The University of Edinburgh

Computer Architecture

2017-2018

Assignment 1

Understanding Branch Prediction

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How you have you implemented each predictor?

All the three branch predictors were implemented entirely.

For Local: LHR array (Line 38) stores the Local History Table Registers. PHT (string) dynamic array (Line 39) stores the Page History Table. We then get the seven Least Significant Bits (sevenb) (Line 54) in integer form (%128: instead of 10^7 we take 2^7 for base 2). We then make our prediction by indexing and accessing the PHT(Line 56). For training we add the LHR bits (*2 instead of binary shift because we are using integers) and update the strength using the scheme provided in the question.

For Global: GHR (Line 90) stores the Local History Table Registers. PHT (string) dynamic array (Line 91) stores the Page History Table. We then get the PHT location in integer form (%number of entries for base 2) and XOR operation is done (Line103). We then make our prediction by indexing and accessing the PHT(Line 104). We train the GHR in the predictor similar to LHR entry.

For Tournament: We create objects for both global and local and we call their predictions according to the PHT entry specified. We then update the value based on the accuracy of the predictions of both local and gshare predictors as specified in the question.

Why and how, varying the size of the PHT impacts (or not) the prediction accuracy for each of the predictors?

The more the PHT entries, the higher is the accuracy for all the three predictors. This is because there is a much larger amount of history for the predictor to compare with. Since the data set is larger the predictor works better and generates higher accuracy for all three kinds of predictors.

What are the advantages and disadvantages of the Local predictor?

Local Predictor stores the addresses of all the branches. If the pattern belongs to a particular branch then local predictor delivers very high accuracy. The disadvantage here is that there is a high hardware and memory requirement as a whole table of registers is used.

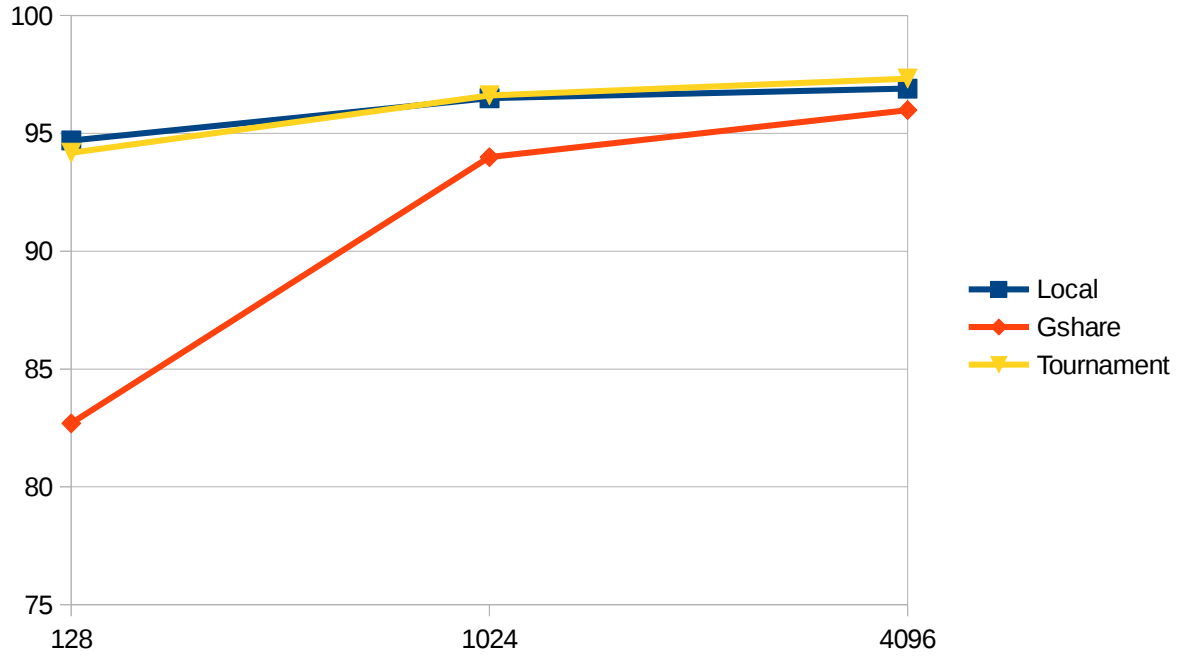
What are the advantages and disadvantages of the Gshare predictor?

Gshare predictor uses only one register as compared to a Local predictor which uses much more space (a whole table). Gshare also cuts excessive overhead since there is less contention for history entries. However, gshare predictor has difficulty in identifying the current branch since it does not keep the address of all the branch addresses.

What benefits did you expect from the addition of the Tournament predictor? Did the results match your expectations?

