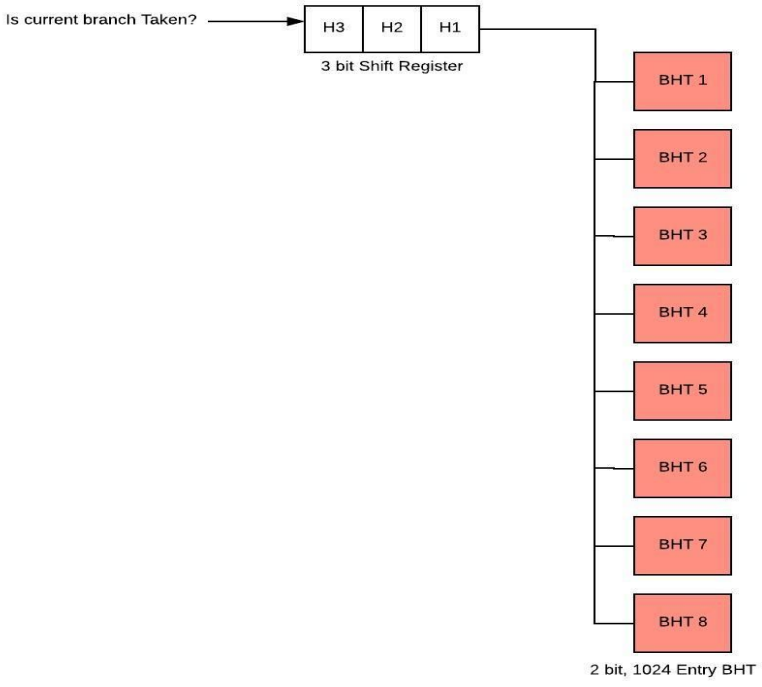
Step 8:

The predictor with the least mis-prediction rate is the (2,2) 1024 BHT predictor among the previously tested predictors in this lab. The predictions by this predictor is more accurate because it uses 2 levels of global history of previous branch taken status and chooses a relevant BHT among 4 BHTs in order to predict the next branch taken status.

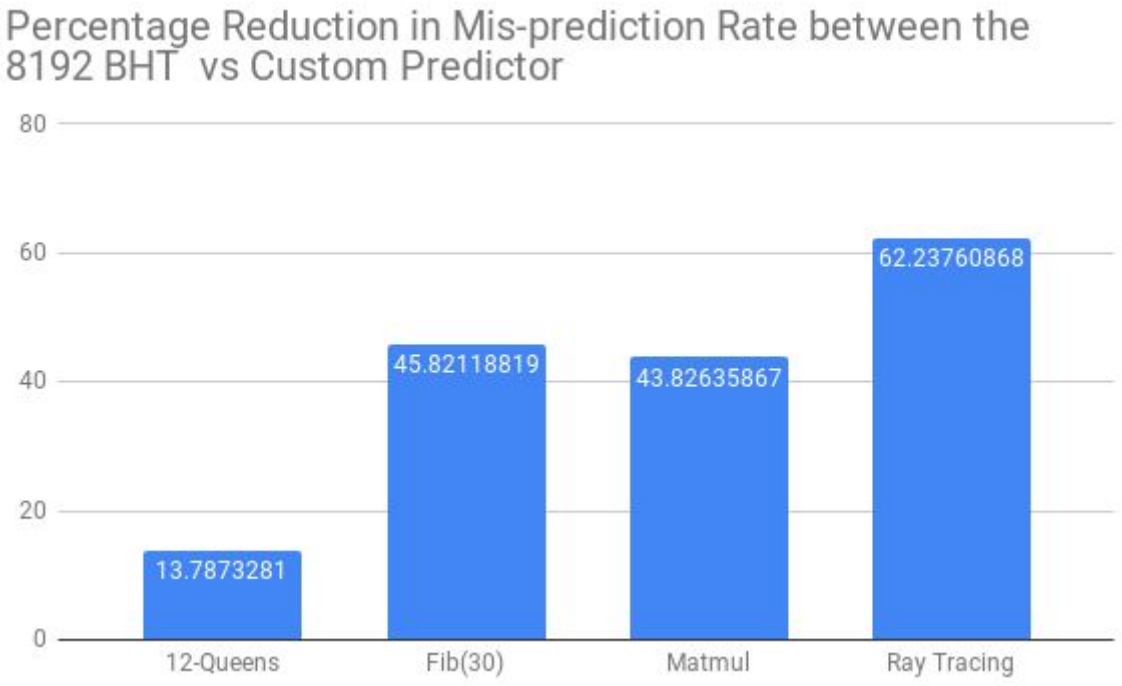
So, improving this predictor, A custom predictor was implemented (a (3,2) 1024 BHT predictor) which could store 3 levels of global branch prediction history. So, by using this predictor, common prediction patterns occurring among 3 adjacent branches can be successfully stored in a relevant BHT among 8 BHTs.

