CS4202 P2: Branch Prediction

1 Introduction

1.1 Aims and Objectives

The primary aim for this practical was to develop understanding of: branch prediction, computer architecture simulation, and methods and reasoning for scientific experimentation and analysis in computer science.

With those aims, the first objective was to design and implement simulations of various branch prediction strategies on a collection of trace files. Next, to design a evaluate

2 Empirical Evaluation

2.1 Abstract

2.2 Introduction

Accurate branch prediction is an essential part of modern systems. Branching allows programs to alter the flow of execution basedo on the current state of the application and it's variables. These include conditional, and loops. For each branch, there are two potential following instructions to be executed, potentially requiring a jump in the program counter. Being able to predict and pre-load the correct instruction has a significant performance benefit on modern systems.

A naïve prediction algorithm may just predict a branch is taken independent of any previous branches. However, patterns form such as a for loop over an integer range being taken until the end of the range. These local patterns for each branches are often tracked using bit-predictors. Global patterns in the sequence of different branches executed are also trackable through a global history.

An additional optimisation to these state-based prediction algorithms is profiling, where the predictors are first ran on the given program in an evaluation mode to gather information on the types of patterns present.

This evaluation seeks to analyse and compare the performance of three different algorithms implementing the above pattern trackers. First, the naïve *Always True* predictor, then a *2-bit* predictor, tracking local changes, and a *gshare* predictor, which mixes the local history tracking of the 2-bit predictor, with a global history. Profiling is achieved

through running through an initial set of traces from the given file, simulating running the program in an evaluation mode.

2.3 Methods

2.3.1 Materials

All tests were conducted on the same lab PC with the specs given in Figure 1.

```
CPU: Intel i5-8400 (6) @ 4.000GHz
GPU: Intel CoffeeLake-S GT2 [UHD Graphics 630]
Memory: 32GiB (33MHz, 200 Series/Z370)
```

Figure 1: Lab PC specifications used for all tests.

The trace files used were given in the practical specification. All trace files in the `traces/` directory were used.

2.3.2 Software Environment

```
OS: AlmaLinux 9.3 (Shamrock Pampas Cat) x86_64
Host: ASUSTeK COMPUTER INC. PRIME H310I-PLUS R2.0
Kernel: 5.14.0-362.24.2.el9_3.x86_64
Shell: bash 5.1.8
CMake Version: 3.20.2
Compiler: g++ (version 11.4.1 Red Hat)
Ninja Version: 1.10.2
```

Figure 2: Software environment used to run all tests.

2.3.3 Implementation Details

The 2-bit implementation tracks local patterns by converting the branch program address to an index into a table of two-bit values. The first bit stores the current prediction, and the second stores whether the previous prediction was incorrect. When two incorrect predictions in a row are made, the prediction swaps and previous prediction accuracy tracker reset to 0.

The indexing is calculating using the least-significant bits of the program counter. These change more than the more significant bits, and this hopefully ensures that more branches can be tracked separately.

The gshare implementation is a subclass of the 2-bit implementation, but the indexing is done by using an XOR function on the program counters least significant bits, and a global history, which just stores the ground truth taken status of the last set of traces.

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2.3.4 Procedure

The evaluation program is defined in the `test/eval.cpp` file. For each file, it runs and outputs the results of the always true predictor to be used as a baseline, and then runs both the 2-bit and gshare predctors repeatedly, with each combination of table sizes and profiling traces.

The output consists of the total number of traces predicted, the number and percentage correctly/incorrectly predicted, and the total runtime. This was then used to calculate a runtime per trace and runtime per correct prediction, as the sample files had different sizes.

The table sizes tested were 512, 1024, 2048, and 4096 entries. The different number of traces used in profile mode were: 0, 100, 500, 1000, 2000, 5000, 10000, 20000.

2.4 Results

Over all bit predictor table size and profiling combinations. The two-bit and gshare predictors always out performed the always true algorithm in terms of accuracy. Figure 3 shows that even the worst-case configurations still outperform the always true accuracy for every file.
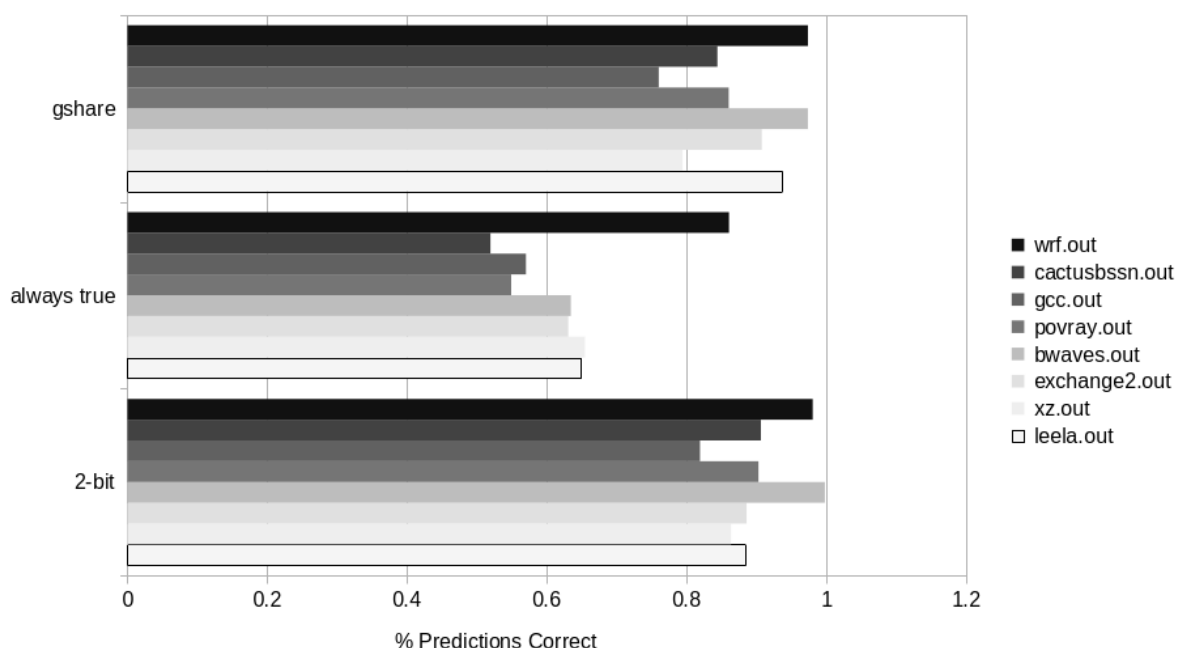
Figure 3: Graph showing the worst-case performance setup for the two-bit and gshare predictors in terms of accuracy over bit table sizes and profiling trace count combinations for each file. Shown against the always true predictor's performance for each file. Data from Appendix A

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3
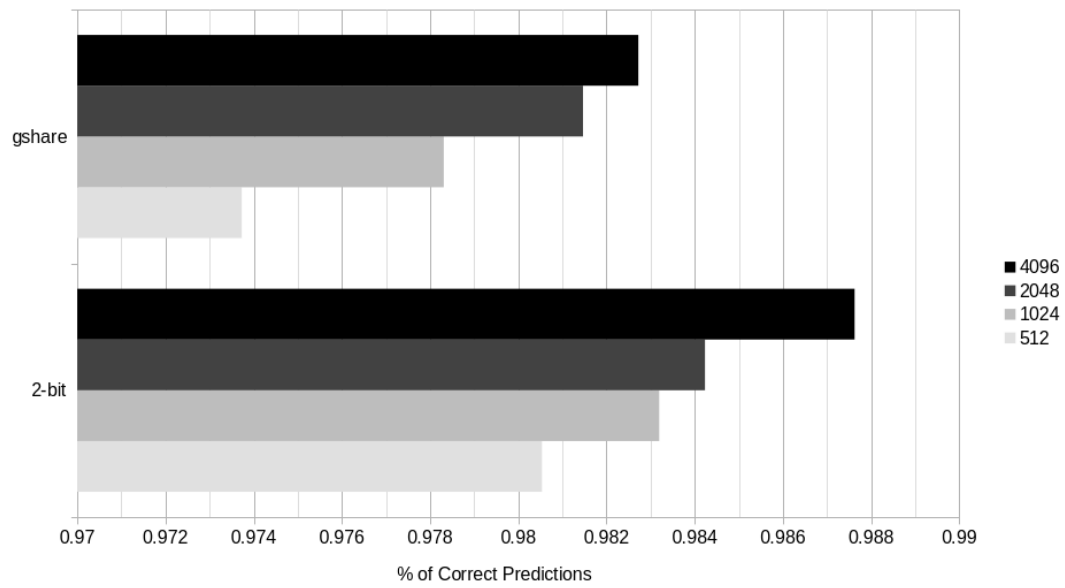
Figure 4: Graph showing the effect table size has on the average accuracy of each predictor type over each trace file. Data from Appendix A

