Tai Duc Nguyen - ECEC412 - 10/01/2019

Project 1

TOC

Branch Predictor Evaluation

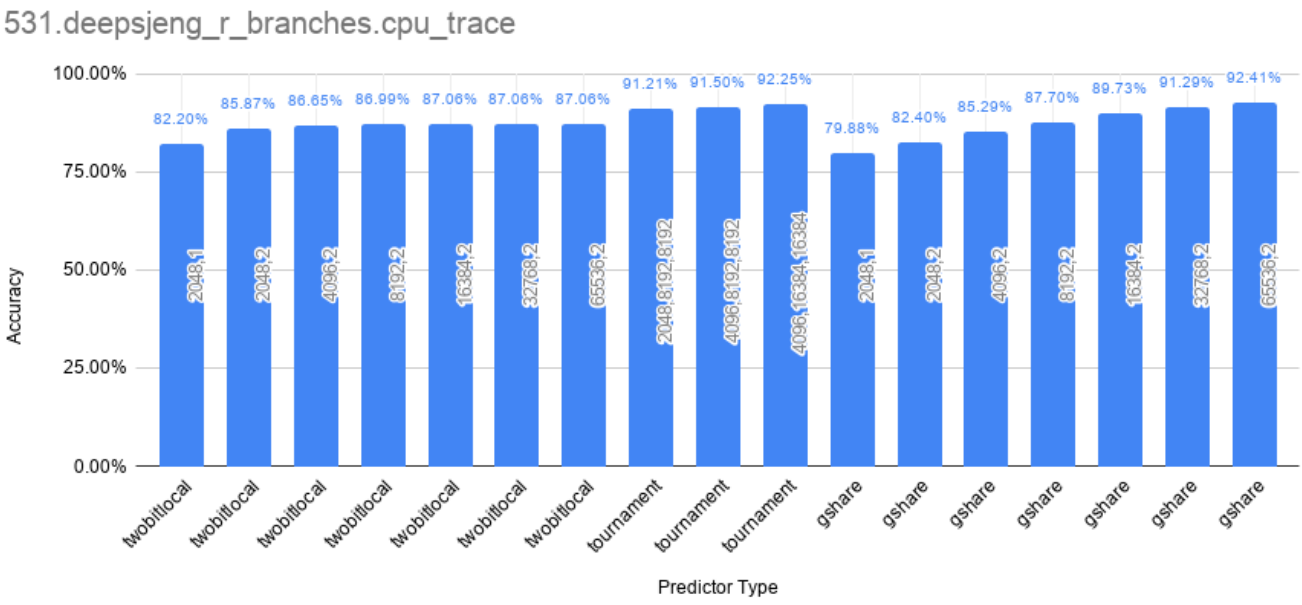
Results from simulation

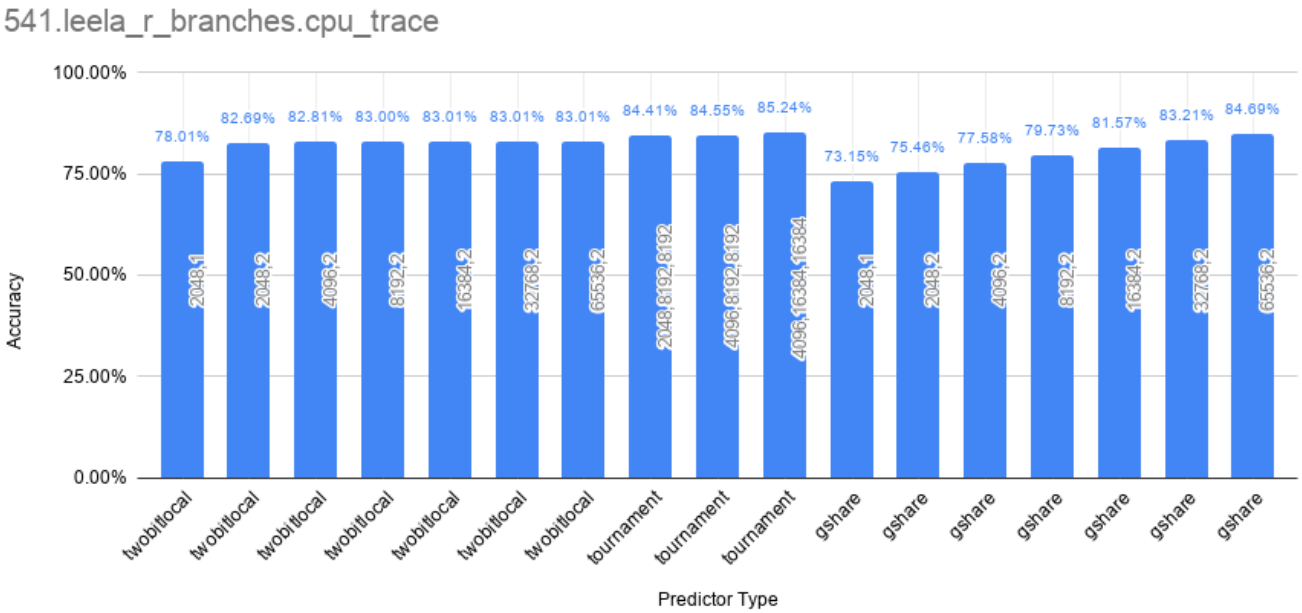
The performance of 3 predictors: Two Bit Local, Tournament and Gshare with 3 different sets of instructions are detailed in the tables and graphs below

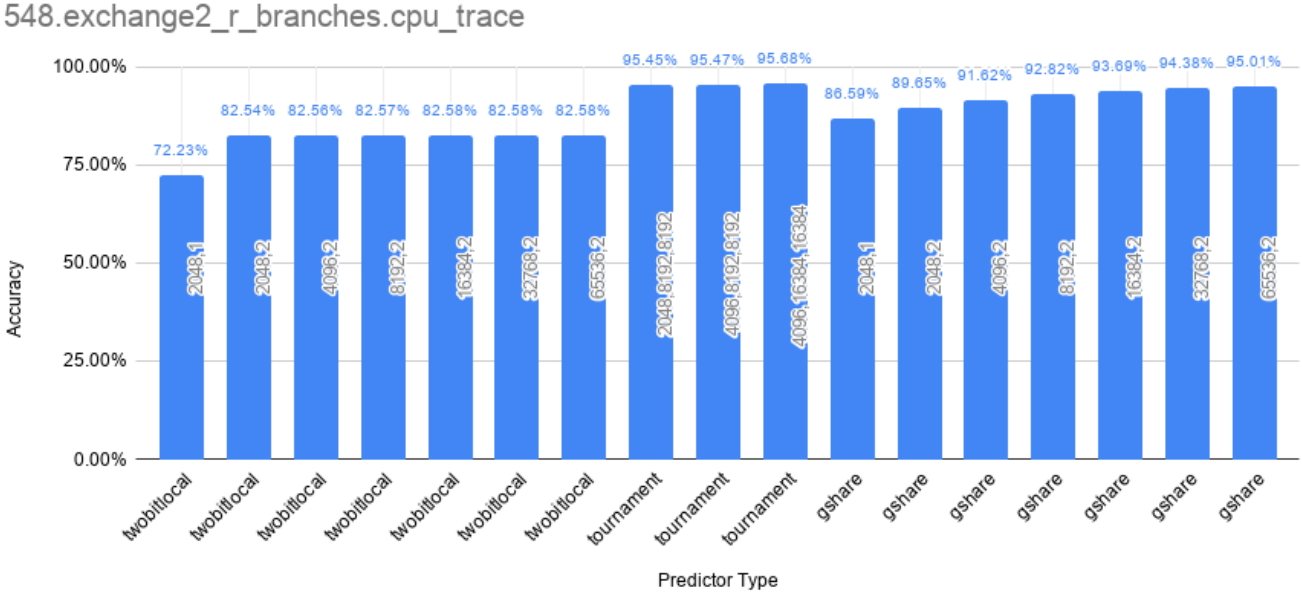
531.deepsjeng_r_branches.cpu_trace						
Predictor Type	Configuration	# Instructions	# Branches	Correct	Incorrect	Accuracy
twobitlocal	2048, 1	204719966	204719966	168274768	36445198	82.20%
twobitlocal	2048, 2	204719966	204719966	175794247	28925719	85.87%
twobitlocal	4096, 2	204719966	204719966	177385518	27334448	86.65%
twobitlocal	8192, 2	204719966	204719966	178085223	26634743	86.99%
twobitlocal	16384, 2	204719966	204719966	178223608	26496358	87.06%
twobitlocal	32768, 2	204719966	204719966	178223992	26495974	87.06%
twobitlocal	65536, 2	204719966	204719966	178224001	26495965	87.06%
tournament	2048, 8192, 8192	204719966	204719966	186733512	17986454	91.21%
tournament	4096, 8192, 8192	204719966	204719966	187322783	17397183	91.50%
tournament	4096, 16384, 16384	204719966	204719966	188849887	15870079	92.25%
gshare	2048, 1	204719966	204719966	163524096	41195870	79.88%
gshare	2048, 2	204719966	204719966	168679044	36040922	82.40%
gshare	4096, 2	204719966	204719966	174604586	30115380	85.29%
gshare	8192, 2	204719966	204719966	179529273	25190693	87.70%
gshare	16384, 2	204719966	204719966	183701357	21018609	89.73%
gshare	32768, 2	204719966	204719966	186896906	17823060	91.29%
gshare	65536, 2	204719966	204719966	189182509	15537457	92.41%

