ECE 586
COMPUTER ARCHITECTURE
TEAM 14

For the competition predictor we have used Hybrid predictor.

Overview:

The Gshare prediction table is indexed by the XOR result of the PC and the GHR, the Bimodal prediction table is indexed by the PC, and the Select Table prediction table has the same structure as the Bimodal prediction table. When the instruction fetch unit issues an instruction fetch request, the PC will also be generated at the same time. Finally, the prediction results of the Bimodal predictor and the Gshare predictor are selected through the prediction results of the Select table.

Branch Prediction Algorithm Description:

In this branch prediction mechanism, three key components are utilized: the Bimodal Predictor, the Gshare Predictor, and the Select Table Predictor. Each component serves a distinct purpose in predicting branch outcomes.

Bimodal Predictor:

- Indexing: The Bimodal Predictor utilizes the Program Counter (PC) as the indexing mechanism. Each entry in the prediction table corresponds to a specific PC.
- Prediction: Based solely on the PC, the Bimodal Predictor predicts whether a branch is likely to be taken or not taken.
- Updation: Based on Branch outcome, it will be updated according to saturating counter.

G share Predictor:

- Indexing: Unlike the Bimodal Predictor, the Gshare Predictor employs the XOR result of the PC and the Global History Register (GHR) as the index for its prediction table.
- Prediction: By combining the PC and the GHR using XOR, the Gshare Predictor offers predictions based on global branch history, potentially enhancing prediction accuracy.
- Updation: Based on Branch outcome, it will be updated according to saturating counter.

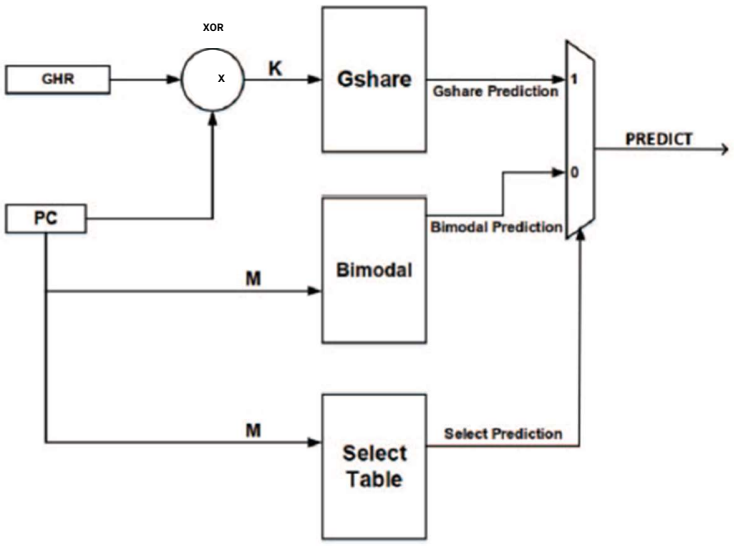
Select Table Predictor:

- Structure: The Select Table Predictor shares the same structure as the Bimodal Predictor. Its prediction table is indexed by the PC.
- Functionality: The Select Table Predictor serves as the arbitrator between the predictions generated by the Bimodal and Gshare predictors.
- Selection Process: When an instruction fetch request is initiated, the PC is used to access both the Bimodal and Gshare predictors. Subsequently, the prediction results from these predictors are compared, and the Select Table Predictor determines which prediction to employ for the given branch.
- Updation: Based on Branch outcome, it will be updated according to saturating counter.

Operation Overview:

Upon receiving an instruction fetch request, the PC is generated simultaneously. The PC is utilized to access the prediction tables of both the Bimodal and G share predictors. Additionally, the PC, along with the GHR, is subjected to XOR operation to index the G share Predictor's table. Predictions from both the Bimodal and Gshare predictors are obtained. The Select Table Predictor evaluates these predictions and selects the most appropriate one for further processing, thereby facilitating accurate branch prediction. Based on Branch outcome, it will be updated according to saturating counter. This branch prediction mechanism combines both to enhance prediction accuracy, with the Select Table Predictor acting as the decision-maker between the two prediction sources.

Block Diagram:



Space Budget:

A) Hybrid Predictor

GShare= 8kib x 2 = 16 kib
Bi-modal Predictor= 1kib x 2 = 2 kib
Select predictor= 1 kib x 2 = 2kib
Global Path History(GHR) = 13 bits

Total = 20 kib + 13 bits
= 2.5 kiB + 13 bits

B) 21264 Tournament Branch Predictor

Global Predictor = 4kib x 2 = 8 kib
Local Predictor= 1kib x 3 = 3 kib
Choice predictor= 4 kib x 2 = 8kib
Local History Table = 1kib x 10 = 10 kib
Global Path History = 12 bits

