I write three programs that can transforms an instance of QCP to a CNF formula. The first program in acd folder uses properties (a) (c) and (d), which is the minimal subset of the properties (a) through (f). The second program in abcd folder uses properties (a) (b) (c) and (d), which consists the first set, plus some additional properties among (a) through (f). The third program in bef folder uses properties (b) (e) and (f), which is other correct subset of clauses corresponding to (a) through (f).

I use SLIME (<https://github.com/maxtuno/slime-sat-solver>) as the SAT solver, and record the solver running time for each qcp files. Here are the results:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| properties (a) (c) (d) | | | | | |
| order | #1 | #2 | #3 | #4 | mean |
| 10 | UNSAT | UNSAT | UNSAT | UNSAT |  |
| 16 | 0.318 | 0.327 | 0.337 | 0.347 | 0.332 |
| 20 | UNSAT | UNSAT | 0.683 | 0.83 | 0.757 |
| 24 | 1.325 | UNSAT | 1.443 | 1.319 | 1.362 |
| 30 | 6.454 | 7.02 | 8.718 | 7.764 | 7.489 |
| 32 | 15.767 | 14.807 | 14.201 | 10.719 | 13.874 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| properties (a) (b) (c) (d) | | | | | |
| order | #1 | #2 | #3 | #4 | mean |
| 10 | UNSAT | UNSAT | UNSAT | UNSAT |  |
| 16 | 0.352 | 0.352 | 0.4 | 0.356 | 0.365 |
| 20 | UNSAT | UNSAT | 0.727 | 0.784 | 0.756 |
| 24 | 1.618 | UNSAT | 1.626 | 1.475 | 1.573 |
| 30 | 8.575 | 11.809 | 10.673 | 10.877 | 10.484 |
| 32 | 15.501 | 8.698 | 12.637 | 13.308 | 12.536 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| properties (b) (e) (f) | | | | | |
| order | #1 | #2 | #3 | #4 | mean |
| 10 | UNSAT | UNSAT | UNSAT | UNSAT |  |
| 16 | 650.86 | 34.638 | 36.342 | 106.012 | 206.963 |

For the SAT result that uses properties (b) (e) and (f), I only record SAT solver running time for order 10 and order 16, because order 16 already takes way longer time than the other two SAT results’ order 16’s time. I tried to run order 20, but the solver did not give result more than 10 minutes, the order 24, 30, and 32 would even take longer time, so I did not record them.

Here is the plot illustrating the effect of the choice of transformation on the solver running time:

(SAT result used properties (b) (e) (f) takes way longer than the other two SAT results, so it is not on the plot)

For order 16 and 20, SAT result used properties (a) (c) (d) and SAT result used properties (a) (b) (c) (d) use the similar time. For order 24 and 30, SAT result used properties (a) (c) (d) takes less time than SAT result used properties (a) (b) (c) (d). For order 24 and 30, SAT result used properties (a) (c) (d) takes more time than SAT result used properties (a) (b) (c) (d). SAT result used properties (b) (e) (f) takes way longer than the other two SAT results.

There are three folders: abcd, acd, and bef, the names of the folders are corresponding to the propertis that the program used.

Go to one of the folders, "A2-qcp-instances" folder stores the qcp files, "output" folder stores cnf files generated by "qcp2cnf.py".

To run the program, use "python3 qcp2cnf.py example.qcp example.cnf", for example "python3 qcp2cnf.py q\_10\_01.qcp q\_10\_01.cnf"".

If you want to generate all cnf files, use "python3 qcp2cnf.py all".