Anonymous Networks: Randomization = 2-Hop Coloring

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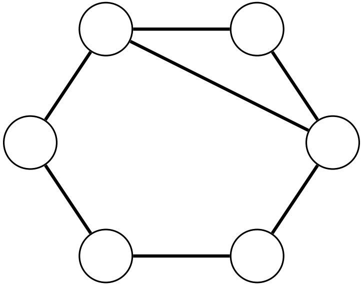
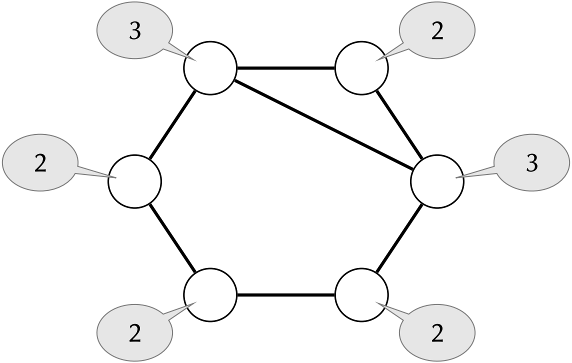
[1] *Technion – Faculty of Industrial Engineering and Management – ie.technion.ac.il*

[2] *ETH Zurich – Distributed Computing Group – www.disco.ethz.ch*

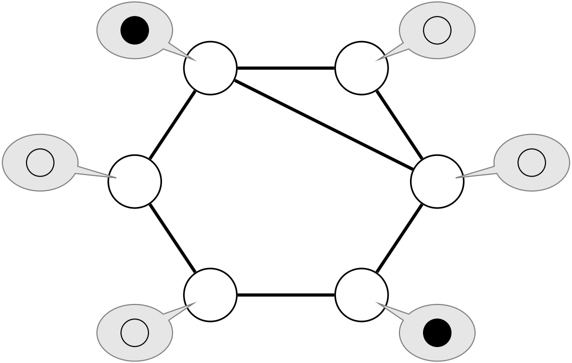
Anonymous Networks



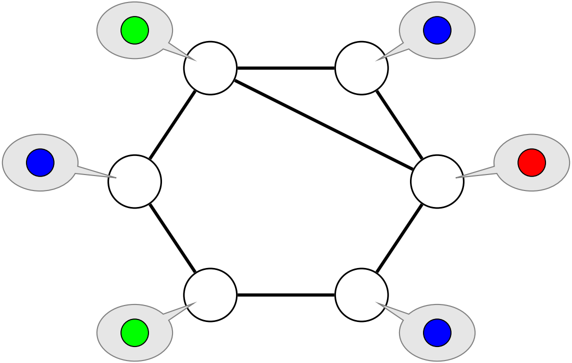
Anonymous Networks



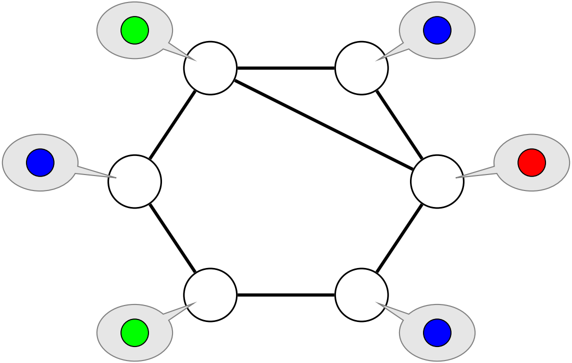
Maximal Independent Set



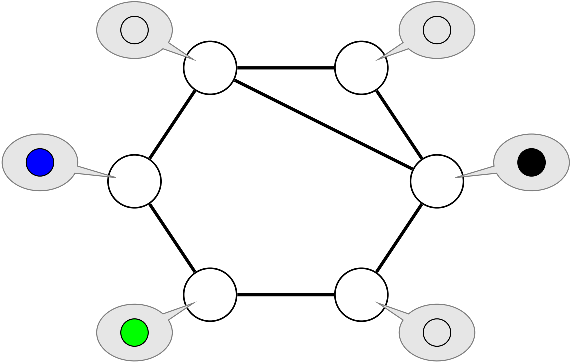
Coloring



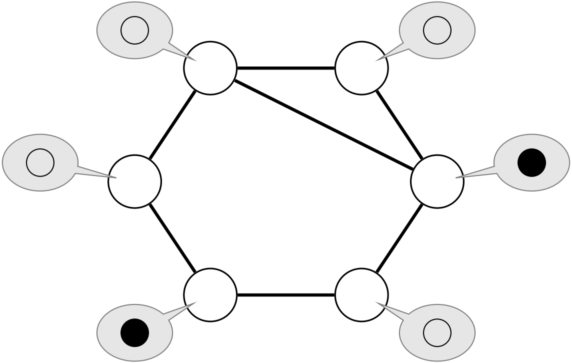
