

SUMMARY GOES HERE, FOR THE INTERESTING PART SCROLL FURTHER:

Ultimately the cooperation between the CPU and the GPU processors is the most efficient method since while waiting for memory transfer to complete the CPU performs its work.

The CPU's algorithm performance is greatly improved because all graphs are partitioned into groups and accessed by all threads instead of frequently polling for a next problem.

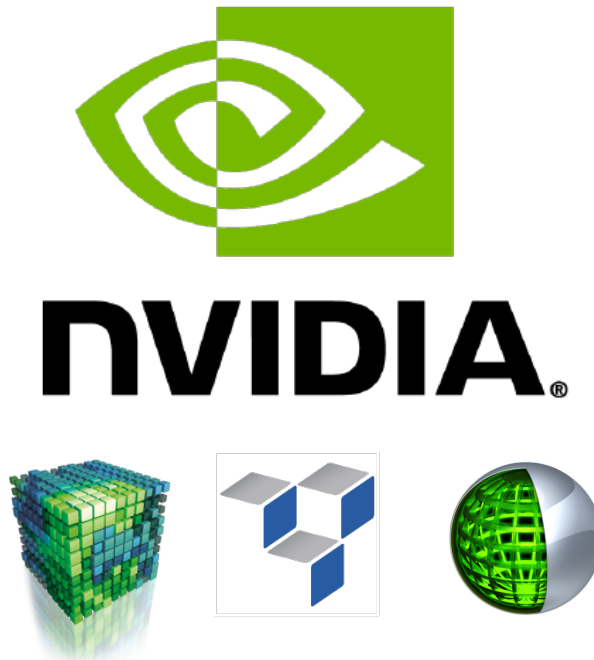
All threads allocate the least amount of memory possible and allocate it only (!) once. Then on almost only computations reuse existing arrays to the maximum possible extent. Both winning algorithms were improved by limiting LINQ usage and reverting to the good old arrays and indices (thus limiting unnecessary array creation operations).

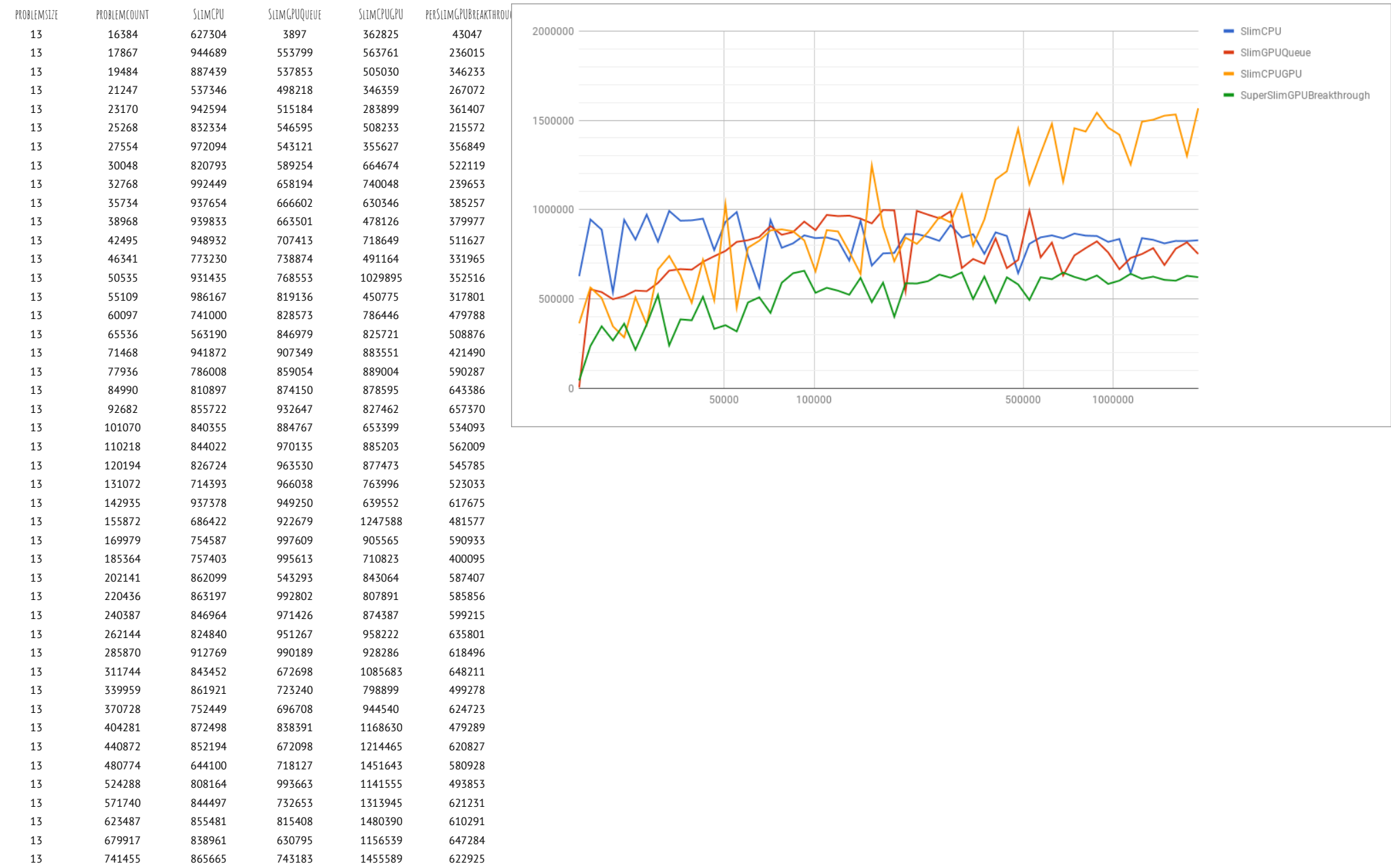
Now each virtual processor accesses its own part of the whole array (actually it accesses the original large array only within the appropriate range). Previous generations of CPU algorithms were poor at being computed in parallel. PLINQ was used, along with AsOrdered command which dramatically slowed down execution time.