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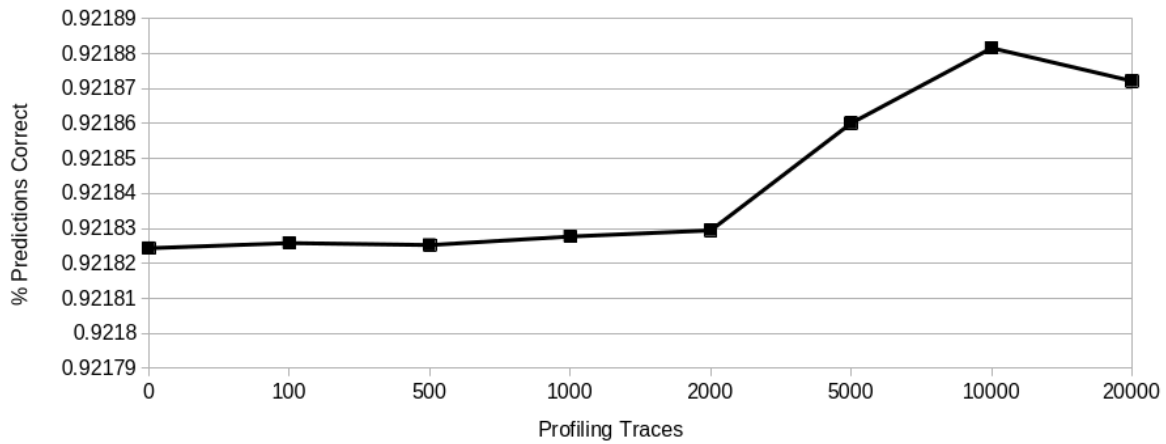
(a)
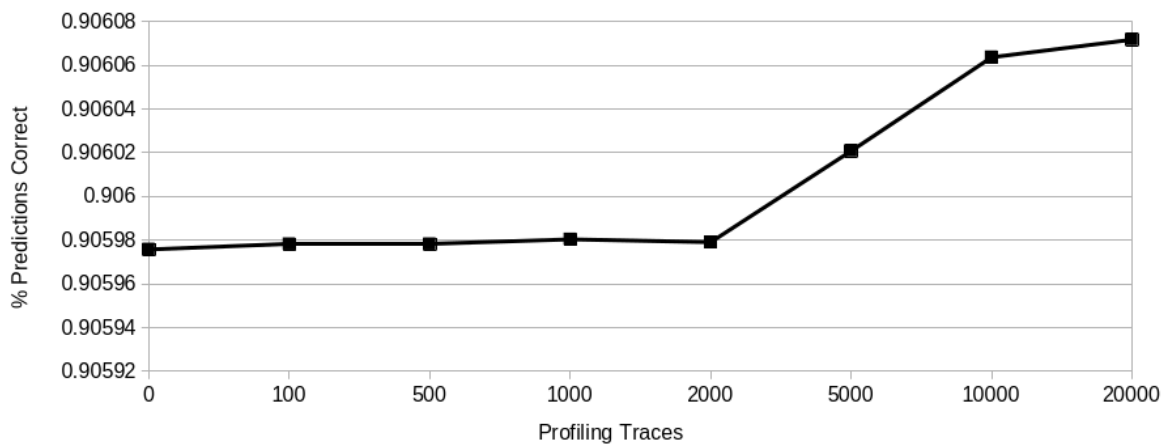
(b)

Figure 5: The relative effect of profiling trace count on prediction accuracy averaged over each trace file for the 2-bit predictor (a), and the gshare predictior (b).

The results in Figure 5 show the 2-bit predictor was most accurate with 10,000 profiling traces, where the gshare predictor performed best with 20,000. There was a very small accuracy benefit from profile trace counts 0 to 2000.
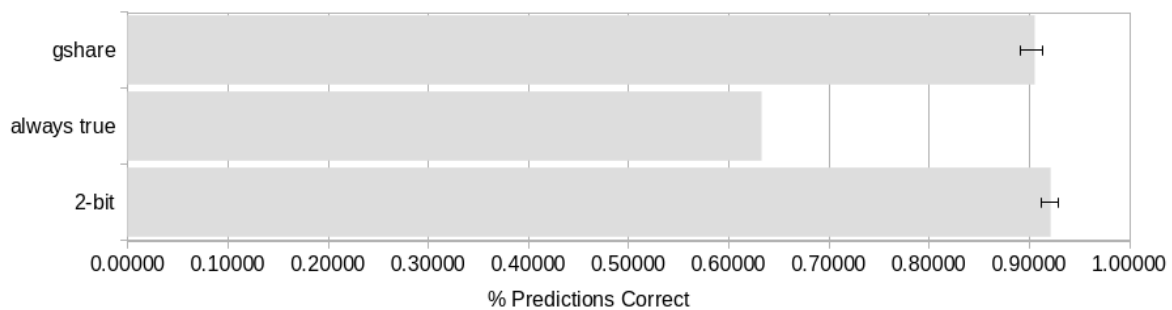
Figure 6: Graph showing the relative impact of profiling (error bars show min/max of profiling, averaged over each trace file) compared to the difference between predictor algorithms.

Figure 7 shows the 2-bit predictor had the most correct predictions per seconds ran. The always true predictor outperformed the gshare predictor in this metric.
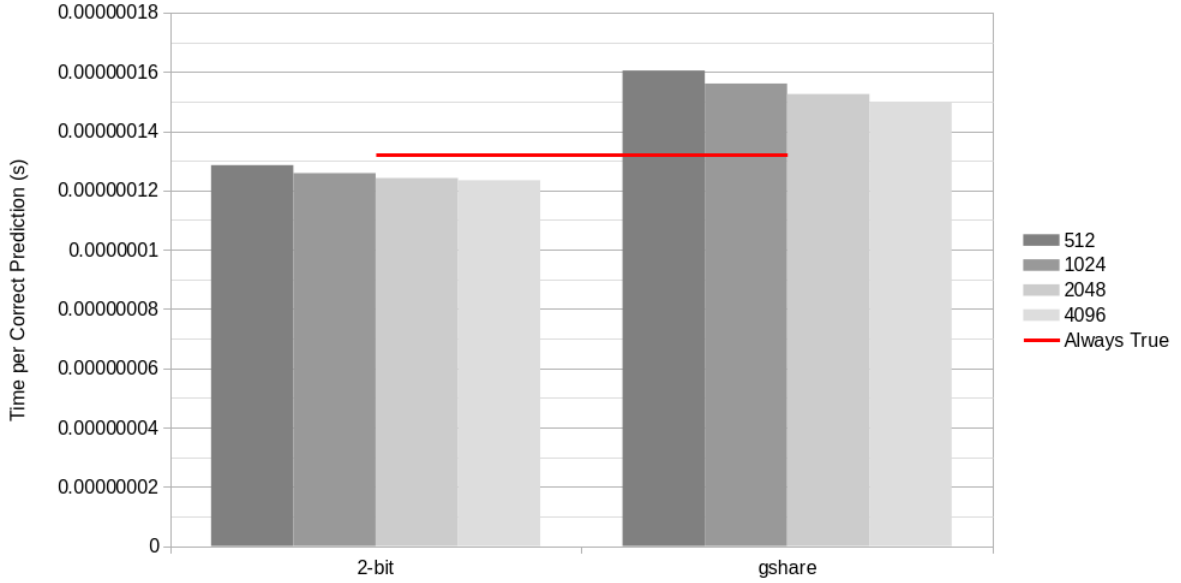
Figure 7: Graph comparing the average time per correct prediction between the 2-bit and gshare predictors to the baseline always true predictor for each bit predictor table size. Data from Appendix A.

2.5 Discussion

2.5.1 Predictor Comparison

The naïve always true predictor does nothing with the trace input, and instead immediately returns true for all inputs. This means the always true runtime can act as a very good baseline, giving information on how long the trace file takes to parse (the not-prediction computation done by the simulator).

The results in Figure 7 suggest that the 2-bit predictor is the most efficient. The accuracy performance benefit overcomes the increased runtime when compared to the always true algorithm. This is not the case for the gshare algorithm, which has a higher seconds per correct prediction than both other predictors. This is an important result, as the goal of branch prediction is to increase performance. However, it is important to note that this is just a simulator environment, and on specialist hardware, the accuracy improvements would remain similar, but the runtimes may be vastly different.

2.5.2 Profiling

As shown in Figure 6, the performance benefit/loss from profiling is extremely minor when compared to the impact of which predictor algorithm is used. This suggests

optimising profiling should only be done after we have a good method for choosing which predictor to use on a particular program.

2.5.3 BP Table Size

The results in Figure 4 show that the for both the tow-bit and gshare predictors, a larger table size performed better in terms of prediction accuracy.

The tools available for efficiency monitoring were limited. As an indirect measure, runtime was measured for each algorithm. A limitation to this approach is that RAM resource requirements only have an effect on runtime when resource limits are neared. None of the experiments reached anywhere near the machines resource limits, and so it is not possible to see the impact on storage requirements of the larger bit-predictor table sizes.

2.6 Conclusion

Overall, the gshare predictor outperformed both the standard two-bit and always true algorithms. However, this came at the cost of an increase in the runtime. This may suggest that a middle ground two-bit predictor may be more desirable as it outperformed the always true and gshare predictors in terms of seconds per correct prediction, despite being overal less accurate than the gshare, and having a longer runtime than always true.

3 Reflection

Overall, this practical successfully met the objective designed and implemented each of the required branch prediction algorithms. An empirical evaluation was also outlined, with clear details of the setup and results, with a discussion on the meaning of those results. An interesting trade-off between runtime of prediction algorithms and their accuracy was found, and it's relevance put into context.