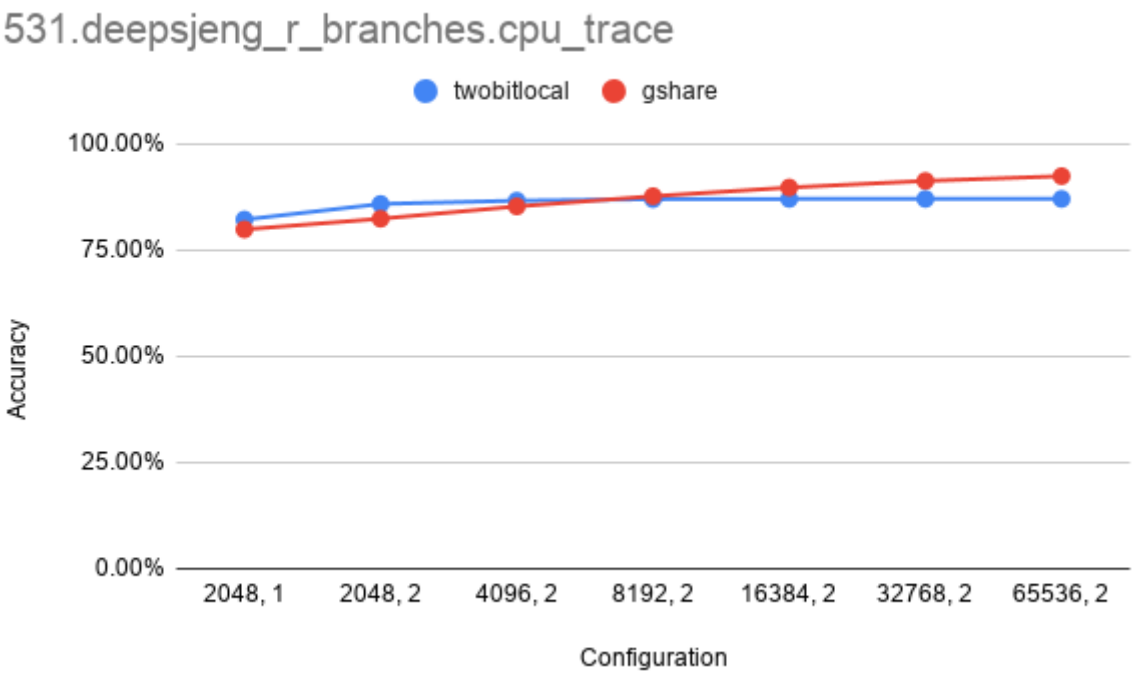
541.leela_r_branches.cpu_trace						
Predictor Type	Configuration	# Instructions	# Branches	Correct	Incorrect	Accuracy
twobitlocal	2048, 1	216132773	216132773	168602556	47530217	78.01%
twobitlocal	2048, 2	216132773	216132773	178713549	37419224	82.69%
twobitlocal	4096, 2	216132773	216132773	178989861	37142912	82.81%
twobitlocal	8192, 2	216132773	216132773	179391515	36741258	83.00%
twobitlocal	16384, 2	216132773	216132773	179415029	36717744	83.01%
twobitlocal	32768, 2	216132773	216132773	179417105	36715668	83.01%
twobitlocal	65536, 2	216132773	216132773	179417270	36715503	83.01%
tournament	2048, 8192, 8192	216132773	216132773	182428083	33704690	84.41%
tournament	4096, 8192, 8192	216132773	216132773	182744423	33388350	84.55%
tournament	4096, 16384, 16384	216132773	216132773	184227759	31905014	85.24%
gshare	2048, 1	216132773	216132773	158111753	58021020	73.15%
gshare	2048, 2	216132773	216132773	163098178	53034595	75.46%
gshare	4096, 2	216132773	216132773	167678309	48454464	77.58%
gshare	8192, 2	216132773	216132773	172317632	43815141	79.73%
gshare	16384, 2	216132773	216132773	176292704	39840069	81.57%
gshare	32768, 2	216132773	216132773	179837616	36295157	83.21%
gshare	65536, 2	216132773	216132773	183053012	33079761	84.69%

