2018-2019

APPLIED MATHEMATICS NEWSLETTER

University of Colorado at Boulder

Table of Contents

Title Page 1
Table of Contents 2
Affiliated Faculty 3
Applied Mathematics Faculty and Staff 4
Letter from the Department Chair 5
Spring 2019 Outstanding Graduate Award Winners 6-7
Spring 2019 Graduates 8-9
Newsletter Articles 10-25
- Applied Mathematics Department's 30th Anniversary 10
- Nuclear Fusion Research Awarded Simons Grant 11-12
- Recent Graduate Alum, Dr. Plumley, Receives Turcotte Award 12
- Applied Mathematics Alum Q&A 13-15
- Anne Dougherty Receives Doug Faires Award 15-16
- Graduate Student Awarded Figueroa Family Fellowship 16
- New Graduate Program Students Prepare for TA Positions 17-18
- Professor Ablowitz Recieves Honorary Degree 19
- Welcome New Assistant Professor, Nancy Rodriguez 20
- Graduate Student, Shay Gilpin, Awarded Best Student Presentation 21
- Associate Professor Appelo to Visit Top Swedish University 22
- Professor Ablowitz Receives Distinguished Fellowship 23
- Chancellor's Recognition Award Winners 23
- Ellen Considine Awarded Goldwater Scholarship 24
- In Remembrance of Joseph Evans 25

Annual Fund Drive 26

AFFILIATED FACULTY

Anderson, Robert - Geological Sciences
Betterton, Meredith – Physics
Bradley, Elizabeth – Computer Science
Brown, Jed - Computer Science
Cai, Xiao-Chuan – Computer Science
Calkins, Michael – Physics
Cary, John – Physics
Clauset, Aaron – Computer Science
Crimaldi, John – Civil, Env. Archit. Engineering
DeGrand, Thomas – Physics
Doostan, Alireza – Aerospace Engineering Sciences
Elkington, Scot – LASP
Evans, John - Aerospace
Flaxman, Samuel – Ecology & Evolutionary Sciences
Flyer, Natasha – Institute for Math Applied to Geosci.
Fournier, Aimé – Mathematics
Fox-Kemper, Baylor - CIRES
Frongillo, Rafael – Computer Science
Glover, Fred – Leeds School of Bus.
Hauser, Thomas – Research Computing
Herzfeld, Ute – CIRES; Electrical, Comp. & Energy Engineering
Horányi, Mihály – Physics, LASP
Hrenya, Christine – Chem. & Biological Engineering
Hussein, Mahmoud I. – Aerospace Engineering Sciences
Jessup, Elizabeth – Computer Science
Kantha, Lakshmi – Aerospace
Kompala, Dhinaker – Chem & Biological Engineering
Kram, Rodger - Integrative Physiology
Laguna, Manuel – Leeds School of Bus.
Lomeli, Hector – University of Texas
Martins-Filho, Carlos - Economics
Matsuo, Tomoko - Aerospace Engineering Sciences
Meyer, Francois – Electrical, Comp. & Energy Engineering
Moyen, Nathalie – Leeds School of Bus.
Nychka, Douglas – NCAR, Institute for Math Applied to Geosci.
O'Rourke, Sean - Mathematics
Ostrovsky, Lev A. – NOAA
Parker, Scott – Physics
Pouquet, Annick – NCAR
Rajaram, Harihar – Civil, Env. & Archit. Engineering
Rey, Ana Maríe – JILA; Physics
Sankaranarayanan, Sriram – Computer Science
Scheeres, Daniel – Aerospace Engineering Sciences
Shull, J. Michael – Astrophysical & Planetary Sciences
Skodje, Rex - Chemistry
Syvitski, James – INSTAAR; Geological Sciences
Toomre, Juri – JILA
Tufo, Henry – Computer Science
Varanasi, Mahesh – Electrical & Computer Engineering
Vernerey, Franck – Mechanical Engineering
Weidman, Patrick – Mechanical Engineering
Weiss, Jeffrey B. – ATOC
Werne, Joseph – Colorado Research Associates
Zylberberg Joel – Physiology and Biophysics

APPLIED MATHEMATICS FACULTY

Department Chair: Keith Julien, Professor
Associate Department Chair: Anne Dougherty, Senior Instructor
Graduate Committee Chair: Mark Hoefer, Associate Professor