This technique allows for full processor utilization thus outperforming the GPU.

Initial poor GPU performance is the effect of lazy PTX instructions compiling (JIT compiling)

All in all the best GPU algorithm turns out to be a smartly scaled up and highly parallelized CPU algorithm (smart BFS queue)

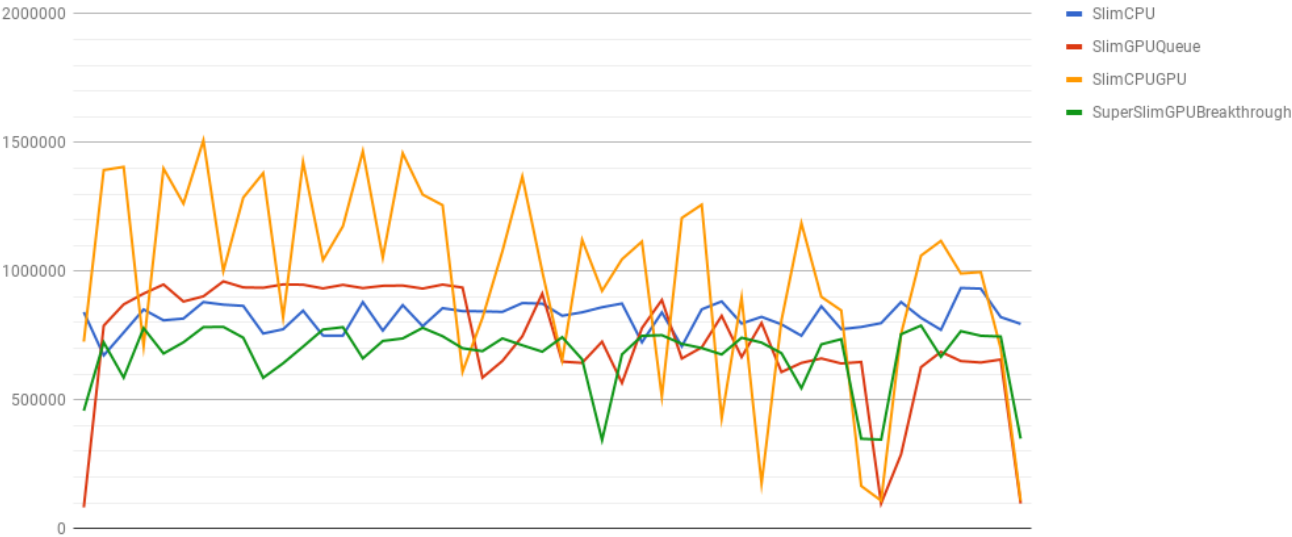




13	808563	854089	784166	1437211	604469
13	881744	851952	822225	1542784	630906
13	961548	819131	760034	1458871	583578
13	1048576	835390	666127	1419290	602201
13	1143480	644332	729098	1252357	640552
13	1246974	840213	751079	1492123	612747
13	1359835	830577	784107	1503364	624580
13	1482910	810559	689484	1525895	606506
13	1617125	824567	780671	1532582	601771
13	1763488	823858	816607	1300797	629107
13	1923097	828175	751533	1567757	621621