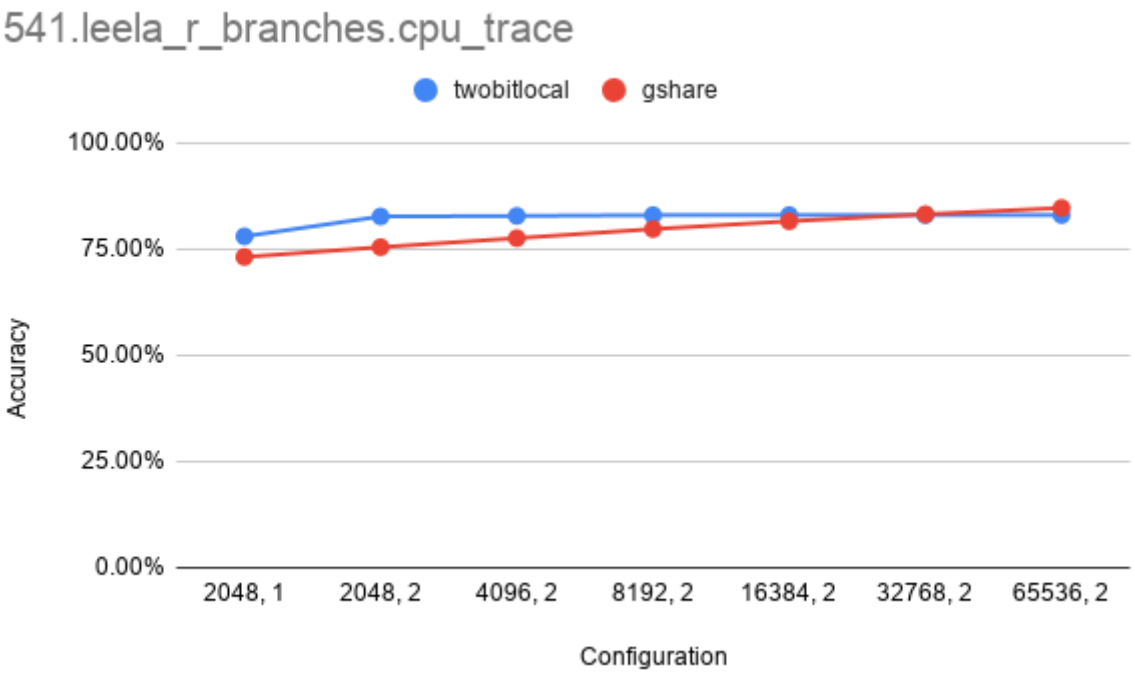
548.exchange2_r_branches.cpu_trace						
Predictor Type	Configuration	# Instructions	# Branches	Correct	Incorrect	Accuracy
twobitlocal	2048, 1	353851200	353851200	255602221	98248979	72.23%
twobitlocal	2048, 2	353851200	353851200	292073706	61777494	82.54%
twobitlocal	4096, 2	353851200	353851200	292146797	61704403	82.56%
twobitlocal	8192, 2	353851200	353851200	292178159	61673041	82.57%
twobitlocal	16384, 2	353851200	353851200	292195854	61655346	82.58%
twobitlocal	32768, 2	353851200	353851200	292198756	61652444	82.58%
twobitlocal	65536, 2	353851200	353851200	292200308	61650892	82.58%
tournament	2048, 8192, 8192	353851200	353851200	337742000	16109200	95.45%
tournament	4096, 8192, 8192	353851200	353851200	337826831	16024369	95.47%
tournament	4096, 16384, 16384	353851200	353851200	338578309	15272891	95.68%
gshare	2048, 1	353851200	353851200	306414277	47436923	86.59%
gshare	2048, 2	353851200	353851200	317228138	36623062	89.65%
gshare	4096, 2	353851200	353851200	324191040	29660160	91.62%
gshare	8192, 2	353851200	353851200	328448818	25402382	92.82%
gshare	16384, 2	353851200	353851200	331533004	22318196	93.69%
gshare	32768, 2	353851200	353851200	333952566	19898634	94.38%
gshare	65536, 2	353851200	353851200	336179077	17672123	95.01%

