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

- **The Discrete Newton's Algorithm for a Submodular Line Search Problem** *June 2021 – present*
  - An ongoing research project on the analysis of the discrete Newton's algorithm for a submodular line search problem $\delta^* = \max\{\delta \geq 0 : \min_{S \subset V}(f(S) - \delta a(S)) \geq 0\}$, where $f : 2^V \to \mathbb{R}_+$ is a non-negative submodular set function on a ground set V, and $a : 2^V \to \mathbb{R}$ is a modular function on V. In collaboration with two undergraduate students at Massachusetts Institute of Technology as part of the Extended Summer Program in Undergraduate Research (SPUR+) in the Department of Mathematics.
- **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 strongly Reyleigh distributions of spanning trees, the cactus representation of minimum cuts 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
  Extended Summer Program in Undergraduate Research (Department of Mathematics) *June 2022 – August 2022*
  - Mentoring two undergraduate students to perform a research project on the analysis of the discrete Newton's algorithm for a submodular line search problem $\delta^* = \max\{\delta \geq 0 : \min_{S \subset V}(f(S) - \delta a(S)) \geq 0\}$, where $f : 2^V \to \mathbb{R}_+$ is a non-negative submodular set function on a ground set V, and $a : 2^V \to \mathbb{R}$ is a modular function on V.
- **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

- Randomization in Recent Progress on Traveling Salesman Problem. MIT 6.842 project. Massachusetts Institute of Technology. Cambridge, MA. 2022. [Slides]
- *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 2022)

Programming Skills

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