Assignment 1

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1. Reduction of the N-queens problem to SAT

Code for the reduction of the N-queens to SAT problem is available in *src/reduce_nq_sat.py*.

2. Reduction of the dominanting set problem to SAT

Description

Input: Graph $G = \{V, E\}$ and integer k.
Problem: Does in graph G contains a dominanting set $\{DS\}$ of size $\geq k$?
Variables: x_i^r is true if node i is the r-th node of the $\{DS\}$, where $1 \leq i \leq n$, $1 \leq r \leq k$ and $n = |V|$.
Clauses:

1. Some node is the r-th node of the $\{DS\}$:
   For each r: $x_1^r \vee x_2^r \vee ... \vee x_n^r$
2. No node is both the r-th and s-th node of the $\{DS\}$:
   For each i, $r < s$: $\neg x_i^r \vee \neg x_i^s$
3. Only one node can be the r-th node of the $\{DS\}$:
   For each r, $i < j$: $\neg x_i^r \vee \neg x_j^r$
4. At least one of the i-th node or one of its neighbour nodes must be in the $\{DS\}$:
   For each i and its neighbours[1]: $(x_i^1 \vee x_{adj(i,1)}^1 \vee x_{adj(i,2)}^1 \vee ... \vee x_{adj(i,m)}^1) \vee ... \vee (x_i^r \vee x_{adj(i,1)}^r \vee x_{adj(i,2)}^r \vee ... \vee x_{adj(i,m)}^r)$

Code

Code for the reduction of the dominanting set to SAT problem is available in *src/reduce_ds_sat.py*.

[1]Node $adj(i, m)$ is the m-th neighbour of the i-th node.

Solutions

We have manually performed search with bisection and found the following sizes of the minimal dominanting sets:

1. *g1.col*: 40
2. *g2.col*: 3
3. *g3.col*: 15
4. *g4.col*: Not found any solution
5. *g5.col*: 5

3. Other

We have also implemented reduction of the vertex cover (*src/reduce_vc_sat.py*) and clique problem (src/reduce_clique_sat.py) the to SAT.