Further work may have implemented more complex profiling algorithms, using the `isConditional` and `isDirect` information.

A Full Results Table

Results - Full

Predictor	BP Entries	Profiles	Trace File	Total Traces	Correct	Correct %	Incorrect	Incorrect %	Runtime (s)
always true			bwaves.out	15105617	9582022	0.63434	5523595	0.36567	1.21867
2-bit	512	0	bwaves.out	15105617	15071195	0.99772	34422	0.00228	1.71080
gshare	512	0	bwaves.out	15105617	14705489	0.97351	400128	0.02649	2.09943
2-bit	512	100	bwaves.out	15105517	15071126	0.99772	34391	0.00228	1.71173
gshare	512	100	bwaves.out	15105517	14705429	0.97351	400088	0.02649	2.05547
2-bit	512	500	bwaves.out	15105117	15070748	0.99773	34369	0.00228	1.72072
gshare	512	500	bwaves.out	15105117	14705064	0.97352	400053	0.02649	2.05917
2-bit	512	1000	bwaves.out	15104617	15070326	0.99773	34291	0.00227	1.71688
gshare	512	1000	bwaves.out	15104617	14704641	0.97352	399976	0.02648	2.09832
2-bit	512	2000	bwaves.out	15103617	15069429	0.99774	34188	0.00226	1.71652
gshare	512	2000	bwaves.out	15103617	14703715	0.97352	399902	0.02648	2.06867
2-bit	512	5000	bwaves.out	15100617	15067152	0.99778	33465	0.00222	1.71690
gshare	512	5000	bwaves.out	15100617	14701637	0.97358	398980	0.02642	2.05534
2-bit	512	10000	bwaves.out	15095617	15063073	0.99784	32544	0.00216	1.72401
gshare	512	10000	bwaves.out	15095617	14698115	0.97367	397502	0.02633	2.06356
2-bit	512	20000	bwaves.out	15085617	15053894	0.99790	31723	0.00210	1.72232
gshare	512	20000	bwaves.out	15085617	14689512	0.97374	396105	0.02626	2.06786
2-bit	1024	0	bwaves.out	15105617	15072937	0.99784	32680	0.00216	1.71757
gshare	1024	0	bwaves.out	15105617	14706957	0.97361	398660	0.02639	2.10683
2-bit	1024	100	bwaves.out	15105517	15072868	0.99784	32649	0.00216	1.71896
gshare	1024	100	bwaves.out	15105517	14706900	0.97361	398617	0.02639	2.06087
2-bit	1024	500	bwaves.out	15105117	15072489	0.99784	32628	0.00216	1.72443
gshare	1024	500	bwaves.out	15105117	14706536	0.97361	398581	0.02639	2.05954
2-bit	1024	1000	bwaves.out	15104617	15072064	0.99785	32553	0.00216	1.71683
gshare	1024	1000	bwaves.out	15104617	14706110	0.97362	398507	0.02638	2.09682
2-bit	1024	2000	bwaves.out	15103617	15071167	0.99785	32450	0.00215	1.71500
gshare	1024	2000	bwaves.out	15103617	14705179	0.97362	398438	0.02638	2.06734
2-bit	1024	5000	bwaves.out	15100617	15068851	0.99790	31766	0.00210	1.71313
gshare	1024	5000	bwaves.out	15100617	14703098	0.97368	397519	0.02633	2.05998
2-bit	1024	10000	bwaves.out	15095617	15064638	0.99795	30979	0.00205	1.72405

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gshare	1024	10000	bwaves.out	15095617	14699368	0.97375	396249	0.02625	2.06112
2-bit	1024	20000	bwaves.out	15085617	15055390	0.99800	30227	0.00200	1.71631
gshare	1024	20000	bwaves.out	15085617	14690640	0.97382	394977	0.02618	2.07107
2-bit	2048	0	bwaves.out	15105617	15074199	0.99792	31418	0.00208	1.71755
gshare	2048	0	bwaves.out	15105617	14708341	0.97370	397276	0.02630	2.09596
2-bit	2048	100	bwaves.out	15105517	15074130	0.99792	31387	0.00208	1.72493
gshare	2048	100	bwaves.out	15105517	14708286	0.97370	397231	0.02630	2.06298
2-bit	2048	500	bwaves.out	15105117	15073752	0.99792	31365	0.00208	1.72452
gshare	2048	500	bwaves.out	15105117	14707926	0.97371	397191	0.02630	2.06322
2-bit	2048	1000	bwaves.out	15104617	15073327	0.99793	31290	0.00207	1.72533
gshare	2048	1000	bwaves.out	15104617	14707507	0.97371	397110	0.02629	2.06204
2-bit	2048	2000	bwaves.out	15103617	15072430	0.99794	31187	0.00207	1.71675
gshare	2048	2000	bwaves.out	15103617	14706576	0.97371	397041	0.02629	2.06778
2-bit	2048	5000	bwaves.out	15100617	15070097	0.99798	30520	0.00202	1.72008
gshare	2048	5000	bwaves.out	15100617	14704442	0.97376	396175	0.02624	2.06231
2-bit	2048	10000	bwaves.out	15095617	15065829	0.99803	29788	0.00197	1.72530
gshare	2048	10000	bwaves.out	15095617	14700602	0.97383	395015	0.02617	2.06436
2-bit	2048	20000	bwaves.out	15085617	15056564	0.99807	29053	0.00193	1.72558
gshare	2048	20000	bwaves.out	15085617	14691805	0.97390	393812	0.02611	2.06262
2-bit	4096	0	bwaves.out	15105617	15075194	0.99799	30423	0.00201	1.71922
gshare	4096	0	bwaves.out	15105617	14709476	0.97378	396141	0.02623	2.06715
2-bit	4096	100	bwaves.out	15105517	15075125	0.99799	30392	0.00201	1.71364
gshare	4096	100	bwaves.out	15105517	14709422	0.97378	396095	0.02622	2.06591
2-bit	4096	500	bwaves.out	15105117	15074747	0.99799	30370	0.00201	1.72139
gshare	4096	500	bwaves.out	15105117	14709063	0.97378	396054	0.02622	2.06653
2-bit	4096	1000	bwaves.out	15104617	15074322	0.99799	30295	0.00201	1.72431
gshare	4096	1000	bwaves.out	15104617	14708653	0.97379	395964	0.02622	2.06531
2-bit	4096	2000	bwaves.out	15103617	15073425	0.99800	30192	0.00200	1.71816
gshare	4096	2000	bwaves.out	15103617	14707739	0.97379	395878	0.02621	2.07128
2-bit	4096	5000	bwaves.out	15100617	15071093	0.99805	29524	0.00196	1.72124
gshare	4096	5000	bwaves.out	15100617	14705619	0.97384	394998	0.02616	2.07066
2-bit	4096	10000	bwaves.out	15095617	15066751	0.99809	28866	0.00191	1.71790
gshare	4096	10000	bwaves.out	15095617	14701616	0.97390	394001	0.02610	2.06639

2-bit	4096	20000	bwaves.out	15085617	15057452	0.99813	28165	0.00187	1.72506
gshare	4096	20000	bwaves.out	15085617	14692726	0.97396	392891	0.02604	2.06341
always true			cactusbssn.out	14634918	7600263	0.51932	7034655	0.48068	1.20998
2-bit	512	0	cactusbssn.out	14634918	13262544	0.90623	1372374	0.09377	1.72445
gshare	512	0	cactusbssn.out	14634918	12352315	0.84403	2282603	0.15597	2.08978
2-bit	512	100	cactusbssn.out	14634818	13262475	0.90623	1372343	0.09377	1.71929
gshare	512	100	cactusbssn.out	14634818	12352255	0.84403	2282563	0.15597	2.09258
2-bit	512	500	cactusbssn.out	14634418	13262097	0.90623	1372321	0.09377	1.71973
gshare	512	500	cactusbssn.out	14634418	12351890	0.84403	2282528	0.15597	2.09319
2-bit	512	1000	cactusbssn.out	14633918	13261675	0.90623	1372243	0.09377	1.72114
gshare	512	1000	cactusbssn.out	14633918	12351467	0.84403	2282451	0.15597	2.08949
2-bit	512	2000	cactusbssn.out	14632918	13260778	0.90623	1372140	0.09377	1.72498
gshare	512	2000	cactusbssn.out	14632918	12350541	0.84402	2282377	0.15598	2.08194
2-bit	512	5000	cactusbssn.out	14629918	13258511	0.90626	1371407	0.09374	1.72093
gshare	512	5000	cactusbssn.out	14629918	12348478	0.84406	2281440	0.15594	2.09112
2-bit	512	10000	cactusbssn.out	14624918	13254381	0.90629	1370537	0.09371	1.72033
gshare	512	10000	cactusbssn.out	14624918	12344888	0.84410	2280030	0.15590	2.08929
2-bit	512	20000	cactusbssn.out	14614918	13244999	0.90627	1369919	0.09373	1.72022
gshare	512	20000	cactusbssn.out	14614918	12335898	0.84406	2279020	0.15594	2.08598
2-bit	1024	0	cactusbssn.out	14634918	13538933	0.92511	1095985	0.07489	1.71807
gshare	1024	0	cactusbssn.out	14634918	12760006	0.87189	1874912	0.12811	2.07096
2-bit	1024	100	cactusbssn.out	14634818	13538864	0.92511	1095954	0.07489	1.71491
gshare	1024	100	cactusbssn.out	14634818	12759949	0.87189	1874869	0.12811	2.07548
2-bit	1024	500	cactusbssn.out	14634418	13538485	0.92511	1095933	0.07489	1.71515
gshare	1024	500	cactusbssn.out	14634418	12759585	0.87189	1874833	0.12811	2.07745
2-bit	1024	1000	cactusbssn.out	14633918	13538060	0.92512	1095858	0.07489	1.70851
gshare	1024	1000	cactusbssn.out	14633918	12759159	0.87189	1874759	0.12811	2.07492
2-bit	1024	2000	cactusbssn.out	14632918	13537163	0.92512	1095755	0.07488	1.71942
gshare	1024	2000	cactusbssn.out	14632918	12758228	0.87189	1874690	0.12812	2.07272
2-bit	1024	5000	cactusbssn.out	14629918	13534855	0.92515	1095063	0.07485	1.71774
gshare	1024	5000	cactusbssn.out	14629918	12756167	0.87192	1873751	0.12808	2.07651
2-bit	1024	10000	cactusbssn.out	14624918	13530606	0.92518	1094312	0.07483	1.70751
gshare	1024	10000	cactusbssn.out	14624918	12752405	0.87196	1872513	0.12804	2.08071