Coloring → Maximal Independent Set



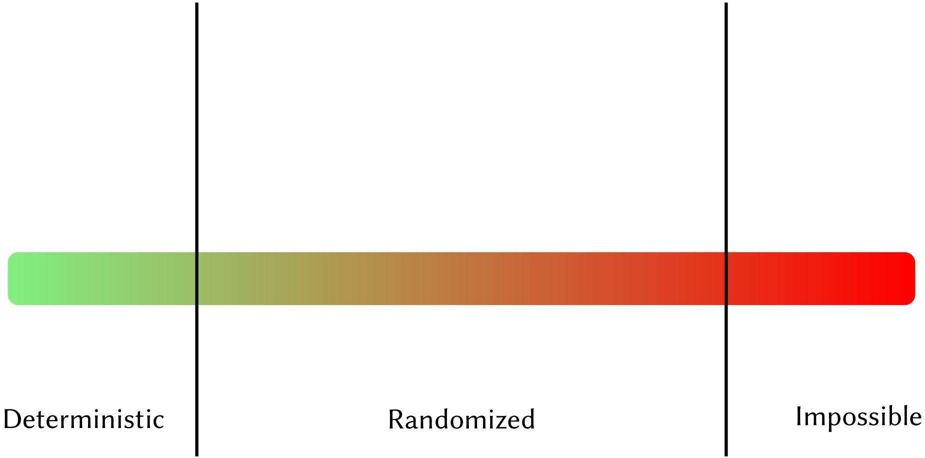
Coloring → Maximal Independent Set



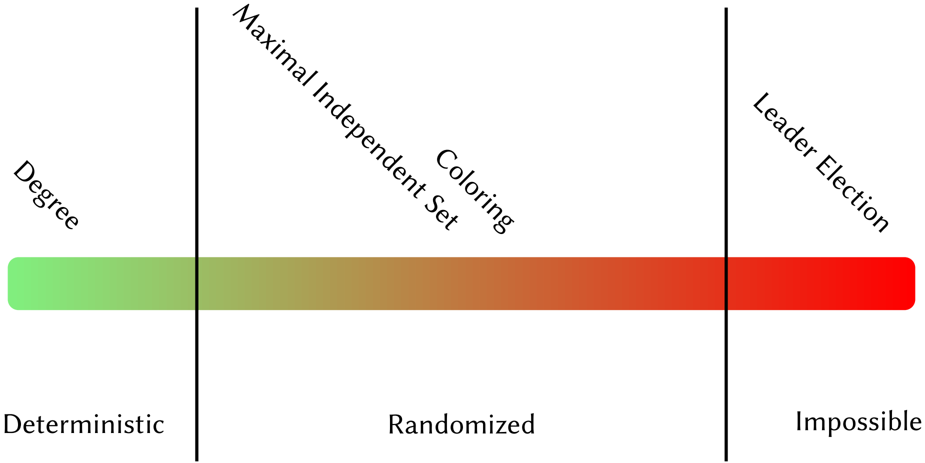
Coloring → Maximal Independent Set



Computability

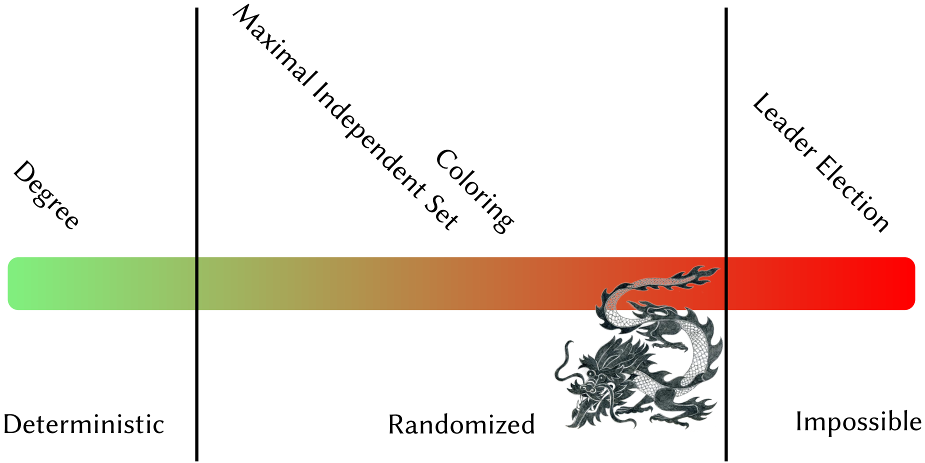


Computability

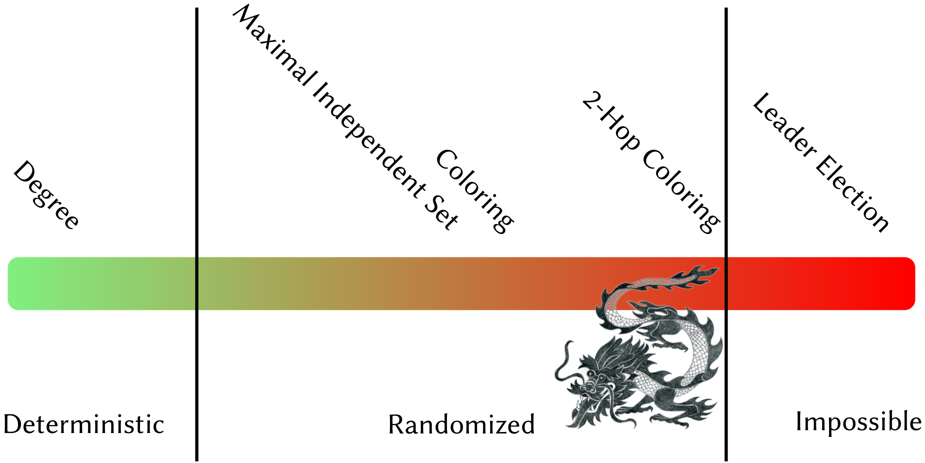


D. Angluin.
Local and global properties in networks of processors (extended abstract).
STOC, 1980.

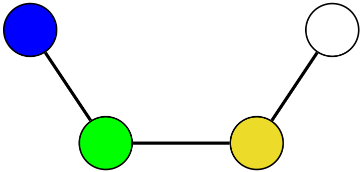
Computability



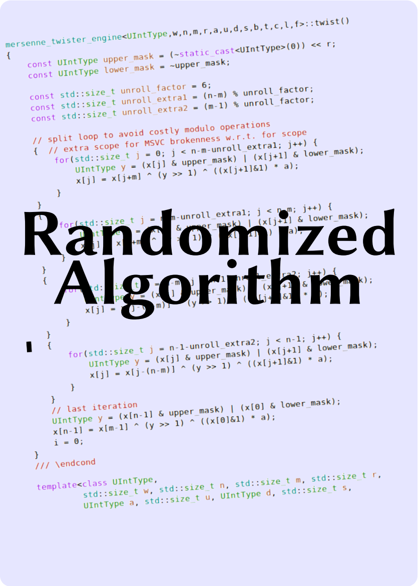
Computability



2-Hop Coloring?!



Theorem

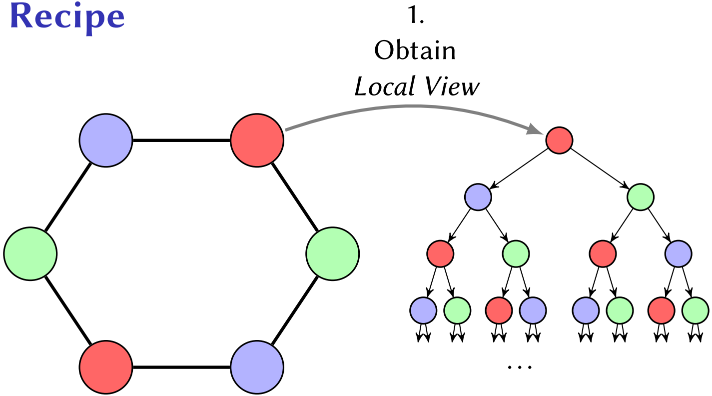


=[1]

