Yuchong Pan

https://ypan.me

Email : yuchong@mit.edu
Mobile : +1 (617) 749-5906

Research Interests

Algorithms, combinatorics, optimization, theoretical computer science, operations research, network flow theory, traveling salesman problem, submodular optimization, graph algorithms, graph theory

Education

- **Massachusetts Institute of Technology** — Cambridge, MA
  Ph.D., Applied Mathematics — *September 2021 – May 2026 (anticipated)*
  - **GPA**: 5.0/5.0
  - **Relevant Coursework**: Algebraic Methods in Extremal Combinatorics, Randomness and Computation, An Algorithmist's Toolkit, Matrix Multiplication and Graph Algorithms, Graph Theory and Additive Combinatorics, Recent Progress on Traveling Salesman Problem
- **University of British Columbia** — Vancouver, BC
  B.Sc., Combined Honours Computer Science and Mathematics, with Distinction — *September 2017 – May 2021*
  - **GPA**: 94.4%
  - **Thesis**: *Optimization Problems on Network Flows with Degree Constraints*, advised by F. Bruce Shepherd [Link]
  - **Relevant Coursework**: Combinatorial Optimization, Submodular Optimization, Tools for Modern Algorithm Analysis, Applications of Linear Algebra in Theoretical Computer Science, Complexity Theory, Real Analysis, Measure-Theoretic Probability and Stochastic Processes

Employment

- **Microsoft** — Vancouver, BC
  Software Engineer Intern — *May 2020 – August 2020*
  - **.NET Runtime IL Interpreter**: Resurrected the IL (intermediate language) interpreter inside .NET Runtime. Conducted performance analyses for the various configurations of the IL interpreter. [GitHub]
- **Microsoft** — Redmond, WA
  Software Engineer Intern — *June 2019 – August 2019*
  - **.NET Core Uninstall Tool**: A guided tool that enables the controlled clean-up of a system such that only the desired versions of .NET Core SDKs and Runtimes remain. Prepared user documentation. Released as an open source command-line tool by Microsoft to external users. [GitHub] [Blog] [Documentation]
  - **MSBuild Binary Log Query Language**: A domain-specific language extending XPath (XML Path Language) that provides multiple search operators for advanced queries on the target graph parsed from MSBuild binary logs.
- **Microsoft** — Vancouver, BC
  Software Engineer Intern — *May 2018 – August 2018*
  - **Earth Lens**: An open-source project for iPad that identifies, tracks, and analyzes objects in aerial imagery to assist in disaster relief and environmental conservation. The project uses Xamarin and CoreML. [GitHub] [Blog]
- **Sogou** — Beijing, China
  Software Engineer Intern — *May 2017 – July 2017*
  - **Speech-Recognition & OCR Proofreading Tools**: Web apps for internal proofreading and testing of AI-Cloud speech recognition and OCR services; based on Bootstrap, Vue.js, Flask and Docker.
  - **Receipt Recognition Service**: A service for receipt format and content recognition; based on Flask, scikit-image and Sogou AI-Cloud OCR Service; used for reimbursement management of Sogou's financial department.
- **THE Hack** — Shanghai, China
  Co-Founder, Chief Technology Officer — *February 2017 – July 2018*
  - **Corporate Relations**: Negotiated sponsorships and partnerships from big corporations, including Google, Apple, Sogou and Wolfram, venture capitals and incubators.
  - **Technological Support**: Directed and supervised full-stack software development; designed and implemented event websites using Docker, Django and Vue.js; see thehack.org.cn and hackinit.org.
- **InitialView** — Beijing, China
  Software Engineer Intern — *September 2016 – May 2017*
  - **Web and App Development**: Implemented server end, booking system, user portals, video players and blog; refactored homepage. Implemented a cross-platform app for iOS and Android based on Ionic and AngularJS.