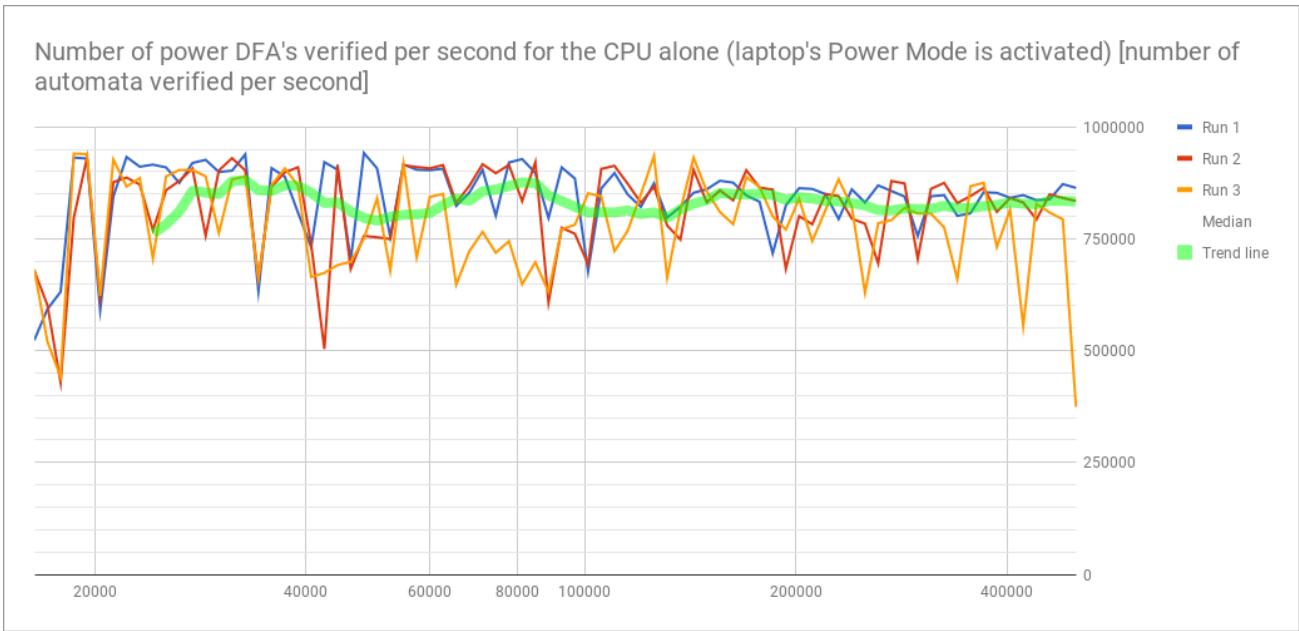
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13	131072	841212	82417	726395	457840
13	131072	672901	788495	1393094	723483
13	131072	761724	871187	1405488	586530
13	131072	851372	912909	709401	778820
13	131072	809197	948527	1398994	680177
13	131072	816102	882189	1262629	723859
13	131072	880140	902437	1508451	782696
13	131072	870152	960569	1000665	783786
13	131072	865351	937128	1285922	741707
13	131072	757925	935680	1381395	585813
13	131072	774501	948859	820567	642326
13	131072	846754	947561	1424545	706960
13	131072	750003	933207	1043450	773483
13	131072	749946	947055	1175045	782609
13	131072	879882	934407	1466064	661153
13	131072	769197	943344	1053052	728973
13	131072	868374	944385	1458659	738803
13	131072	786372	932641	1297815	780073
13	131072	856473	948016	1256716	747514
13	131072	845042	936477	609041	700710
13	131072	844184	586563	818486	689446
13	131072	842076	651324	1077428	738916
13	131072	876202	747236	1368017	712306
13	131072	874171	912965	998529	687334
13	131072	827040	648767	655456	743721
13	131072	840303	643925	1122206	657554
13	131072	860033	726149	923470	344018
13	131072	874522	565747	1046482	676757
13	131072	723631	778875	1115280	749021
13	131072	840001	888308	512794	751509
13	131072	708051	660655	1206938	717847
13	131072	851858	704135	1258633	701469
13	131072	882693	826769	428556	676617
13	131072	796669	666338	897991	741545
13	131072	822727	798916	175470	722767
13	131072	793550	608126	808738	681536
13	131072	749388	643734	1186842	545577
13	131072	863560	661025	900694	715846
13	131072	774842	641602	847571	736030
13	131072	783340	647383	165576	348944
13	131072	798326	97726	108573	345635
13	131072	880298	288091	755934	755170
13	131072	818946	627217	1060608	788851

Constant problem count (131k) [number of automata verified per second]



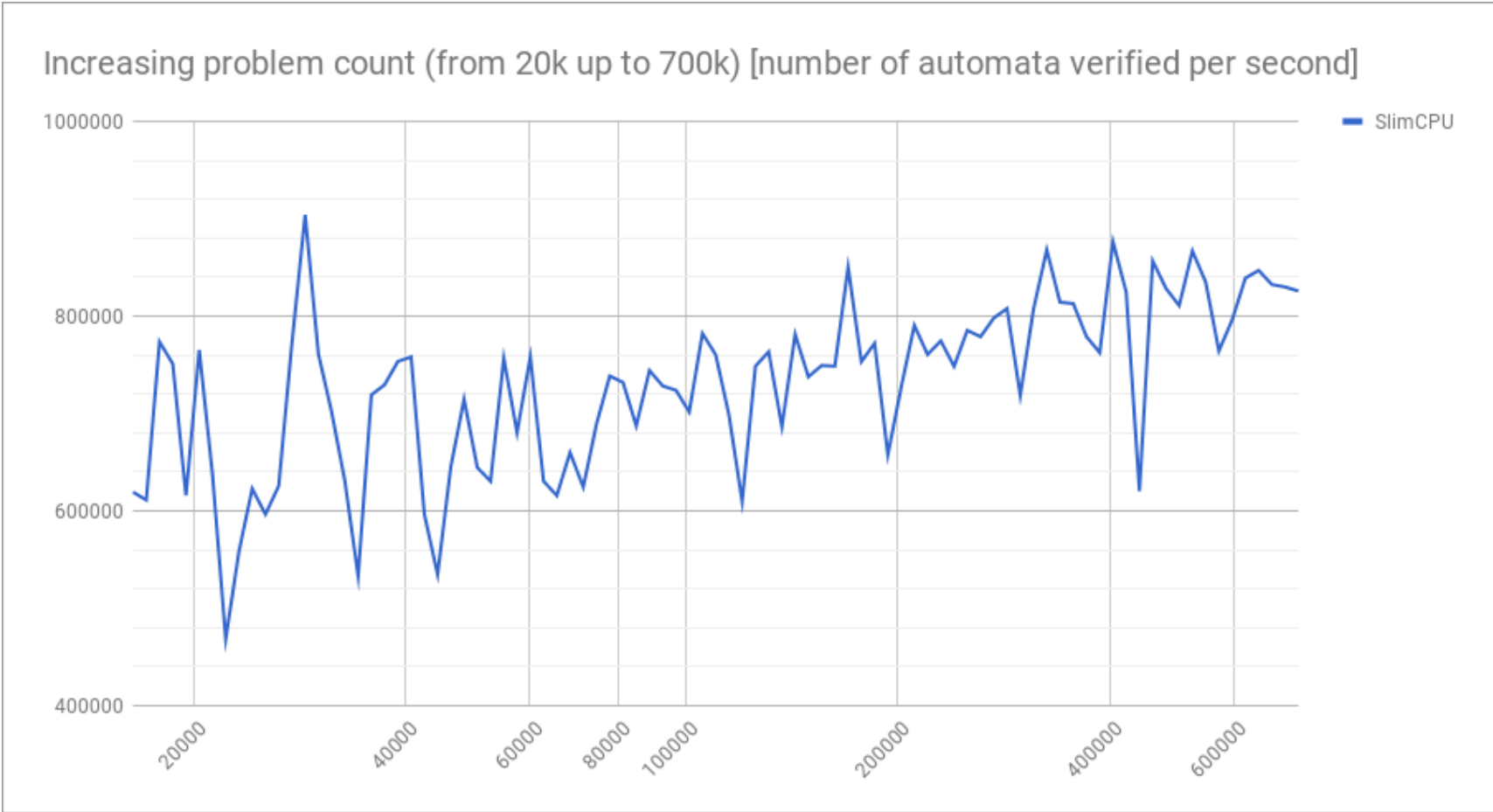
13	131072	772197	686761	1117950	667673
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13	131072	932391	645263	996722	749226
13	131072	821815	656812	699718	746191
13	131072	795350	97428	107791	349626

