ECE 586
Winter 2024
Final Project

Branch Prediction

Project Group No. :- 11

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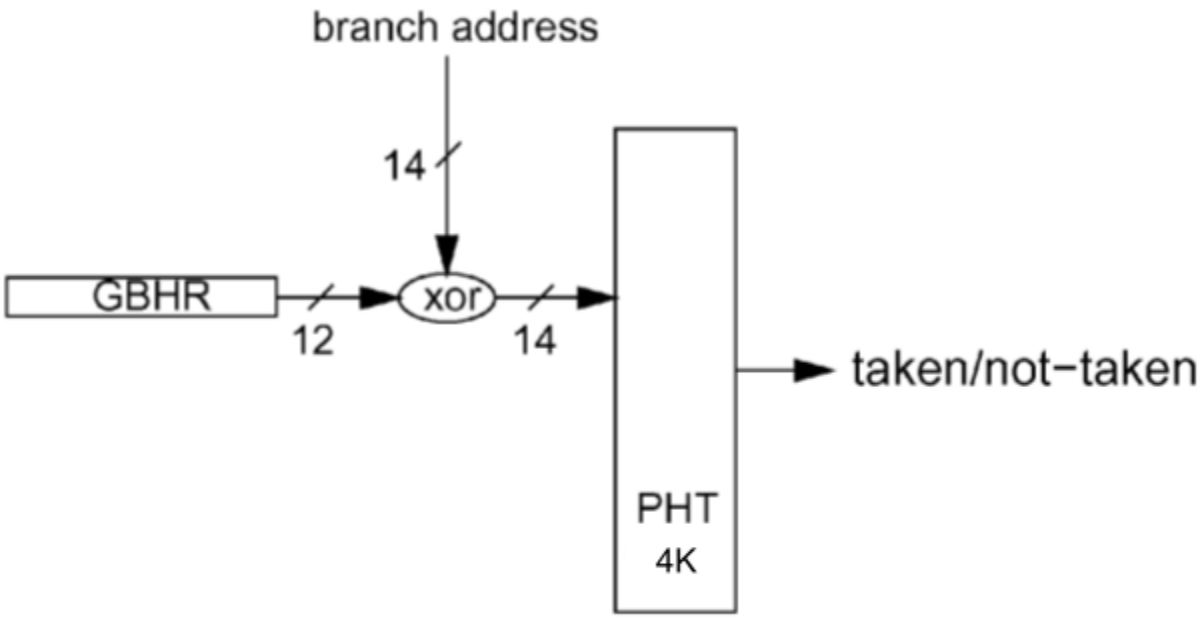
Competition Predictor:

- We have used the gshare branch predictor mechanism to build a competition predictor.
- We have implemented two functions get_prediction() and update_predictor() in predictor.cc file.
- First we initialized the global history register (GHR) and history table (PHT) to be 0 which indicates that weakly not taken state for all branches.
- In get_prediction(), index for PHT is calculated using XOR operation between branch address and global history, also applied a mask to ensure index value stays within the bounds. After this, retrieve the counter value from PHT and make predictions.
- In update_predictor(), PHT and GHR are updated based on the latest outcome obtained from get_prediction() and then it will recalculate PHT index using the same XOR operation and updates counter based on branch taken or not, also GHR is updated by shift left operation to mask it to maintain correct length.

Space budget:
History table (PHT) = 2^{14} x 2bits= 16384 bits x 2 = 32768 bits
Global history register (GHR) = 14 bits
Total storage = 32782 bits ≅4KiB

Data structures:

Global history table
Pattern history table
History length
PHT size
PHT index mask



Results of Alpha Tournament Predictor and gshare Predictor:

Trace file names	Alpha Predictor Rate	Gshare Predictor Rate
DIST-INT-1	8.434	8.799
DIST-INT-2	11.921	10.429
DIST-INT-3	13.357	14.964
DIST-INT-4	2.745	2.840
DIST-INT-5	0.449	0.501
DIST-FP-1	2.603	3.924
DIST-FP-2	1.375	1.155
DIST-FP-3	0.576	0.486
DIST-FP-4	0.388	0.318
DIST-FP-5	1.698	1.098
DIST-MM-1	9.169	8.890
DIST-MM-2	11.905	11.831

DIST-MM-3	3.479	6.309
DIST-MM-4	2.330	1.930
DIST-MM-5	7.383	7.403
DIST-SERV-1	18.946	12.884
DIST-SERV-2	19.659	13.280
DIST-SERV-3	10.680	9.119
DIST-SERV-4	17.382	11.495
DIST-SERV-5	19.068	12.077