Cerny conjecture verification algorithms

Sumary

## SUMMARY GOES HERE, FOR THE INTERESTING PART SCROLL DOWN FOR COOL CHARTS:

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.

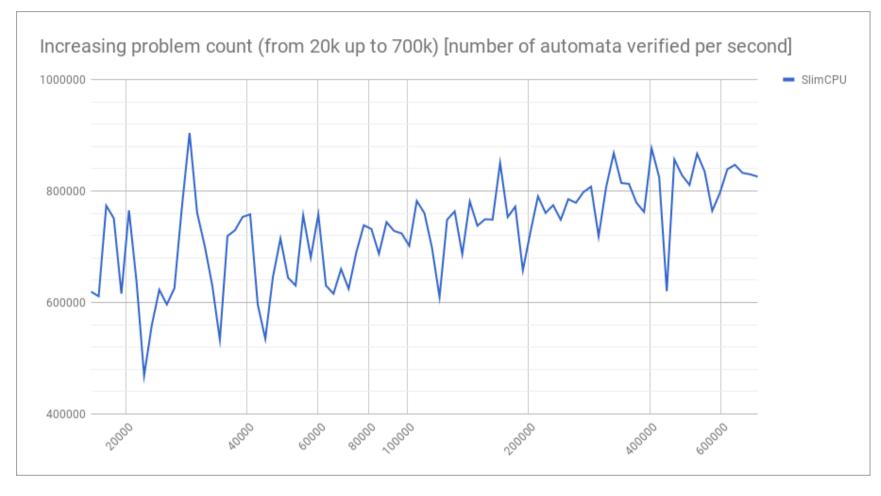
This technique allows for full processor utilization thus outperforming the GPU.

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

The GPU algorithm is speciffically tuned NVIDIA GeForce mx150, the CPU algorithm is universally optimized

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

| PROBLEMSIZE | PROBLEMCOUNT | SLIMCPU |
|-------------|--------------|---------|
| 13          | 16384        | 619309  |
| 13          | 17109        | 611145  |
| 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  |
|             |              |         |

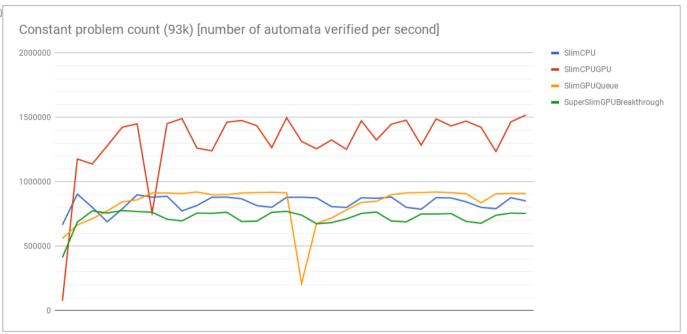


The benchmark above is performed on faculty's standard computer (CPU: 8-core i7-2600, unfortunately the compiler doesn't JIT compile for NVIDIA Quadro 2000).

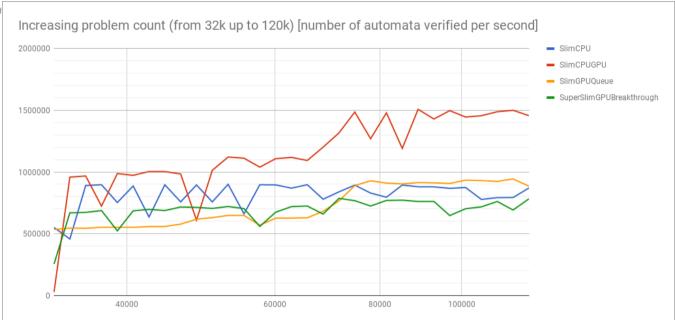
| 13 | 57549  | 680464 |
|----|--------|--------|
| 13 | 60097  | 758264 |
| 13 | 62757  | 630546 |
| 13 | 65536  | 615754 |
| 13 | 68438  | 659871 |
| 13 | 71468  | 624476 |
| 13 | 74632  | 689312 |
| 13 | 77936  | 738577 |
| 13 | 81386  | 731989 |
| 13 | 84990  | 687371 |
| 13 | 88752  | 744207 |
| 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 |
|    |        |        |