PROBLEMSIZE	PROBLEM COUNT	RUN 1	RUN 2	RUN 3	MEDIAN
13	16384	523273	679011	682192	679011
13	17109	592795	601840	520427	592795
13	17867	631519	428807	440988	440988
13	18658	931424	797006	940523	931424
13	19484	929372	931473	938812	931473
13	20347	590343	618236	622545	618236
13	21247	844566	876646	927124	876646
13	22188	932802	886825	866878	886825
13	23170	911082	871295	885642	885642
13	24196	915721	769375	705933	769375
13	25268	909454	858769	889427	889427
13	26386	874818	879314	903664	879314
13	27554	919450	906898	903991	906898
13	28774	926377	756679	889572	889572
13	30048	899315	902649	762814	899315
13	31379	902281	930151	882774	902281
13	32768	938629	902956	889089	902956
13	34219	632650	662679	661473	661473
13	35734	907906	866466	870349	870349
13	37316	888817	898531	907393	898531
13	38968	808716	909762	869303	869303
13	40693	731161	737551	664747	731161
13	42495	921277	503834	673670	673670
13	44376	904431	915481	691260	904431
13	46341	702304	682529	698415	698415
13	48393	941764	756433	750367	756433
13	50535	907271	753410	840614	840614
13	52773	754193	749322	679022	749322
13	55109	916159	914385	917335	916159
13	57549	904398	910437	708232	904398
13	60097	903179	907485	843416	903179
13	62757	906669	914617	850503	906669
13	65536	823599	830352	647493	823599
13	68438	853359	868547	722636	853359
13	71468	904004	916682	765335	904004
13	74632	801694	896500	718716	801694
13	77936	920545	915133	744635	915133
13	81386	928108	834311	648358	834311
13	84990	897214	921086	697637	897214
13	88752	796373	607787	631550	631550
13	92682	909495	774642	771612	774642
13	96785	884616	761186	781207	781207
13	101070	677179	692877	851672	692877
13	105545	862507	906190	844763	862507
13	110218	896871	913038	722316	896871



13	115098	849148	873194	767739	849148
13	120194	821205	830687	849202	830687
13	125515	874032	866667	935333	874032
13	131072	797528	779634	663797	779634
13	136875	821265	748195	814649	814649
13	142935	852891	904053	931377	904053
13	149263	860606	831360	856127	856127
13	155872	879691	858287	809837	858287
13	162773	875579	835760	782540	835760
13	169979	846860	903284	887794	887794
13	177505	832874	864331	865985	864331
13	185364	717356	859994	800085	800085
13	193571	824550	682684	770361	770361
13	202141	862998	800644	839625	839625
13	211090	861384	782452	744806	782452
13	220436	849871	850063	814059	849871
13	230195	794147	845307	882874	845307
13	240387	860594	794997	821455	821455
13	251030	831065	783715	629628	783715
13	262144	869312	694962	784850	784850
13	273750	856895	879133	791524	856895
13	285870	844344	873689	819206	844344
13	298527	756204	705178	806605	756204
13	311744	845026	861591	806256	845026
13	325546	847434	874862	775565	847434
13	339959	801284	829718	659757	801284
13	355010	807089	845545	867365	845545
13	370728	854064	863792	875275	863792
13	387141	852593	810215	731633	810215
13	404281	841485	841036	815161	841036
13	422180	847456	831032	554556	831032
13	440872	836289	793167	828028	828028
13	460391	838043	849221	808838	838043
13	480774	872216	841273	793625	841273
13	502060	863729	834363	374377	834363