2-bit	1024	20000	cactusbssn.out	14614918	13521193	0.92516	1093725	0.07484	1.70966
gshare	1024	20000	cactusbssn.out	14614918	12743379	0.87194	1871539	0.12806	2.07525
2-bit	2048	0	cactusbssn.out	14634918	13732722	0.93835	902196	0.06165	1.71415
gshare	2048	0	cactusbssn.out	14634918	13121797	0.89661	1513121	0.10339	2.06351
2-bit	2048	100	cactusbssn.out	14634818	13732653	0.93836	902165	0.06165	1.71429
gshare	2048	100	cactusbssn.out	14634818	13121742	0.89661	1513076	0.10339	2.06276
2-bit	2048	500	cactusbssn.out	14634418	13732275	0.93836	902143	0.06165	1.70652
gshare	2048	500	cactusbssn.out	14634418	13121382	0.89661	1513036	0.10339	2.06674
2-bit	2048	1000	cactusbssn.out	14633918	13731850	0.93836	902068	0.06164	1.70565
gshare	2048	1000	cactusbssn.out	14633918	13120963	0.89661	1512955	0.10339	2.07117
2-bit	2048	2000	cactusbssn.out	14632918	13730953	0.93836	901965	0.06164	1.70177
gshare	2048	2000	cactusbssn.out	14632918	13120032	0.89661	1512886	0.10339	2.08838
2-bit	2048	5000	cactusbssn.out	14629918	13728626	0.93839	901292	0.06161	1.71198
gshare	2048	5000	cactusbssn.out	14629918	13117918	0.89665	1512000	0.10335	2.06179
2-bit	2048	10000	cactusbssn.out	14624918	13724337	0.93842	900581	0.06158	1.70817
gshare	2048	10000	cactusbssn.out	14624918	13114031	0.89669	1510887	0.10331	2.06667
2-bit	2048	20000	cactusbssn.out	14614918	13714910	0.93842	900008	0.06158	1.70767
gshare	2048	20000	cactusbssn.out	14614918	13104979	0.89669	1509939	0.10332	2.06737
2-bit	4096	0	cactusbssn.out	14634918	13839461	0.94565	795457	0.05435	1.71012
gshare	4096	0	cactusbssn.out	14634918	13399311	0.91557	1235607	0.08443	2.05218
2-bit	4096	100	cactusbssn.out	14634818	13839392	0.94565	795426	0.05435	1.70980
gshare	4096	100	cactusbssn.out	14634818	13399257	0.91557	1235561	0.08443	2.05002
2-bit	4096	500	cactusbssn.out	14634418	13839014	0.94565	795404	0.05435	1.70399
gshare	4096	500	cactusbssn.out	14634418	13398898	0.91557	1235520	0.08443	2.06523
2-bit	4096	1000	cactusbssn.out	14633918	13838589	0.94565	795329	0.05435	1.70278
gshare	4096	1000	cactusbssn.out	14633918	13398488	0.91558	1235430	0.08442	2.06530
2-bit	4096	2000	cactusbssn.out	14632918	13837692	0.94566	795226	0.05435	1.70037
gshare	4096	2000	cactusbssn.out	14632918	13397574	0.91558	1235344	0.08442	2.05250
2-bit	4096	5000	cactusbssn.out	14629918	13835362	0.94569	794556	0.05431	1.71763
gshare	4096	5000	cactusbssn.out	14629918	13395471	0.91562	1234447	0.08438	2.05694
2-bit	4096	10000	cactusbssn.out	14624918	13830998	0.94572	793920	0.05429	1.70325
gshare	4096	10000	cactusbssn.out	14624918	13391430	0.91566	1233488	0.08434	2.06311
2-bit	4096	20000	cactusbssn.out	14614918	13821565	0.94572	793353	0.05428	1.70033

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gshare	4096	20000	cactusbssn.out	14614918	13382339	0.91566	1232579	0.08434	2.06198
always true			exchange2.out	15203193	9588014	0.63066	5615179	0.36934	1.19157
2-bit	512	0	exchange2.out	15203193	13466850	0.88579	1736343	0.11421	1.70919
gshare	512	0	exchange2.out	15203193	13796941	0.90750	1406252	0.09250	2.08111
2-bit	512	100	exchange2.out	15203093	13466781	0.88579	1736312	0.11421	1.71379
gshare	512	100	exchange2.out	15203093	13796881	0.90751	1406212	0.09250	2.07489
2-bit	512	500	exchange2.out	15202693	13466403	0.88579	1736290	0.11421	1.71808
gshare	512	500	exchange2.out	15202693	13796516	0.90751	1406177	0.09250	2.07665
2-bit	512	1000	exchange2.out	15202193	13465981	0.88579	1736212	0.11421	1.70872
gshare	512	1000	exchange2.out	15202193	13796093	0.90751	1406100	0.09249	2.08799
2-bit	512	2000	exchange2.out	15201193	13465084	0.88579	1736109	0.11421	1.71395
gshare	512	2000	exchange2.out	15201193	13795167	0.90751	1406026	0.09249	2.08520
2-bit	512	5000	exchange2.out	15198193	13462814	0.88582	1735379	0.11418	1.71250
gshare	512	5000	exchange2.out	15198193	13793087	0.90755	1405106	0.09245	2.07719
2-bit	512	10000	exchange2.out	15193193	13458762	0.88584	1734431	0.11416	1.72333
gshare	512	10000	exchange2.out	15193193	13789564	0.90762	1403629	0.09239	2.07476
2-bit	512	20000	exchange2.out	15183193	13449532	0.88582	1733661	0.11418	1.71383
gshare	512	20000	exchange2.out	15183193	13780870	0.90764	1402323	0.09236	2.08471
2-bit	1024	0	exchange2.out	15203193	13539344	0.89056	1663849	0.10944	1.71007
gshare	1024	0	exchange2.out	15203193	13996140	0.92061	1207053	0.07940	2.07795
2-bit	1024	100	exchange2.out	15203093	13539275	0.89056	1663818	0.10944	1.71025
gshare	1024	100	exchange2.out	15203093	13996083	0.92061	1207010	0.07939	2.07201
2-bit	1024	500	exchange2.out	15202693	13538896	0.89056	1663797	0.10944	1.71365
gshare	1024	500	exchange2.out	15202693	13995719	0.92061	1206974	0.07939	2.07467
2-bit	1024	1000	exchange2.out	15202193	13538471	0.89056	1663722	0.10944	1.70603
gshare	1024	1000	exchange2.out	15202193	13995293	0.92061	1206900	0.07939	2.07908
2-bit	1024	2000	exchange2.out	15201193	13537574	0.89056	1663619	0.10944	1.70905
gshare	1024	2000	exchange2.out	15201193	13994362	0.92061	1206831	0.07939	2.07841
2-bit	1024	5000	exchange2.out	15198193	13535265	0.89058	1662928	0.10942	1.70931
gshare	1024	5000	exchange2.out	15198193	13992280	0.92065	1205913	0.07935	2.07166
2-bit	1024	10000	exchange2.out	15193193	13531075	0.89060	1662118	0.10940	1.70113
gshare	1024	10000	exchange2.out	15193193	13988546	0.92071	1204647	0.07929	2.07303
2-bit	1024	20000	exchange2.out	15183193	13521783	0.89058	1661410	0.10942	1.72023