| PROBLEMCOUNT | SLIMCPU  | SLIMCPUGPU  | SLIMGPUQUEUE   | :RSLIMGPUBREAKTHRO   |
|--------------|--|---|--|--|
| 92682        | 665118   | 74223   | 559483   | 412424   |
| 92682        | 903869   | 1176733   | 665000   | 686730   |
| 92682        | 801392   | 1138180   | 713025   | 774220   |
| 92682        | 689375   | 1279110   | 773319   | 757204   |
| 92682        | 788853   | 1423011   | 844144   | 776106   |
| 92682        | 899064   | 1450314   | 859496   | 768815   |
| 92682        | 880491   | 757179  | 913722   | 763443   |
| 92682        | 887150   | 1451738   | 912797   | 709102   |
| 92682        | 773801   | 1490675   | 908574   | 696092   |
| 92682        | 815692   | 1261434   | 920449   | 756572   |
| 92682        | 879576   | 1240304   | 899710   | 754842   |
| 92682        | 880650   | 1462726   | 900268   | 762962   |
| 92682        | 867740   | 1475884   | 912834   | 690743   |
| 92682        | 815053   | 1435955   | 916304   | 694160   |
| 92682        | 801634   | 1265420   | 918390   | 762595   |
| 92682        | 879251   | 1497148   | 914510   | 769984   |
| 92682        | 880285   | 1313563   | 210172   | 741250   |
| 92682        | 874716   | 1256223   | 675140   | 673826   |
| 92682        | 807273   | 1324691   | 718286   | 682731   |
| 92682        | 800197   | 1251913   | 781319   | 711438   |
| 92682        | 875426   | 1473414   | 839119   | 753984   |
| 92682        | 871616   | 1324611   | 848306   | 764998   |
| 92682        | 881473   | 1446960   | 899369   | 694976   |
| 92682        | 801470   | 1478076   | 913745   | 688477   |
| 92682        | 786393   | 1284277   | 916714   | 749474   |
| 92682        | 876408   | 1488459   | 920302   | 749710   |
| 92682        | 874283   | 1433226   | 915248   | 752894   |
| 92682        | 844238   | 1471297   | 907769   | 692143   |
| 92682        | 801189   | 1423416   | 836942   | 678083   |
| 92682        | 790451   | 1234521   | 906349   | 739714   |
| 92682        | 876302   | 1465365   | 909711   | 756588   |
| 92682        | 850780   | 1518036   | 908602   | 753754   |
|              | 92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682<br>92682 | 92682 903869 92682 801392 92682 689375 92682 788853 92682 899064 92682 887150 92682 887150 92682 873801 92682 87576 92682 879576 92682 867740 92682 867740 92682 815053 92682 801634 92682 879576 92682 800197 92682 879576 92682 874716 92682 87483 92682 874283 92682 874283 92682 874283 92682 874283 92682 874511 | 92682         665118         74223           92682         903869         1176733           92682         801392         1138180           92682         689375         1279110           92682         788853         1423011           92682         899064         1450314           92682         880491         757179           92682         887150         1451738           92682         773801         1490675           92682         815692         1261434           92682         879576         1240304           92682         880650         1462726           92682         867740         1475884           92682         815053         1435955           92682         879251         1497148           92682         879251         1497148           92682         874716         1256223           92682         807273         1324691           92682         807273         1324691           92682         871616         1324611           92682         881473         1446960           92682         876408         1488459           92682         8 | 92682         665118         74223         559483           92682         903869         1176733         665000           92682         801392         1138180         713025           92682         689375         1279110         773319           92682         788853         1423011         844144           92682         899064         1450314         859496           92682         880491         757179         913722           92682         887150         1451738         912797           92682         87560         1490675         908574           92682         815692         1261434         920449           92682         879576         1240304         899710           92682         880650         1462726         900268           92682         815053         1435955         916304           92682         815053         1435955         916304           92682         879251         1497148         914510           92682         879251         1497148         914510           92682         874716         1256223         675140           92682         874716         1256223 |

