Brief Announcement:
Distributed Derandomization Revisited

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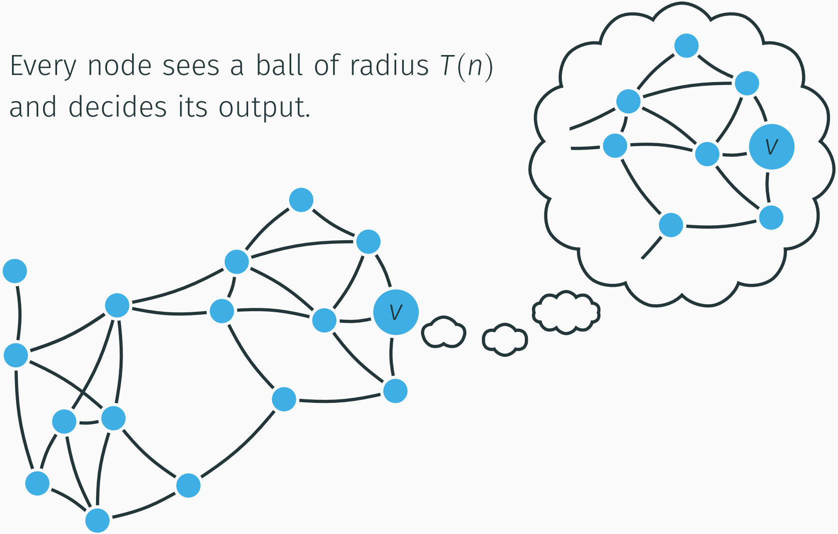
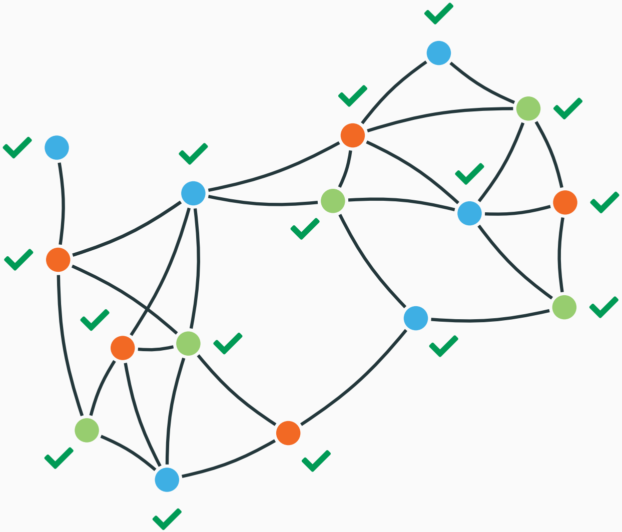
The LOCAL model

[Linial 1992]

Every node sees a ball of radius $T(n)$ and decides its output.



Locally checkable labeling problems (LCLs) [Naor, Stockmeyer 1995]



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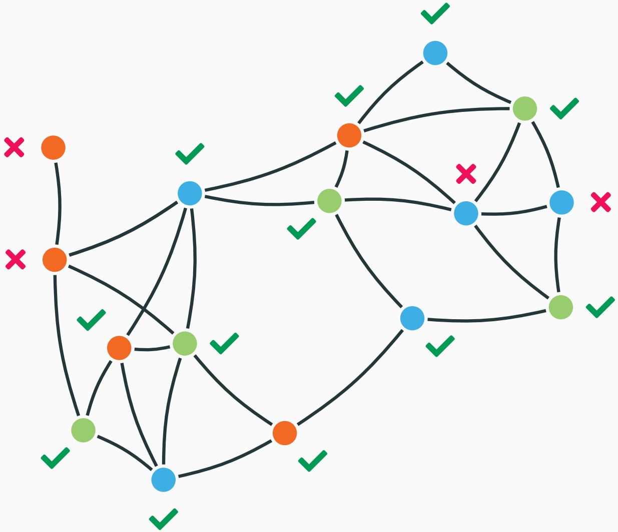
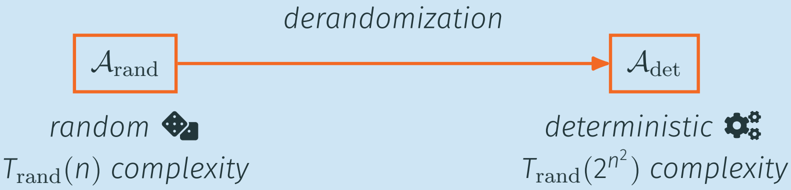


Prior work and limitations

Theorem (Chang, Kopelowitz, and Pettie[1])

Let $\mathcal{A}_{\mathrm{rand}}$ be a randomized LOCAL algorithm solving an LCL problem and that uses at most $r(n)$ random bits.



