Sorathan (Tum) Chaturapruek

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Education

B.Sc. in Mathematics
B.Sc. in Computer Science
Harvey Mudd College, Claremont, CA

Graduation Anticipated, May 2014
GPA: 3.91, Dean's List since 2010
Math Major GPA: 4.00, CS Major GPA: 3.75

Employment

Yelp, Inc., Summer 2013.
Search Team, Software Engineering Internship

Learning Programs, Harvey Mudd College, Fall 2012.
Academic Excellence Facilitator in Mathematics

Starfish LLC. & Mathematics Department, Harvey Mudd College, Summer 2012.
Educational Geometry Game Developer, sponsored by HMC via a grant from the Colegato Foundation

Mathematics Department, Harvey Mudd College, Fall 2011.
Abstract Algebra (Math 171) Grader and Tutor

Private Employment, Spring 2011.
AP Calculus Tutor

Preprints and Publications

Marianna Bolla, Brian Bullins, Sorathan Chaturapruek, Shiwen Chen, Katalin Friedl, When the largest eigenvalue of the modularity and normalized modularity matrix is zero, *ArXiv*. (click to view the paper) .

Sorathan Chaturapruek, Jonah Breslau, Daniel Yazdi, Theodore Kolokolnikov and Scott G. McCalla, "Crime Modeling with Lévy Flights", submitted to *SIAM J. Appl. Math.* (click to view the paper)

Sorathan Chaturapruek, 2009, "On Sequences of Bicentric Quadrilaterals." Mahidol Wittayanusorn School Journal. Thailand. (accepted and waiting for publication)

Mathematical Divertimenti

Chaturapruek S., 2006, "T-Score" My Maths Magazine. May 2006. Volume 2 No.4 ISSN1686-6630, Thailand.

Chaturapruek S., 2006, *Math Talent of YorWor* (Math Contest). 60th Anniversary of Hatyai Wittayalai School. Thailand.

Honors and Awards

2012 Ranked 14th nationally for the 2012 Putnam. I was recognized in the N1 category, which is the second-highest level of distinction possible in the Competition (just under Putnam Fellow). I will receive a $1,000 cash prize. I was also awarded an RIF Prize Check from the Department of Mathematics, HMC. Nationwide 4,277 students competed, and this year the MEDIAN score was 0 out of a total of 120 points.

2012 The Courtney S. Coleman Prize in Mathematics for rising juniors, the Mathematics Department, Harvey Mudd College

2011 Top 100 nationally in the Putnam Contest (and Top 200 in 2010)

2011 The James Prize in Mathematics for rising sophomores, the Mathematics Department, Harvey Mudd College

2010 Ranked 16th nationally in the Virginia Tech Regional Math Exam (1st among Harvey Mudd students)

2010 Henry N. Square Computer Science award and Mathematics award in the Prize Day at Kent School, CT

2010 Individual First Place in General Electric's Connecticut High School Contest in Computer Science

2010 Individual First Prize $6,000 scholarship winner in the Twenty-Second Annual Worcester Polytechnic Institute Mathematics Meet

2008 Bronze Medal for Thailand, the XX Asian Pacific Mathematics Olympiad 2008 (APMO)

Research and Relevant Experience

2013   Researcher (current). Spectral Clustering of Networks. **Budapest Semester in Mathematics**, Hungary.
(collaborated with Professor Marianna Bolla (Technical University of Budapest)) Networks can be modeled by edge-weighted graphs, where edge-weights are pairwise similarities between the sites (vertices of the graph). We want to find clusters (in other words, communities) of the vertices such that the information flow between the cluster pairs and within the clusters is as homogeneous as possible; minimum and maximum multiway cuts are special cases. For this purpose, we define objective functions, for the minimization or maximization of which we use spectral relaxaton. To estimate minimum multiway cuts we use the smallest eigenvalues of the Laplacian or normalized Laplacian matrix assigned to the graph, whereas clusters are found by means of the corresponding eigenvectors. Marianna Bolla, Brian Bullins, Sorathan Chaturapruek, Shiwen Chen, Katalin Friedl, "When the largest eigenvalue of the modularity and normalized modularity matrix is zero", *ArXiv.* (click to view the paper).