gshare	1024	20000	exchange2.out	15183193	13979736	0.92074	1203457	0.07926	2.06264
2-bit	2048	0	exchange2.out	15203193	13595286	0.89424	1607907	0.10576	1.70384
gshare	2048	0	exchange2.out	15203193	14110317	0.92812	1092876	0.07189	2.07301
2-bit	2048	100	exchange2.out	15203093	13595217	0.89424	1607876	0.10576	1.70775
gshare	2048	100	exchange2.out	15203093	14110262	0.92812	1092831	0.07188	2.06463
2-bit	2048	500	exchange2.out	15202693	13594839	0.89424	1607854	0.10576	1.71582
gshare	2048	500	exchange2.out	15202693	14109902	0.92812	1092791	0.07188	2.06321
2-bit	2048	1000	exchange2.out	15202193	13594414	0.89424	1607779	0.10576	1.71344
gshare	2048	1000	exchange2.out	15202193	14109483	0.92812	1092710	0.07188	2.06517
2-bit	2048	2000	exchange2.out	15201193	13593517	0.89424	1607676	0.10576	1.70918
gshare	2048	2000	exchange2.out	15201193	14108552	0.92812	1092641	0.07188	2.07113
2-bit	2048	5000	exchange2.out	15198193	13591191	0.89426	1607002	0.10574	1.70591
gshare	2048	5000	exchange2.out	15198193	14106419	0.92816	1091774	0.07184	2.06310
2-bit	2048	10000	exchange2.out	15193193	13586949	0.89428	1606244	0.10572	1.71375
gshare	2048	10000	exchange2.out	15193193	14102561	0.92822	1090632	0.07178	2.06703
2-bit	2048	20000	exchange2.out	15183193	13577637	0.89425	1605556	0.10575	1.71452
gshare	2048	20000	exchange2.out	15183193	14093716	0.92825	1089477	0.07176	2.06661
2-bit	4096	0	exchange2.out	15203193	13617287	0.89569	1585906	0.10431	1.70520
gshare	4096	0	exchange2.out	15203193	14198126	0.93389	1005067	0.06611	2.06940
2-bit	4096	100	exchange2.out	15203093	13617218	0.89569	1585875	0.10431	1.70535
gshare	4096	100	exchange2.out	15203093	14198072	0.93389	1005021	0.06611	2.06930
2-bit	4096	500	exchange2.out	15202693	13616840	0.89569	1585853	0.10431	1.70484
gshare	4096	500	exchange2.out	15202693	14197713	0.93390	1004980	0.06611	2.06135
2-bit	4096	1000	exchange2.out	15202193	13616415	0.89569	1585778	0.10431	1.71140
gshare	4096	1000	exchange2.out	15202193	14197303	0.93390	1004890	0.06610	2.06543
2-bit	4096	2000	exchange2.out	15201193	13615518	0.89569	1585675	0.10431	1.70589
gshare	4096	2000	exchange2.out	15201193	14196389	0.93390	1004804	0.06610	2.07395
2-bit	4096	5000	exchange2.out	15198193	13613193	0.89571	1585000	0.10429	1.70759
gshare	4096	5000	exchange2.out	15198193	14194272	0.93395	1003921	0.06606	2.07183
2-bit	4096	10000	exchange2.out	15193193	13608870	0.89572	1584323	0.10428	1.71020
gshare	4096	10000	exchange2.out	15193193	14190267	0.93399	1002926	0.06601	2.06380
2-bit	4096	20000	exchange2.out	15183193	13599534	0.89570	1583659	0.10430	1.71621
gshare	4096	20000	exchange2.out	15183193	14181333	0.93402	1001860	0.06599	2.06425

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always true			gcc.out	14655608	8355606	0.57013	6300002	0.42987	1.25066
2-bit	512	0	gcc.out	14655608	12005776	0.81919	2649832	0.18081	1.78273
gshare	512	0	gcc.out	14655608	11140381	0.76015	3515227	0.23986	2.14915
2-bit	512	100	gcc.out	14655508	12005707	0.81919	2649801	0.18081	1.77402
gshare	512	100	gcc.out	14655508	11140321	0.76015	3515187	0.23985	2.15941
2-bit	512	500	gcc.out	14655108	12005329	0.81919	2649779	0.18081	1.77183
gshare	512	500	gcc.out	14655108	11139956	0.76014	3515152	0.23986	2.20364
2-bit	512	1000	gcc.out	14654608	12004907	0.81919	2649701	0.18081	1.77505
gshare	512	1000	gcc.out	14654608	11139533	0.76014	3515075	0.23986	2.14838
2-bit	512	2000	gcc.out	14653608	12004010	0.81919	2649598	0.18082	1.78296
gshare	512	2000	gcc.out	14653608	11138607	0.76013	3515001	0.23987	2.14595
2-bit	512	5000	gcc.out	14650608	12001743	0.81920	2648865	0.18080	1.77540
gshare	512	5000	gcc.out	14650608	11136537	0.76014	3514071	0.23986	2.13910
2-bit	512	10000	gcc.out	14645608	11997513	0.81919	2648095	0.18081	1.76757
gshare	512	10000	gcc.out	14645608	11132734	0.76014	3512874	0.23986	2.15518
2-bit	512	20000	gcc.out	14635608	11988011	0.81910	2647597	0.18090	1.77124
gshare	512	20000	gcc.out	14635608	11123521	0.76003	3512087	0.23997	2.15019
2-bit	1024	0	gcc.out	14655608	12840482	0.87615	1815126	0.12385	1.75395
gshare	1024	0	gcc.out	14655608	11821168	0.80660	2834440	0.19340	2.12830
2-bit	1024	100	gcc.out	14655508	12840413	0.87615	1815095	0.12385	1.75825
gshare	1024	100	gcc.out	14655508	11821111	0.80660	2834397	0.19340	2.12890
2-bit	1024	500	gcc.out	14655108	12840034	0.87615	1815074	0.12385	1.75283
gshare	1024	500	gcc.out	14655108	11820747	0.80660	2834361	0.19340	2.12864
2-bit	1024	1000	gcc.out	14654608	12839609	0.87615	1814999	0.12385	1.75178
gshare	1024	1000	gcc.out	14654608	11820321	0.80659	2834287	0.19341	2.13330
2-bit	1024	2000	gcc.out	14653608	12838712	0.87615	1814896	0.12385	1.75142
gshare	1024	2000	gcc.out	14653608	11819390	0.80659	2834218	0.19341	2.12618
2-bit	1024	5000	gcc.out	14650608	12836402	0.87617	1814206	0.12383	1.75865
gshare	1024	5000	gcc.out	14650608	11817316	0.80661	2833292	0.19339	2.12566
2-bit	1024	10000	gcc.out	14645608	12832116	0.87618	1813492	0.12383	1.75770
gshare	1024	10000	gcc.out	14645608	11813459	0.80662	2832149	0.19338	2.12058
2-bit	1024	20000	gcc.out	14635608	12822466	0.87611	1813142	0.12389	1.75052
gshare	1024	20000	gcc.out	14635608	11804090	0.80653	2831518	0.19347	2.13422

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2-bit	2048	0	gcc.out	14655608	13421437	0.91579	1234171	0.08421	1.73113
gshare	2048	0	gcc.out	14655608	12534388	0.85526	2121220	0.14474	2.11329
2-bit	2048	100	gcc.out	14655508	13421368	0.91579	1234140	0.08421	1.72706
gshare	2048	100	gcc.out	14655508	12534333	0.85526	2121175	0.14474	2.10350
2-bit	2048	500	gcc.out	14655108	13420990	0.91579	1234118	0.08421	1.74051
gshare	2048	500	gcc.out	14655108	12533973	0.85526	2121135	0.14474	2.10203
2-bit	2048	1000	gcc.out	14654608	13420565	0.91579	1234043	0.08421	1.73199
gshare	2048	1000	gcc.out	14654608	12533554	0.85526	2121054	0.14474	2.11215
2-bit	2048	2000	gcc.out	14653608	13419668	0.91579	1233940	0.08421	1.73089
gshare	2048	2000	gcc.out	14653608	12532623	0.85526	2120985	0.14474	2.11378
2-bit	2048	5000	gcc.out	14650608	13417338	0.91582	1233270	0.08418	1.73111
gshare	2048	5000	gcc.out	14650608	12530494	0.85529	2120114	0.14471	2.10002
2-bit	2048	10000	gcc.out	14645608	13413034	0.91584	1232574	0.08416	1.73959
gshare	2048	10000	gcc.out	14645608	12526653	0.85532	2118955	0.14468	2.10484
2-bit	2048	20000	gcc.out	14635608	13403367	0.91581	1232241	0.08420	1.73962
gshare	2048	20000	gcc.out	14635608	12517263	0.85526	2118345	0.14474	2.10393
2-bit	4096	0	gcc.out	14655608	13696160	0.93453	959448	0.06547	1.73667
gshare	4096	0	gcc.out	14655608	13097265	0.89367	1558343	0.10633	2.09240
2-bit	4096	100	gcc.out	14655508	13696091	0.93454	959417	0.06547	1.72350
gshare	4096	100	gcc.out	14655508	13097211	0.89367	1558297	0.10633	2.08170
2-bit	4096	500	gcc.out	14655108	13695713	0.93454	959395	0.06547	1.72933
gshare	4096	500	gcc.out	14655108	13096852	0.89367	1558256	0.10633	2.08458
2-bit	4096	1000	gcc.out	14654608	13695288	0.93454	959320	0.06546	1.73312
gshare	4096	1000	gcc.out	14654608	13096442	0.89367	1558166	0.10633	2.08845
2-bit	4096	2000	gcc.out	14653608	13694391	0.93454	959217	0.06546	1.72541
gshare	4096	2000	gcc.out	14653608	13095528	0.89367	1558080	0.10633	2.08697
2-bit	4096	5000	gcc.out	14650608	13692060	0.93457	958548	0.06543	1.72527
gshare	4096	5000	gcc.out	14650608	13093419	0.89371	1557189	0.10629	2.09102
2-bit	4096	10000	gcc.out	14645608	13687701	0.93459	957907	0.06541	1.72348
gshare	4096	10000	gcc.out	14645608	13089506	0.89375	1556102	0.10625	2.07867
2-bit	4096	20000	gcc.out	14635608	13678035	0.93457	957573	0.06543	1.73113
gshare	4096	20000	gcc.out	14635608	13080056	0.89372	1555552	0.10629	2.08864
always true			leela.out	15344502	9934322	0.64742	5410180	0.35258	1.23778

