Packing and Covering with Geometric Objects

Aniket Basu Roy

advised by

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Geometric Optimization
Problems that are
Computationally Hard

Approximation Algorithms
that run in
Polynomial Time

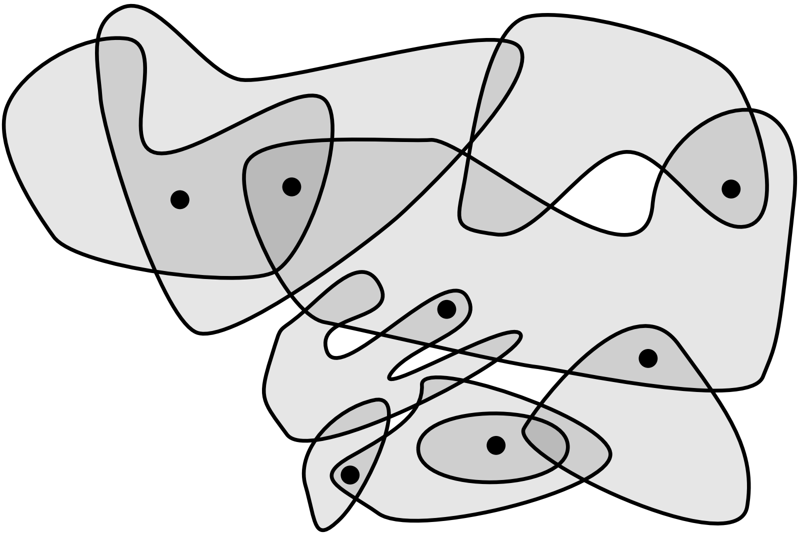
Geometric Optimization Problems that are NP-Hard

Approximation Algorithms that run in Polynomial Time

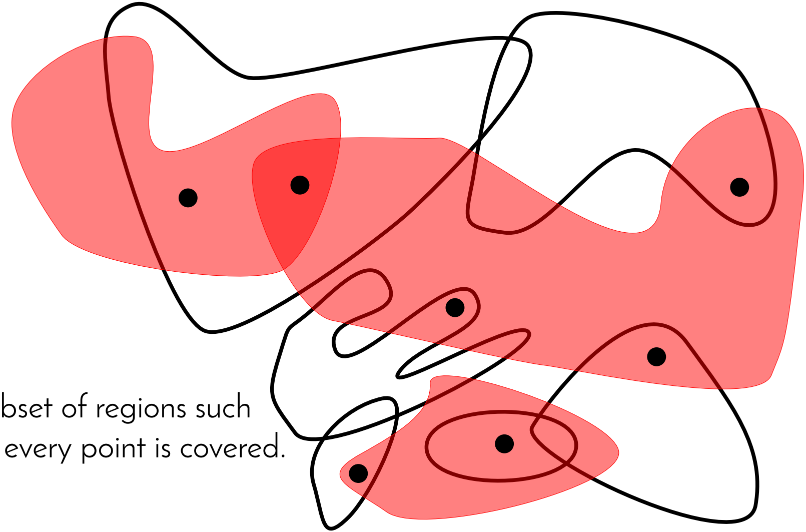
Packing and Covering Problems that are NP-Hard

Approximation Algorithms that run in Polynomial Time

Packing and Covering Problems that are NP-Hard

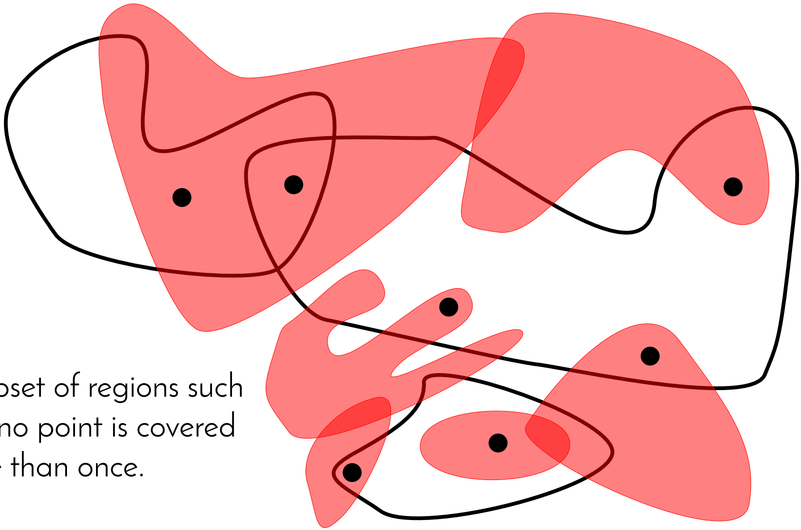


Set Cover



A subset of regions such
that every point is covered.

