CS422 Assignment 2 Report
By Vineet Purswani
12813

1. Perlbench Results

- Part A

Mispredictions in %ge	Total Mispredictions	Forward Mispredictions	Backward Mispredictions
Static Predictor(FNBT)	41.44	37.78	56.18
Bimodal	9.43	9.78	8.01
SAg	3.62	3.69	3.33
GAg	11.71	12.37	9.04
gshare	9.97	10.04	9.68
hybrid SAg & GAg	3.92	3.99	3.60
hybrid SAg, GAg & gshare, majority	4.94	4.99	4.72
hybrid SAg, GAg & gshare, 3 metapredictors	5.69	5.76	5.40

** Total count of conditional branches = 130094723

Observations:
1. SAg performs better than GAg, as expected. Reason is the same as discussed in the class.
2. gshare performs better than GAg but worse than SAg. This was also expected as gshare tries to combine GAg with some sort of set or branch wise indexing.
3. Static predictor is the worst among all. This will be seen in all the following results too. Reason stays in the word STATIC.
4. Hybrid of SAg & GAg performs just as SAg does. That's just because this predictor considers both, along with their probability to be right. It performs a bit worse than SAg as it needs time to learn that SAg is better than GAg.
5. Other two hybrids perform even poorer because they need even more time to learn that SAg is accurate among all others.
6. <u>Best Predictor : SAg</u>

- Part B

	%ge of Misses	%ge of Mispredictions
BTB indexed with PC	44.84	44.84
BTB indexed with a hash of PC and global path history	30.49	21.70

** Total count of indirect calls = 2798041

Observations:
1. Such high percentages of misses and mispredictions might be because of a lot indirect calls that go to to different target addresses every time.
2. BTB indexed with a hash of PC & global history register performs better than the other. Reason could be, such large number of indirect calls cause a huge number of replacements. Second way of indexing can be an improvement to that.

2. BZIP2 Results

- Part A

Mispredictions in %ge	Total Mispredictions	Forward Mispredictions	Backward Mispredictions
Static Predictor(FNBT)	46.89	30.98	61.94
Bimodal	9.99	10.79	9.24
SAg	10.14	11.42	8.92
GAg	12.51	14.75	10.38
gshare	11.30	12.11	10.54
hybrid SAg & GAg	10.67	12.11	9.31
hybrid SAg, GAg & gshare, majority	9.30	10.20	8.45
hybrid SAg, GAg & gshare, 3 metapredictors	10.48	11.63	9.40

** Total count of conditional branches = 129923085

Observations:
1. Almost all the observations are same as stated in perlbench results.
2. Best Predictor: hybrid SAg, GAg & gshare, majority

- Part B

	%ge of Misses	%ge of Mispredictions
BTB indexed with PC	76.92	0
BTB indexed with a hash of PC and global path history	84.61	0

** Total count of indirect calls = 13

Observation:
1. Because of small number of indirect calls, BTB misses are high. 0% mispredictions can also be explained with the same reason.

3. GCC Results

- Part A

Mispredictions in %ge	Total Mispredictions	Forward Mispredictions	Backward Mispredictions
Static Predictor(FNBT)	36.58	31.80	54.11
Bimodal	12.94	14.72	6.42
SAg	5.09	5.36	4.10
GAg	15.40	16.15	12.64
gshare	9.73	9.13	11.94
hybrid SAg & GAg	5.43	5.67	4.57
hybrid SAg, GAg & gshare, majority	5.39	5.35	5.52
hybrid SAg, GAg & gshare, 3 metapredictors	6.50	6.45	6.65

** Total count of conditional branches = 145808234

Observations:
1. Almost all the observations are same as stated in perlbench results.
2. Best Predictor: SAg

- Part B

	%ge of Misses	%ge of Mispredictions
BTB indexed with PC	1.25986e-05	0
BTB indexed with a hash of PC and global path history	0.000330084	0

** Total count of indirect calls = 396869

Observations:
1. Such a large number of indirect calls, but still a low BTB miss rate suggests that there are very few calls, executed many a times.
2. 0% mispredictions tells that very few indirect calls have more than one target. All the calls go to the same target as they had gone for the first time.

4. MCF Results

- Part A

Mispredictions in %ge	Total Mispredictions	Forward Mispredictions	Backward Mispredictions
Static Predictor(FNBT)	31.94	35.70	28.18
Bimodal	18.02	16.28	19.75
SAg	13.05	15.09	11.00
GAg	9.28	9.22	9.34
gshare	10.21	10.34	10.09
hybrid SAg & GAg	9.72	9.95	9.49
hybrid SAg, GAg & gshare, majority	8.68	8.76	8.60
hybrid SAg, GAg & gshare, 3 metapredictors	9.58	9.75	9.42

** Total count of conditional branches = 178242979

Observations:
1. Almost all the observations are same as stated in perlbench results.
2. Best Predictor: hybrid SAg, GAg & gshare, majority

- Part B

	%ge of Misses	%ge of Mispredictions
BTB indexed with PC	NA	NA
BTB indexed with a hash of PC and global path history	NA	NA

** Total count of indirect calls = 0

Observations:
1. No indirect calls encountered.