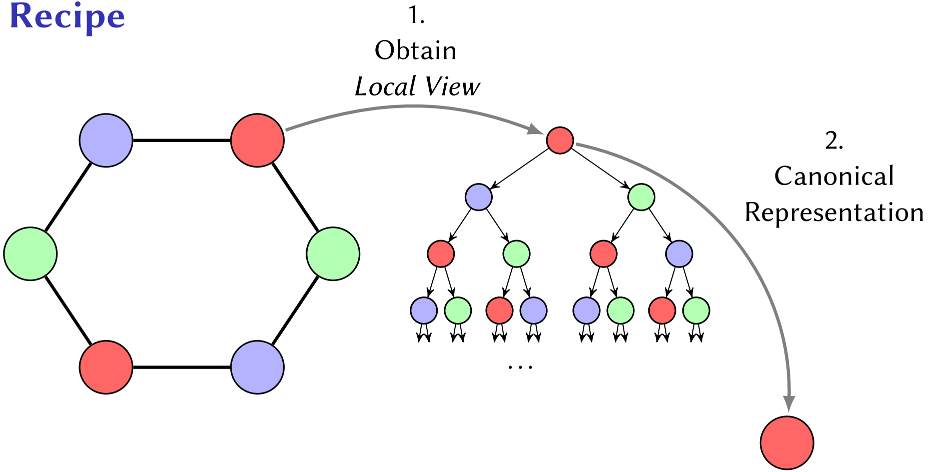
+

[1] Subject to Restrictions

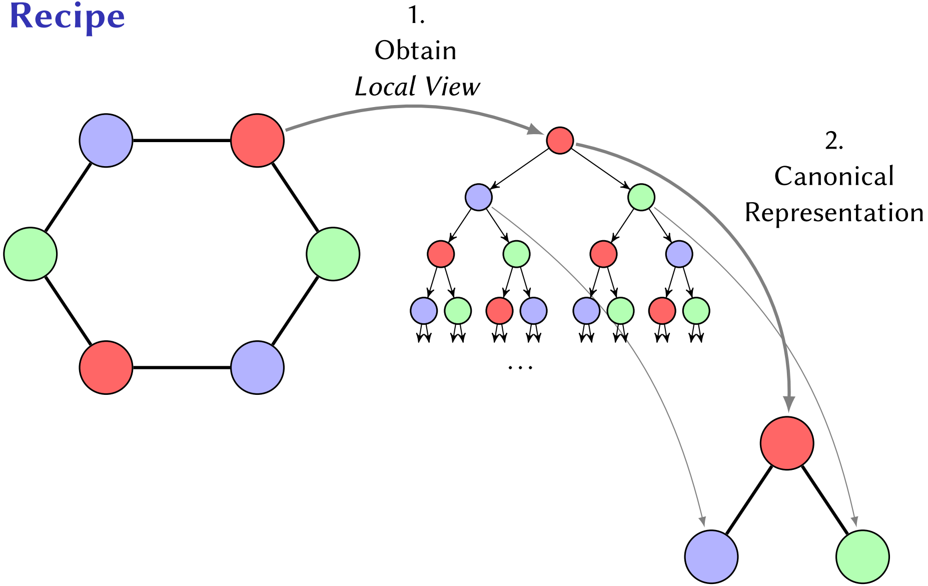
Recipe



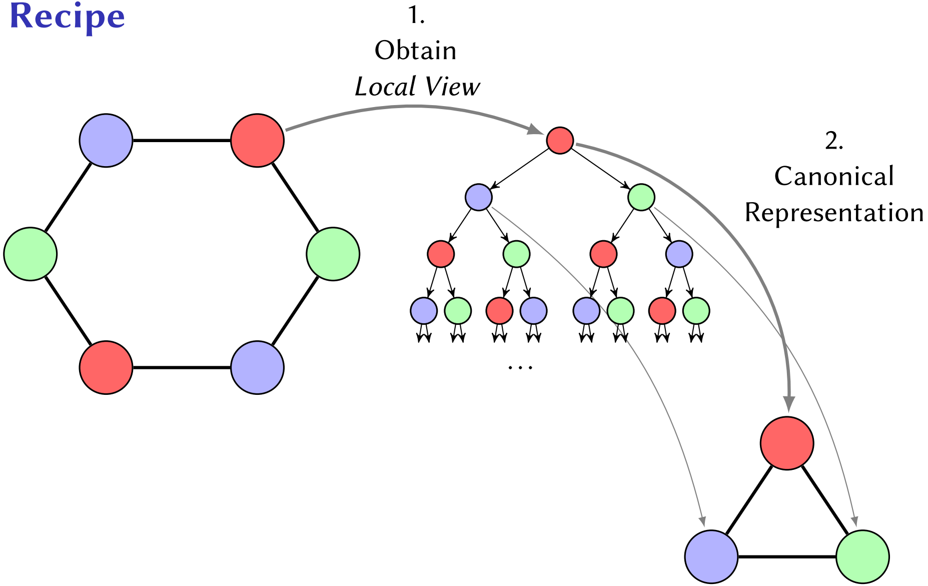
Recipe



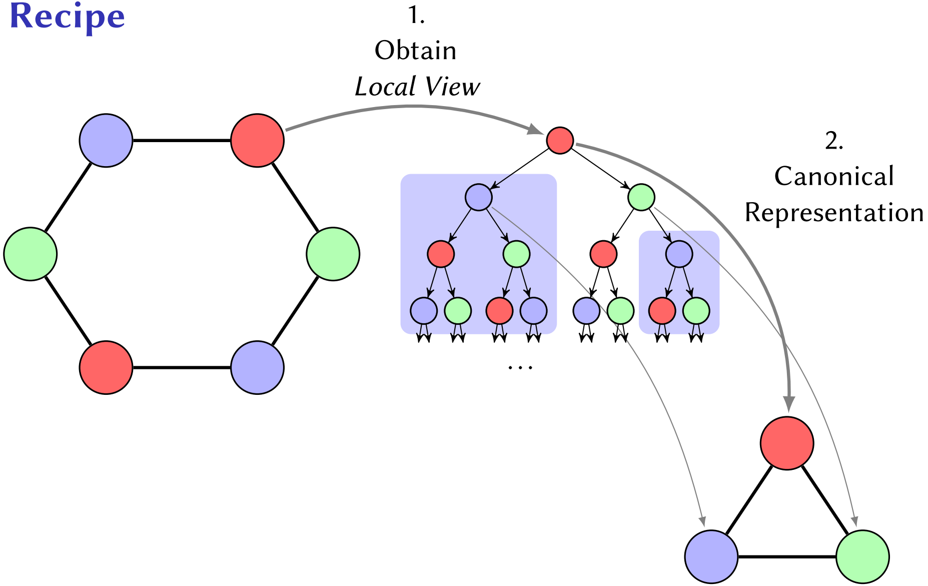
Recipe



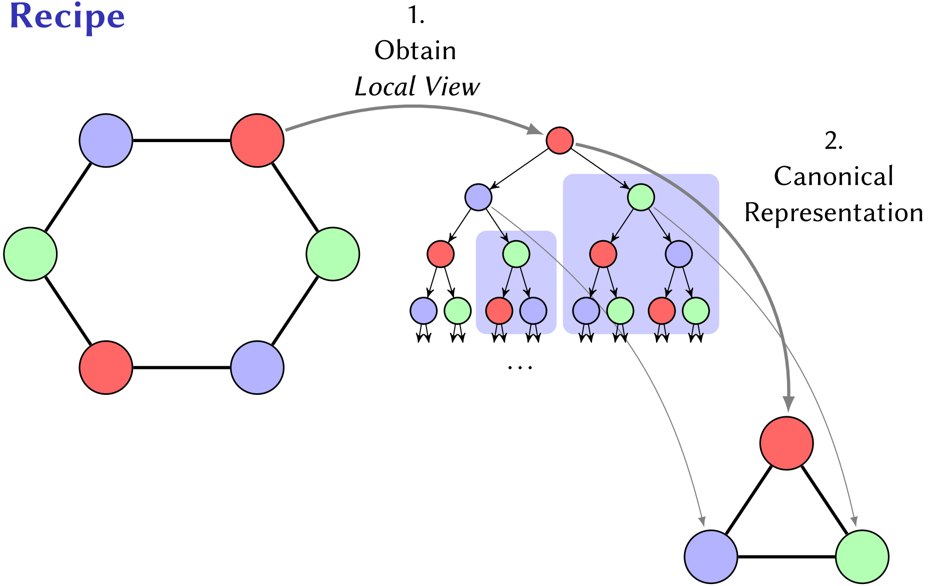
Recipe



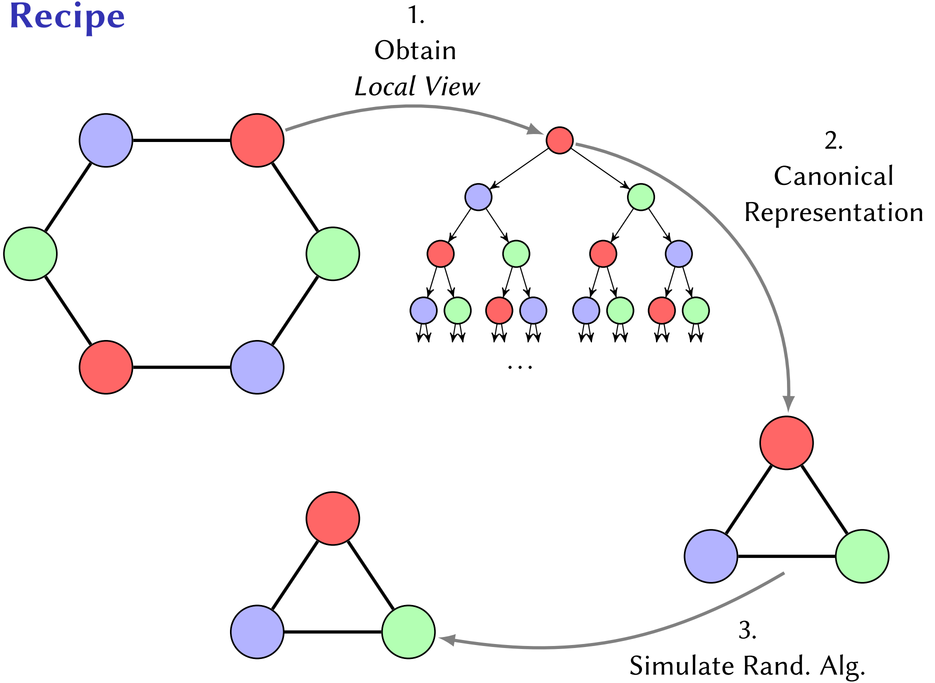
Recipe



