

Jeffrey D. Oldham

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Education

Ph.D. in Computer Science (1992–99)

STANFORD UNIVERSITY.

Ph.D., August 1999. Work on experimental and theoretical analysis of network flow algorithms. Advisor: Serge Plotkin. National Science Foundation Graduate Student Fellow.

Thesis title: *Multicommodity and Generalized Flow Algorithms: Theory and Practice*. Multicommodity flow problems involve simultaneously shipping multiple commodities through a single network so the total (multi)flow obeys arc capacity constraints. Recent theoretical work yielded combinatorial approximation algorithms for the no-cost and the minimum-cost problem variants with provably small running times and space requirements. Unfortunately, a direct implementation of the theories is not fast. I designed and evaluated algorithms which are experimentally fast while maintaining the same asymptotic complexity. These implementations are several orders of magnitude faster than commercial linear programming solvers.

Generalized flow problems generalize ordinary network flow problems by adding a flow multiplier to each arc. Because these problems can have full rank, these generalized network flow problems have appeared more difficult to solve than ordinary network flow problems. I show how to combine parametric search and the Bellman-Ford shortest path framework to solve a generalized shortest path problem. Using this algorithm as a subroutine, I present combinatorial, fully polynomial-time approximation schemes for all generalized flow problems (with nonnegative costs).

M.S. in Computer Science (1992–96)

STANFORD UNIVERSITY.

B.A. in Computer Science (1987–91)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND RICE UNIVERSITY.

Graduated summa cum laude. National Merit Scholar. Tau Beta Pi.

Work and Teaching Experience

Software Engineer (June 2000–)

CODESOURCERY, LLC. <http://www.codesourcery.com/>

Develop compilers. Projects include implementing compiler optimizations, testing implementations for correctness, developing specifications, and implementing specifications.

Assistant Professor (August 1999–May 2000)

TRINITY UNIVERSITY COMPUTER SCIENCE DEPT, SAN ANTONIO. <http://www.cs.trinity.edu/>

Taught courses in introductory programming (two semesters), operating systems, and simulation. With 44 students, designed and implemented sales tax server prototype. With 12 students, developed models and simulated investment accumulation and contraction.

Visiting Assistant Professor (Spring 1999)

DARTMOUTH UNIVERSITY

Taught second-level algorithms course (CS 45) emphasizing mathematical analysis, design principles, and an introduction to NP-completeness to upper-level undergraduate students.

Summer Employee (Summer 1998)

AT&T LABS, FLORHAM PARK, NEW JERSEY. <http://www.research.att.com/>

The proposed HTTP 1.1 protocol permits persistent connections between servers and clients. To decide when persistent connections can reduce a server or client's load, we designed and experimentally evaluated policies to predict when to terminate persistent HTTP connections. We also developed a theoretical model for this distributed, multiple-player problem. Supervisor: Edith Cohen.

Teaching Assistant for Intensive C++ Course (Summer 1997)

WESTERN INSTITUTE OF COMPUTER SCIENCE, STANFORD UNIVERSITY

Teaching assistant for intensive, one-week course teaching all aspects of C++ programming (introduction, data abstraction, inheritance, templates, generic programming, and applicators) to computer professionals. Held laboratory sessions, answered questions, and introduced students to the Stanford computer system. Instructors: Andy Koenig (AT&T Labs) and Barbara Moo (AT&T).

Instructor for Compiler Course (Summer 1996)

STANFORD UNIVERSITY

Taught upper-level undergraduate and masters level course (CS 143) about the principles and practices of designing programming language compilers. Led sections; wrote and graded exams, programming assignments, and homeworks; created course policies; held office hours; set grades. Lectures were given via videotape from a previous quarter. Course included students working at San Francisco area computer companies and participating via closed-circuit television.

Instructor for Programming Languages Course (Summer 1995)

STANFORD UNIVERSITY

Taught undergraduate senior and masters level course (CS 242) about the basic elements of programming languages and programming paradigms: functional, imperative, and object-oriented. Same

instructor responsibilities as for the compilers course described above.

Teaching Assistant for Compiler Optimization Course (Winter 1995)

STANFORD UNIVERSITY

Led section for compiler optimization course (CS 243), appropriate for undergraduate seniors and masters level students. Also graded homework and programming assignments, and held office hours. Course included students working at San Francisco area companies and participating via closed-circuit television. Instructor: Professor Monica Lam.