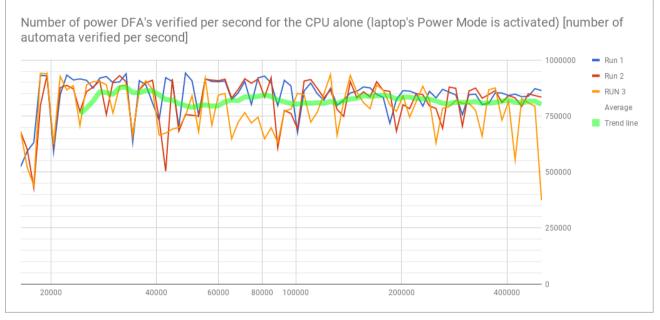


| PROBLEMSIZE | PROBLEMCOUNT | SLIMCPU | SLIMCPUGPU | SLIMGPUQUEUE | ERSLIM GPUBREAKTHRO |
|-------------|--------------|---------|------------|--------------|---------------------|
| 13          | 32768        | 550666  | 26773      | 534049       | 254685              |
| 13          | 34219        | 456803  | 958499     | 545258       | 669053              |
| 13          | 35734        | 890518  | 967648     | 543816       | 672782              |
| 13          | 37316        | 896754  | 723404     | 552462       | 687470              |
| 13          | 38968        | 752609  | 987354     | 551995       | 522941              |
| 13          | 40693        | 886786  | 973040     | 551546       | 685356              |
| 13          | 42495        | 635415  | 1003912    | 557598       | 696940              |
| 13          | 44376        | 896318  | 1003433    | 558353       | 687380              |
| 13          | 46341        | 758131  | 983965     | 577545       | 716312              |
| 13          | 48393        | 894795  | 610041     | 617811       | 713152              |
| 13          | 50535        | 757859  | 1014284    | 630141       | 704716              |
| 13          | 52773        | 900519  | 1121393    | 648287       | 720340              |
| 13          | 55109        | 661062  | 1112066    | 648011       | 703565              |
| 13          | 57549        | 896769  | 1039286    | 569041       | 559061              |
| 13          | 60097        | 895569  | 1108034    | 625954       | 674020              |
| 13          | 62757        | 869078  | 1118512    | 626740       | 719357              |
| 13          | 65536        | 897064  | 1093530    | 629012       | 724303              |
| 13          | 68438        | 779173  | 1201750    | 681495       | 658692              |
| 13          | 71468        | 839225  | 1316562    | 765310       | 786449              |
| 13          | 74632        | 893745  | 1486098    | 890003       | 767537              |
| 13          | 77936        | 829340  | 1269777    | 928983       | 724194              |
| 13          | 81386        | 795484  | 1479638    | 910149       | 769461              |
| 13          | 84990        | 894224  | 1191137    | 903055       | 771589              |
| 13          | 88752        | 880560  | 1508259    | 914676       | 761027              |
| 13          | 92682        | 879800  | 1429647    | 912261       | 761560              |
| 13          | 96785        | 867557  | 1497402    | 907203       | 646963              |
| 13          | 101070       | 874387  | 1445513    | 933899       | 702425              |
| 13          | 105545       | 777696  | 1456446    | 930624       | 717702              |
| 13          | 110218       | 792169  | 1488618    | 923828       | 761073              |
| 13          | 115098       | 793027  | 1500229    | 943737       | 692029              |
| 13          | 120194       | 870541  | 1456701    | 885023       | 782500              |



