

# HANLIN REN

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## EDUCATION

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**Tsinghua University, China**

Bachelor of Engineering

Major: Computer Science (Special Pilot CS Class, a.k.a Yao Class)

*August 2016 - Present*

## RESEARCH INTERESTS

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I am interested in **Algorithm Design** and **Computational Complexity**.

## RESEARCH EXPERIENCE

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**Approximating Bounded-leg Distances by Fast Matrix Multiplication**

*2017 Fall*

*Advisor: Prof. Ran Duan*

- We studied the Bounded-leg Shortest Path problem in general graphs: Given vertices  $u, v$  and a number  $L$ , what is the shortest path from  $u$  to  $v$  using edges with length at most  $L$ ?
- We showed that a data structure can be constructed in  $\tilde{O}(n^{(\omega+3)/2}\epsilon^{-1.5}\log W)$  time to  $(1 + \epsilon)$ -approximate such queries. This improves the previous state-of-the-art of  $\tilde{O}(n^3)$  construction time.
- Our techniques include faster (max, min)-product of matrices, and row/column balancing.
- Paper accepted to ICALP 2018.

**Approximate Distance Oracles Under Multiple Vertex Failures**

*2018 Fall*

*Advisor: Prof. Ran Duan*

- We studied the following problem: how to maintain (approximate) shortest paths in undirected graphs, when a lot of vertices may fail? Previously, no nontrivial data structures were known if at least 3 vertices fail.
- We showed that the number of failed vertices is at most  $\log n / \log \log n$ , then we can preprocess the graph in polynomial time to answer the queries in  $\text{poly}(\epsilon^{-1}, \log n, d)$  time, with an  $(1 + \epsilon)$ -approximate answer. We can also construct data structures with worse guarantee but tolerates more failures.
- Our techniques include a previous work on edge failures, the “high-degree hierarchy” for handling vertex failures, and some new ideas for combining these known techniques.

**Visiting Student in Massachusetts Institute of Technology**

*2019 Summer*

*Advisor: Prof. Ryan Williams and Prof. Virginia Vassilevska Williams*

- We studied some fundamental algorithmic and complexity theoretic problems.
- Lijie Chen and I made progress on tightening the connection between circuit-analysis algorithms and circuit lower bounds. We showed, roughly, that an algorithm estimating the acceptance probability of a circuit class with enough accuracy implies a strong average-case lower bound against that circuit.
- New technical ingredients include a construction in the paper *Cryptography in  $\text{NC}^0$* .

## PUBLICATIONS

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(Note: in Theoretical Computer Science, the list of authors are usually sorted in alphabetical order.)

Approximating All-Pair Bounded-Leg Shortest Path and APSP-AF in Truly-Subcubic Time

- Ran Duan and **Hanlin Ren**
- In 45th International Colloquium on Automata, Languages, and Programming (ICALP 2018)
- DOI: 10.4230/LIPIcs.ICALP.2018.42

## MANUSCRIPTS / IN SUBMISSION

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Approximate Distance Oracles Subject to Multiple Vertex Failures

- Ran Duan, Yong Gu and **Hanlin Ren**

Strong Average-Case Lower Bounds from Non-trivial Derandomization

- Lijie Chen and **Hanlin Ren**

## SELECTED AWARDS

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JUL 2015 Gold medal in Chinese National Olympiad in Informatics (NOI)

DEC 2016 Gold medal in 2016 ACM-ICPC China Final

SEP 2017 Baidu 'Future Star' Scholarship

SEP 2018 Evergrande Scholarship

SEP 2019 Yao Award, bronze prize

## LANGUAGES

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**Chinese:** native

**English:** TOEFL 110 (Reading 30 + Listening 29 + Speaking 23 + Writing 28, May 2019)