Set Packing



A subset of regions such that no point is covered more than once.

Packing and Covering Problems that are NP-Hard

Approximation Algorithms that run in Polynomial Time

Shallow Packing

Point Packing

Runaway Rectangle Escape problem

Unique Coverage

Multi-Covering problem

Prize Collecting Set Cover

Art Gallery problems

Approximation Algorithms that run in Polynomial Time

Shallow Packing

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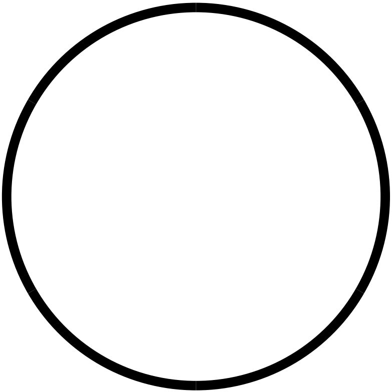
Art Gallery problems

Local Search Algorithms that run in Polynomial Time

Local Search Algorithms that run in Polynomial Time

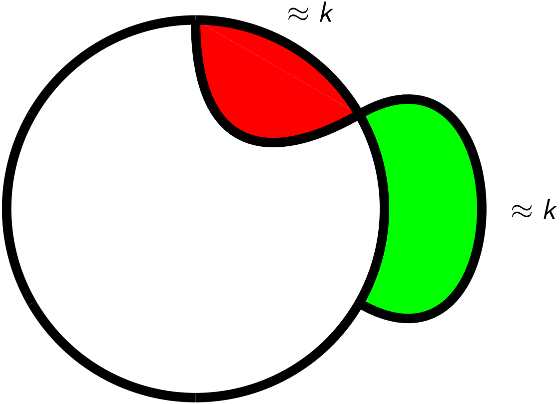
Local Search

parameter k



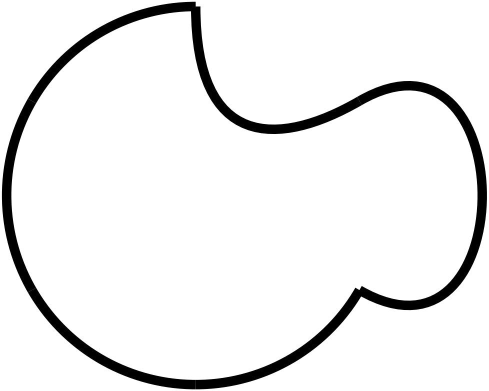