2012-3   Project Manager and Software Developer. The Online Learning Platform Project. **Harvey Mudd College**.
(collaborated with Wee Pittayakanchit HMC'16) Developed a web platform for putting classes online and encouraging interactive learning. We experimented with Math 40 (Introduction to Linear Algebra). Our project advisor is Professor Su. (click to see the project descriptions)

2012   Researcher. Applied Representation Theory. **Harvey Mudd College**.
(collaborated with Jeremy Usatine HMC'14, Professors Michael Orrison and Susan Martonosi) Studied the observation and mixing events. We use an isotypic decomposition of $\mathbb{C}[X]$ such that the isotypic subspaces correspond to irreducible representations of the Fourier transform on S_n, which are indexed by partitions of n, to show that some of this methodology can be extended to the case where X is k sized subsets of $\{1, 2, \ldots, n\}$. (click to see the project write-up)

2012   Researcher. Crime Modeling (Summer 2012). **UCLA (REU)**.
(collaborated with Jonah Breslau (Pomona), Daniel Yazdi (UCLA), Professor Theodore Kolokolnikov and Scott G. McCalla (UCLA)) Studied how Lévy flights affect the stability of hot-spots in a crime model.
Abstract: The UCLA burglary hotspot model, introduced in [Short et.al., Math. Models. Meth. Appl. Sci., 18, Suppl. (2008), pp. 1249–1267], models the formation of hotspots of criminal activity. We extend the UCLA model to incorporate a more realistic model of human locomotion. The movement of the criminal agents follows a biased Lévy flight with step-sizes distributed according to a power-law distribution. Starting with an agent-based model, we derive its continuum limit. This consists of two equations and involves the fractional Laplacian operator. A numerical method based on the Fast Fourier transform is used to simulate the continuum model; these simulations compare favorably with the direct numerical simulations of the agent-based model. A Turing-type analysis is performed to estimate how the instability of the homogeneous steady state, as well as the expected number of hotspots, depends on the system parameters and especially the exponent of the underlying power law. (click to see the paper)

2012   Researcher. Algebraic Statistics. (Summer 2012). **Harvey Mudd College**.
(collaborated with Jacob Brumbaugh-Smith (Pomona) and Professor Michael Orrison))
Studied the Markov basis for some graphs such as the Johnson graph. (Click to see more details) .

2011   Researcher. **The University of Utah Research Experiences for Undergraduates (REU)**
Studied geometry through Lie groups and discrete subgroups. We began by exploring existing knowledge and then studied research questions. For example, we first learned a nilpotent linear group and a solvable linear group, both of which are linear Lie groups. Then we investigated the growth rates of these two groups using Cayley graph and the words metric. Thorough attention was paid to study the relationship between discrete cocompact subgroup and the properties of group actions such as properly discontinous, free actions. We then incorporated geometric insights such as Iwasawa decomposition to describe the structure of the special linear group. We were exposed to many important theorems and topics such as Thurston Theorem, p-adic numbers, buildings and Coxeter groups. Many of my research interests are carried by this summer research. For example, I am now interested in representation theory, buildings (a combinatorial representation), and knot theory.

2011   Participant. **Institute for Advanced Study/Park City Mathematical Institute**, Park City, Utah
Studied the moduli space of Riemann surfaces via topology and hyperbolic geometry. We were building our learning toward the study of the mapping class groups. In surface topology class, we thoroughly studied (and proved) Jordan Curve Theorem as a tool to prove the classification of compact connected surface. I also attended the graduate lectures on the Nielson-Thurston classification of surfaces.

2007,   Researcher. **Srinakharinwirot Patumwan University and Mahidol Wittayanusorn School,**
2009   **Thailand.**
Studied design theory (a branch of combinatorial mathematics and computer science) and the decomposition of complete bipartite graphs with Prof. Dinesh G. Sarvate from College of Charleston, SC. We decomposed the complete bipartite graphs into specific types of subspaces, such as the set of paths of a fixed length and the set of star with equal degree. This study made me interested in discrete mathematics and how to think about them in both systematic and creative ways. (click to see the write-up)

2007-   Researcher. **Chulalongkorn University and Mahidol Wittayanusorn School**, Thailand
2009   Studied the structure of a sequence of geometric transformations of bicentric quadrilaterals, also using a computer software (The Geometer's Sketchpad) as a researching tool. Won a special prize in the International Scientific Conference of Students, XVIII Annual Sakharov's Readings, Saint Petersburg, Russia. (Click to see the paper)

Grants and Fellowships

2013-4   The 2013 Giovanni Borrelli Fellowship. Harvey Mudd College Mathematics Department. The grant comes with a \$5000 stipend and \$1000 cash for traveling costs to research seminars. A recognition of a high-quality research proposal and exemplary class work at Harvey Mudd. (Click to see the proposal)

2012-3   An honorable mention for the 2012 Giovanni Borrelli Fellowship. Harvey Mudd College Mathematics Department. A recognition of a high-quality research proposal and an exemplary class work at Harvey Mudd.

2010-   The Royal Thai Scholarship. From the Royal Thai Government to pursue an undergraduate degree through a post-doctoral degree in mathematics in the United States. Full-tuition and stipends.

2008-   The Long-Term Junior Science Talent Project (JSTP) Scholarship. Grants for conducting research in Thailand for the 2008 project and for any future research in Thailand. The project I did using this grant is titled *On Sequences of Bicentric Quadrilaterals.*

Computational Skills

Programming Languages: C/C++, Java, Python, Scheme, HTML, Prolog, Ruby on Rails, 4ti2, OpenGL

Software: MS Excel, PowerPoint, Access, Django, OpenOffice, LaTeX, Beamer, Maple, Mathematica, Matlab

Professional Development

Participant, the Western Algebraic Geometry Seminar (WAGS), University of Utah. October 20-21, 2012.