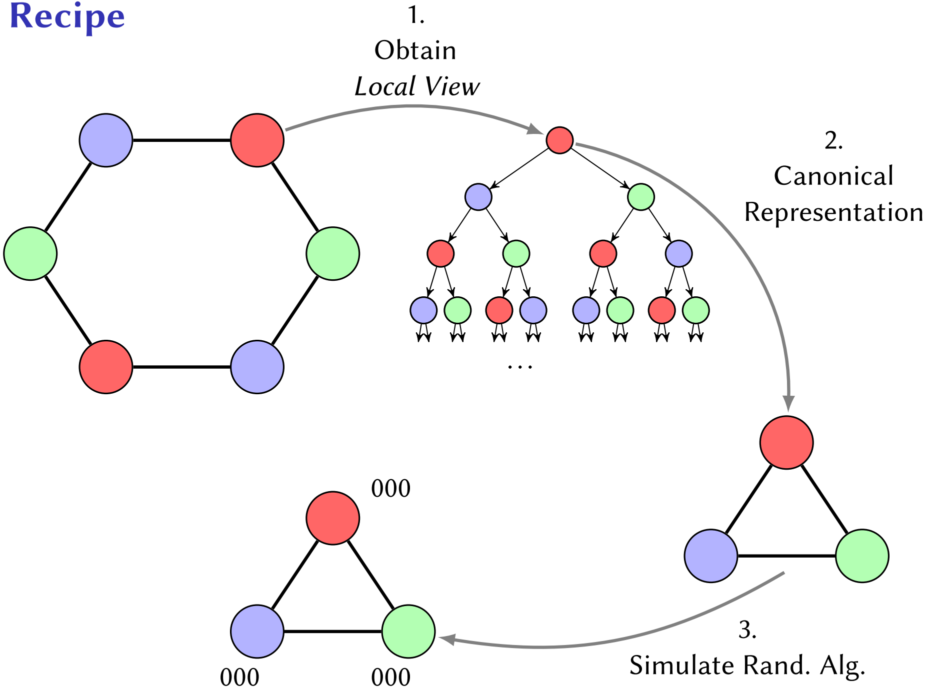
Recipe



Recipe


1.
Obtain
Local View
...
2.
Canonical
Representation
3.
Simulate Rand. Alg.

Recipe


1.
Obtain
Local View
...
2.
Canonical
Representation
3.
Simulate Rand. Alg.
000
000
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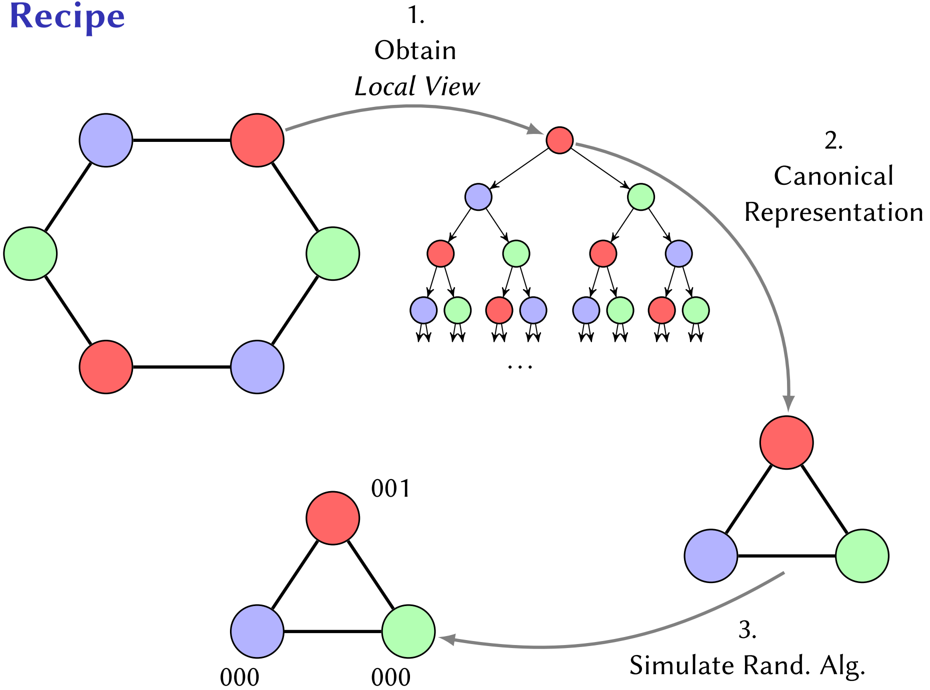
Recipe