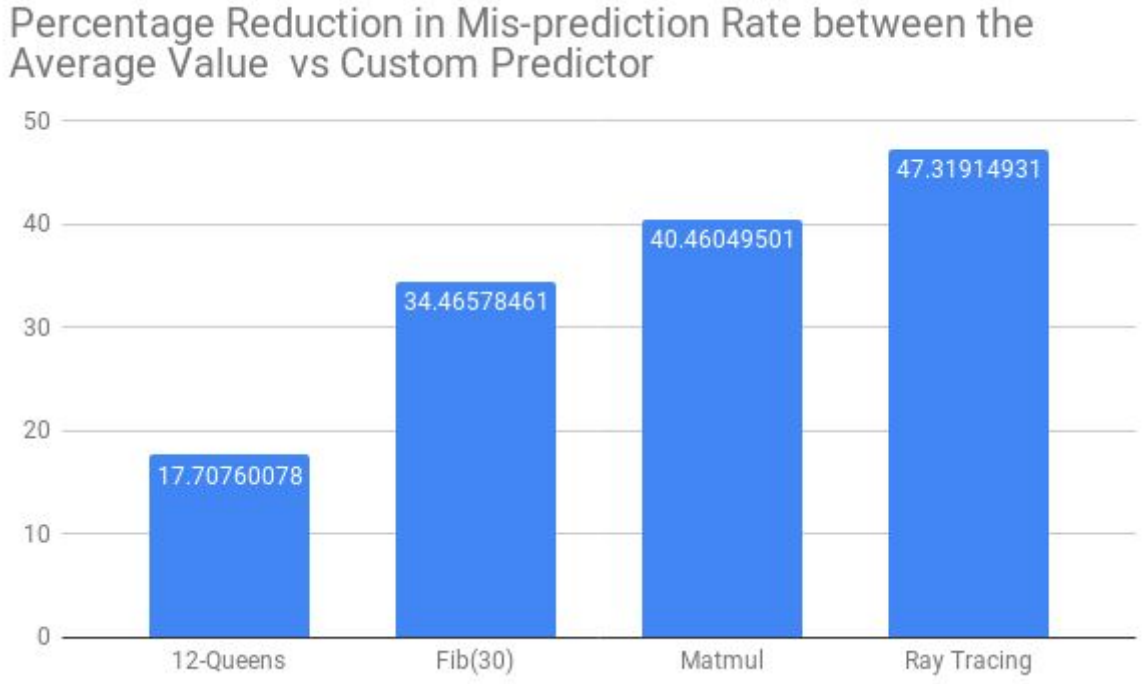
The design adds a 3-bit shift register instead of 2-bit one in the (2,2) 1024 BHT predictor. Further, additional 4 BHTs will be used for predictions. These 4BHTs will require additional 8Kb of memory for the BHTs.

The design is not too different in terms of hardware complexity then (2,2) 1024 BHT predictor. But, the memory consumption doubles with the design. With the improvement of accuracy from this design, it's justifiable to trade off memory consumption for improved accuracy by using this design.



Step 10:





Observations:
According to both the graphs above, the Custom Predictor performs considerably better with predicting the next correct branch taken. 12-Queens problem has the least improvement and Ray Tracing has the most improvement in terms of accuracy.

Justification:
All four algorithms run with many iterations and has recursion. So, having more levels of global branch history will increase the branch prediction accuracy in large numbers. Further, Ray Tracing has a largely increased accuracy because the actual algorithm has many nested loops. So, increased levels of branch history increases the accuracy greatly.