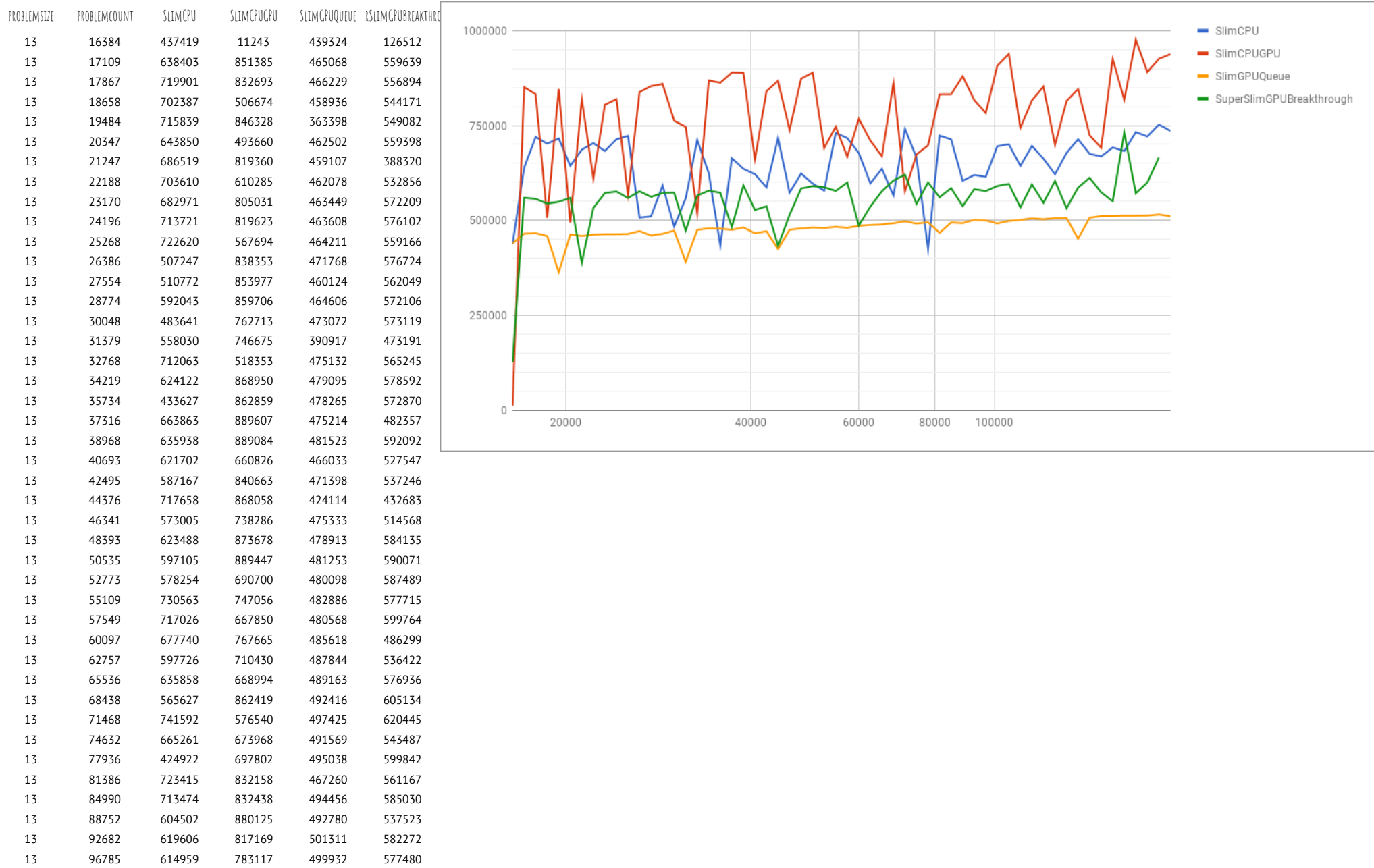
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13	17867	773671
13	18658	751100
13	19484	615787
13	20347	765296
13	21247	637543
13	22188	468331
13	23170	558315
13	24196	622778
13	25268	596493
13	26386	625621
13	27554	772457
13	28774	904095
13	30048	761071
13	31379	701426
13	32768	630431
13	34219	533009
13	35734	719139
13	37316	729633
13	38968	753500
13	40693	758145
13	42495	596404
13	44376	534775
13	46341	645492
13	48393	714642
13	50535	644499
13	52773	630402
13	55109	756744



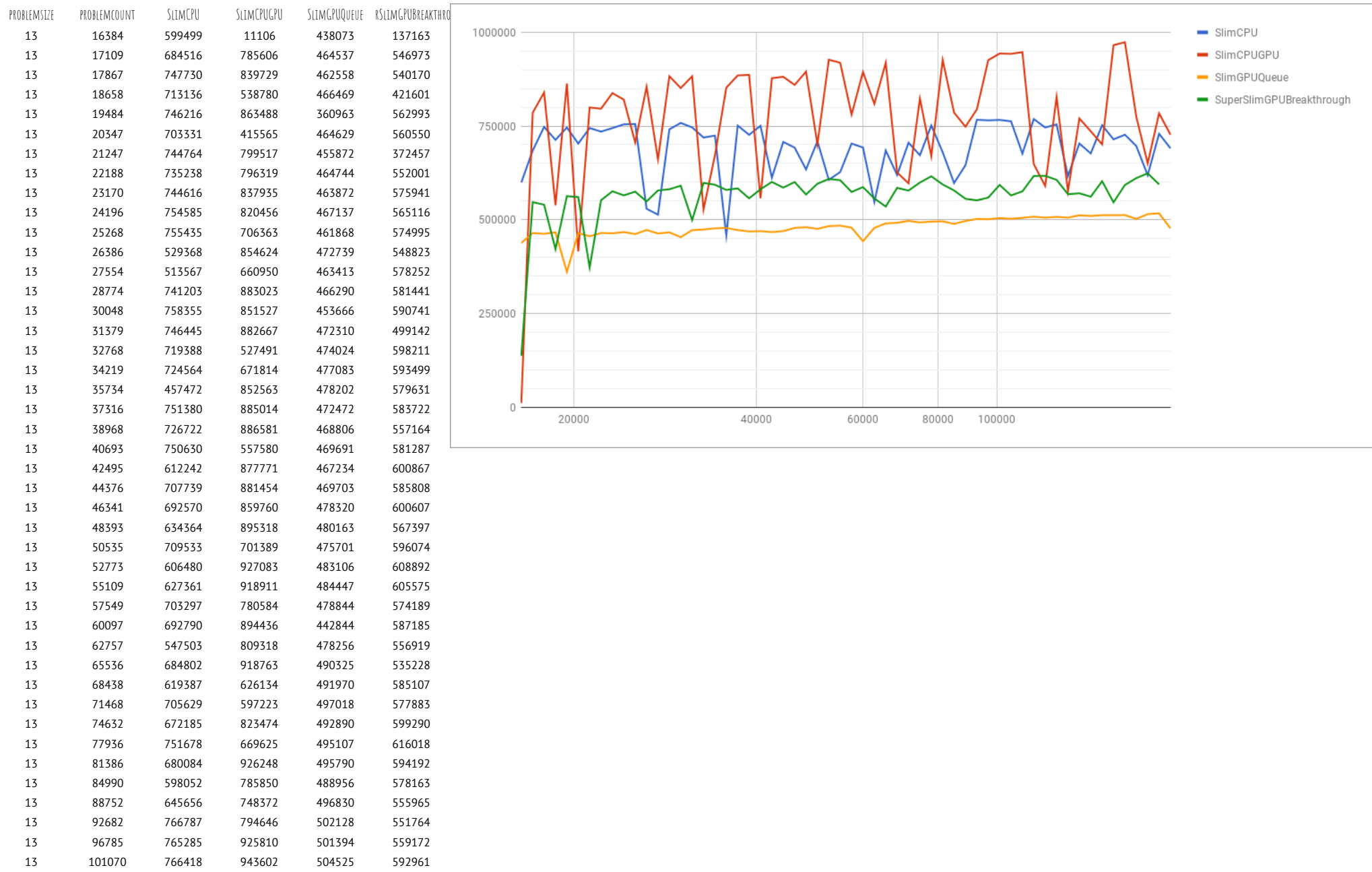
(CPU: 8-core i7-2600, unfortunately the compiler doesn't JIT compile for NVIDIA Quadro 2000).