1.
Obtain
Local View
2.
Canonical
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3.
Simulate Rand. Alg.
001
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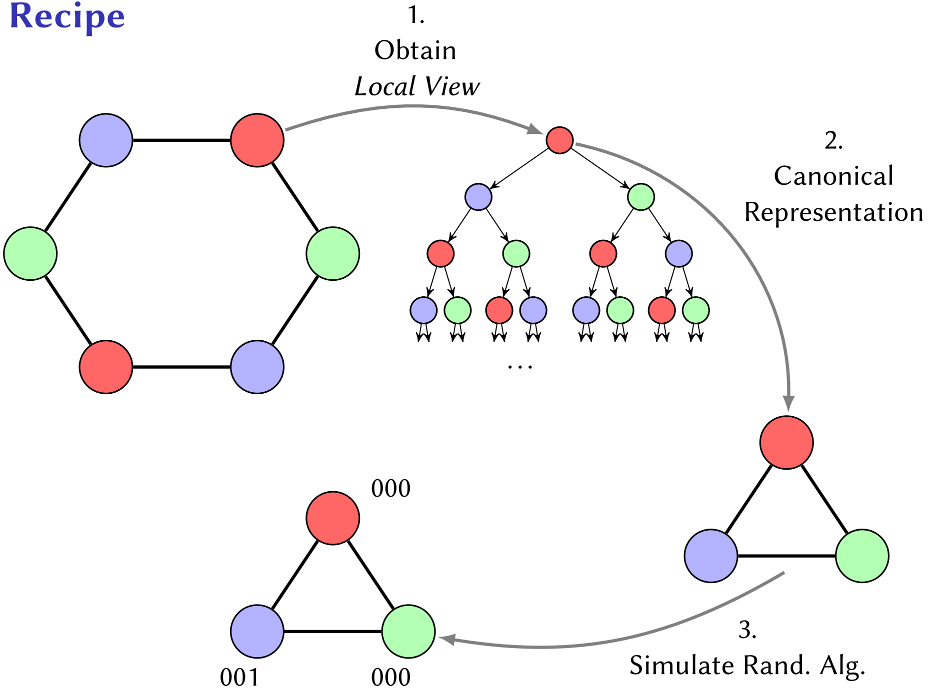
...

Recipe


1.
Obtain
Local View
2.
Canonical
Representation
3.
Simulate Rand. Alg.
...
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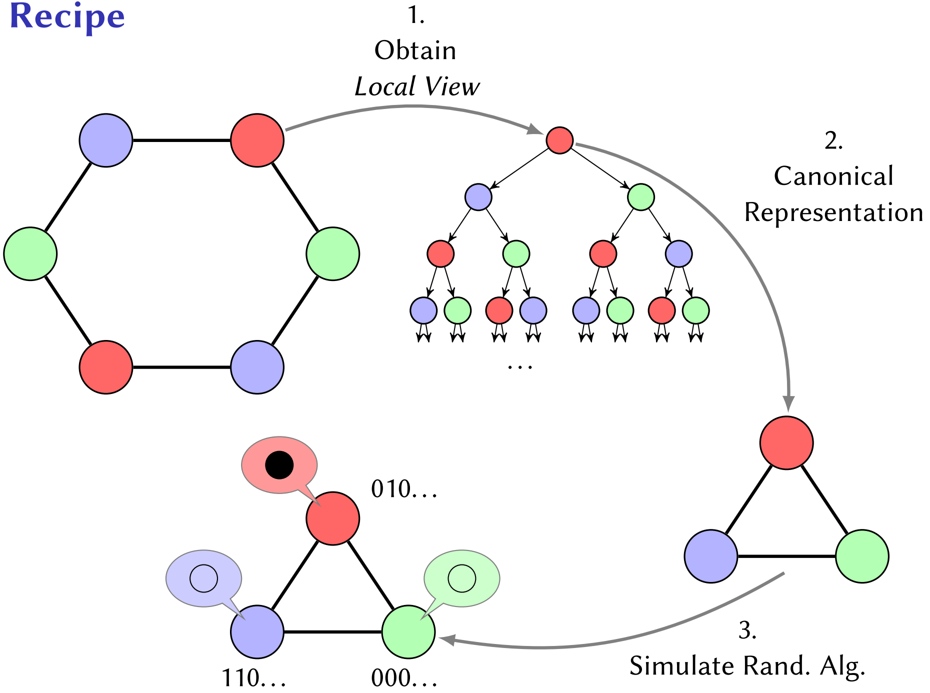
Recipe


1.
Obtain
Local View
2.
Canonical
Representation
3.
Simulate Rand. Alg.
. . .
010. . .
110. . .
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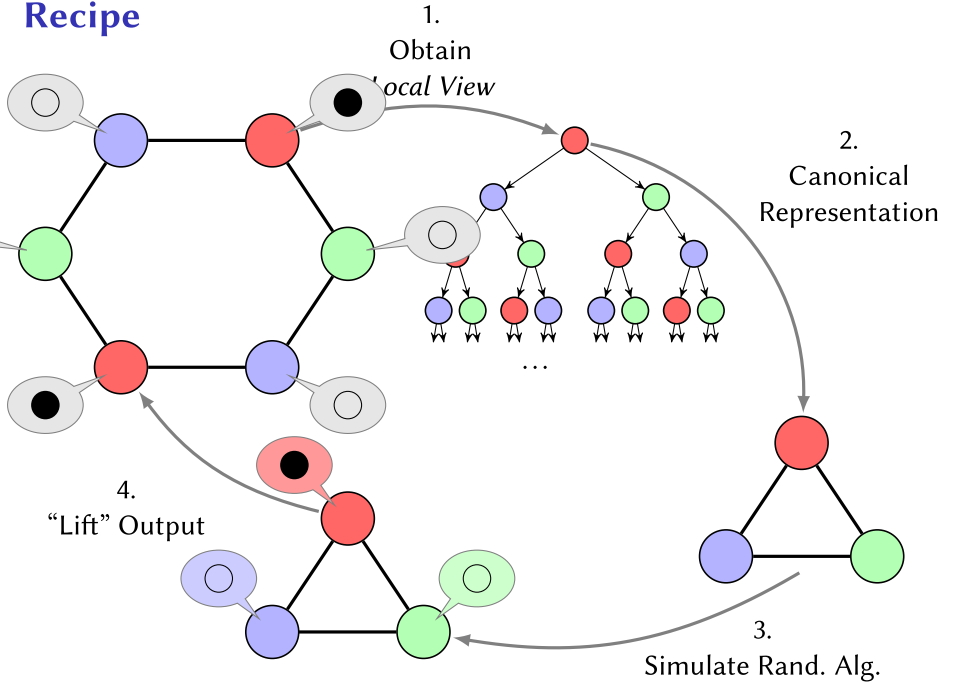
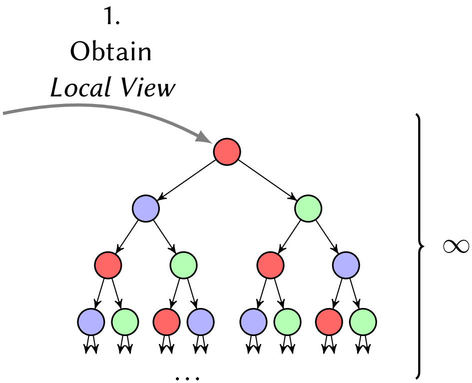
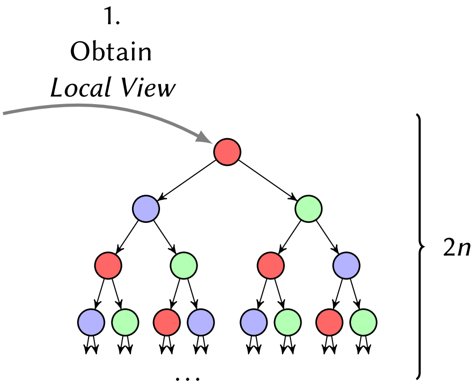
Recipe