2-bit	512	0	leela.out	15344502	13557316	0.88353	1787186	0.11647	1.76443
gshare	512	0	leela.out	15344502	14362502	0.93600	982000	0.06400	2.08815
2-bit	512	100	leela.out	15344402	13557247	0.88353	1787155	0.11647	1.75677
gshare	512	100	leela.out	15344402	14362442	0.93601	981960	0.06400	2.09498
2-bit	512	500	leela.out	15344002	13556869	0.88353	1787133	0.11647	1.75308
gshare	512	500	leela.out	15344002	14362077	0.93601	981925	0.06399	2.10046
2-bit	512	1000	leela.out	15343502	13556447	0.88353	1787055	0.11647	1.75740
gshare	512	1000	leela.out	15343502	14361654	0.93601	981848	0.06399	2.09021
2-bit	512	2000	leela.out	15342502	13555550	0.88353	1786952	0.11647	1.76100
gshare	512	2000	leela.out	15342502	14360728	0.93601	981774	0.06399	2.09955
2-bit	512	5000	leela.out	15339502	13553288	0.88356	1786214	0.11645	1.76514
gshare	512	5000	leela.out	15339502	14358662	0.93606	980840	0.06394	2.09445
2-bit	512	10000	leela.out	15334502	13549169	0.88357	1785333	0.11643	1.75072
gshare	512	10000	leela.out	15334502	14355056	0.93613	979446	0.06387	2.09638
2-bit	512	20000	leela.out	15324502	13539794	0.88354	1784708	0.11646	1.75176
gshare	512	20000	leela.out	15324502	14346126	0.93616	978376	0.06384	2.09350
2-bit	1024	0	leela.out	15344502	13562236	0.88385	1782266	0.11615	1.75717
gshare	1024	0	leela.out	15344502	14491535	0.94441	852967	0.05559	2.08825
2-bit	1024	100	leela.out	15344402	13562167	0.88385	1782235	0.11615	1.76017
gshare	1024	100	leela.out	15344402	14491478	0.94442	852924	0.05559	2.09166
2-bit	1024	500	leela.out	15344002	13561788	0.88385	1782214	0.11615	1.75820
gshare	1024	500	leela.out	15344002	14491114	0.94442	852888	0.05558	2.09423
2-bit	1024	1000	leela.out	15343502	13561363	0.88385	1782139	0.11615	1.75605
gshare	1024	1000	leela.out	15343502	14490688	0.94442	852814	0.05558	2.09740
2-bit	1024	2000	leela.out	15342502	13560466	0.88385	1782036	0.11615	1.75746
gshare	1024	2000	leela.out	15342502	14489757	0.94442	852745	0.05558	2.08812
2-bit	1024	5000	leela.out	15339502	13558161	0.88387	1781341	0.11613	1.76554
gshare	1024	5000	leela.out	15339502	14487693	0.94447	851809	0.05553	2.09236
2-bit	1024	10000	leela.out	15334502	13553915	0.88388	1780587	0.11612	1.75837
gshare	1024	10000	leela.out	15334502	14483923	0.94453	850579	0.05547	2.09274
2-bit	1024	20000	leela.out	15324502	13544493	0.88385	1780009	0.11615	1.76030
gshare	1024	20000	leela.out	15324502	14474927	0.94456	849575	0.05544	2.09537
2-bit	2048	0	leela.out	15344502	13562748	0.88388	1781754	0.11612	1.75998

gshare	2048	0	leela.out	15344502	14559987	0.94887	784515	0.05113	2.08886
2-bit	2048	100	leela.out	15344402	13562679	0.88388	1781723	0.11612	1.75904
gshare	2048	100	leela.out	15344402	14559932	0.94888	784470	0.05112	2.08590
2-bit	2048	500	leela.out	15344002	13562301	0.88388	1781701	0.11612	1.75964
gshare	2048	500	leela.out	15344002	14559572	0.94888	784430	0.05112	2.08712
2-bit	2048	1000	leela.out	15343502	13561876	0.88388	1781626	0.11612	1.75780
gshare	2048	1000	leela.out	15343502	14559153	0.94888	784349	0.05112	2.12778
2-bit	2048	2000	leela.out	15342502	13560979	0.88388	1781523	0.11612	1.75757
gshare	2048	2000	leela.out	15342502	14558222	0.94888	784280	0.05112	2.09299
2-bit	2048	5000	leela.out	15339502	13558651	0.88390	1780851	0.11610	1.75857
gshare	2048	5000	leela.out	15339502	14556109	0.94893	783393	0.05107	2.08429
2-bit	2048	10000	leela.out	15334502	13554368	0.88391	1780134	0.11609	1.76052
gshare	2048	10000	leela.out	15334502	14552220	0.94899	782282	0.05102	2.08939
2-bit	2048	20000	leela.out	15324502	13544922	0.88387	1779580	0.11613	1.75718
gshare	2048	20000	leela.out	15324502	14543201	0.94902	781301	0.05098	2.09593
2-bit	4096	0	leela.out	15344502	13563846	0.88396	1780656	0.11605	1.75742
gshare	4096	0	leela.out	15344502	14646571	0.95452	697931	0.04548	2.09141
2-bit	4096	100	leela.out	15344402	13563777	0.88396	1780625	0.11604	1.75514
gshare	4096	100	leela.out	15344402	14646517	0.95452	697885	0.04548	2.08628
2-bit	4096	500	leela.out	15344002	13563399	0.88395	1780603	0.11605	1.76345
gshare	4096	500	leela.out	15344002	14646158	0.95452	697844	0.04548	2.08374
2-bit	4096	1000	leela.out	15343502	13562974	0.88396	1780528	0.11604	1.75900
gshare	4096	1000	leela.out	15343502	14645748	0.95452	697754	0.04548	2.09012
2-bit	4096	2000	leela.out	15342502	13562077	0.88396	1780425	0.11605	1.76015
gshare	4096	2000	leela.out	15342502	14644834	0.95453	697668	0.04547	2.09413
2-bit	4096	5000	leela.out	15339502	13559747	0.88398	1779755	0.11602	1.75538
gshare	4096	5000	leela.out	15339502	14642736	0.95458	696766	0.04542	2.08641
2-bit	4096	10000	leela.out	15334502	13555386	0.88398	1779116	0.11602	1.76358
gshare	4096	10000	leela.out	15334502	14638717	0.95463	695785	0.04537	2.08537
2-bit	4096	20000	leela.out	15324502	13545934	0.88394	1778568	0.11606	1.77112
gshare	4096	20000	leela.out	15324502	14629650	0.95466	694852	0.04534	2.08792
always true			povray.out	15024530	8248924	0.54903	6775606	0.45097	1.27437
2-bit	512	0	povray.out	15024530	13564474	0.90282	1460056	0.09718	1.78695