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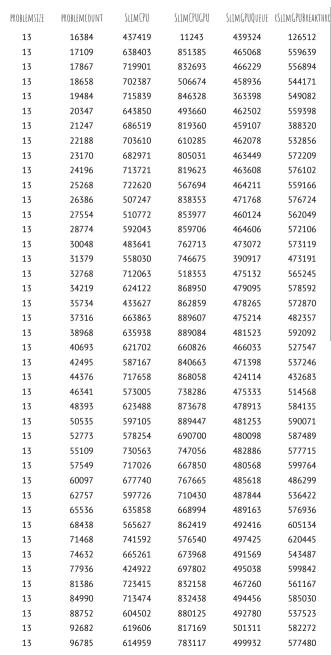
| PROBLEMSIZE | PROBLEMCOUNT | RUN 1  | Run 2  | RUN 3  | AVERAGE     |
|-------------|--------------|--------|--------|--------|-------------|
| 13          | 16384        | 523273 | 679011 | 682192 | 628158.6667 |
| 13          | 17109        | 592795 | 601840 | 520427 | 571687.3333 |
| 13          | 17867        | 631519 | 428807 | 440988 | 500438      |
| 13          | 18658        | 931424 | 797006 | 940523 | 889651      |
| 13          | 19484        | 929372 | 931473 | 938812 | 933219      |
| 13          | 20347        | 590343 | 618236 | 622545 | 610374.6667 |
| 13          | 21247        | 844566 | 876646 | 927124 | 882778.6667 |
| 13          | 22188        | 932802 | 886825 | 866878 | 895501.6667 |
| 13          | 23170        | 911082 | 871295 | 885642 | 889339.6667 |
| 13          | 24196        | 915721 | 769375 | 705933 | 797009.6667 |
| 13          | 25268        | 909454 | 858769 | 889427 | 885883.3333 |
| 13          | 26386        | 874818 | 879314 | 903664 | 885932      |
| 13          | 27554        | 919450 | 906898 | 903991 | 910113      |
| 13          | 28774        | 926377 | 756679 | 889572 | 857542.6667 |
| 13          | 30048        | 899315 | 902649 | 762814 | 854926      |
| 13          | 31379        | 902281 | 930151 | 882774 | 905068.6667 |
| 13          | 32768        | 938629 | 902956 | 889089 | 910224.6667 |
| 13          | 34219        | 632650 | 662679 | 661473 | 652267.3333 |
| 13          | 35734        | 907906 | 866466 | 870349 | 881573.6667 |
| 13          | 37316        | 888817 | 898531 | 907393 | 898247      |
| 13          | 38968        | 808716 | 909762 | 869303 | 862593.6667 |
| 13          | 40693        | 731161 | 737551 | 664747 | 711153      |
| 13          | 42495        | 921277 | 503834 | 673670 | 699593.6667 |
| 13          | 44376        | 904431 | 915481 | 691260 | 837057.3333 |
| 13          | 46341        | 702304 | 682529 | 698415 | 694416      |
| 13          | 48393        | 941764 | 756433 | 750367 | 816188      |
| 13          | 50535        | 907271 | 753410 | 840614 | 833765      |
| 13          | 52773        | 754193 | 749322 | 679022 | 727512.3333 |
| 13          | 55109        | 916159 | 914385 | 917335 | 915959.6667 |
| 13          | 57549        | 904398 | 910437 | 708232 | 841022.3333 |
| 13          | 60097        | 903179 | 907485 | 843416 | 884693.3333 |
| 13          | 62757        | 906669 | 914617 | 850503 | 890596.3333 |
| 13          | 65536        | 823599 | 830352 | 647493 | 767148      |
| 13          | 68438        | 853359 | 868547 | 722636 | 814847.3333 |
| 13          | 71468        | 904004 | 916682 | 765335 | 862007      |
| 13          | 74632        | 801694 | 896500 | 718716 | 805636.6667 |
| 13          | 77936        | 920545 | 915133 | 744635 | 860104.3333 |
| 13          | 81386        | 928108 | 834311 | 648358 | 803592.3333 |
| 13          | 84990        | 897214 | 921086 | 697637 | 838645.6667 |
| 13          | 88752        | 796373 | 607787 | 631550 | 678570      |
| 13          | 92682        | 909495 | 774642 | 771612 | 818583      |
| 13          | 96785        | 884616 | 761186 | 781207 | 809003      |
| 13          | 101070       | 677179 | 692877 | 851672 | 740576      |
| 13          | 105545       | 862507 | 906190 | 844763 | 871153.3333 |
| 13          | 110218       | 896871 | 913038 | 722316 | 844075      |
|             |              |        |        |        |             |