Software Consultant (Summers 1992, 1993)

TRANSPORT STUDIES UNIT, OXFORD UNIVERSITY. <http://www.tsu.ox.ac.uk/>

Corrected a large transportation modeling program. Wrote an interactive, stated preference survey concerning drivers' responses to road-congestion pricing. Facilitated the survey's administration. Purchased and installed software on a Sun UNIX computer. Adviser: John Polak (Imperial College).

Research Programmer (May 1991–May 1992)

CENTER FOR RESEARCH ON PARALLEL COMPUTATION, RICE UNIVERSITY. <http://www.crpc.-rice.edu/CRPC/>

Added color graphics to the user interface of the ParaScope Editor, an interactive tool to find and exploit parallelism in sequential Fortran programs. Supervisors: Ken Kennedy and Scott Warren.

Teaching Assistant for Introductory Computer Science Math Course (Summer and Autumn 1991)

RICE UNIVERSITY

Held office hours to answer students' questions in this undergraduate introduction to the mathematics of computer science. Also graded exams and homeworks. Instructor: Professor Mark Krentel.

Teaching Assistant for Introductory Programming Course (Spring 1991)

RICE UNIVERSITY

Taught laboratory sessions for this introductory programming course, teaching the principles of program design, rules of program evaluation, and an introduction to programming language features. Held office hours, graded exams and homeworks. Instructor: Bruce Duba.

Mathematician (Summers 1989, 1990)

SHELL DEVELOPMENT COMPANY, BELLAIRE, TX.

Wrote a computer program to extract status information from the nodes of a hypercube computer. Attempted to export the X Windows System to the hypercube computer. Supervisor: Dave Tolle.

Tutor for Multivariate Calculus Course (Spring 1988)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Tutored individual students on vector and multivariate calculus. Held office hours and graded exams and homeworks.

Publications

Multicommodity and Generalized Flows: Theory and Practice by Jeffrey D. Oldham. Ph.D. Thesis.

An Implementation of a Combinatorial Approximation Algorithm for Minimum-Cost Multicommodity Flows by Andrew Goldberg, Jeffrey D. Oldham, Serge Plotkin, and Cliff Stein. A conference version of much of my thesis work. Published in proceedings of Integer Programming and Combinatorial Optimization 1998. Technical report version: STAN-CS-TR-97-1600, <http://theory.stanford.edu/~oldham/publications/MCMCF-TR/MCMCF-TR.ps>.

Combinatorial Approximation Algorithms for Generalized Flow Problems by Jeffrey D. Oldham. Invited paper for *Journal of Algorithms* special issue of best SODA 1999 papers. Presented at Symposium on Discrete Algorithms (SODA) 1999. I presented a Bellman-Ford-based algorithm for the single-source generalized shortest paths problem, also called the restricted generalized uncapacitated transshipment problem. Using this algorithm as a subroutine, I presented combinatorial, fully polynomial-time approximation schemes for all generalized flow problems (with nonnegative costs). Also available as <http://theory.stanford.edu/~oldham/publications/generalized/sp.ps>.

Parallel Algorithms for the All-Sources Generalized Shortest Paths Problem by Jeffrey D. Oldham and Vaughan Pratt. Using monotonic piecewise-linear functions and the Floyd-Warshall algorithm, we present a logarithmic-time PRAM algorithm for the all-sources generalized shortest paths problem. Also available as <http://theory.stanford.edu/~oldham/publications/generalized/asgsp.ps>.

Accurate Approximations for Asian Options by Donald Aingworth, Rajeev Motwani, and Jeffrey D. Oldham. Presented at the Symposium on Discrete Algorithms (SODA) 2000. We presented an asymptotic fully-polynomial approximation scheme for pricing Asian options on a lattice. This is the first algorithm yielding guaranteed error bounds in polynomial time.

How to Beat Random Sampling Every Time by Donald Aingworth, Rajeev Motwani, and Jeffrey D. Oldham. We present an unbiased estimator with lower variance than regular random sampling when each random event's value and probability are known.

Means for Searching by Jeffrey D. Oldham. We generalize binary and generalized search by demonstrating a one-to-one relationship between search techniques, means, and continuous, strictly monotonic functions.

The Incremental Investment Problem: Determining Sustainable Withdrawal and Accumulation Rates by Jeffrey D. Oldham. We define the incremental investment problem is to determine the probability of reaching a specified financial goal through periodically adding or withdrawing from an investment, presenting a one-pass, matrix-based algorithm for use with historical data. We also extend to incorporate capital gains.

