ECE552 - Lab 2 Branch Prediction
Results Report

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Microbenchmarking

In order to test the functionality of our 2-level PaP predictor, within a loop that ran a 100,000 times, we created 2 branches that relied heavily on the History of that branch. One of the branches would require 6 bits of branch history in order to correctly predict all outcomes of the branch while the other would require 7. Our PaP predictor contained only 6 bits of history so we speculated that the first branch would result in very few mispredictions while the second one would result in a lot. We used the -O0 compilation flag for this as the code is relatively small and the assembly snippets were easy to spot. Detailed descriptions of the scenarios and the assembly snippets have been provided as comments in *mb.c*.

Performance of the 3 Branch Predictors

	Biomodal		**PaP**		**OpenEnded**	
	NMP	MPKI	NMP	MPKI	NMP	MPKI
astar	3695830	24.639	1785464	11.903	480213	3.073
bwaves	1182969	7.886	1071909	7.146	187421	1.021
bzip2	1224967	8.166	1297677	8.651	1191394	7.907
gcc	3161868	21.079	2223671	14.824	130961	0.834
gromacs	1363248	9.088	1122586	7.484	850180	5.544
hmmer	2035080	13.567	2230774	14.872	2097525	13.502
mcf	3657986	24.387	2024172	13.494	1609452	10.614
soplex	1065988	7.107	1022869	6.819	622803	4.007
Average		**14.489875**		**10.649125**		**5.81275**

Note: NMP - Number of MisPredictions

Open-ended Branch Predictor Implementation

The open-ended branch predictor has been implemented using an 8 component TAGE predictor. While, most of the elements of the predictor have been borrowed from the original paper, some have also been borrowed from the paper describing the updated version of the predictor, also written by Andre Seznec. The predictor uses 129691 bits of storage space which is below the required limit. A more detailed explanation of the storage analysis and design decisions has been provided in preedictor.cc in form of comments.

CACTI Statistics

1. PAP Two Level Predictor

a. Configuration Parameters Specified
   i. Cache Size: 4096 Bytes
   ii. Tag Size: 1 bit
b. Data Collected
   i. Tag side (with Output driver) (ns): 0.210196
   ii. Tag array Total dynamic read energy/access (nJ): 0.000722087
   iii. Tag array Total leakage read/write power of a bank (mW): 0.780885
   iv. Tag array Area (mm2): 0.00354569
   v. Tag array Height (mm): 0.0704999
   vi. Tag Array Width (mm): 0.0502936

2. Open Ended Predictor (TAGE)

2.1. PAP Two Level Predictor (T0)

a. Configuration Parameters Specified
   i. Cache Size: 10752 Bytes
   ii. Tag Size: 2 bit
b. Data Collected
   i. Tag side (with Output driver) (ns): 0.243318
   ii. Tag array Total dynamic read energy/access (nJ): 0.00159068
   iii. Tag array Total leakage read/write power of a bank (mW): 1.89549
   iv. Tag array Area (mm2): 0.00855434
   v. Tag array Height (mm): 0.0905493
   vi. Tag Array Width (mm): 0.0944716

2.2. Tagged Tables (T1-T7)

c. Configuration Parameters Specified
   i. Cache Size: 1024 Bytes
   ii. Tag Size: 15 bit
d. Data Collected
   i. Tag side (with Output driver) (ns): 0.206091
   ii. Tag array Total dynamic read energy/access (nJ): 0.00083778
   iii. Tag array Total leakage read/write power of a bank (mW): 0.839318
   iv. Tag array Area (mm2): 0.00356849
   v. Tag array Height (mm): 0.0693467
   vi. Tag Array Width (mm): 0.0514587

Work Distribution

Tirthak and Pushkar together: Two Bit Saturated BP, PAP Predictor, CACTII, Microbenchmark, Open End