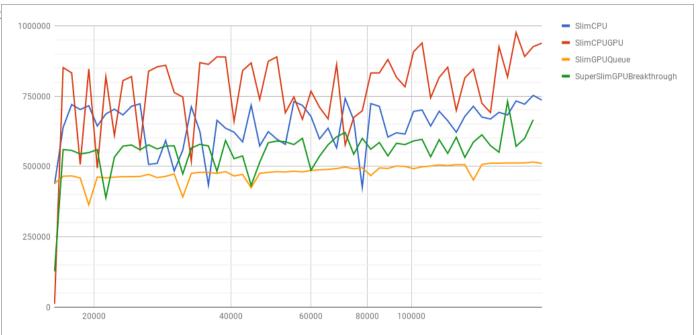


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| 13 | 115098 | 849148 | 873194 | 767739 | 830027      |
|----|--------|--------|--------|--------|-------------|
| 13 | 120194 | 821205 | 830687 | 849202 | 833698      |
| 13 | 125515 | 874032 | 866667 | 935333 | 892010.6667 |
| 13 | 131072 | 797528 | 779634 | 663797 | 746986.3333 |
| 13 | 136875 | 821265 | 748195 | 814649 | 794703      |
| 13 | 142935 | 852891 | 904053 | 931377 | 896107      |
| 13 | 149263 | 860606 | 831360 | 856127 | 849364.3333 |
| 13 | 155872 | 879691 | 858287 | 809837 | 849271.6667 |
| 13 | 162773 | 875579 | 835760 | 782540 | 831293      |
| 13 | 169979 | 846860 | 903284 | 887794 | 879312.6667 |
| 13 | 177505 | 832874 | 864331 | 865985 | 854396.6667 |
| 13 | 185364 | 717356 | 859994 | 800085 | 792478.3333 |
| 13 | 193571 | 824550 | 682684 | 770361 | 759198.3333 |
| 13 | 202141 | 862998 | 800644 | 839625 | 834422.3333 |
| 13 | 211090 | 861384 | 782452 | 744806 | 796214      |
| 13 | 220436 | 849871 | 850063 | 814059 | 837997.6667 |
| 13 | 230195 | 794147 | 845307 | 882874 | 840776      |
| 13 | 240387 | 860594 | 794997 | 821455 | 825682      |
| 13 | 251030 | 831065 | 783715 | 629628 | 748136      |
| 13 | 262144 | 869312 | 694962 | 784850 | 783041.3333 |
| 13 | 273750 | 856895 | 879133 | 791524 | 842517.3333 |
| 13 | 285870 | 844344 | 873689 | 819206 | 845746.3333 |
| 13 | 298527 | 756204 | 705178 | 806605 | 755995.6667 |
| 13 | 311744 | 845026 | 861591 | 806256 | 837624.3333 |
| 13 | 325546 | 847434 | 874862 | 775565 | 832620.3333 |
| 13 | 339959 | 801284 | 829718 | 659757 | 763586.3333 |
| 13 | 355010 | 807089 | 845545 | 867365 | 839999.6667 |
| 13 | 370728 | 854064 | 863792 | 875275 | 864377      |
| 13 | 387141 | 852593 | 810215 | 731633 | 798147      |
| 13 | 404281 | 841485 | 841036 | 815161 | 832560.6667 |
| 13 | 422180 | 847456 | 831032 | 554556 | 744348      |
| 13 | 440872 | 836289 | 793167 | 828028 | 819161.3333 |
| 13 | 460391 | 838043 | 849221 | 808838 | 832034      |
| 13 | 480774 | 872216 | 841273 | 793625 | 835704.6667 |
| 13 | 502060 | 863729 | 834363 | 374377 | 690823      |
|    |        |        |        |        |             |

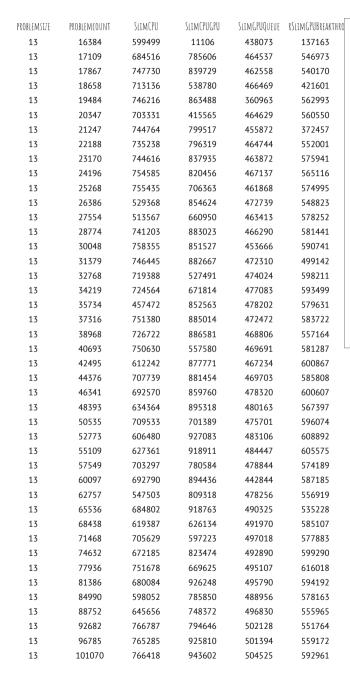
Cerny conjecture verification algorithms