Managing TCP Connections Under Persistent HTTP by Edith Cohen, Haim Kaplan, and Jeffrey D. Oldham. Presented at The Eighth International World Wide Web Conference. Persistent HTTP connections, included in the draft HTTP/1.1 protocol, permit several HTTP request/response

messages to be sent using the same TCP connection. We designed and experimentally evaluated policies to predict when to terminate persistent HTTP connections. Available at <http://www8.org/w8-papers/5c-protocols/policies/policies.html>.

Experiences Using the ParaScope Editor: An Interactive Parallel Programming Tool by Mary W. Hall, Timothy J. Harvey, Ken Kennedy, Nathaniel McIntosh, Kathryn S. McKinley, Jeffrey D. Oldham, Michael H. Paleczny, Gerald Roth. *Proceedings of the Fourth ACM SIGPLAN Symposium on Principles & Practice of Parallel Programming (PPOPP)*. May 1993. pp. 33–43. Technical report version: CRPC-TR93297, Rice University, also available as <ftp://softlib.rice.edu/softlib/CRPC-TRs/-reports/CRPC-TR93297.ps.gz>.

Presentations

MCMCF: Computational Tool for Checking Whether a Network Can Support a Given Set of Requirements by Jeffrey D. Oldham. Presentation on multicommodity flow research. Workshop on Routing and Switching, Center for Telecommunications at Stanford. 1997 September 04. Slides available at <http://theory.stanford.edu/~oldham/talks/MCMCF-talk.ps>.

MCMCF: A Tool for Network Design by Jeffrey D. Oldham. Presentation on multicommodity flow research. Center for Telecommunications at Stanford University 1997 Annual Research Review. 1997 November 18. Slides available at <http://theory.stanford.edu/~oldham/talks/MCMCF-talk-short.ps>.

Pork Bellies and Orange Juice: An Introduction to Multicommodity Flows by Jeffrey D. Oldham. An informal introduction to multicommodity flows presented at AT&T Labs 1998 June. Some of the presentation used a whiteboard but some slides are available at <http://theory.stanford.edu/~oldham/talks/MCMCF-talk.ps>.

A Simpler Combinatorial Generalized Flow Algorithm by Jeffrey D. Oldham. Presentation at the Stanford Algorithms Seminar about a network-flow-based approach to solving generalized shortest paths problems, i.e., shortest paths problems with losses and gains. 1998 September 24.

Generalized + Shortest Paths = Binary Search + Bellman-Ford by Jeffrey D. Oldham. Presentation on a network-flow-based approach to solving generalized shortest paths problems, i.e., shortest paths problems with losses and gains. Presented at the Bonn Workshop on Discrete Optimization, Institute for Discrete Mathematics, Bonn University, 1998 October 01. Slides available at <http://theory.stanford.edu/~oldham/talks/Bonn98/gsp-Bonn.ps>.

Parallel Algorithms for All-Sources Generalized Shortest Paths by Jeffrey D. Oldham. Presentation on using monotonic piecewise-linear functions and the Floyd-Warshall algorithm to yield a logarithmic-time PRAM algorithm for the all-sources generalized shortest paths problem. This joint work with Vaughan Pratt was presented at the 1999 ACM Symposium on Parallel Algorithms and Architectures Revue.

Implementing Generalized Shortest Paths Algorithms by Jeffrey D. Oldham. Presentation of the running times of various implementations of generalized shortest path algorithms described in my Ph.D. thesis. Presented at Informs 1999 November conference, 1999 November 07.

Software Development

Generalized Shortest Paths Implementations (1998–99)

STANFORD AND TRINITY UNIVERSITIES

Implementations of several different generalized shortest path algorithms. These algorithms are a combination of geometric search and dynamic-programming implementations. We show that different Bellman-Ford-Moore-like implementations have asymptotically different running times and these running times differ from those for ordinary shortest path problems.

Multicommodity Flow Approximation Implementation (1995–97)

STANFORD UNIVERSITY

The program solves the network flow optimization problems of minimum-cost and no-cost multi-commodity flows. The problems involve allocating shared resources among flows between different locations. Given a graph, an arc capacity function, a set of commodities (a source node, a destination node, and a demand), and an arc cost function, determine the cheapest way to route each commodity's flow so the total flow (of all the commodities) on any arc is at most its capacity.