Local Search

parameter k



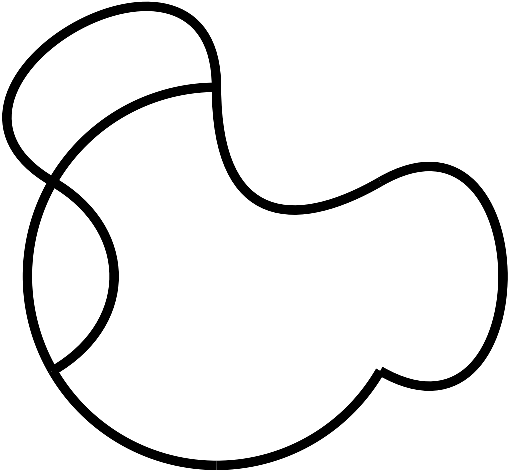
Local Search

parameter k



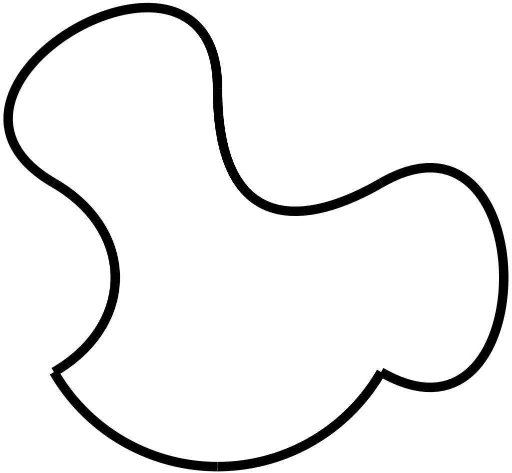
Local Search

parameter k



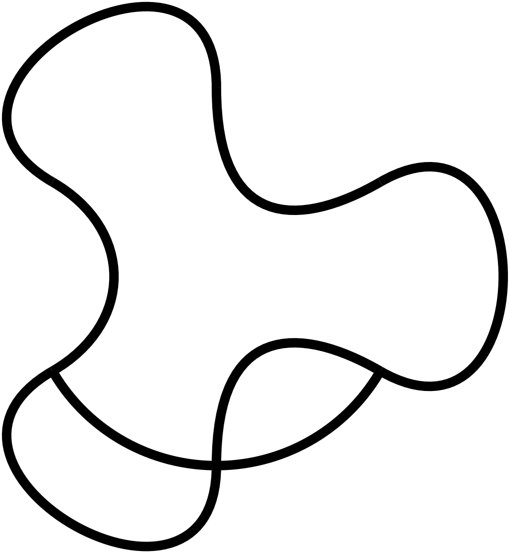
Local Search

parameter k



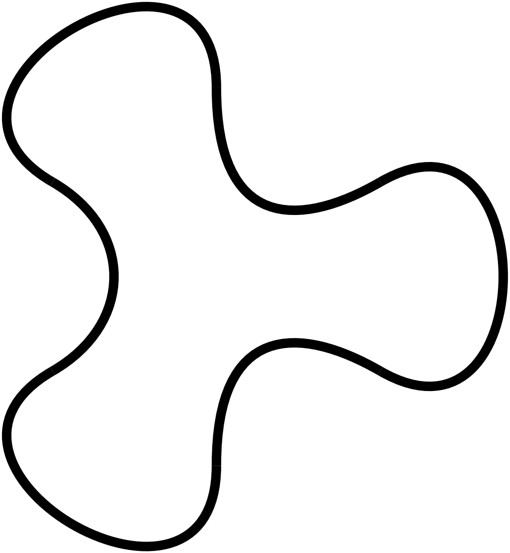
Local Search

parameter k

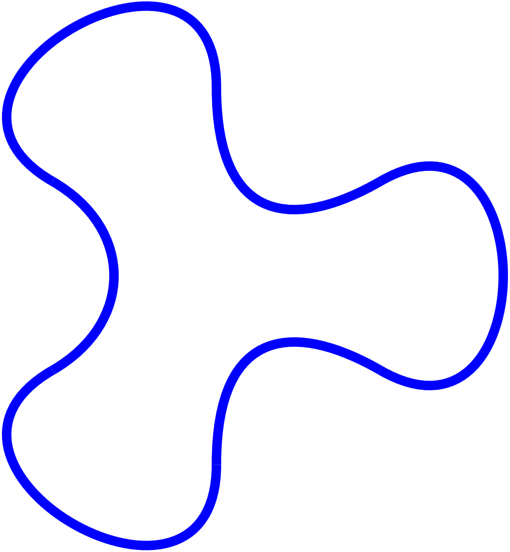


Local Search

parameter k



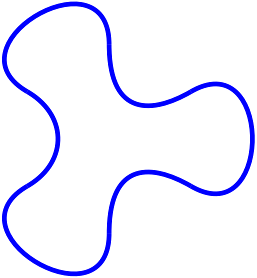
Local Search Solution



$(1+\epsilon)-$approximation

$\epsilon = c/\sqrt{k}$

Local Search Solution



$(1+\epsilon)$−approximation

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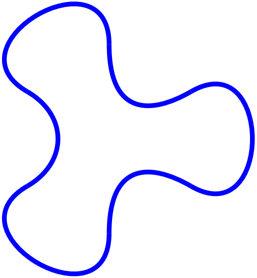
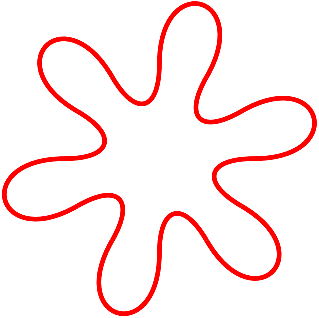
Local Search Solution