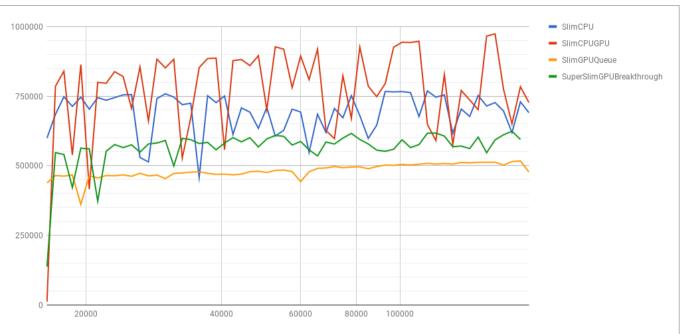




| 13 | 101070 | 695391 | 907661 | 491971 | 590613 |
|----|--------|--------|--------|--------|--------|
| 13 | 105545 | 700526 | 938913 | 498500 | 595985 |
| 13 | 110218 | 643520 | 743916 | 501262 | 534176 |
| 13 | 115098 | 696203 | 816422 | 505342 | 594914 |
| 13 | 120194 | 662566 | 852686 | 503119 | 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 |
| 13 | 185364 | 752594 | 925883 | 515542 | 665868 |
| 13 | 193571 | 736053 | 938226 | 510808 |        |

Cerny conjecture verification algorithms



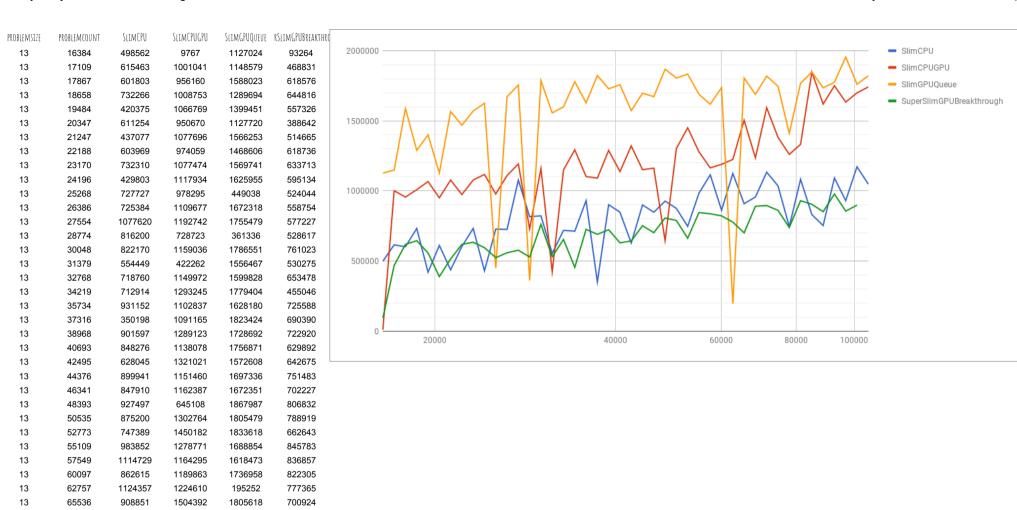


| 13 | 105545 | 762682 | 942704 | 502738 | 564968 |
|----|--------|--------|--------|--------|--------|
| 13 | 110218 | 676682 | 947277 | 505157 | 575801 |
| 13 | 115098 | 768843 | 648191 | 508287 | 616864 |
| 13 | 120194 | 746124 | 590194 | 505683 | 617273 |
| 13 | 125515 | 754521 | 827715 | 507745 | 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 |        |