DNA Sequence Alignment Program (Spring 1995)

STANFORD UNIVERSITY

Given two character sequences, e.g., DNA bases, introduce gaps into the sequences so as many characters match as possible. Sequence alignment is used frequently to identify and match gene sequences. This dynamic programming implementation has been used in Stanford University's MIS 214/CS 274 course since 1995.

ParaScope Editor (May 1991–May 1992)

RICE UNIVERSITY

Added color graphics to the ParaScope Editor research tool, an interactive tool to find and exploit parallelism in sequential Fortran programs.

Literature Reviews

Computing Reviews article about "On the Existence of Equilibria in Noncooperative Optimal Flow Control," by Korilis and Lazar. Vol. 37, No. 7, Jul 1996. Review 9507-0515, pp. 362–363.

Computing Reviews article about "Graphs Generalizing Closed Curves with Linear Construction of the Hamiltonian Cycle," by Malgouyres. Vol. 37, No. 7, Jul 1996. Review 9507-0514, p. 362.

Computing Reviews article about *The Language of Machines*, by Beigel and Floyd. Vol. 37, No. 6, Jun 1996. Review 9606-0400, pp. 288–289.

Computing Reviews article about “Wait-free Consensus using Asynchronous Hardware,” by Chor et al. Vol. 36, No. 7, Jul 1995. Review 9506-0491, pp. 366–367.

Computing Reviews article about “Tentative and Definite Distributed Computations: An Optimistic Approach to Network Synchronization,” by Garofalakis et al. Vol. 36, No. 6, Jun 1995. Review 9506-0400, pp. 308–309.

Computing Reviews article about “Some Results on Elusive Graph Properties,” by Eberhard Triesch. Vol. 35, No. 12, Dec 1994, Review 9412-0894, p. 650.

Publication Work

Technical Illustrator for *The Art of Computer Programming*, Volumes 1–3, Third Edition by Donald E. Knuth.

Produced over five hundred flowcharts, (computer science) trees, graphs, and other technical illustrations using the MetaPost computer language for this classic computer science series, essential for all computer scientists.

Accuracy Checker, Computer Algebra System Exercise Reviewer, Exercise Answer Checker for *Calculus and Analytical Geometry*, Ninth Edition by Thomas and Finney.

Corrected galleys of this textbook for beginning undergraduate and high school senior calculus courses. Marked mathematical, typographical, and formatting problems. Reviewed and solved (using Mathematica) computer algebra system exercises. Verified exercise answers provided in the textbook.

Accuracy Checker for *Calculus for Engineers and Scientists*, Preliminary Edition, Volumes 1 and 2 by Giordano, Weir, and Finney.

Corrected galleys of some chapters of this textbook for an undergraduate engineering and science calculus courses. Marked mathematical, typographical, and formatting problems.

Accuracy Checker for *Calculus, Preliminary Edition* by Al Shenk.

Corrected galleys of some chapters of this proposed textbook for an undergraduate calculus course. Marked mathematical, typographical, and formatting problems.

Accuracy Checker for *Calculus: A Complete Course*, second edition by Ross L. Finney, Franklin D. Demana, Bert K. Waits, Daniel Kennedy.

Corrected galleys of this textbook for beginning undergraduate and high school senior calculus courses. Marked mathematical, typographical, and formatting problems.

Reviewer for *Programming in Standard C++: A New Approach* by Andrew Koenig and Barbara Moo.

Reviewed this proposed book teaching C++. Unlike most other C++ books which first assume the reader is fluent in the C programming language, this book immediately starts with C++ concepts including the Standard Template Library, polymorphism, and data abstraction. Also indicated typographical errors in the manuscript.

Manuscript Reviewer for *Software Solutions for The C++ Programming Language* by David Van-devoorde.

Reviewed this book of exercise solutions for Bjarne Stroustrup's *The C++ Programming Language*, Third Edition. Commented on the choice of exercises to solve, the text and style of the solutions, and the introductory material in this book appropriate for computer programmers. Indicated programming and typographical errors in the manuscript.

Manuscript Reviewer for *C++ Primer Answer Book* by C. Tondo and Bruce Leung.

Reviewed this book of solutions to the exercises in Lippman and Lajoie's *C++ Primer*, Third Edition. Commented on the text, style, and correctness of the solutions. Indicated programming and typographical errors in the manuscript.

Book Proposal Reviewer for proposed generic programming and frameworks book.

