Brief Announcement:

Local Approximability of Minimum Dominating Set on Planar Graphs

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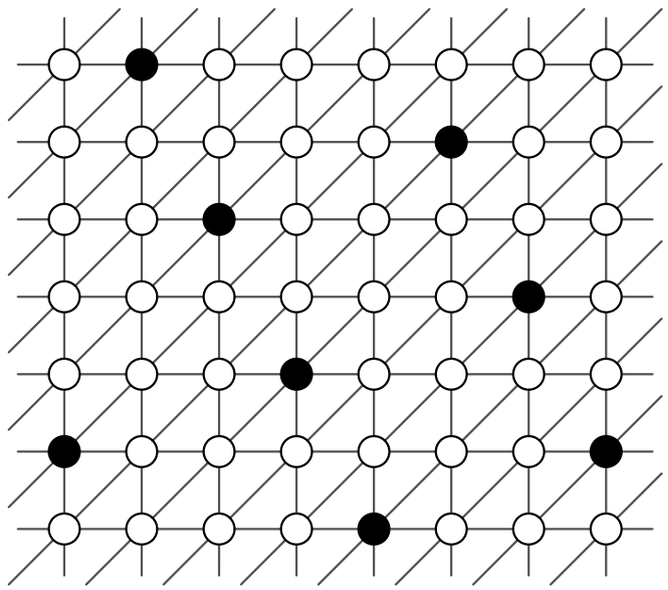


Theorem

- **Not possible:**

a $(7-\varepsilon)$-approximation of minimum dominating set on planar graphs in $O(1)$ communication rounds with deterministic distributed algorithms

Prior work

- **Possible: 52-approximation**
  - Czygrinow et al. (DISC 2008)
  - Lenzen et al. (*Dist. Comp.* 2013)
  - Wawrzyniak (*Inf. Proc. Letters* 2014)

Prior work

- **Possible: 52-approximation**
- **Possible: 636-approximation in anonymous networks**
  - Wawrzyniak (PODC 2013)

Prior work

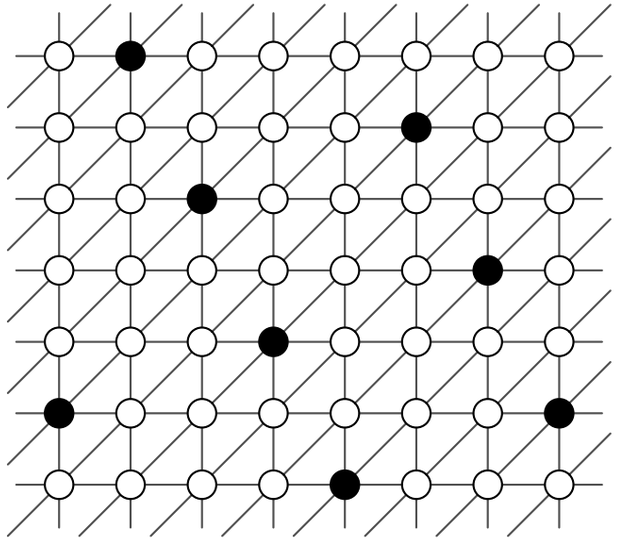
- **Possible: 52-approximation**
- **Possible: 636-approximation in anonymous networks**
- **Not possible: (5 – ε)-approximation**
  - Czygrinow et al. (DISC 2008)

Prior work

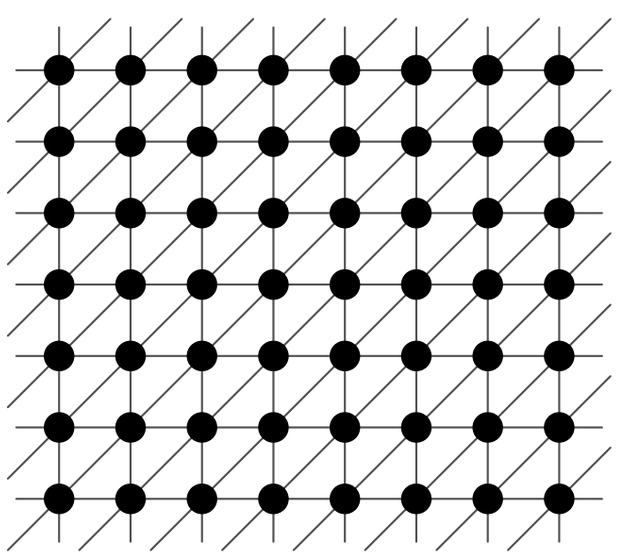
- **Possible: 52-approximation**
- **Possible: 636-approximation in anonymous networks**
- **Not possible: (5 − ε)-approximation**
- **New lower bound: (7 − ε)-approximation**