x

gshare	512	0	povray.out	15024530	12924724	0.86024	2099806	0.13976	2.14980
2-bit	512	100	povray.out	15024430	13564405	0.90282	1460025	0.09718	1.78130
gshare	512	100	povray.out	15024430	12924664	0.86024	2099766	0.13976	2.15826
2-bit	512	500	povray.out	15024030	13564027	0.90282	1460003	0.09718	1.77727
gshare	512	500	povray.out	15024030	12924299	0.86024	2099731	0.13976	2.15735
2-bit	512	1000	povray.out	15023530	13563605	0.90282	1459925	0.09718	1.78198
gshare	512	1000	povray.out	15023530	12923876	0.86024	2099654	0.13976	2.15009
2-bit	512	2000	povray.out	15022530	13562716	0.90283	1459814	0.09718	1.78692
gshare	512	2000	povray.out	15022530	12922954	0.86024	2099576	0.13976	2.15179
2-bit	512	5000	povray.out	15019530	13560431	0.90285	1459099	0.09715	1.79085
gshare	512	5000	povray.out	15019530	12920853	0.86027	2098677	0.13973	2.14764
2-bit	512	10000	povray.out	15014530	13556312	0.90288	1458218	0.09712	1.78164
gshare	512	10000	povray.out	15014530	12917269	0.86032	2097261	0.13968	2.15397
2-bit	512	20000	povray.out	15004530	13546967	0.90286	1457563	0.09714	1.78425
gshare	512	20000	povray.out	15004530	12908365	0.86030	2096165	0.13970	2.15135
2-bit	1024	0	povray.out	15024530	13913197	0.92603	1111333	0.07397	1.76891
gshare	1024	0	povray.out	15024530	13403728	0.89212	1620802	0.10788	2.13085
2-bit	1024	100	povray.out	15024430	13913128	0.92603	1111302	0.07397	1.77825
gshare	1024	100	povray.out	15024430	13403671	0.89213	1620759	0.10788	2.13514
2-bit	1024	500	povray.out	15024030	13912749	0.92603	1111281	0.07397	1.77032
gshare	1024	500	povray.out	15024030	13403307	0.89213	1620723	0.10788	2.16410
2-bit	1024	1000	povray.out	15023530	13912324	0.92604	1111206	0.07396	1.77345
gshare	1024	1000	povray.out	15023530	13402881	0.89213	1620649	0.10787	2.14687
2-bit	1024	2000	povray.out	15022530	13911435	0.92604	1111095	0.07396	1.77396
gshare	1024	2000	povray.out	15022530	13401954	0.89212	1620576	0.10788	2.12794
2-bit	1024	5000	povray.out	15019530	13909112	0.92607	1110418	0.07393	1.78173
gshare	1024	5000	povray.out	15019530	13399863	0.89216	1619667	0.10784	2.13315
2-bit	1024	10000	povray.out	15014530	13904879	0.92610	1109651	0.07391	1.78234
gshare	1024	10000	povray.out	15014530	13396086	0.89221	1618444	0.10779	2.13478
2-bit	1024	20000	povray.out	15004530	13895497	0.92609	1109033	0.07391	1.77406
gshare	1024	20000	povray.out	15004530	13387135	0.89221	1617395	0.10779	2.14069
2-bit	2048	0	povray.out	15024530	14145613	0.94150	878917	0.05850	1.76647
gshare	2048	0	povray.out	15024530	13775550	0.91687	1248980	0.08313	2.13630

2-bit	2048	100	povray.out	15024430	14145544	0.94150	878886	0.05850	1.76614
gshare	2048	100	povray.out	15024430	13775495	0.91687	1248935	0.08313	2.13329
2-bit	2048	500	povray.out	15024030	14145166	0.94150	878864	0.05850	1.77111
gshare	2048	500	povray.out	15024030	13775135	0.91687	1248895	0.08313	2.12759
2-bit	2048	1000	povray.out	15023530	14144741	0.94151	878789	0.05849	1.77385
gshare	2048	1000	povray.out	15023530	13774716	0.91688	1248814	0.08312	2.12856
2-bit	2048	2000	povray.out	15022530	14143852	0.94151	878678	0.05849	1.76468
gshare	2048	2000	povray.out	15022530	13773789	0.91688	1248741	0.08313	2.13431
2-bit	2048	5000	povray.out	15019530	14141507	0.94154	878023	0.05846	1.76401
gshare	2048	5000	povray.out	15019530	13771646	0.91692	1247884	0.08308	2.13207
2-bit	2048	10000	povray.out	15014530	14137233	0.94157	877297	0.05843	1.76398
gshare	2048	10000	povray.out	15014530	13767742	0.91696	1246788	0.08304	2.12589
2-bit	2048	20000	povray.out	15004530	14127823	0.94157	876707	0.05843	1.76756
gshare	2048	20000	povray.out	15004530	13758747	0.91697	1245783	0.08303	2.12758
2-bit	4096	0	povray.out	15024530	14244237	0.94807	780293	0.05194	1.76329
gshare	4096	0	povray.out	15024530	14049519	0.93511	975011	0.06490	2.12793
2-bit	4096	100	povray.out	15024430	14244168	0.94807	780262	0.05193	1.76421
gshare	4096	100	povray.out	15024430	14049465	0.93511	974965	0.06489	2.12839
2-bit	4096	500	povray.out	15024030	14243790	0.94807	780240	0.05193	1.76299
gshare	4096	500	povray.out	15024030	14049106	0.93511	974924	0.06489	2.12033
2-bit	4096	1000	povray.out	15023530	14243365	0.94807	780165	0.05193	1.76950
gshare	4096	1000	povray.out	15023530	14048698	0.93511	974832	0.06489	2.12012
2-bit	4096	2000	povray.out	15022530	14242476	0.94807	780054	0.05193	1.77086
gshare	4096	2000	povray.out	15022530	14047786	0.93512	974744	0.06489	2.11887
2-bit	4096	5000	povray.out	15019530	14240129	0.94811	779401	0.05189	1.76223
gshare	4096	5000	povray.out	15019530	14045657	0.93516	973873	0.06484	2.12497
2-bit	4096	10000	povray.out	15014530	14235777	0.94813	778753	0.05187	1.76474
gshare	4096	10000	povray.out	15014530	14041597	0.93520	972933	0.06480	2.12469
2-bit	4096	20000	povray.out	15004530	14226359	0.94814	778171	0.05186	1.76382
gshare	4096	20000	povray.out	15004530	14032562	0.93522	971968	0.06478	2.12023
always true			wrf.out	14488676	12470050	0.86068	2018626	0.13932	1.10973
2-bit	512	0	wrf.out	14488676	14204982	0.98042	283694	0.01958	1.56372
gshare	512	0	wrf.out	14488676	14105763	0.97357	382913	0.02643	1.89618

2-bit	512	100	wrf.out	14488576	14204913	0.98042	283663	0.01958	1.57506
gshare	512	100	wrf.out	14488576	14105703	0.97357	382873	0.02643	1.89530
2-bit	512	500	wrf.out	14488176	14204535	0.98042	283641	0.01958	1.56911
gshare	512	500	wrf.out	14488176	14105338	0.97358	382838	0.02642	1.90278
2-bit	512	1000	wrf.out	14487676	14204113	0.98043	283563	0.01957	1.57072
gshare	512	1000	wrf.out	14487676	14104915	0.97358	382761	0.02642	1.89541
2-bit	512	2000	wrf.out	14486676	14203216	0.98043	283460	0.01957	1.56979
gshare	512	2000	wrf.out	14486676	14103989	0.97358	382687	0.02642	1.92935
2-bit	512	5000	wrf.out	14483676	14200938	0.98048	282738	0.01952	1.56702
gshare	512	5000	wrf.out	14483676	14101902	0.97364	381774	0.02636	1.90140
2-bit	512	10000	wrf.out	14478676	14196859	0.98054	281817	0.01946	1.56558
gshare	512	10000	wrf.out	14478676	14098314	0.97373	380362	0.02627	1.89717
2-bit	512	20000	wrf.out	14468676	14187733	0.98058	280943	0.01942	1.57129
gshare	512	20000	wrf.out	14468676	14089865	0.97382	378811	0.02618	1.89220
2-bit	1024	0	wrf.out	14488676	14243667	0.98309	245009	0.01691	1.56710
gshare	1024	0	wrf.out	14488676	14172271	0.97816	316405	0.02184	1.90227
2-bit	1024	100	wrf.out	14488576	14243598	0.98309	244978	0.01691	1.56659
gshare	1024	100	wrf.out	14488576	14172214	0.97817	316362	0.02184	1.89347
2-bit	1024	500	wrf.out	14488176	14243219	0.98309	244957	0.01691	1.56882
gshare	1024	500	wrf.out	14488176	14171850	0.97817	316326	0.02183	1.89805
2-bit	1024	1000	wrf.out	14487676	14242794	0.98310	244882	0.01690	1.56651
gshare	1024	1000	wrf.out	14487676	14171424	0.97817	316252	0.02183	1.89458
2-bit	1024	2000	wrf.out	14486676	14241897	0.98310	244779	0.01690	1.56521
gshare	1024	2000	wrf.out	14486676	14170493	0.97817	316183	0.02183	1.90084
2-bit	1024	5000	wrf.out	14483676	14239581	0.98315	244095	0.01685	1.56129
gshare	1024	5000	wrf.out	14483676	14168409	0.97823	315267	0.02177	1.89374
2-bit	1024	10000	wrf.out	14478676	14235355	0.98320	243321	0.01681	1.57149
gshare	1024	10000	wrf.out	14478676	14164615	0.97831	314061	0.02169	1.94200
2-bit	1024	20000	wrf.out	14468676	14226170	0.98324	242506	0.01676	1.56970
gshare	1024	20000	wrf.out	14468676	14156017	0.97839	312659	0.02161	1.90021
2-bit	2048	0	wrf.out	14488676	14258771	0.98413	229905	0.01587	1.55961
gshare	2048	0	wrf.out	14488676	14218182	0.98133	270494	0.01867	1.89290
2-bit	2048	100	wrf.out	14488576	14258702	0.98413	229874	0.01587	1.57232