1.
Obtain
Local View
2.
Canonical
Representation
...
3.
Simulate Rand. Alg.
4.
"Lift" Output

Obstacles

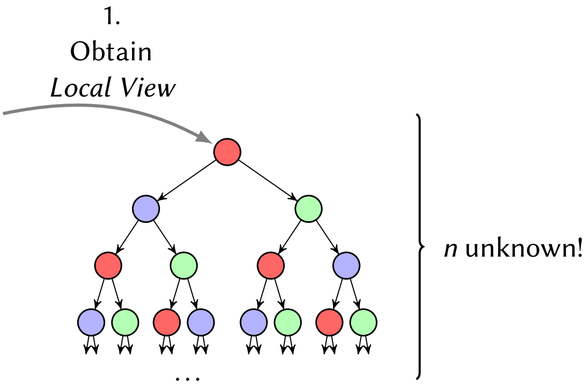


Obstacles



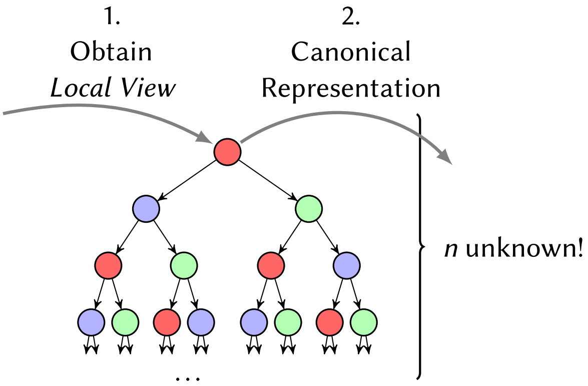
N. Norris.
Universal covers of graphs: Isomorphism to depth $n-1$ implies isomorphism to all depths.
Discrete Applied Mathematics, 56(1):61–74, 1995.

Obstacles



N. Norris.
Universal covers of graphs: Isomorphism to depth $n-1$ implies isomorphism to all depths.
Discrete Applied Mathematics, 56(1):61–74, 1995.

Obstacles

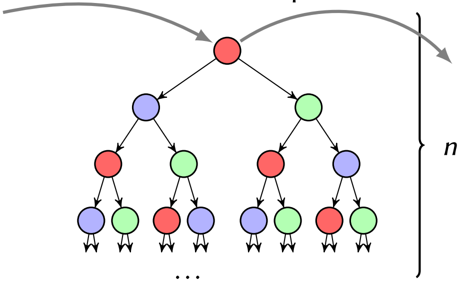


N. Norris.
Universal covers of graphs: Isomorphism to depth $n-1$ implies isomorphism to all depths.
Discrete Applied Mathematics, 56(1):61–74, 1995.

Obstacles

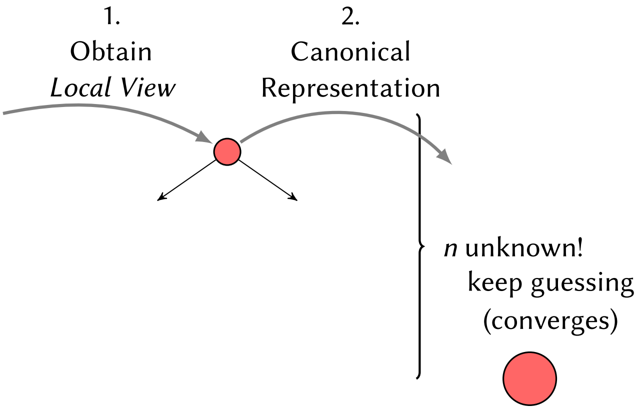
1.
Obtain
Local View

2.
Canonical
Representation

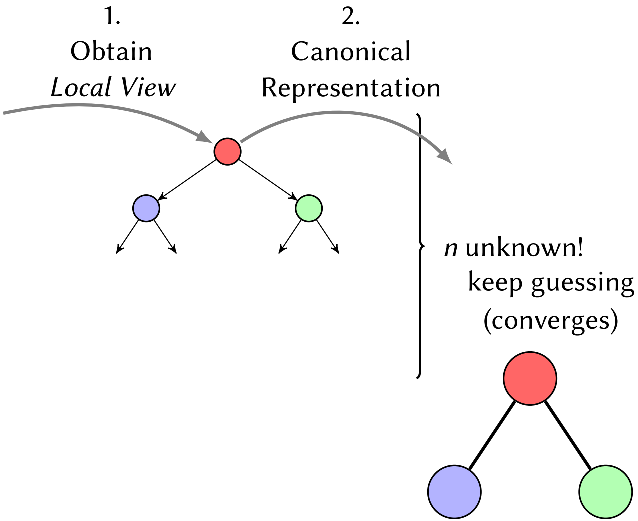


n unknown!
keep guessing
(converges)