Participant, the Southern California Algebraic Geometry Seminar. March 12, 2011. University of California San Diego, San Diego, CA.

Participant, HMC Mathematics Conference: Broadening Participation in the Mathematical Sciences. February 4-5, 2011. Harvey Mudd College, CA.

Participant, the International Conference on Algebra and Related Topics. May 28-30, 2008, the Tawanna Hotel, Bangkok, Thailand

Participant, the 13th Annual Meeting in Mathematics 2008. 6 - 7 May 2008, Srinakharinwirot University, Thailand

Selected Coursework

Mathematics

Geometry and Topology: Algebraic Topology (A) [Munkres]. Algebraic Geometry (A) [Reid].

Differential Equations: Intro and Topics in PDEs (A, A). Intermediate Differential Equations (A).

Algebra and Discrete Mathematics: Abstract Algebra (A) [Dummit & Foote]. Independent Study in Discrete Mathematics (A). Intermediate Linear Algebra (placement) [Axler]. Complex Variables and Integral Transforms (A). Combinatorial Optimization (A+, Budapest).

Analysis: Real Analysis I and II (A, A) [Rudin]. Multivariable Calculus (A).

Probability: Intermediate Probability (A) [Ross].

Research and seminar classes: Research in Spectral Clustering and networks (current, in Hungary). Independent Study in Applied Representation Theory (A). Putnam Seminar (2 semesters). Mathematical Contest in Modeling/Interdisciplinary Contest in Modeling (MCM/ICM) Seminar. Mathematical Forum (A). Mathematical Colloquium. Computer Science Colloquium.

Computer Science and Other Coursework

Data Structures and Program Development (B+). Programming Practicum (A). Computational Biology (A). Gravitation (A). Computer Systems (A). Theory of Computing (current). Algorithms and Data Structures (current). Computer Graphics (current). Structure and Dynamics of Complex Networks (current). Data Mining (current). Two years of Chinese (pass, A-, A, A). Derivatives and Financial Markets Modeling (A).

Service and Invited Talks

2013   Invited Research Talk in Canada. "Nonlocal interactions in social, physical, and biological sciences"
        The Canadian Mathematical Society (CMS) meeting in Halifax, Canada, June 4-7, 2013, as a result of my UCLA research in summer 2012. (Click to see the talk abstract.)

2012   The CalTech Harvey Mudd Competition (CHMMC).
        I was the main problem writer, problem tester, and also the head proctor for grading.
        (Click to see the problems.)

2012   Math Club
        I am the vice president of the Math Club/SIAM Student Chapter at Harvey Mudd Collge. We organized social events such as "Pancakes With the Profs" to connect the students and professors. We also organized Math Tea almost every Friday. I am also a webmaster for the Math Club's website :

2011-2 GRE Preparation Sessions.
        I ran several workshops in both spring and fall semesters, for Harvey Mudd students to prepare for the GRE tests. We solved problems together and also talked about other interesting mathematical concepts inspired from some GRE problems.

2010   The CalTech Harvey Mudd Competition (CHMMC).
        I was a proctor and a grader.

2010   Invited Talk: "Mathematics Inspiration"
        I gave a talk with Professor Paisan Nakmahachalasint to about 200 students in Science Math Ability Project program at Hatyai Wittayalai School, Songkhla, Thailand.

2009   Outreach: a science camp for rural school students at Nongkhayang School, Udhaithani, Thailand.
        I was a head of Mathematics and Physics sections. We tried to bridge the gap of science education in the urban and rural areas.

2008   Mathematical Olympiad Training (MOT) Club.
        I taught other students. It is a preparation for students who are taking mathematics competition, including International Mathematical Olympiad (IMO).

2007   Outreach: Mathematics Camp "Friends Help Friends for Mathematical Learning" at Princess Chulabhorn's College Seminar, Lopburi, Thailand.
        I was one of the camp organizers. I gave talks about polyominoes approximately eight runs, each run there were about 25 students. We also organized other fun activities to inspire them to appreciate the beauty of mathematics.

2007   Invited Speaker: Polyominoes Workshop
        I organized a workshop for about 20 teachers from Princess Chulabhorn's College to get a hands-on experience with polyominoes and some interesting invariances on tiling, a topic I learned from the Math Olympiad camps. .

2007-   AVISO Book Publication Club, Mahidol Wittayanusorn School, Thailand.
2009   We wrote about mathematical olympiad materials for both mathematical and non-mathematical audience. Examples of topics are combinatorics, inequalities, geometry, and number theory. We worked on the edition of the first volume. The second volume was also ready and waited for publication.