5. SOPLEX Results

- Part A

Mispredictions in %ge	Total Mispredictions	Forward Mispredictions	Backward Mispredictions
Static Predictor(FNBT)	16.95	19.93	15.51
Bimodal	4.82	0.91	6.72
SAg	7.98	0.65	11.53
GAg	3.80	0.85	5.22
gshare	3.97	1.30	5.26
hybrid SAg & GAg	3.55	0.67	4.94
hybrid SAg, GAg & gshare, majority	3.78	0.82	5.21
hybrid SAg, GAg & gshare, 3 metapredictors	3.71	0.86	5.09

** Total count of conditional branches = 103254451

Observations:
1. Forward mispredictions for all predictors are much lower than backward mispredictions. This could be because of many reasons, one of which could be that almost all branches are taken are backward branches.
2. The above reason also explains relatively better performance of Static predictor. Almost all branches would be backward branches.
3. Other observations are similar to that of perlbench.
4. Best Predictor: hybrid SAg & GAg

- Part B

	%ge of Misses	%ge of Mispredictions
BTB indexed with PC	16.21	0
BTB indexed with a hash of PC and global path history	22.52	0

** Total count of indirect calls = 111

Observations:
1. 0 mispredictions, or 100% correct predictions. Achievable, as said in the problem statement.

6. HMMER Results

- Part A

Mispredictions in %ge	Total Mispredictions	Forward Mispredictions	Backward Mispredictions
Static Predictor(FNBT)	63.91	76.63	0.66
Bimodal	8.55	10.20	0.35
SAg	9.12	10.86	0.48
GAg	11.76	13.61	2.56
gshare	10.27	11.79	2.70
hybrid SAg & GAg	9.70	11.47	0.92
hybrid SAg, GAg & gshare, majority	8.68	10.31	0.62
hybrid SAg, GAg & gshare, 3 metapredictors	9.59	11.26	1.29

** Total count of conditional branches = 144361424

Observations:
5. Backward mispredictions for all predictors are much lower than forward mispredictions. This could be because of many reasons, one of which could be that almost all branches are taken are forward branches.
6. The above reason also explains relatively poorer performance of Static predictor. Almost all branches would be forward branches.
7. Other observations are similar to that of perlbench.
8. Best Predictor: Bimodal

- Part B

	%ge of Misses	%ge of Mispredictions
BTB indexed with PC	0.31	0
BTB indexed with a hash of PC and global path history	1.87	0

** Total count of indirect calls = 959

Observations:
1. Low miss rate as well as 100% success rate of predictions. Achievable and explainable.

7. OMNETPP Results

- Part A

Mispredictions in %ge	Total Mispredictions	Forward Mispredictions	Backward Mispredictions
Static Predictor(FNBT)	34.12	33.72	36.18
Bimodal	10.39	9.72	13.88
SAg	5.00	4.36	8.33
GAg	12.23	11.82	14.34
gshare	10.84	10.37	13.25
hybrid SAg & GAg	5.27	4.64	8.56
hybrid SAg, GAg & gshare, majority	5.48	4.76	9.22
hybrid SAg, GAg & gshare, 3 metapredictors	6.72	6.10	9.90

** Total count of conditional branches = 117335261

Observations:
1. Almost all the observations are same as stated in perlbench results.
2. Best Predictor: SAg

- Part B

	%ge of Misses	%ge of Mispredictions
BTB indexed with PC	0.84	0.48
BTB indexed with a hash of PC and global path history	0.77	0.49

** Total count of indirect calls = 3689258

Observations:
1. Most normal and predictable result.

8. XALANC Results

- Part A

Mispredictions in %ge	Total Mispredictions	Forward Mispredictions	Backward Mispredictions
Static Predictor(FNBT)	5.95	6.57	3.85
Bimodal	2.58	2.87	1.63
SAg	1.40	1.54	0.92
GAg	3.32	3.58	2.47
gshare	2.93	3.11	2.30
hybrid SAg & GAg	1.32	1.45	0.90
hybrid SAg, GAg & gshare, majority	1.60	1.71	1.24
hybrid SAg, GAg & gshare, 3 metapredictors	1.79	1.93	1.34

** Total count of conditional branches = 202164030

Observations:
1. Better Performance of the static predictor suggests that backward branches are much more than forward ones.
2. All over better predictions may account to a higher number of conditional branches.
3. Almost all the observations are same as stated in perlbench results.
4. Best Predictor: hybrid SAg & GAg

- Part B

	%ge of Misses	%ge of Mispredictions
BTB indexed with PC	1.75	1.22
BTB indexed with a hash of PC and global path history	2.90	1.03

** Total count of indirect calls = 8903073

Observations:
1. Most normal and predictable result.