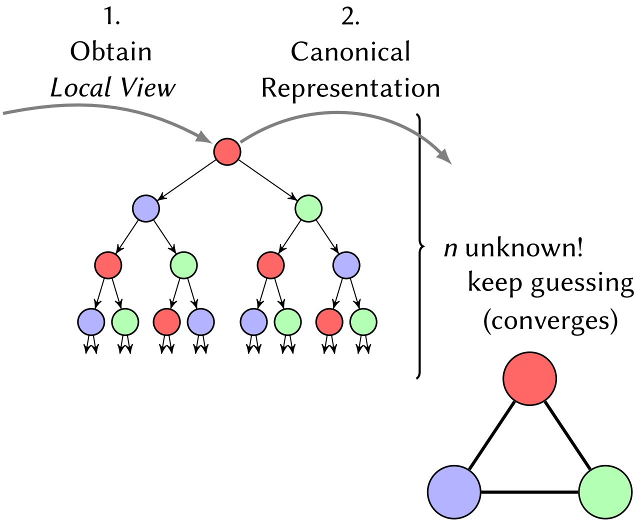
Obstacles


1.
Obtain
Local View
2.
Canonical
Representation
n unknown!
keep guessing
(converges)

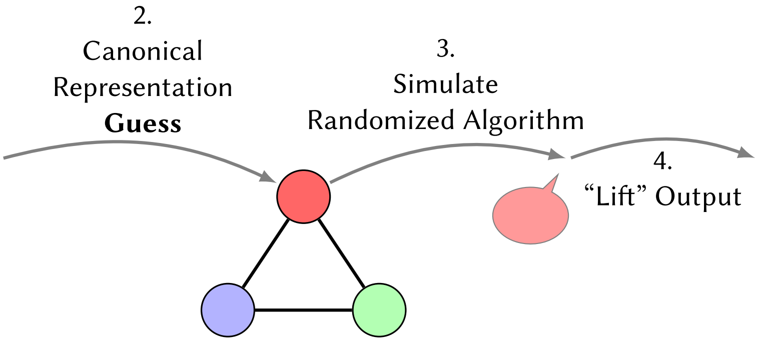
Obstacles


1.
Obtain
Local View
2.
Canonical
Representation
n unknown!
keep guessing
(converges)

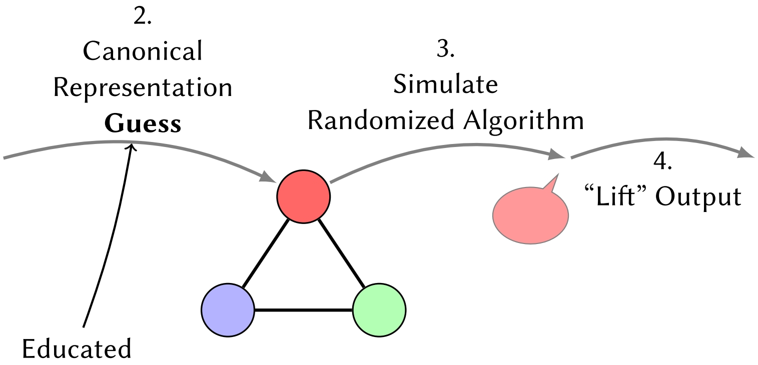
Obstacles


1.
Obtain
Local View
2.
Canonical
Representation
n unknown!
keep guessing
(converges)

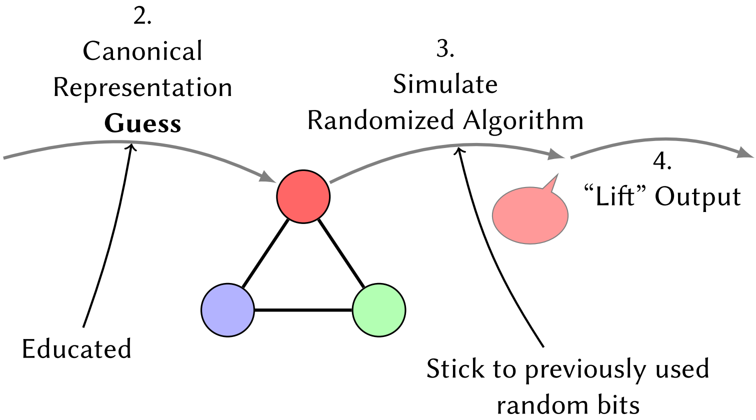
Obstacles


2.
Canonical
Representation
Guess
3.
Simulate
Randomized Algorithm
4.
"Lift" Output

Obstacles

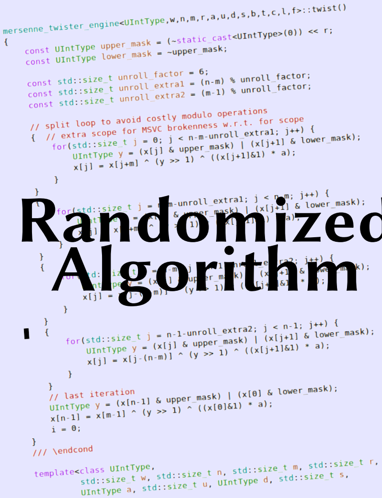

2.
Canonical
Representation
Guess
Educated
3.
Simulate
Randomized Algorithm
4.
“Lift” Output

Obstacles



2.
Canonical
Representation
Guess
Educated
3.
Simulate
Randomized Algorithm
Stick to previously used
random bits
4.
“Lift” Output

Theorem



Randomized Algorithm

$=$[1]