Mark Ablowitz, Professor
Gregory Beylkin, Professor
James H. Curry, Professor
Vanja Dukic, Professor
Bengt Fornberg, Professor
Keith Julien, Professor
Congming Li, Professor
James Meiss, Professor
Harvey Segur, Professor
Daniel Appelö, Associate Professor
David Bortz, Associate Professor
Jem Corcoran, Associate Professor
Mark Hoefer, Associate Professor
Manuel Lladser, Associate Professor
Juan G. Restrepo, Associate Professor
Eric Vance, Associate Professor
Stephen Becker, Assistant Professor
Ian Grooms, Assistant Professor
Yu-Jui Huang, Assistant Professor
Zachary Kilpatrick, Assistant Professor
William Kleiber, Assistant Professor
Nancy Rodriguez, Assistant Professor
Jerrold Bebernes, Professor Emeritus
Bob Easton, Professor Emeritus
Tom Mantueffel, Professor Emeritus
Steve McCormick, Professor Emeritus

Anne Dougherty, Senior Instructor
Adam Norris, Senior Instructor
Sujeet Bhat, Instructor
Murray Cox, Instructor
Danielle Lyles, Instructor
Maribeth Oscamou, Instructor, Student Support Specialist
Eric Thaler, Instructor
Brian Zaharatos, Instuctor
Silva Chang, Instructor, Math Placement Advisor
Rachel Tutmaher, Lecturer, Help Room Coordinator
Justin Cole, Instructor, Research Associate
Ezio Iacocca, Instructor, Research Associate
Lucas Monzon, Instructor, Research Associate
Susan Hallowell, Lecturer
Jonathan Kish, Lecturer
Daniel “Seneca” Lindsey, Lecturer, Help Room Coordinator
Sandy Williams, Lecturer
Nicholas Featherstone, Senior Research Associate
Tahra Eissa, Research Associate
Benjamin Miquel, Research Associate
Igor Rumanov, Lecturer, Research Associate
John Ruge, Research Associate
Ben Southworth, Research Associate

APPLIED MATHEMATICS STAFF

Ian Cunningham, Office Coordinator, Undergraduate Program Assistant
Mary Fentress, Program Manager
Dalina Gonzalez, Student Assistant
Desiree Holtz, Accounting Tech

Dominique Ingoglia, IT Manager
Blake Kleinhans, Student Assistant
Alexus Longo, Student Writer, Newsletter Editor
Patrick McCreery, Student Writer
Emily O’Connor, Graduate Student Coordinator
Kyle Zhou, IT Assistant

Letter from Department Chair

(APPM) Applied Mathematics at CU Boulder continues to be a vibrant unit with many moving parts and new initiatives. The past year was a tremendously busy time for all. APPM is a healthy and dynamic unit that fulfills all of its missions with excellence and dedication. The APPM Department strives to uphold the feelings of camaraderie and healthy departmental climate found by the academic review process (ARPAC) evaluations conducted during AY16-17.

A significant event in the unit's history was approval by the CU Board of Regents for its second undergraduate degree, a BA in Statistics and Data Science to be offered in the College of Arts and Sciences.

The Regents stated, "The bachelors in statistics and data science is intended to produce alumni who will have a STEM-based understanding of statistics and its applications. The degree, which will be offered by the Department of Applied Mathematics in the College of Arts and Sciences, will prepare students for a wide range of careers in engineering, economics, data science, public health, epidemiology, insurance, forestry, psychology, social justice and human rights, and more... No other university in the state offers an undergraduate degree program in statistics and data science, so this degree will increase the ability of CU Boulder to attract high-quality resident and nonresident students and enable the Boulder campus to place its alumni in highly desirable positions at top companies, national labs and graduate programs."

The new BA officially began the Fall 2018 semester of this academic year and will be the culmination of a decade long effort in recruiting a critical mass of faculty of excellence capable of delivering a high-quality education to our students. Many thanks to Professor Vanja Dukic, Associate Chair Anne Dougherty, and the statistics steering committee for their dedicated effort in bringing this venture to fruition.

The APPM undergraduates have had several notable accomplishments. As in years past, our students did exceptionally well in the international Mathematical Contest in Modeling (MCM). This 4-day contest has continued to grow, with 25,370 three-person teams competing from around the world. APPM had 12 teams with 3 of these teams awarded Outstanding. 3 teams were awarded Meritorious, 2 teams awarded Honorable Mention, and 3 awarded Successful Participant designation.

I would like to take this parting opportunity to thank faculty, staff, alumni and friends for their continued engagement, contributions and dedication in advancing the Department of Applied Mathematics.

- Department Chair, Keith Julien

Spring 2019

OUTSTANDING GRADUATE AWARD WINNERS

CONGRATULATIONS!

Outstanding Graduate award winners for the College of Engineering and Applied Mathematics were announced on April 26, at the DEAA Banquet. The represented departments and programs were also encouraged to recognize the award winners and nominees at their individual spring graduation ceremonies.

