

# Yuchong Pan

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http://ypan.me

RESEARCH INTERESTS      Algorithms, combinatorics, optimization, theoretical computer science – especially combinatorial optimization, submodular optimization, network flow theory, network design, graph theory, theory of computation, theory of complexity.

EDUCATION      **University of British Columbia**  
B.Sc., Computer Science and Mathematics, Combined Honours, expected 2021  
◦ Minor in Arts, Philosophy

EMPLOYMENT      **Microsoft Corporation**  
Software Engineer Intern, 2020  
Software Engineer Intern, 2019  
Software Engineer Intern, 2018  
  
**University of British Columbia**  
Undergraduate Teaching Assistant, 2020  
Undergraduate Academic Assistant, 2019–2020  
Undergraduate Teaching Assistant, 2019  
Student Assistant, 2019  
Undergraduate Teaching Assistant, 2018  
  
**Jisuanke**  
Teaching Researcher, 2018–2019  
Lecturer, 2018–2019  
  
**Sogou, Inc.**  
Software Engineer Intern, 2017  
  
**InitialView**  
Software Engineer Intern, 2016–2017

RESEARCH EXPERIENCE      **University of British Columbia**  
Optimization problems on network flows with side constraints (thesis), 2020–2021  
◦ Advisor: F. Bruce Shepherd  
◦ Studied several optimization problems on network flows with side constraints (i.e., unsplittable, confluent, and  $d$ -furcated flows), including the *minimum congestion*, *maximum routable demands*, and *minimum number of rounds* problems.  
◦ Studied several classical algorithms on these optimization problems, including

- the 2-approximation algorithm for the *minimum congestion* problem on single-sink unsplittable flows by Dinitz et al. (1999),
- the  $O(1 + \log k)$ -approximation algorithm for the *minimum congestion* problem on confluent flows by Chen et al. (2004),

- the 3-approximation algorithm for the *maximum demands* problem on confluent flows by Chen et al. (2004), and
- the  $(1 + \frac{1}{d-1})$ -approximation algorithm for the *minimum congestion* problem on  $d$ -furcated flows with  $d \geq 2$  by Donovan et al. (2007).
- Studied several open questions relevant to these optimization problems, including Michel Goemans' 2-congestion conjecture for the cost version of the *minimum congestion* problem on single-sink unsplittable flows,  $O(1)$ -congestion for bifurcated flows, and  $O(1)$  confluent rounds to route all demands.
- Documents: [Proposal]

Gradual typing of recursive types, 2019–2020

- Advisor: Ronald Garcia
- Applied the *Abstract Gradual Typing (AGT)* approach, based upon abstract interpretation, to iso-recursive and equi-recursive types to obtain static and dynamic semantics for *gradual typing* in terms of pre-existing static types, which enables programming languages to seamlessly combine dynamic and static checking. In particular, the dynamic semantics of the gradual language are induced from an internal runtime language whose terms represent corresponding source gradual typing derivations.
- Proved that the gradual language with recursive types induced by the AGT approach satisfies the refined criteria for gradual typing of Siek et al. (2015), including type safety, static guarantee and dynamic guarantee.
- Wrote a tutorial that demonstrates the AGT approach on a toy language BA (Boolean and Arithmetic Language), which produces TBA, GBA and MBA (Typed/Gradual/Mixed Boolean and Arithmetic Language, respectively).

TEACHING  
EXPERIENCE

## University of British Columbia

*Teaching Assistant*

|              |   |
|--------------|---|
| CPSC 311     | Definition of Programming Languages, Fall 2020            |
| CPSC 421/501 | Introduction to Theory of Computing (graduate), Fall 2019 |
| CPSC 121     | Models of Computation, Fall 2018                          |

*Academic Assistant*

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| CPSC 411 | Introduction to Compiler Construction, Fall 2019–Spring 2020<br><i>Involved in the redesign of the course, supervised by William J. Bowman.</i> |
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## Jisuanke

*Lecturer*

Competitive Programming, Level 6      Spring 2019

*Topics: network flows and bipartite graphs, data structures (splay tree, treap, link-cut tree), the Aho-Corasick algorithm, bitmask dynamic programming, probability, computational geometry, query decomposition techniques*

Competitive Programming, Level 5      Fall 2018

*Topics: graph connectivity, segment tree and binary indexed tree, string algorithms (KMP, trie), hashing, elementary game theory, dynamic programming (tree DP, space-time optimizations), elementary number theory, divide-and-conquer techniques*

Competitive Programming, Level 3      Summer 2018

*Topics: C++, dynamic programming (longest increasing subsequence, maximum subarray, longest common subsequence, edit distance, knapsack problems), search techniques (BFS, DFS, pruning, state representation)*

*Teaching Researcher*

Competitive Programming, Level 6      Spring 2019

*Topics: network flows and bipartite graphs, data structures (splay tree, treap, link-cut tree), the Aho-Corasick algorithm, bitmask dynamic programming, probability, computational geometry, query decomposition techniques*

