HANLIN REN

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EDUCATION

Tsinghua University, China *August 2016 - Present*
Bachelor of Engineering
Major: Computer Science (Special Pilot CS Class, a.k.a Yao Class)

RESEARCH INTERESTS

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

RESEARCH EXPERIENCE

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* $\mathbf{NC}^0$.

PUBLICATIONS

(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

Strong Average-Case Lower Bounds from Non-trivial Derandomization
- Lijie Chen and **Hanlin Ren**
- In 52nd Annual ACM Symposium on Theory of Computing (STOC 20)

MANUSCRIPTS / IN SUBMISSION

Approximate Distance Oracles Subject to Multiple Vertex Failures

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

SELECTED AWARDS

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

Chinese: native

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