Research/Directed Reading Experience

- **Directed Reading on the Traveling Salesman Problem** *September 2021 – present*
  - An ongoing directed reading project on recent development on the approximability of the traveling salesman problem (TSP), including the $(3/2-\varepsilon)$-approximation algorithm of the metric TSP problem and the $(3/2-\varepsilon)$ bound on the integrality gap of the subtour LP for TSP, both by Karlin, Klein and Oveis Gharan. Advised by Prof. Michel X. Goemans at Massachusetts Institute of Technology.
  - Studied background materials which form key ingredients of recent developments on TSP, including the cactus and deformable polygon representations of near-minimum-cuts.
- **Extending the Győri-Lovász Theorem** *April 2021 – present*
  - An ongoing research project on finding an algorithmic proof for the Győri-Lovász theorem, an important result in graph theory. In collaboration with Prof. F. Bruce Shepherd at the University of British Columbia.
- **Optimization problems on network flows with side constraints** *September 2020 – April 2021*
  - Studied several optimization problems on network flows with side constraints (i.e., unsplittable, confluent, and d-furcated flows) imposed by new telecommunication technologies such as IP routing and optical networks. Advised by Prof. F. Bruce Shepherd at the University of British Columbia.
  - Studied algorithms on these optimization problems, e.g. for congestion minimization, the 2-approximation algorithm for single-sink unsplittable flows by Dinitz et al. (1999), the $O(1+\log k)$-approximation algorithm for confluent flows by Chen et al. (2004), and the 2-approximation algorithm for bifurcated flows by Donovan et al. (2007).
  - Attempted open questions relevant to these optimization problems, including Michel X. Goemans' 2-congestion conjecture for the cost version of congestion minimization problem on single-sink unsplittable flows, constant congestion for bifurcated flows, and constant confluent rounds to route all demands.

Teaching Experience

- **University of British Columbia** Vancouver, BC
  Teaching Assistant
  - **CPSC 420 Advanced Algorithms Design and Analysis**: Spring 2021
  - **CPSC 311 Definition of Programming Languages**: Fall 2020
  - **CPSC 421/501 Introduction to Theory of Computing (graduate-level)**: Fall 2019
  - **CPSC 121 Models of Computation**: Fall 2018

Mentoring Experience

- **Massachusetts Institute of Technology** Cambridge, MA
  Directed Reading Program (Department of Mathematics) *January 2022 – February 2022*
  - Mentored two undergraduate students to read *Randomized Algorithms* by Motwani and Raghavan. Advised the students on the presentation in the directed reading program symposium.

Manuscripts

- Optimization Problems on Network Flows with Degree Constraints. Undergraduate honours thesis, University of British Columbia, 2021. [Link]
- Unsplittable Flow Problem on Paths and Trees: Closing the LP Relaxation Integrality Gap (with A. Jozefiak). UBC CPSC 531F project, 2019. [Link]

Talks and Presentations

- *Roundtrip Spanners and Roundtrip Routing in Directed Graphs* by Roditty, Thorup, and Zwick (2008). MIT 6.890 project. Massachusetts Institute of Technology. Cambridge, MA. 2021. [Slides]
- On the Sensitivity of Boolean Functions. UBC CPSC 531F project. University of British Columbia. Online. 2021. [Slides]
- Perturbation-Stable Maximum Cuts. Algorithms Reading Group, UBC Department of Computer Science. University of British Columbia. Online. 2020. [Slides]
- Unsplittable Flow Problem on Paths and Trees: Closing the LP Relaxation Integrality Gap (with A. Jozefiak). UBC CPSC 531F project. University of British Columbia. Vancouver, BC. 2019. [Slides]

Awards

- **Graduation with Distinction** *2021*
- **Science Scholar / Dean's Honour List** *2018, 2019, 2020, 2021*
- **Work Learn International Undergraduate Research Award** *2021*
- **Stanley M Grant Scholarship in Mathematics** *2019, 2021*
- **Faculty of Science International Student Scholarship** *2018, 2019, 2020*
- **J Fred Muir Memorial Scholarship in Science** *2020*
- **Trek Excellence Scholarship** *2018, 2019, 2020*
- **Dean of Science Scholarship** *2018, 2019*
- **Marie Kendall Memorial Scholarship in Science** *2018*
- **Joel Harold Marcoe Memorial Scholarship** *2018*
- **11th Place, ACM International Collegiate Programming Contest Pacific NW Region** *2017*
- **1st Place, Microsoft College Code Competition** *2017*
- **Outstanding International Student Award** *2017*
- **Silver Medal, China Team Selection Competition for International Olympiad in Informatics** *2015*
- **Bronze Medal, Asia Pacific Informatics Olympiad** *2015*
- **First Prize, National Olympiad in Informatics in Provinces (China)** *2013, 2014*

Professional Services

- **Journal Review**: SIAM Journal on Discrete Mathematics (SIDMA)
- **Conference Review**: ACM-SIAM Symposium on Discrete Algorithms (SODA 2021)

Programming Skills

- **Languages**: C++, Python, Java, C#, SQL, MATLAB, Go, JavaScript, LaTeX