Commented on a proposed book about programming frameworks and generic programming. Given a table of contents and a sample chapter, commented on whether the book should be published and its importance, choice of topics, and possible audience.

Technical Consultant for *Computer Musings: The Associative Law* by Donald E. Knuth.

Chose captioning text added to a videotape of Stanford Professor Donald E. Knuth's lecture about binary trees. Part of University Video Communications's Distinguished Lecture Series, this tape is aimed at upper undergraduate, graduate, and professional computer scientists.

Leadership Positions

Algorithms Seminar and Theory Colloquium Coordinator (1993–95)

STANFORD UNIVERSITY. <http://theory.stanford.edu/~aflb/colloq.html> and <http://theory.stanford.edu/~aflb/aflb.html>

Invited speakers, advertised, and hosted a weekly algorithms seminar for the theory group of the Computer Science Department. Also, coordinated the monthly theory colloquium to bring the best theoretical computer scientists to speak at Stanford. Responsibilities included inviting speakers, advertising, hosting, establishing meetings between the speaker and faculty and students, and arranging accommodations and food logistics.

Graduate Resident Assistant (1993–97)

STANFORD UNIVERSITY. <http://gradres.stanford.edu/gra/duties.html>

Served as a resident assistant, for two years serving seventy-one foreign and American graduate students living in an on-campus graduate apartment complex, and for two years serving one hundred fifty graduate students in an on-campus graduate mobile home park. Responsibilities included welcoming new students to the Stanford campus; planning social, educational, and multi-cultural programs; serving as a liaison between the residents and the Stanford administration; serving as a leader during emergencies; resolving conflicts between residents; and providing counseling. Activities included helping roommates resolve conflicts, referring a clinically-depressed resident to the campus psychological services, establishing a resident-run weekly movie night series, inviting Secretary of State George Shultz to speak, and leading numerous trips, e.g., to the San Francisco Airport air traffic control tower, to build apartments for Habitat for Humanity, skiing, etc.

Graduate Housing Advisory Committee Chairperson (1992–94)

STANFORD UNIVERSITY.

Chaired meetings of graduate students and Stanford graduate housing officials to improve on-campus graduate housing. Prepared the agenda for biweekly meetings and ensured decisions were made. Accomplishments included changing the officials' philosophy on rental rates to reflect the different dormitories' conditions, encouraging a university-wide graduate housing renovation project, and encouraging a change in the housing schedule to permit residents more than one day to move into and out of apartments.

Rice University Interviewer (1994–1999)

RICE UNIVERSITY. <http://www.ruf.rice.edu/~admi/>

Interview prospective Rice University undergraduate students living in Silicon Valley, California. Try to learn about what motivates these high school students and about their interests to determine whether they should be admitted to Rice University. Answer their questions about being an undergraduate at Rice University. For each interview, submit interviewer report to be included with the student's application.

Administrative Council Chairperson (1996–1999)

FIRST UNITED METHODIST CHURCH, SUNNYVALE, CA. <http://www.sunnyvalefumc.org/>

The church's Administrative Council oversees its administration and programming, establishing objectives and goals, determining policies, and evaluating the church's ministries. As chairperson, I am responsible for ensuring the committees fulfill their missions, conveying information between committees, and serving ex-officio on the Finance, Pastor-Parish Relations (personnel issues), and Senior Nutrition Program (an outreach program administered by the church and receiving government funding) Committees.

Lay Minister (1996–1999)

FIRST UNITED METHODIST CHURCH, SUNNYVALE, CA. <http://www.sunnyvalefumc.org/>

Respond to members' spiritual and emotional needs, e.g., when experiencing the death of a loved person, dealing with a terminal disease, or losing a job.

Staff-Parish Relations Committee member (1995–97)

FIRST UNITED METHODIST CHURCH, SUNNYVALE, CA. <http://www.sunnyvalefumc.org/>

The committee oversees church staffing by hiring, evaluating, and firing the pastor and the church staff. Wrote the church's employee handbook describing hiring procedures, job performance evaluation, benefits, and job termination. Gained experience writing job descriptions and hiring employees.

Service Project Coordinator (1991–92)

MEMORIAL DRIVE UNITED METHODIST CHURCH, HOUSTON. <http://www.mdumc.org/>

Organized monthly service projects for a group of fifty single young adults. Responsibilities included locating service opportunities, contacting other organizations to participate, recruiting participants from the class, and ensuring proper execution of the events.