13	57549	680464
13	60097	758264
13	62757	630546
13	65536	615754
13	68438	659871
13	71468	624476
13	74632	689312
13	77936	738577
13	81386	731989
13	84990	687371
13	88752	744207
13	92682	728357
13	96785	723875
13	101070	701712
13	105545	782201
13	110218	760386
13	115098	698651
13	120194	609531
13	125515	748576
13	131072	763482
13	136875	686630
13	142935	781189
13	149263	737758
13	155872	749346
13	162773	748685
13	169979	850596
13	177505	753279
13	185364	772144
13	193571	657566
13	202141	726607
13	211090	790517

13	220436	760681
13	230195	774590
13	240387	748480
13	251030	785379
13	262144	778931
13	273750	798076
13	285870	807883
13	298527	718488
13	311744	807338
13	325546	868094
13	339959	814366
13	355010	812929
13	370728	779002
13	387141	762546
13	404281	876485
13	422180	824681
13	440872	620299
13	460391	856750
13	480774	828580
13	502060	810952
13	524288	866865
13	547500	835110
13	571740	764416
13	597053	796140
13	623487	839157
13	651091	847037
13	679917	832519
13	710020	829953
13	741455	825860

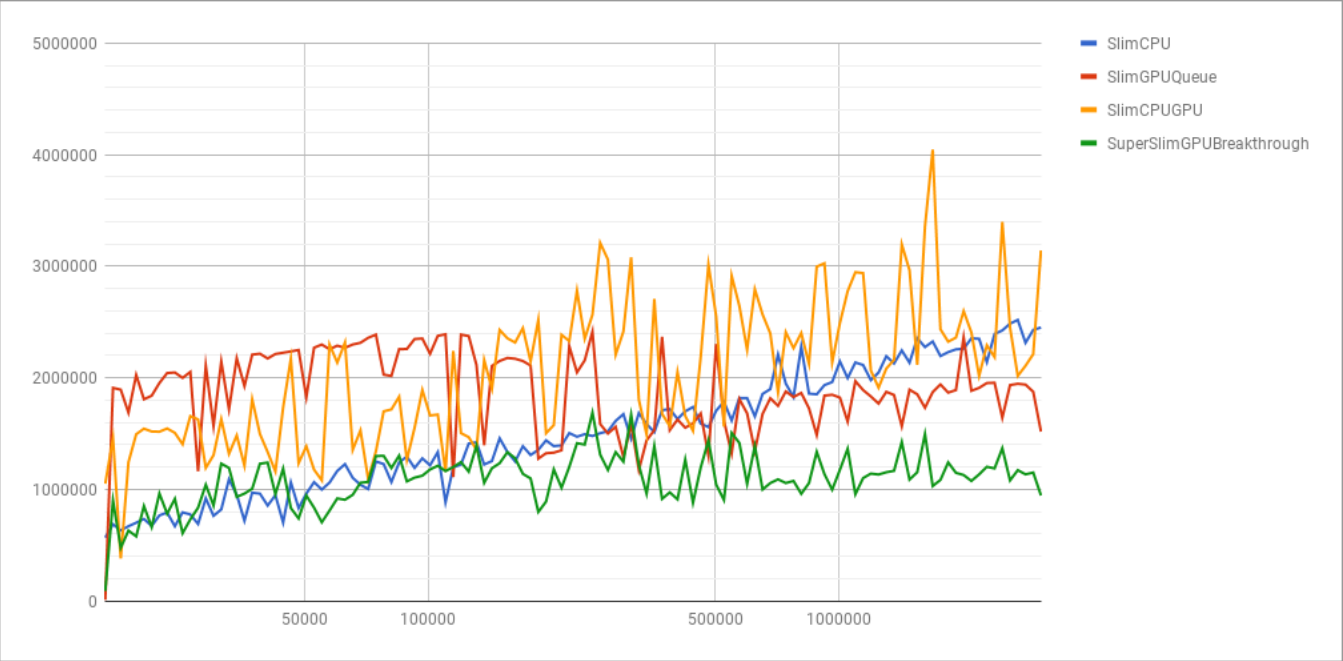


13	101070	695391	907661	491971	590613
13	105545	700526	938913	498500	595985