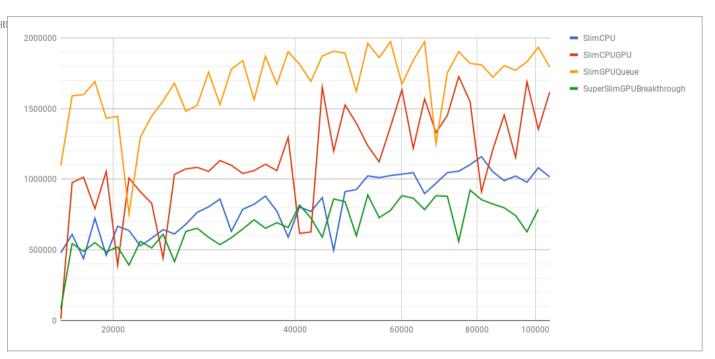
| PROBLEMSIZE | PROBLEMCOUNT | SLIMCPU | SLIMCPUGPU | SLIMGPUQUEUE | RSLIM GPUBREAKTHR |
|-------------|--------------|---------|------------|--------------|-------------------|
| 13          | 16384        | 458148  | 9742       | 1149577      | 86565             |
| 13          | 17109        | 606017  | 954477     | 1239522      | 551316            |
| 13          | 17867        | 475071  | 957667     | 1636112      | 543514            |
| 13          | 18658        | 626715  | 1012256    | 1405256      | 567872            |
| 13          | 19484        | 556215  | 993879     | 1575751      | 563566            |
| 13          | 20347        | 595258  | 1068331    | 1074367      | 520406            |
| 13          | 21247        | 646912  | 1022907    | 1321298      | 482315            |
| 13          | 22188        | 564863  | 1000216    | 1495975      | 511148            |
| 13          | 23170        | 757113  | 1102027    | 1546636      | 540576            |
| 13          | 24196        | 609789  | 1039825    | 1386074      | 586648            |
| 13          | 25268        | 685872  | 1102900    | 1394227      | 646867            |
| 13          | 26386        | 711589  | 1137990    | 1416257      | 542483            |
| 13          | 27554        | 367109  | 1324584    | 1739301      | 534988            |
| 13          | 28774        | 746570  | 1328820    | 1626596      | 552128            |
| 13          | 30048        | 637654  | 1095032    | 1816577      | 581358            |
| 13          | 31379        | 679324  | 1052326    | 1748104      | 621564            |
| 13          | 32768        | 931076  | 1067125    | 1615086      | 614670            |
| 13          | 34219        | 672961  | 1108699    | 1739867      | 570191            |
| 13          | 35734        | 697483  | 1085256    | 1860497      | 689267            |
| 13          | 37316        | 348508  | 1071452    | 1584153      | 715514            |
| 13          | 38968        | 586866  | 1340516    | 1727879      | 665735            |
| 13          | 40693        | 851999  | 607486     | 1475796      | 719127            |
| 13          | 42495        | 521714  | 602091     | 1839555      | 662235            |
| 13          | 44376        | 912079  | 1152166    | 1654716      | 495871            |
| 13          | 46341        | 884343  | 964555     | 1850856      | 789316            |
| 13          | 48393        | 1006213 | 859481     | 1103664      | 734684            |
| 13          | 50535        | 822017  | 1465382    | 1938718      | 768493            |
| 13          | 52773        | 982461  | 1344097    | 1654419      | 825312            |
| 13          | 55109        | 950312  | 1779150    | 1514345      | 786541            |
| 13          | 57549        | 1003746 | 1382612    | 1956351      | 684965            |
| 13          | 60097        | 786709  | 1059979    | 1625504      | 816012            |
| 13          | 62757        | 867543  | 1222702    | 1722432      | 836669            |
| 13          | 65536        | 1105923 | 1286601    | 1425492      | 889237            |
| 13          | 68438        | 901922  | 1294003    | 1764917      | 790674            |
| 13          | 71468        | 719785  | 1398936    | 1724364      | 738396            |
| 13          | 74632        | 895087  | 1412396    | 1857095      | 585408            |
| 13          | 77936        | 1010789 | 1496254    | 1819370      | 901688            |
| 13          | 81386        | 885855  | 1555252    | 1699582      | 892845            |
| 13          | 84990        | 1102970 | 1120343    | 1743016      | 841708            |
| 13          | 88752        | 984430  | 1647479    | 1767859      | 889857            |
| 13          | 92682        | 1023328 | 1342595    | 1797448      | 748982            |
| 13          | 96785        | 1146857 | 1642347    | 1380127      | 903255            |
|             |              |         |            |              |                   |