Outstanding Graduate of the College

overall strength in academics, research, and service or international engagement

Marc Thomson, AMEN BS/MS + CHEN BS

Outstanding Graduate for International Engagement

Michael Anthony, AREN BS

Outstanding Graduate for Service

Elvin Viloria, AREN BS/MS

Outstanding Graduate for Research

Simon Hafner, MCEN BS/MS

Outstanding Graduates for Academic Achievement

highest undergraduate career GPA

William Barham, AMEN BS/MS
Jacob Crawford, CSEN BS
Brent Frieden, MCEN BS
Catherine Witt, EEEN BS
Mingxuan Zhang, AMEN BS

SPRING 2019 GRADUATES

MASTER OF SCIENCE

Ann Casey Hughes
Mark Tedder
Adhithya Sivakumar

MASTER & BACHELOR OF SCIENCE

Grant Baker
William Barham
Adam Binswanger
William Boshell
Nikhil Krishnan
Jeffrey Matthew Maierhofer
Marc Thomson
Xiao Xiao

BACHELOR OF SCIENCE

Christopher Arehart
Dawson Beatty
Andrew Beel
David Bloom
Brenden Boyd
Chloe Bruce
Jetanat Datephanyawat
Yang Kuan Du
Yuqing Du
Joseph Evans
Jeffrey Everett
Liam Fisher
Michael Fromandi
Akash Gaonkar
Kathryn Gray
Jonathan Hanna
Cheryl Hansen
Nicholas Inslee
Josh Jacobson
Matthew Jankousky
Zack Jensen
Minaje Kim
Quinn Kudzma Park
Lucas Liard
Rain Ada Lambek
Jeremiah Lane
Justus Leben
Ksenia Lepikhina
Sarah Liddle
Elysia Lucas
Iva Majeticova
Trevor McCord
Sean McKee
Kelsey McKenna
Dylan McNally
Rachel Moore
Wade Myers
Virginia Ann Nystrom
Rohan Peddi
Marika Schubert
Tyler Schuessler
Alec Stiller
Adrian Strock
Weiliang Sun
Jacob Tiede
Huy Tran
Amelia Westerdale
Alexander Winoker
Yue Yao
Arthur Zambronsky
Mingxuan Zhang

Doctor of Philosophy

TRACY BABB

Accelerated Time-Stepping of Parabolic and Hyperbolic PDEs via Fast Direct Solvers for Elliptic Problems

Dissertation Advisor: Per-Gunnar Martinsson, Ph.D, Applied Mathematics

ANNA BROIDO

Describing the Tails of Degree Distributions in Real-World Networks

Dissertation Advisor: Aaron Clauset, Ph. D., Computer Science

JESSICA GRONSKI

Non-Convex Optimization and Applications to Bilinear Programming and Super-Resolution Imaging

Dissertation Advisor: Stephen Becker, Ph. D., Applied Mathematics

NATHAN HEAVNER

Building Rank-Revealing Factorizations with Randomization

Dissertation Advisor: Per-Gunnar Martinsson, Ph. D., Applied Mathematics

ERIC KIGHTLEY

Sparsified Gaussian Mixture Models

Dissertation Advisor: Stephen Becker, Ph. D., Applied Mathematics

MICHELLE MAIDEN

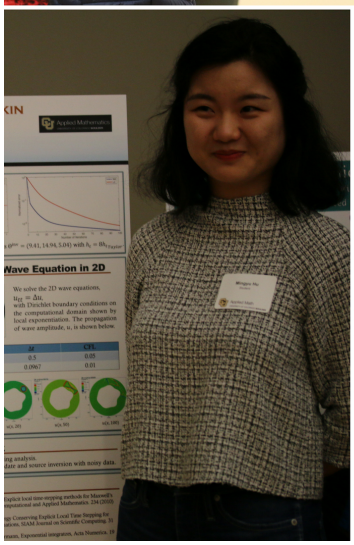
Dispersive Hydrodynamics in Viscous Fluid Conduits

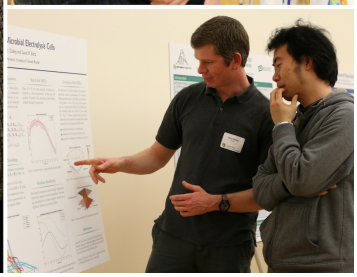
Dissertation Advisor: Mark Hoefer, Ph. D., Applied Mathematics