13	110218	643520	743916	501262	534176
13	115098	696203	816422	505342	594914
13	120194	662566	852686	503119	546341
13	125515	621545	698834	506149	603812
13	131072	677866	814840	506275	532089
13	136875	713893	846084	451614	586351
13	142935	675454	724317	507013	612342
13	149263	668488	691393	511486	573876
13	155872	692272	925550	511434	550527
13	162773	682912	818118	512225	731203
13	169979	732724	976214	512197	571490
13	177505	721259	890855	512464	599728
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13	193571	736053	938226	510808	



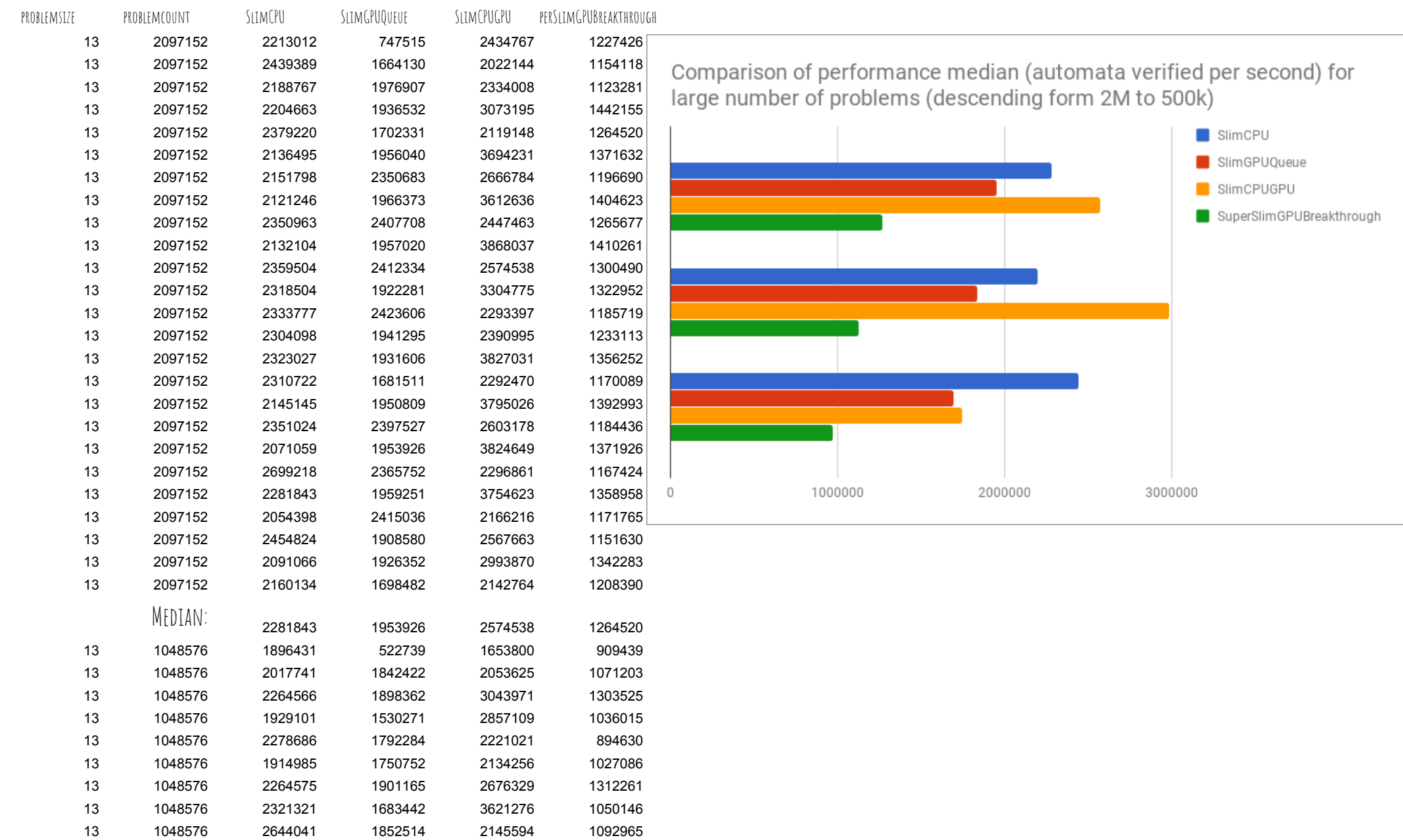
13	105545	762682	942704	502738	564968
13	110218	676682	947277	505157	575801
13	115098	768843	648191	508287	616864
13	120194	746124	590194	505683	617273
13	125515	754521	827715	507745	606459
13	131072	616761	576208	505753	568204
13	136875	703503	770339	511778	570638
13	142935	676998	736078	510288	561560
13	149263	752356	701225	512259	602902
13	155872	714571	965864	512447	546505
13	162773	726866	973757	512568	592750
13	169979	696778	774819	502301	611112
13	177505	618953	650458	515017	623830
13	185364	729596	783984	517150	594515
13	193571	690694	727097	477221	