| 13 | 101070 | 1123920 | 1561460 | 1755901 | 852701 |
|----|--------|---------|---------|---------|--------|
| 13 | 105545 | 976814  | 1805339 | 1863683 |        |



| PROBLEMSIZE | PROBLEMCOUNT | SLIMCPU | SLIMCPUGPU         | SLIMGPUQUEUE | RSLIMGPUBREAKTHI |
|-------------|--------------|---------|--------------------|--------------|------------------|
| 13          | 16384        | 478749  | 9519               | 1095180      | 80977            |
| 13          | 17109        | 608456  | 975450             | 1589347      | 543937           |
| 13          | 17867        | 436830  | 1013903            | 1598465      | 488801           |
| 13          | 18658        | 722904  | 791099             | 1691063      | 550561           |
| 13          | 19484        | 460508  | 1055580            | 1431310      | 485368           |
| 13          | 20347        | 666370  | 390948             | 1444064      | 519520           |
| 13          | 21247        | 635668  | 1007483            | 754261       | 391606           |
| 13          | 22188        | 527568  | 910703             | 1297718      | 558985           |
| 13          | 23170        | 581855  | 828115             | 1446606      | 512853           |
| 13          | 24196        | 642840  | 439728             | 1553964      | 609431           |
| 13          | 25268        | 611782  | 1033148            | 1680198      | 415503           |
| 13          | 26386        | 680764  | 1072501            | 1480530      | 629515           |
| 13          | 27554        | 765132  | 1083153            | 1523297      | 652008           |
| 13          | 28774        | 803359  | 1054506            | 1757803      | 588295           |
| 13          | 30048        | 858963  | 1131500            | 1528056      | 535968           |
| 13          | 31379        | 630214  | 1098631            | 1777948      | 584990           |
| 13          | 32768        | 785687  | 1039957            | 1839122      | 646465           |
| 13          | 34219        | 822481  | 1060196            | 1562190      | 712290           |
| 13          | 35734        | 879896  | 1105730            | 1870694      | 651809           |
| 13          | 37316        | 773496  | 1060108            | 1670995      | 691488           |
| 13          | 38968        | 589324  | 1295806            | 1902177      | 657521           |
| 13          | 40693        | 802395  | 616015             | 1813664      | 816333           |
| 13          | 42495        | 771152  | 625674             | 1692414      | 724817           |
| 13          | 44376        | 869065  | 1649960            | 1872634      | 589230           |
| 13          | 46341        | 495733  | 1198597            | 1905594      | 859816           |
| 13          | 48393        | 911304  | 1525679            | 1892059      | 840436           |
| 13          | 50535        | 926342  | 1395081            | 1621192      | 597958           |
| 13          | 52773        | 1022935 | 1236090            | 1961151      | 888122           |
| 13          | 55109        | 1010579 | 1122666            | 1859378      | 727266           |
| 13          | 57549        | 1025222 | 1371243            | 1973370      | 778801           |
| 13          | 60097        | 1035240 | 1632388            | 1672739      | 883120           |
| 13          | 62757        | 1045851 | 1218254            | 1840948      | 864661           |
| 13          | 65536        | 897285  | 1567941            | 1974464      | 784018           |
| 13          | 68438        | 971053  | 1328367            | 1248989      | 882714           |
| 13          | 71468        | 1045915 | 1451507            | 1752711      | 878281           |
| 13          | 74632        | 1056273 | 1725943            | 1902785      | 559199           |
| 13          | 77936        | 1102752 | 1548743            | 1818848      | 921750           |
| 13          | 81386        | 1159236 | 911449             | 1810239      | 854611           |
| 13          | 84990        | 1052028 | 1209192            | 1721320      | 823458           |
| 13          | 88752        | 988962  | 1454972            | 1803558      | 796968           |
| 13          | 92682        | 1022447 | 1154180            | 1771286      | 742087           |
| 13          | 96785        | 977669  | 1689193            | 1830795      | 627030           |
| -           |              |         | · · · <del>-</del> |              | · · · · · ·      |



| 13 | 101070 | 1080838 | 1352281 | 1934958 | 787194 |
|----|--------|---------|---------|---------|--------|
| 17 | 105545 | 1016055 | 1616405 | 1702047 |        |