WeGotYouCovered
The Winning Solver from the PACE 2019 Implementation Challenge, Vertex Cover Track

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Vertex Cover and Complementary Problems

Input graph

Vertex cover

Independent Set

Clique
Techniques

Kernelization

Reduce

Branch-and-Bound

Branch

Reduce

Iterated Local Search

Branch

Reduce

(1,2)-Swap
Kernelization [AI2016]

- Technique from FPT algorithms
- Applies rich set of reduction rules
- Significantly reduces graph size
Iterated Local Search [ARW2012]

- Originally developed for independent sets
- Perturbation to escape local optima
- Can often find (near-)optimal solutions
Branch and Reduce [AI2016]

- Reduce graph after each branch
- Additional branching rules to reduce graph size
- Prune search based on lower bounds
Branch and Bound [LJM2017]

- Originally developed for maximum cliques
- Incremental MaxSAT reasoning to prune search
- Combination of static and dynamic vertex ordering
Algorithm Overview

1. Kernelization

2. Kernel

3. Branch-and-Reduce short burst

4. Branch-and-Bound short burst

5. Branch-and-Reduce long run

6. Branch-and-Bound long run

3. Iterated Local Search

Initial Solution
Algorithm Overview

1. Input Graph
   - Kernelization

2. Kernel
   - Iterated Local Search

3. Initial Solution

4. Branch-and-Bound short burst

5. Branch-and-Reduce short burst

6. Branch-and-Bound long run

7. Branch-and-Reduce long run
Algorithm Overview

1. Input Graph
   - Kernelization
   - Branch-and-Reduce
      - short burst

2. Kernel
   - Branch-and-Bound
      - long run
   - Iterated Local Search
      - Initial Solution

3. Branch-and-Reduce
   - short burst

4. Branch-and-Bound
   - short burst

5. Branch-and-Reduce
   - long run

6. Branch-and-Bound
   - long run
Algorithm Overview

1. Input Graph → Kernelization
2. Kernel → Iterated Local Search
3. Branch-and-Reduce short burst
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Initial Solution
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Input Graph
Algorithm Overview

1. Input Graph
   - Kernelization
   - 1. Kernel

2. Iterated Local Search
   - Initial Solution
   - 2. Initial Solution

3. Branch-and-Reduce
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   - short burst

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   - long run

6. Branch-and-Bound
   - long run
Instances Solved Over Time

- BnB
- Kern. + BnB
- ILS + BnR
- WeGotYouCovered
- BnR

Time $t$ (s)

Instances solved

0 40 80 120 160 200

1 10 100 1000
References