Optimum Solution

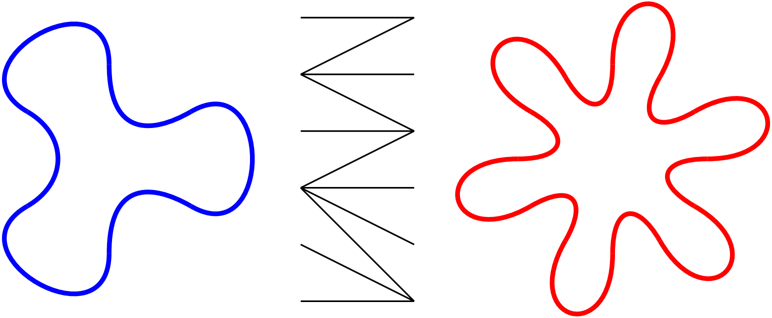


$(1+\epsilon)$−approximation

$\epsilon = c/\sqrt{k}$

Local Search Solution

Optimum Solution



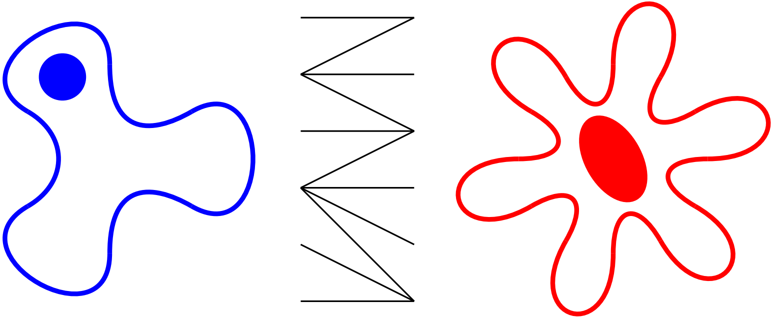
Bipartite Graphs with Small
and Balanced Separators
viz., **Planar Graphs**

$(1+\epsilon)$−approximation

$\epsilon = c/\sqrt{k}$

Local Search Solution

Optimum Solution



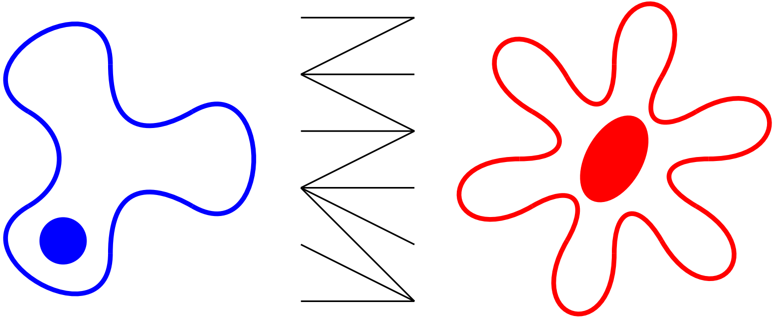
Bipartite Graphs with Small
and Balanced Separators
viz., **Planar Graphs**

$(1+\epsilon)-$approximation

$\epsilon = c/\sqrt{k}$

Local Search Solution

Optimum Solution



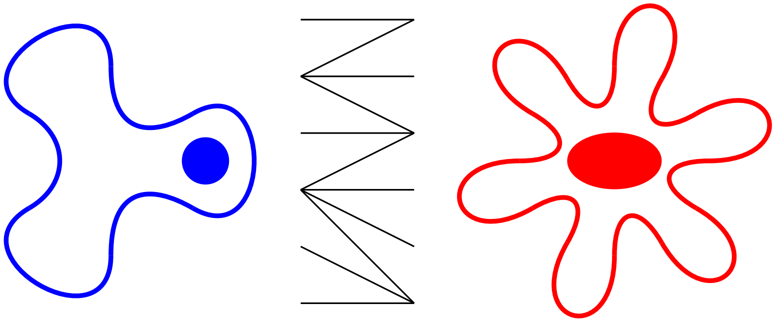
Bipartite Graphs with Small and Balanced Separators viz., **Planar Graphs**

$(1+\epsilon)$−approximation

$\epsilon = c/\sqrt{k}$

Local Search Solution

Optimum Solution



Bipartite Graphs with Small and Balanced Separators viz., **Planar Graphs**

Small Set Expansion

Shallow Packing

Point Packing

Runaway Rectangle Escape problem

Unique Coverage

Multi-Covering problem

Prize Collecting Set Cover

Art Gallery problems

Existence of Bipartite Graphs with

1. Small and Balanced Separators
2. Small Set Expansion property

Intersection Graphs
of shallow arrangements

NOT Planar

Intersection Graphs
of shallow arrangements

have Small and
Balanced Separators
using some appropriate
planar graphs

Shallow Packing[2,3]

Point Packing[2]

Runaway Rectangle Escape problem[1]

Unique Coverage[3]

Multi-Covering problem[3]

Prize Collecting Set Cover[4]

Art Gallery problems[4]

1. The Runaway Rectangle Escape Problem
(with Govindarajan, Maheshwari, Misra, Nandy, Shetty)
CCCG '14, arXiv 1603.04210

2. Packing and Covering with Non-Piercing Regions
(with Govindarajan, Raman, Ray)
ESA '16

3. Local Search strikes again: PTAS for variants of Geometric Covering and Packing
(with Ashok, Govindarajan)
under review

4. Effectiveness of Local Search for Art Gallery and Prize Collecting Problems
(with Bandyapadhyay)
under review

Thank You