gshare	2048	100	wrf.out	14488576	14218127	0.98133	270449	0.01867	1.89838
2-bit	2048	500	wrf.out	14488176	14258324	0.98414	229852	0.01587	1.56492
gshare	2048	500	wrf.out	14488176	14217767	0.98134	270409	0.01866	1.89706
2-bit	2048	1000	wrf.out	14487676	14257899	0.98414	229777	0.01586	1.56196
gshare	2048	1000	wrf.out	14487676	14217348	0.98134	270328	0.01866	1.89351
2-bit	2048	2000	wrf.out	14486676	14257002	0.98415	229674	0.01585	1.55949
gshare	2048	2000	wrf.out	14486676	14216417	0.98134	270259	0.01866	1.89483
2-bit	2048	5000	wrf.out	14483676	14254668	0.98419	229008	0.01581	1.56494
gshare	2048	5000	wrf.out	14483676	14214281	0.98140	269395	0.01860	1.89824
2-bit	2048	10000	wrf.out	14478676	14250396	0.98423	228280	0.01577	1.56545
gshare	2048	10000	wrf.out	14478676	14210349	0.98147	268327	0.01853	1.89940
2-bit	2048	20000	wrf.out	14468676	14241199	0.98428	227477	0.01572	1.57257
gshare	2048	20000	wrf.out	14468676	14201714	0.98155	266962	0.01845	1.89322
2-bit	4096	0	wrf.out	14488676	14307943	0.98753	180733	0.01247	1.56527
gshare	4096	0	wrf.out	14488676	14236450	0.98259	252226	0.01741	1.89467
2-bit	4096	100	wrf.out	14488576	14307874	0.98753	180702	0.01247	1.56156
gshare	4096	100	wrf.out	14488576	14236396	0.98260	252180	0.01741	1.90107
2-bit	4096	500	wrf.out	14488176	14307496	0.98753	180680	0.01247	1.56439
gshare	4096	500	wrf.out	14488176	14236037	0.98260	252139	0.01740	1.89429
2-bit	4096	1000	wrf.out	14487676	14307071	0.98753	180605	0.01247	1.57029
gshare	4096	1000	wrf.out	14487676	14235627	0.98260	252049	0.01740	1.89149
2-bit	4096	2000	wrf.out	14486676	14306174	0.98754	180502	0.01246	1.56346
gshare	4096	2000	wrf.out	14486676	14234713	0.98261	251963	0.01739	1.90055
2-bit	4096	5000	wrf.out	14483676	14303839	0.98758	179837	0.01242	1.56380
gshare	4096	5000	wrf.out	14483676	14232594	0.98266	251082	0.01734	1.89064
2-bit	4096	10000	wrf.out	14478676	14299492	0.98762	179184	0.01238	1.56847
gshare	4096	10000	wrf.out	14478676	14228510	0.98272	250166	0.01728	1.88986
2-bit	4096	20000	wrf.out	14468676	14290271	0.98767	178405	0.01233	1.56017
gshare	4096	20000	wrf.out	14468676	14219789	0.98280	248887	0.01720	1.90171
always true			xz.out	15291703	10007088	0.65441	5284615	0.34559	1.28634
2-bit	512	0	xz.out	15291703	13206384	0.86363	2085319	0.13637	1.81454
gshare	512	0	xz.out	15291703	12143981	0.79416	3147722	0.20585	2.21027
2-bit	512	100	xz.out	15291603	13206315	0.86363	2085288	0.13637	1.81490

gshare	512	100	xz.out	15291603	12143921	0.79416	3147682	0.20584	2.21362
2-bit	512	500	xz.out	15291203	13205937	0.86363	2085266	0.13637	1.81268
gshare	512	500	xz.out	15291203	12143556	0.79415	3147647	0.20585	2.20433
2-bit	512	1000	xz.out	15290703	13205515	0.86363	2085188	0.13637	1.81854
gshare	512	1000	xz.out	15290703	12143133	0.79415	3147570	0.20585	2.19521
2-bit	512	2000	xz.out	15289703	13204618	0.86363	2085085	0.13637	1.82211
gshare	512	2000	xz.out	15289703	12142207	0.79414	3147496	0.20586	2.20446
2-bit	512	5000	xz.out	15286703	13202373	0.86365	2084330	0.13635	1.81320
gshare	512	5000	xz.out	15286703	12140175	0.79417	3146528	0.20583	2.21355
2-bit	512	10000	xz.out	15281703	13197772	0.86363	2083931	0.13637	1.81375
gshare	512	10000	xz.out	15281703	12135766	0.79414	3145937	0.20586	2.21139
2-bit	512	20000	xz.out	15271703	13188585	0.86360	2083118	0.13640	1.81150
gshare	512	20000	xz.out	15271703	12126965	0.79408	3144738	0.20592	2.20765
2-bit	1024	0	xz.out	15291703	13362425	0.87384	1929278	0.12617	1.81486
gshare	1024	0	xz.out	15291703	12375602	0.80930	2916101	0.19070	2.20073
2-bit	1024	100	xz.out	15291603	13362356	0.87384	1929247	0.12616	1.81634
gshare	1024	100	xz.out	15291603	12375545	0.80930	2916058	0.19070	2.20113
2-bit	1024	500	xz.out	15291203	13361977	0.87383	1929226	0.12617	1.80895
gshare	1024	500	xz.out	15291203	12375181	0.80930	2916022	0.19070	2.20512
2-bit	1024	1000	xz.out	15290703	13361552	0.87384	1929151	0.12617	1.80282
gshare	1024	1000	xz.out	15290703	12374755	0.80930	2915948	0.19070	2.20756
2-bit	1024	2000	xz.out	15289703	13360655	0.87383	1929048	0.12617	1.80754
gshare	1024	2000	xz.out	15289703	12373824	0.80929	2915879	0.19071	2.20293
2-bit	1024	5000	xz.out	15286703	13358371	0.87386	1928332	0.12614	1.81687
gshare	1024	5000	xz.out	15286703	12371788	0.80932	2914915	0.19068	2.19890
2-bit	1024	10000	xz.out	15281703	13353751	0.87384	1927952	0.12616	1.81721
gshare	1024	10000	xz.out	15281703	12367415	0.80930	2914288	0.19070	2.20297
2-bit	1024	20000	xz.out	15271703	13344361	0.87380	1927342	0.12620	1.80691
gshare	1024	20000	xz.out	15271703	12358429	0.80924	2913274	0.19076	2.20518
2-bit	2048	0	xz.out	15291703	13403867	0.87655	1887836	0.12346	1.80824
gshare	2048	0	xz.out	15291703	12557840	0.82122	2733863	0.17878	2.20310
2-bit	2048	100	xz.out	15291603	13403798	0.87655	1887805	0.12345	1.80793
gshare	2048	100	xz.out	15291603	12557785	0.82122	2733818	0.17878	2.20356

2-bit	2048	500	xz.out	15291203	13403420	0.87655	1887783	0.12346	1.81045
gshare	2048	500	xz.out	15291203	12557425	0.82122	2733778	0.17878	2.19400
2-bit	2048	1000	xz.out	15290703	13402995	0.87655	1887708	0.12346	1.81499
gshare	2048	1000	xz.out	15290703	12557006	0.82122	2733697	0.17878	2.19717
2-bit	2048	2000	xz.out	15289703	13402098	0.87654	1887605	0.12346	1.81963
gshare	2048	2000	xz.out	15289703	12556075	0.82121	2733628	0.17879	2.20249
2-bit	2048	5000	xz.out	15286703	13399795	0.87657	1886908	0.12344	1.80891
gshare	2048	5000	xz.out	15286703	12553984	0.82124	2732719	0.17876	2.20305
2-bit	2048	10000	xz.out	15281703	13395173	0.87655	1886530	0.12345	1.80930
gshare	2048	10000	xz.out	15281703	12549585	0.82122	2732118	0.17878	2.20224
2-bit	2048	20000	xz.out	15271703	13385783	0.87651	1885920	0.12349	1.80718
gshare	2048	20000	xz.out	15271703	12540543	0.82116	2731160	0.17884	2.19807
2-bit	4096	0	xz.out	15291703	13408113	0.87682	1883590	0.12318	1.81014
gshare	4096	0	xz.out	15291703	12757376	0.83427	2534327	0.16573	2.19338
2-bit	4096	100	xz.out	15291603	13408044	0.87682	1883559	0.12318	1.80543
gshare	4096	100	xz.out	15291603	12757322	0.83427	2534281	0.16573	2.19462
2-bit	4096	500	xz.out	15291203	13407666	0.87682	1883537	0.12318	1.80372
gshare	4096	500	xz.out	15291203	12756963	0.83427	2534240	0.16573	2.22394
2-bit	4096	1000	xz.out	15290703	13407241	0.87682	1883462	0.12318	1.80985
gshare	4096	1000	xz.out	15290703	12756553	0.83427	2534150	0.16573	2.19940
2-bit	4096	2000	xz.out	15289703	13406344	0.87682	1883359	0.12318	1.81023
gshare	4096	2000	xz.out	15289703	12755639	0.83426	2534064	0.16574	2.19112
2-bit	4096	5000	xz.out	15286703	13404037	0.87684	1882666	0.12316	1.81673
gshare	4096	5000	xz.out	15286703	12753566	0.83429	2533137	0.16571	2.18991
2-bit	4096	10000	xz.out	15281703	13399395	0.87683	1882308	0.12317	1.81804
gshare	4096	10000	xz.out	15281703	12749168	0.83428	2532535	0.16572	2.19174
2-bit	4096	20000	xz.out	15271703	13389990	0.87678	1881713	0.12322	1.80732
gshare	4096	20000	xz.out	15271703	12740050	0.83423	2531653	0.16577	2.19494