Techniques

OPT = *n*/7



ALG = *n*

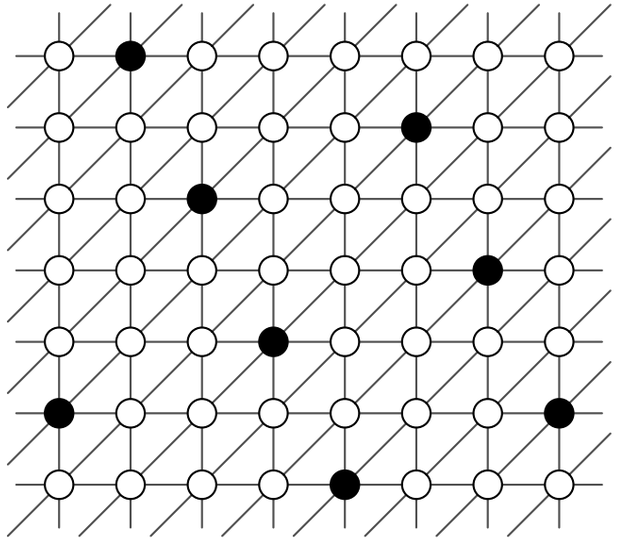


1. Lower-bound construction for “order-invariant algorithms”

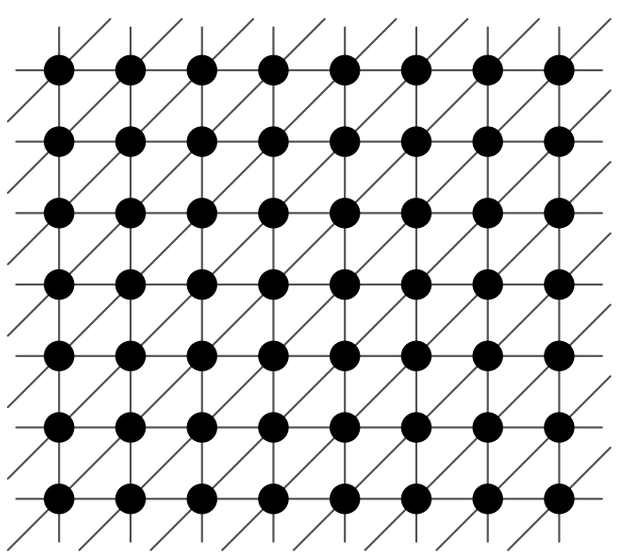
- nodes have unique IDs
- but output only depends on the relative order of nodes
- ***universal*** lower bound: fools any such algorithm

Techniques

OPT = $n/7$



ALG = n



1. **Lower-bound construction for “order-invariant algorithms”**

2. **Apply Ramsey’s theorem: numerical IDs do not help**

   - ***adaptive*** lower bound: different construction for each algorithm

Why should we care?

- **Question: how well can we approximate graph problems in $O(1)$ rounds?**

- **Answer: simple two-step process**
  1. tight bounds for anonymous networks
  2. apply Göös et al.'s simulation result (PODC 2012)

Why should we care?

- **Standard process fails for dominating sets in planar graphs, for two different reasons!**

1. no tight bounds in anonymous networks
2. simulation theorem does not apply in planar graphs

Dominating sets in planar graphs

- **One of the last uncharted corners of local approximability**
- **Negative: 5 → 7 with or without IDs, positive: 52 with IDs, 636 without IDs**
- **Major open question: do unique IDs help?**