**VOLUNTEER  
EXPERIENCE**

**Shaoxing No.1 High School**

Summer Coach (Competitive Programming), 2016

Student Lecturer (Competitive Programming), 2013–2015

**TALKS AND  
PRESENTATIONS**

- The Single-Source Unsplittable Flow Problem. UBC Computer Science. University of British Columbia. Online. 2020. [Note] [Survey]
- Perturbation-Stable Maximum Cuts. Algorithms Reading Group, UBC Computer Science. University of British Columbia. Online. 2020. [Slides]
- Unsplittable Flow Problem on Paths and Trees: Closing the LP Relaxation Integrality Gap (with Adam Jozefiak). UBC CPSC 531F Survey. University of British Columbia. Vancouver, BC. 2019. [Slides] [Survey]
- Introduction to Communication Complexity. Quantum Club Seminar. University of California, Santa Barbara. Santa Barbara, CA. 2019.
- Gradual Typing for Octave Language (with Ada Li, Kathy Wang, and Paul Wang). UBC CPSC 311 Project. University of British Columbia. Vancouver, BC. 2018. [Report]
- Some Math Notes (in Chinese). Competitive Programming Summer School. Shaoxing No. 1 High School. Shaoxing, China. 2016. [Slides]
- Graph Algorithms (in Chinese). Competitive Programming Summer School. Shaoxing No. 1 High School. Shaoxing, China. 2016. [Slides]
- Miller-Rabin Primality Test and Pollard's  $\rho$  Integer Factorization Algorithm (in Chinese). Competitive Programming Seminar. Shaoxing No. 1 High School. Shaoxing, China. 2015. [Slides]

**HONORS AND  
AWARDS**

- Faculty of Science International Student Scholarship (CAD \$7,500), University of British Columbia, 2020.
- J Fred Muir Memorial Scholarship in Science (CAD \$200), University of British Columbia, 2020.
- Trek Excellence Scholarship (CAD \$4,000), University of British Columbia, 2020.
- Science Scholar, University of British Columbia, 2020.
- Dean's Honour List, University of British Columbia, 2020.
- Faculty of Science International Student Scholarship (CAD \$5,000), University of British Columbia, 2019.
- Dean of Science Scholarship (CAD \$350), University of British Columbia, 2019.
- Trek Excellence Scholarship (CAD \$4,000), University of British Columbia, 2019.
- Stanley M Grant Scholarship in Mathematics (CAD \$1,500), University of British Columbia, 2019.
- Programming Language Implementation Summer School Fellowship (€400), 2019.
- Science Scholar, University of British Columbia, 2019.
- Dean's Honour List, University of British Columbia, 2019.
- Faculty of Science International Student Scholarship (CAD \$10,000), University of British Columbia, 2018.
- Dean of Science Scholarship (CAD \$425), University of British Columbia, 2018.
- Trek Excellence Scholarship (CAD \$4,000), University of British Columbia, 2018.
- Marie Kendall Memorial Scholarship in Science (CAD \$925), University of British Columbia, 2018.

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|                      | <ul style="list-style-type: none"> <li>◦ Joel Harold Marcoe Memorial Scholarship (CAD \$150), University of British Columbia, 2018.</li> <li>◦ Science Scholar, University of British Columbia, 2018.</li> <li>◦ Dean's Honour List, University of British Columbia, 2018.</li> <li>◦ Outstanding International Student Award (CAD \$6,000), University of British Columbia, 2017.</li> <li>◦ Silver Medal, China Team Selection Competition for International Olympiad in Informatics, China Computer Federation, 2015.</li> <li>◦ Bronze Medal, Asia Pacific Informatics Olympiad, China Computer Federation, 2015.</li> <li>◦ First Prize, National Olympiad in Informatics in Provinces (Advanced Division), China Computer Federation, 2014.</li> <li>◦ First Prize, National Olympiad in Informatics in Provinces (Advanced Division), China Computer Federation, 2013.</li> </ul> |
| PROFESSIONAL SERVICE | <i>Journal Review</i><br>SIAM Journal on Discrete Mathematics (SIDMA)  |
| SELECTED COURSEWORK  | <i>Mathematics</i><br>Probability (graduate)<br>Stochastic Processes (graduate)<br>Submodular Optimization (graduate)<br>Combinatorial Optimization (graduate)<br>Measure Theory and Integration (graduate)<br>Introduction to Theory of Computing (graduate)<br>Tools for Modern Algorithm Analysis (graduate)<br>Beyond Worst-Case Analysis (seminar)<br>Real Variables I & II<br>Numerical Linear Algebra<br>Introduction to Group Theory<br><br><i>Computer Science and Engineering</i><br>Introduction to Software Engineering<br>Definition of Programming Languages<br>Introduction to Compiler Construction<br>Computer Hardware and Operating Systems<br>Intermediate Algorithm Design and Analysis<br><br><i>Philosophy</i><br>Metaphysics<br>Philosophy of Law<br>Philosophy of Religion<br>Philosophy After 1800 (Russell & Wittgenstein)                                    |
| ACADEMIC TRAINING    | <ul style="list-style-type: none"> <li>◦ Second Programming Language Implementation Summer School. Bertinoro, Italy. 2019.</li> </ul>  |
| RELEVANT SKILLS      | Languages:     English, Mandarin<br>Programming: $\text{\LaTeX}$ , Racket, Standard ML, JavaScript, C/C++, Java, C#, Python, Ruby, MATLAB, Go, MySQL   |
| LAST UPDATED         | December 8, 2020   |