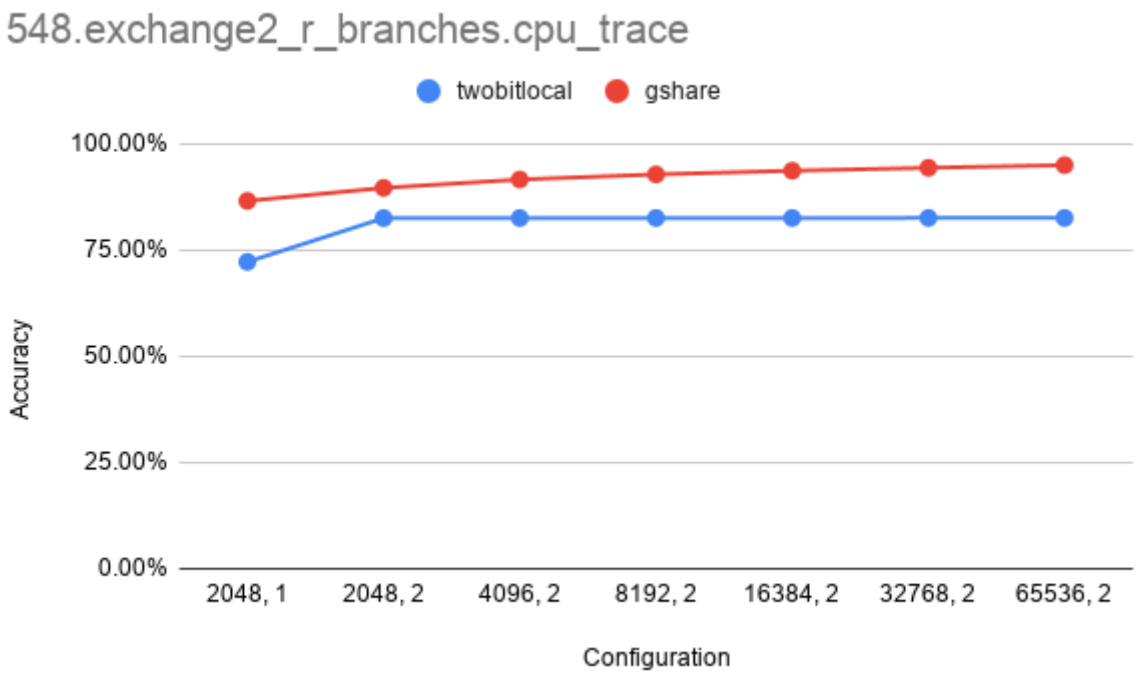

531.deepsjeng_r_branches.cpu_trace
Accuracy
100.00%
75.00%
50.00%
25.00%
0.00%
82.20%
85.87%
86.65%
86.99%
87.06%
87.06%
87.06%
91.21%
91.50%
92.25%
79.88%
82.40%
85.29%
87.70%
89.73%
91.29%
92.41%
2048,1
2048,2
4096,2
8192,2
16384,2
32768,2
65536,2
2048,8192,8192
4096,8192,8192
4096,16384,16384
twobitlocal
tournament
gshare
Predictor Type


541.leela_r_branches.cpu_trace
Accuracy
100.00%
75.00%
50.00%
25.00%
0.00%
78.01%
82.69%
82.81%
83.00%
83.01%
83.01%
83.01%
84.41%
84.55%
85.24%
73.15%
75.46%
77.58%
79.73%
81.57%
83.21%
84.69%
2048,1
2048,2
4096,2
8192,2
16384,2
32768,2
65536,2
2048,8192,8192
4096,8192,8192
4096,16384,16384
twobitlocal
tournament
gshare
Predictor Type


548.exchange2_r_branches.cpu_trace
Accuracy
100.00%
75.00%
50.00%
25.00%
0.00%
72.23%
82.54%
82.56%
82.57%
82.58%
82.58%
82.58%
95.45%
95.47%
95.68%
86.59%
89.65%
91.62%
92.82%
93.69%
94.38%
95.01%
2048,1
2048,2
4096,2
8192,2
16384,2
32768,2
65536,2
2048,8192,8192
4096,8192,8192
4096,16384,16384
twobitlocal
tournament
gshare
Predictor Type


531.deepsjeng_r_branches.cpu_trace
twobitlocal
gshare
100.00%
75.00%
50.00%
25.00%
0.00%
Accuracy
2048, 1
2048, 2
4096, 2
8192, 2
16384, 2
32768, 2
65536, 2
Configuration


541.leela_r_branches.cpu_trace
twobitlocal
gshare
100.00%
75.00%
50.00%
25.00%
0.00%
Accuracy
2048, 1
2048, 2
4096, 2
8192, 2
16384, 2
32768, 2
65536, 2
Configuration



Conclusions and Remarks

Two Bit Local (TBL) Predictor

