A local and global approach to the minimum vertex cover optimisation problem

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Overview

- Minimum Vertex Cover is a NP-hard optimisation problem
- Two local search algorithms and one global stochastic algorithm were implemented in polynomial time and provide a naive solution
- All testing conducted with stage four compile optimisations
- Promising results for the global approach should further research be invested

Local Approach 1

Next-Best Greedy

- Ranks each node based of its degree
- Chooses next node to add to the cover based off highest rank
- No node will be chosen twice in the same cover
- Hash-map randomness ensures a new variation of ‘next-best’ every trial

Graph	Target	Average CPU Time (seconds)	Best Cover	Average Cover
brock800_1.clq	777	0.0669	784	786.31
brock800_2.clq	776	0.06638	784	786.16
brock800_3.clq	775	0.06655	785	786.3
brock800_4.clq	774	0.06662	783	786.1
C2000.9.clq	1922	0.16573	1943	1948.85
C4000.5.clq	3982	5.22589	3986	3988.15
MANN_a45.clq	691	0.00216	700	702.93
p_hat1500.clq	1488	0.70672	1491	1493.4

Local Approach 2

Randomised Local Search

- Chooses next node based off a normally distributed random choice
- Each node has the same chance of being picked
- No node will be chosen twice in the same cover
- Identical local minima compared to next-best greedy

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brock800_1.clq	777	0.0669	784	786.31
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Global Approach

Simulated Annealing

- Outperforms both local search algorithms
- Cooled at a rate of 0.8 for temperature = 100,000
- Iteratively improves its solution at every temperature
- Probability of choosing a worse solution decreases as temperature lowers
- Algorithm approaches better minima as it cools

Graph	Target	Average CPU Time (seconds)	Best Cover	Average Cover
brock800_1.clq	777	2.14652	782	784.04
brock800_2.clq	776	2.13537	782	784.15
brock800_3.clq	775	2.16887	781	784
brock800_4.clq	774	2.14215	783	784.14
C2000.9.clq	1922	8.97447	1941	1944.01
C4000.5.clq	3982	240.951	3985	3986.59
MANN_a45.clq	691	0.186	703	704.44
p_hat1500.clq	1488	37.5072	1490	1491.6

Conclusions

- Local Search algorithms should be avoided for the anti-greedy Brock collection of graphs
- If close enough is good enough an extension to Simulated Annealing should be chosen
- If benchmark results are required further research is required into different types of algorithms