PROBLEMSIZE	PROBLEMCOUNT	SLIMCPU	SLIMGPUQUEUE	SLIMCPUGPU	PERSLIMGPUBREAKTHROUGH
13	16384	568189	9565	1051692	89706
13	17109	687492	1910233	1458369	899579
13	17867	633056	1894537	381644	477219
13	18658	670163	1688614	1244281	631370
13	19484	701631	2025532	1494688	579448
13	20347	735398	1808220	1544646	851065
13	21247	672752	1839902	1519521	663308
13	22188	767175	1953719	1517346	963343
13	23170	792934	2043084	1546450	782440
13	24196	670377	2048200	1507163	915388
13	25268	794454	1999842	1404910	607785
13	26386	775913	2053417	1657235	731747
13	27554	690383	1163397	1627439	836166
13	28774	920070	2107244	1193135	1042227
13	30048	763323	1569430	1307145	856076
13	31379	820860	2145734	1629926	1231413
13	32768	1090878	1719112	1319131	1192670
13	34219	952499	2175605	1484246	932985
13	35734	719493	1926673	1212658	962864
13	37316	970992	2208256	1807718	1006085
13	38968	962520	2216711	1496651	1230594
13	40693	855484	2173725	1335042	1240693
13	42495	948232	2213812	1161427	957377
13	44376	703191	2225298	1733661	1185871
13	46341	1063033	2237107	2172401	833080
13	48393	832913	2249592	1234982	739816
13	50535	962826	1826161	1387131	945129
13	52773	1065377	2270226	1177233	836428
13	55109	998791	2298689	1081281	705711
13	57549	1061193	2256735	2299008	810565
13	60097	1165959	2288320	2136790	919325
13	62757	1226782	2269561	2317219	907649
13	65536	1103878	2299122	1354817	952083
13	68438	1041666	2314386	1528917	1060163
13	71468	1003725	2359202	1092105	1067123
13	74632	1250570	2387483	1342466	1298935
13	77936	1227513	2029039	1699833	1301369
13	81386	1066163	2017381	1716979	1191927
13	84990	1241662	2257568	1830813	1302637
13	88752	1294850	2258648	1265276	1072172
13	92682	1192800	2347979	1553105	1105798
13	96785	1278326	2352462	1891307	1123079
13	101070	1216537	2216039	1662959	1178910
13	105545	1334373	2376888	1671002	1212226
13	110218	885358	2390322	1159658	1164535



13	115098	1197927	1111177	2241616	1200858
13	120194	1223811	2387763	1504497	1244934
13	125515	1411080	2374637	1468561	1159810
13	131072	1422327	2116164	1355488	1392263
13	136875	1223554	1396632	2158816	1059611
13	142935	1254084	2107002	1902295	1189829
13	149263	1458143	2151508	2429375	1235289
13	155872	1336200	2178258	2354669	1333854
13	162773	1251212	2171494	2316951	1279622
13	169979	1387170	2150933	2445977	1139610
13	177505	1308469	2110775	2147372	1098413
13	185364	1354654	1276154	2519495	798372
13	193571	1439904	1324315	1503955	891126
13	202141	1388231	1329669	1576706	1179801
13	211090	1394477	1350746	2386390	1015369
13	220436	1505175	2283641	2329668	1201832
13	230195	1472569	2049061	2781362	1414296
13	240387	1495353	2156955	2350520	1402107
13	251030	1478838	2413996	2566362	1687828
13	262144	1504255	1585867	3209564	1312461
13	273750	1521065	1501161	3060277	1174129
13	285870	1614137	1561403	2207893	1334489
13	298527	1675037	1291363	2415414	1249020
13	311744	1455104	1582869	3080350	1669559
13	325546	1684144	1175076	1803593	1218653
13	339959	1586295	1439462	1492758	962438
13	355010	1513383	1531892	2707607	1389191
13	370728	1710683	2368581	1677896	915247
13	387141	1720137	1531691	1567203	973818
13	404281	1631526	1626756	2051867	911057
13	422180	1699763	1553186	1658020	1266942
13	440872	1739108	1592160	1525415	881047
13	460391	1590820	1681181	2187324	1196881
13	480774	1558792	1304699	3014478	1440121
13	502060	1706046	2303501	2551154	1043438
13	524288	1786282	1616474	1563381	905990
13	547500	1618110	1321347	2914879	1506405
13	571740	1819785	1809749	2644238	1416516
13	597053	1818451	1681854	2251932	1049973
13	623487	1655333	1344021	2794425	1389646
13	651091	1856140	1677113	2568086	999644
13	679917	1899504	1817292	2397786	1057280
13	710020	2208974	1749507	1869770	1090500
13	741455	1948855	1878362	2409420	1057347
13	774282	1827918	1828802	2266519	1076280
13	808563	2279218	1864727	2402167	960688

13	844361	1858783	1727010	2125156	1056871
13	881744	1852653	1487952	2996889	1337179
13	920782	1935112	1841188	3026874	1136987
13	961548	1962445	1848756	2137796	998058
13	1004120	2147182	1823207	2491960	1176046
13	1048576	1997967	1607982	2776900	1364435
13	1095000	2137955	1970678	2947129	956974
13	1143480	2115211	1890735	2938925	1101816
13	1194106	1979931	1833398	2066065	1141849
13	1246974	2048171	1769433	1911824	1133728
13	1302182	2194199	1875054	2083946	1154055
13	1359835	2129542	1846406	2161468	1166936
13	1420040	2246118	1567209	3196442	1424652
13	1482910	2136072	1894143	2964480	1088432
13	1548564	2355598	1852920	2117190	1154209
13	1617125	2276012	1732172	3357742	1495546
13	1688722	2326032	1872218	4046340	1030353
13	1763488	2195911	1941156	2435761	1085467
13	1841564	2230845	1867849	2324385	1242499
13	1923097	2255464	1890609	2360722	1148970
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13	2493948	2425200	1643333	3398007	1369184
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