The TBL predictor performs worst on average out of the 3 predictors in the simulation. The best configuration for this predictor is likely to be: `{localPredictorSize: 16384, localCounterBits: 2}`. Increasing the predictor size beyond this point does not increase the performance of the predictor. Hence, to save on hardware and memory used, 16384 is the best size according to the data.

Tournament (TNM) Predictor

The TNM predictor performs very well, often on par with the Gshare predictor; sometimes, even surpasses it. The highest configuration `{localHistoryTableSize: 4096, globalPredictorSize: 16384, choicePredictorSize: 16384}` provides the best results in the simulation. It is likely that higher value for the `localHistoryTableSize` and the `globalPredictorSize` will give even better performance on more numerous set of instructions. With initial testing, the results for the 3 sets of instructions are:

```
541.leela_r_branches -> 65536, 65536, 65536 -> 86.426079%
531.deepsjeng_r_branches -> 65536, 65536, 65536 -> 93.387856%
548.exchange2_r_branches -> 65536, 65536, 65536 -> 95.802040%
```

The accuracy decreases for the 531 set but increases for the other 2 sets.

Gshare (GSR) Predictor

The GSR predictor also performs very well, surpasses the TNM predictor in the `531.deepsjeng_r_branches` set of instructions, but loses to the TNM predictor in the other two sets by a small margin. The GSR predictor, however, has much better accuracy, by a large margin when compared to

the TBL predictor. The best configurations for the GSR predictor is the highest one: `{globalPredictorSize: 65536, globalCounterBits: 2}`.