NIKOLA KOVACHKI

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EDUCATION

California Institute of Technology   *June 2016*
B.S. in Mathematics
GPA: 3.8

WORK EXPERIENCE

SURF Program Research   June 2015 - August 2015
Undergraduate Research Assistant   *Caltech*

· Worked under Professor Babak Hassibi, investigating properties of a certain infinite LDPC code which was believed to be a tree code. We were able to show that this code's weight enumerator does not satisfy some sufficient conditions to be a tree code even under finite lifting by permutation matrices. We are currently trying to formulate a general theorem on the existence of tree codes defined by non-random Toeplitz parity-check matrices.

SURF Program Research   June 2014 - August 2014
Undergraduate Research Assistant   *Caltech*

· Worked under Professor Benjamin Gillen, analyzing the performance of ARCH/GARCH-type models for some European ETF(s). We concluded that low parameter GARCH models were the best estimators of the dynamic volatility for the underlying stochastic processes. We later worked on applying some of the results to various trading strategies.

SURF Program Research   June 2013 - August 2013
Undergraduate Research Assistant   *Caltech*

· Worked under Professor Nets Katz, analyzing cap sets (no three points are colinear) of vector spaces over finite fields. We were able to analytically prove a result of Professor Raymond Hill which gave an upper bound on the number of intersections of the secant lines through his famous Hill cap. The result was only previously known through computer search.

Metasys Technologies Inc.   June 2012 - August 2012
Systems Developer   *Duluth, GA*

· Completely redesigned and implemented the company's website (which is still their current website). Also build a server-side login system in PHP, so employees can remotely access all necessary work information. The second project brought me in contact with MIT Professor Ronald Rivest who, in an email exchange, explained the security benefits of MD6 and introduced me to cryptography.

RESEARCH PROJECTS

Bubble Propagation   July 2015 - Current

· This is a joint project with another student and Professor Benjamin Gillen. Instead of trying to analyze a single large bubble, we are looking at many small market bubbles in hopes of finding some critical point where enough crashes happen that the effect starts spreading through to larger markets. We are still in a preliminary stage, trying to understand and implement Professor Peter Phillip's multiple bubble detection algorithm.

Bubble Volatility and Dynamics April 2015 - June 2015

· Another joint project with a student working under Professor Adam Wierman. We looked at large stock market bubbles and tried to analyze the performance of Professor Didier Sornette's LPPL model in predicting the crash time. In our paper, we present several stochastic modifications to the deterministic model which we believe explain some of the heavier oscillations that are not captured.

Netflix Prediction Algorithm April 2015 - June 2015

· In 2008, Netflix had a one million dollar competition to see what machine learning techniques and algorithms could best improve their recommendation system. The winning group achieved around a 10.14% improvement to the baseline. In a competition designed for Caltech students, using the same data, my group placed in the top five with a 8.12% baseline improvement.

Sentiment Analysis January 2015 - March 2015

· This was a project with a few math graduate students working under Professor Matilde Marcolli. We applied various machine learning techniques to sentence structures and analyzed their performance on predicting sentiment. We exploited some simple ideas from algebraic geometry to construct feature vectors that relate grammatical structure to word sentiment.

TALKS AND PRESENTATIONS

(Ma10) Regularization of Divergent Series and Applications November 2015

· Presented methods for regularizing divergent series, the analytical continuation of the Riemann zeta function, and their applications to physics and in particular Quantum Electrodynamics.

(SURF) Mathematica Methods in Coding Theory: Tree Codes October 2015

· Presented many of the results from my work with Professor Babak Hassibi. The talk focused mostly on the use of multivariate generating functions in obtaining closed forms for weight enumerators.

(Ma191) Generalizations of the Szemeredi-Trotter Theorem May 2015

· Presented a result which gives a tight bound on a generalization of the Szemeredi-Trotter theorem to n dimensions.

(Ma111) A Dyadic Model for the Euler and Navier-Stokes Equations May 2015

· Presented a result of Professor Nets Katz which shows finite-time blow-up of a dyadic model for the Euler and Navier-Stokes equations.

TECHNICAL SKILLS

Computer Languages	x86 Assembly (NASM), C, C++, Python, Java, C#
Scripting & APIs	Bash, PHP, SciPy, SDL, OpenGL, OpenCL, CUDA
Tools	Matlab, Mathematica, Maple