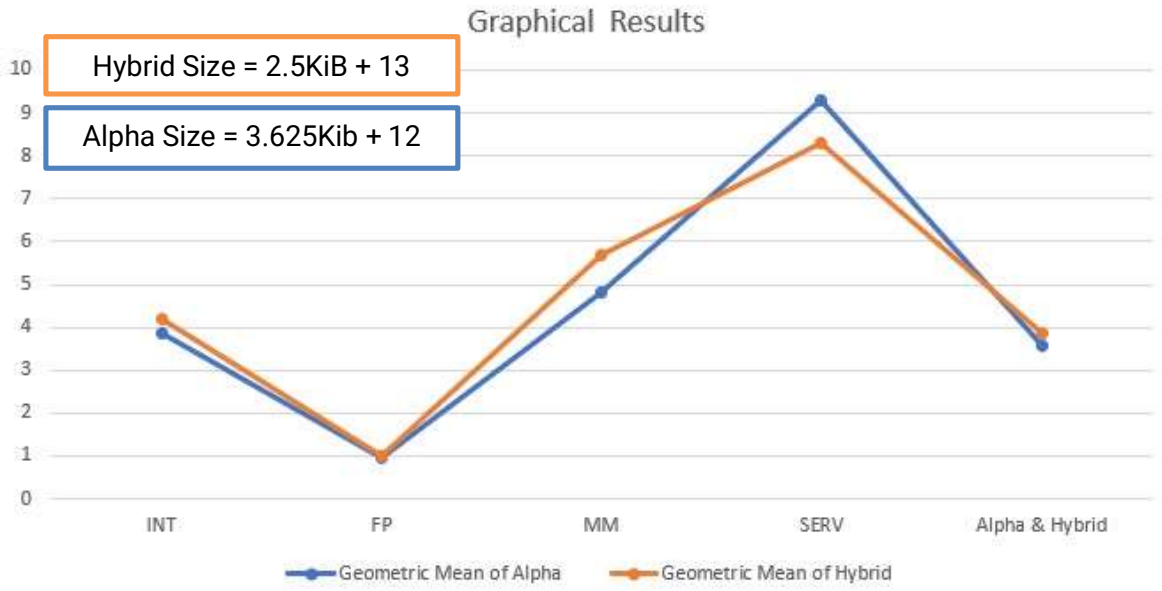
Total = 29 kib + 13 bits
= 3.625 kiB + 12 bits

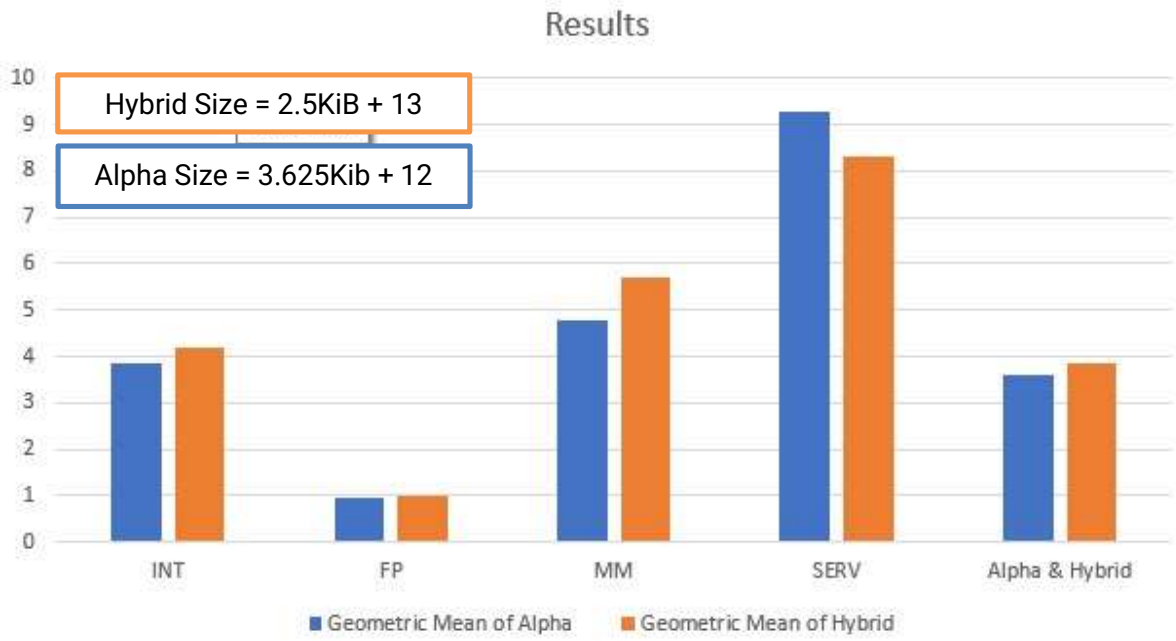
Statistics:

Input Trace File	Alpha Predictor	Hybrid Predictor
DIST-INT-1	7.397	8.722
DIST-INT-2	9.715	9.235
DIST-INT-3	12.050	14.120
DIST-INT-4	2.425	2.728
DIST-INT-5	0.406	0.492
DIST-FP-1	3.286	4.349
DIST-FP-2	1.317	1.211
DIST-FP-3	0.518	0.514
DIST-FP-4	0.266	0.304
DIST-FP-5	1.397	1.698
DIST-MM-1	8.299	8.656
DIST-MM-2	10.970	10.734
DIST-MM-3	2.021	5.099
DIST-MM-4	2.165	2.085
DIST-MM-5	6.436	6.292
DIST-SERV-1	9.853	8.819
DIST-SERV-2	10.299	9.208
DIST-SERV-3	7.687	7.353
DIST-SERV-4	9.492	8.276
DIST-SERV-5	9.788	8.400

Geometric Mean:

	Geometric Mean of Alpha	Geometric Mean of Hybrid
INT	3.85	4.2
FP	0.96	0.99
MM	4.8	5.7
SERV	9.3	8.3
Overall Geometric Mean	3.59	3.86





References:

1) http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=755465&isnumber=16354
2) Analysis and Optimization of the Branch Prediction Unit of SweRV EH1 | IEEE Conference Publication | IEEE Xplore