[1] Yi-Jun Chang, Tsvi Kopelowitz, and Seth Pettie. **An exponential separation between randomized and deterministic complexity in the LOCAL Model.** *SIAM Journal on Computing, 2019.*

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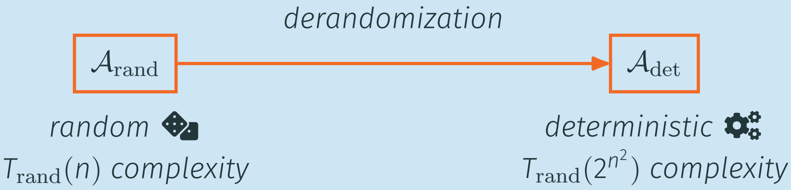

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Main result

Theorem (Dahal, d'Amore, Lievonen, P., Suomela)

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derandomization

$\mathcal{A}_{\mathrm{rand}} \longrightarrow \mathcal{A}_{\mathrm{det}}$

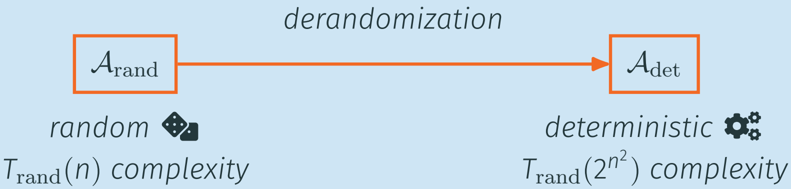
random — $T_{\mathrm{rand}}(n)$ *complexity*

deterministic — $T_{\mathrm{rand}}(2^{n^2})$ *complexity*

Main result

Theorem (Dahal, d'Amore, Lievonen, P., Suomela)

Let $\mathcal{A}_{\mathrm{rand}}$ be a randomized LOCAL algorithm solving a~~n LCL~~ ***component-wise verifiable problem*** ~~*and that uses at most $r(n)$ random bits.*~~

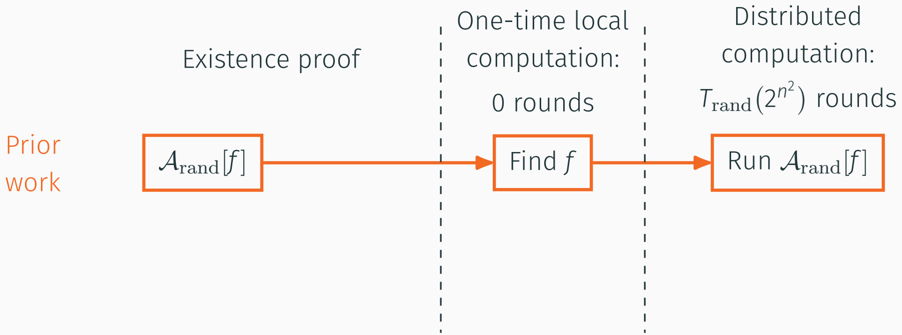


Proof Strategy

Idea:

- lie about the number of vertices, say 2^{n^2} instead of n,
- and find a good function f : IDs $\rightarrow$ bit strings s.t. $\mathcal{A}_{\mathrm{rand}}[f]$ is correct whp.

each vertex v uses $f(id(v))$ as random bit string

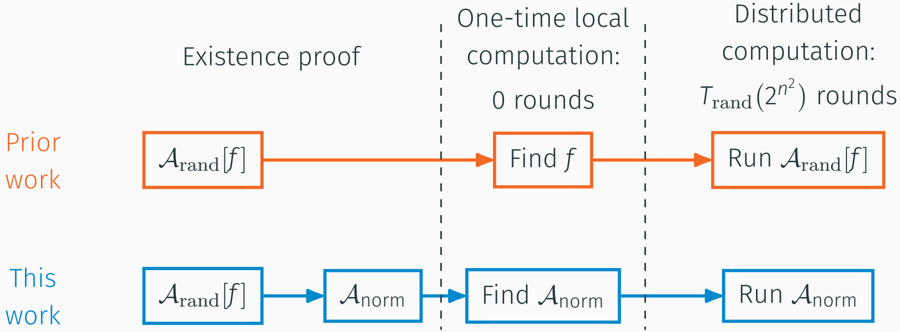


Proof Strategy

Idea:

- lie about the number of vertices, say 2^{n^2} instead of n,
- and find a good function f : IDs $\to$ infinite bit strings s.t. $\mathcal{A}_{\mathrm{rand}}[f]$ is correct whp.

↑ each vertex v uses $f(id(v))$ as random bit string



Conclusion

- Derandomization of LOCAL algorithms for LCLs:
  - No more annoying bounded number of random bits assumption.
  - The new derandomized algorithm is uniform in n.
- Generalization of the original theorem to:
  - component-wise verifiable problems,
  - and LCL problems on connected graphs.

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Thanks for listening!