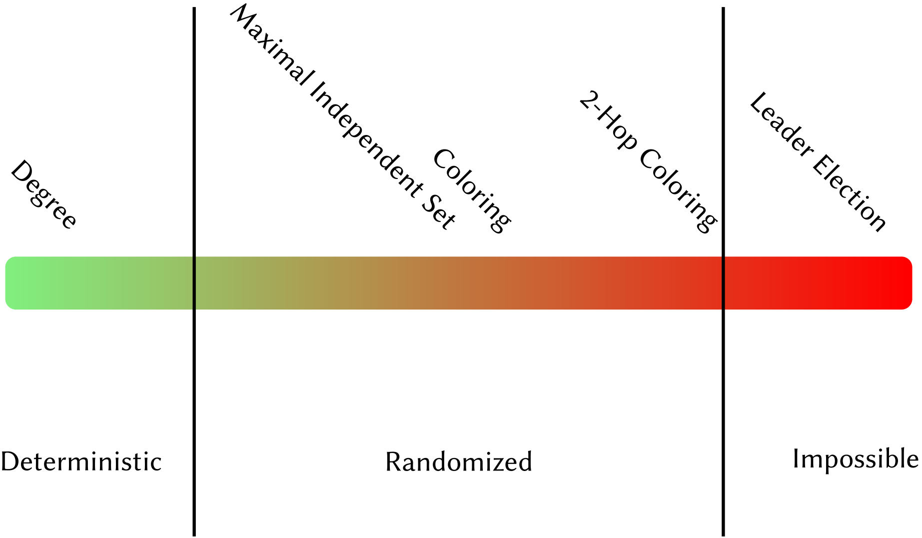
2-Hop Coloring

+

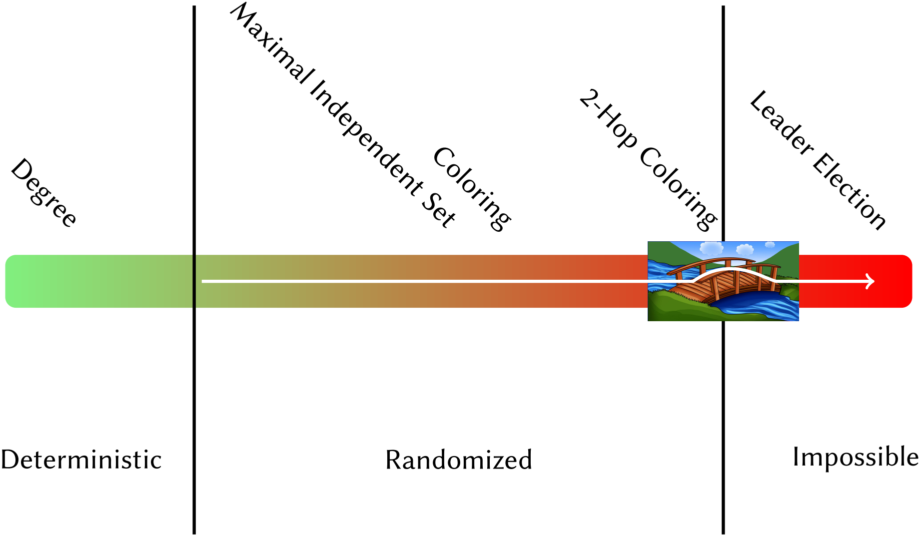
Deterministic Algorithm

[1]Subject to Restrictions

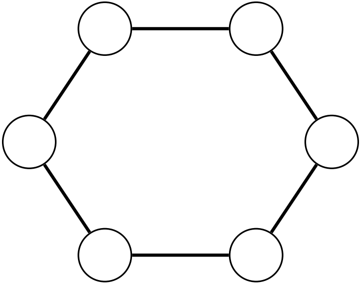
Computability



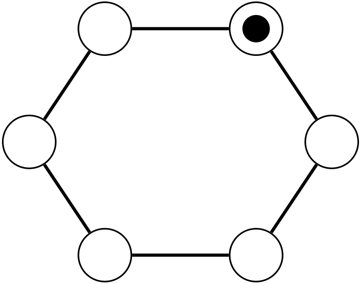
Computability



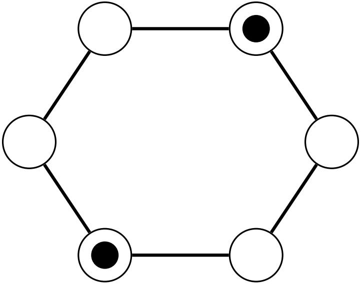
Leader Election



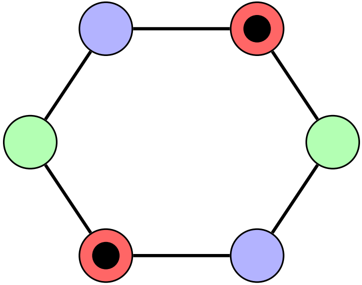
Leader Election



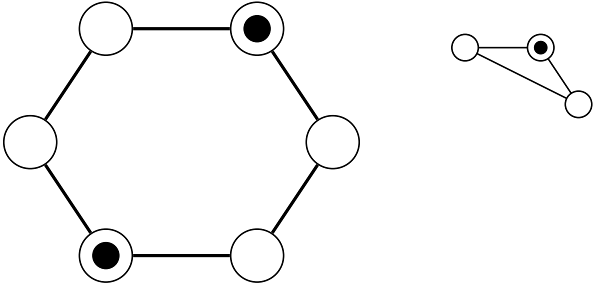
Leader Election



Leader Election

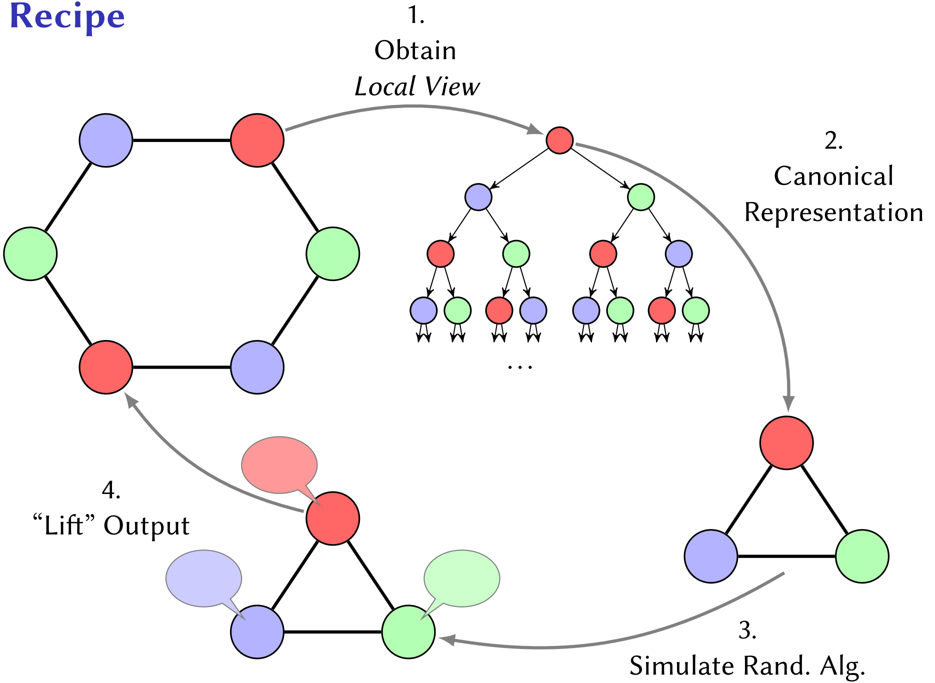


Leader Election

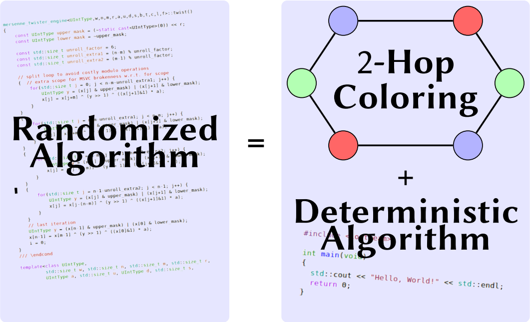


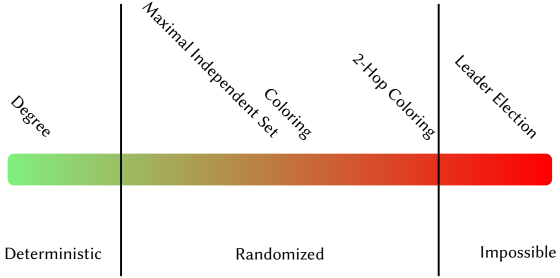
- “Promise” must be *decidable* with anonymous algorithm

Recipe


1.
Obtain
Local View
2.
Canonical
Representation
3.
Simulate Rand. Alg.
4.
"Lift" Output
...

Summary


Randomized Algorithm
=
2-Hop Coloring
+
Deterministic Algorithm


Degree
Maximal Independent Set
Coloring
2-Hop Coloring
Leader Election
Deterministic
Randomized
Impossible