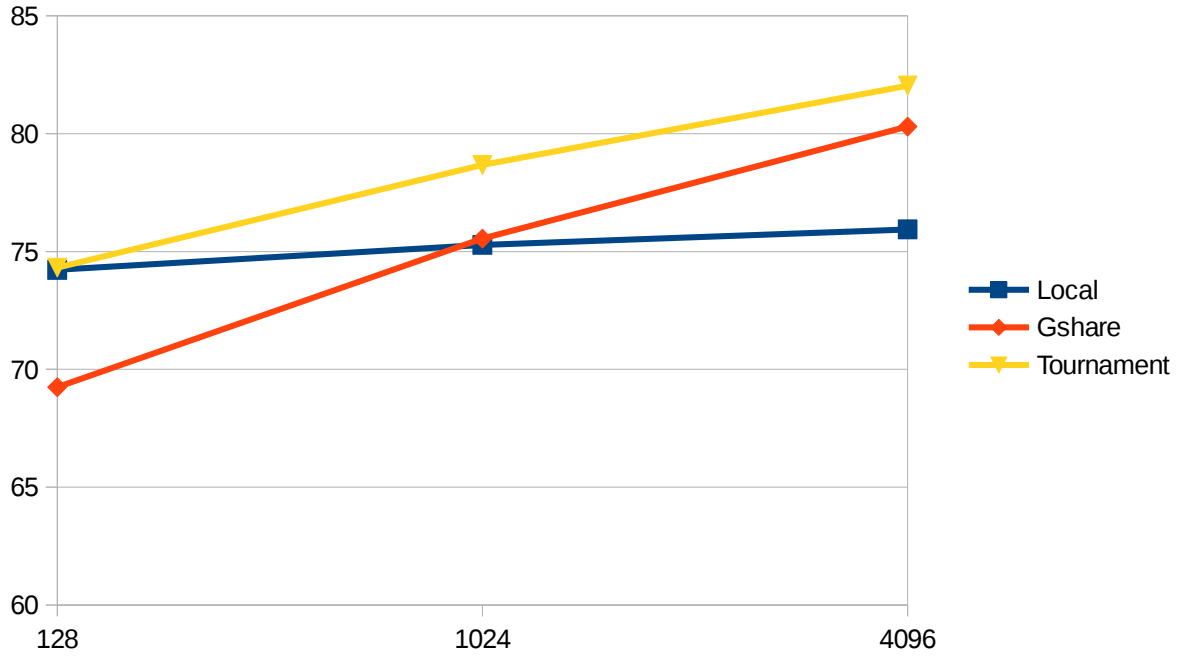
Tournament chooses the best prediction between local and gshare and hence should generally provide better accuracy than both local or gshare. This is true from our result. Although it does show lower than local in a tiny amount of cases (generally when the PHT size is very low or if gshare predictor has very low accuracy), for almost all cases observed tournament provides better accuracy than both local and gshare.

Suite: GROMACS	Local	Gshare	Tournament
128	94.6976	82.6964	94.1758
1024	96.4903	93.9928	96.6097
4096	96.8975	95.9909	97.3248



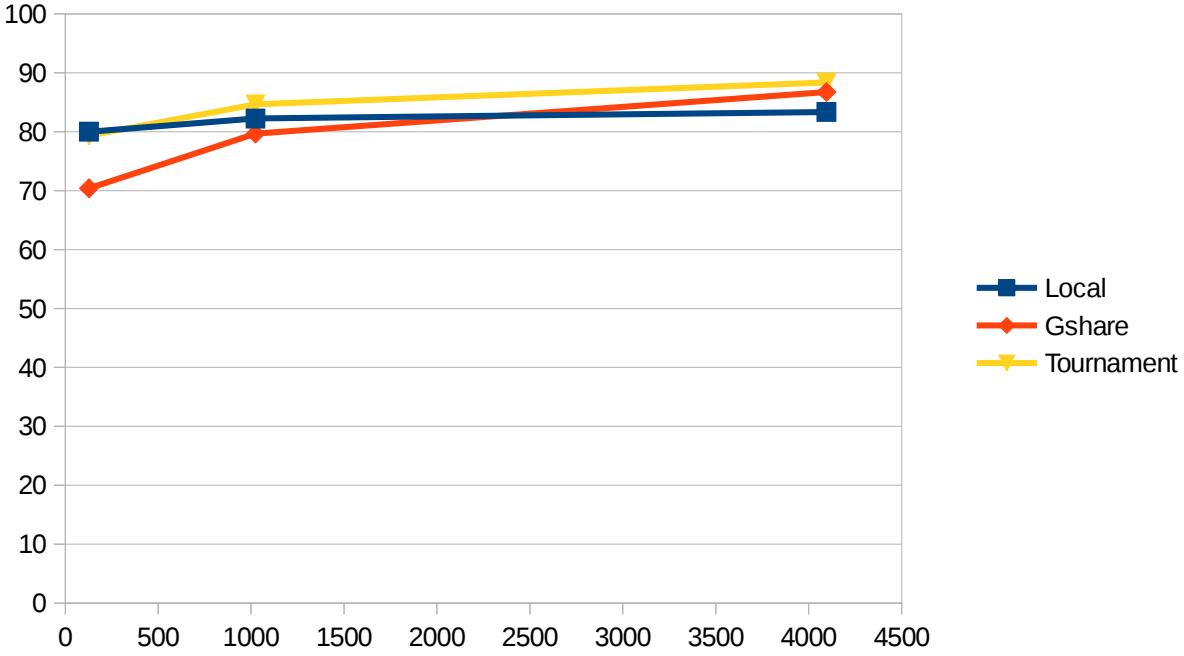
Comparison for GROMACS Suite

Suite: GOBMK	Local	Gshare	Tournament
128	74.2211	69.2407	74.3156
1024	75.2775	75.5441	78.6665
4096	75.9353	80.3013	82.0351



Comparison for GOBMK Suite

Suite: SJENG	Local	Gshare	Tournament
128	80.0034	70.4014	79.3774
1024	82.2450	79.6892	84.6498
4096	83.3552	86.7621	88.3588



Comparison for SJENG Suite