APPLIED MATHEMATICS DEPARTMENT CELEBRATES ITS

30TH ANNIVERSARY

AND WELCOMES PROSPECTIVE GRADUATE STUDENTS





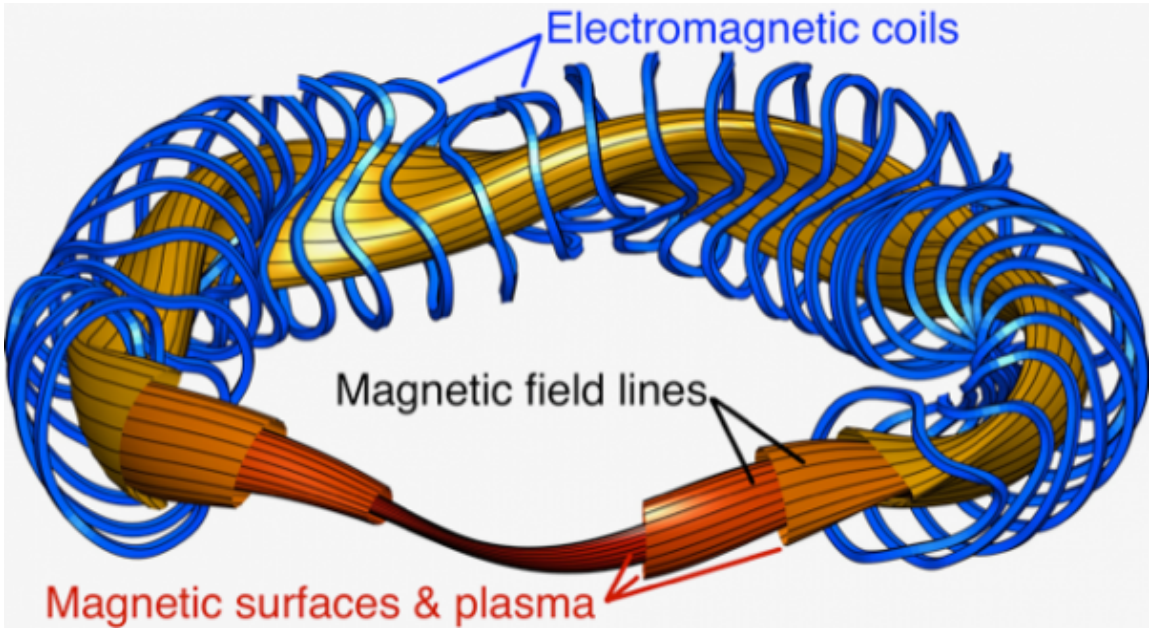
Friday, March 8th, the Applied Mathematics Department celebrated its 30th anniversary and hosted a poster session to welcome prospective incoming graduate students.

The anniversary celebration featured two speakers. One spoke about weather and weather modeling, and the other spoke about her time as a dean of a school in New Jersey. Professor Ablowitz also took some time to speak about the Department and its history.

After the talks, there was food and the poster session. During the poster session, current Applied Mathematics graduate students presented their research to the prospective incoming graduate students and other members of the department.

Dr. Meiss Collaborates on Nuclear Fusion Research, Research Effort Awarded Simons Grant

Dr. Meiss, Professor of Applied Mathematics, is one of ten principle investigators (PIs) awarded a prestigious grant from the Simons Foundation to research optimal stellarator designs. The Simons Grant will be $2million USD a year for four years.



Who's Involved?

The research is led by Princeton University and is a collaboration between Australian National University, Columbia University, Cornell University, Max Planck Institute for Plasma Physics Greifswald, New York University, University of Colorado at Boulder, University of Maryland, University of Texas at Austin, and Warwick University. The ten PIs make up an interdisciplinary team of experts in magnetic fieldline flow, particle confinement, magnetohydrodynamics, and multi-objective stochastic optimization.

What's a Stellarator?

A general outline of a stellarator's electromagnetic coils, magnetic field lines, magnetic surfaces, and plasma are shown in the image. This image is courtesy of the Max Planck Institute for Plasma Physics.

Stellarators are devices that could potentially generate sustained and controlled nuclear fusion power. According to Time Magazine's 2010 article, "10 Questions for Stephen Hawking," when asked about the one scientific advancement he'd like to see in his lifetime, Hawking responded, "I would like nuclear fusion to become a practical power source. It would provide an inexhaustible supply of energy, without pollution or global warming."

> "I WOULD LIKE NUCLEAR FUSION TO BECOME A PRACTICAL POWER SOURCE. IT WOULD PROVIDE AN INEXHAUSTIBLE SUPPLY OF ENERGY, WITHOUT POLLUTION OR GLOBAL WARMING."
>
> - STEPHEN HAWKING

The goal of a magnetic confinement devices, like the stellarator, is to use magnetic fields to confine hot plasma in order to sustain a nuclear fusion reaction (the fusion of two Hydrogen nuclei to form Helium and release a large amount of energy). For a fusion reaction to occur, the electrostatic repulsion between

atomic nuclei must be overcome by heating the particles involved to tens of millions of degrees--turning them into plasma. These devices take advantage of the charges of the particles to contain the plasma using magnetic fields; the plasma particles move around the magnetic field lines in helical orbits, resulting in confinement transverse to the field.

Stellarators vs. Tokamaks

Stellarators have not always been the focus for fusion power devices. Currently, most experimental devices are tokamaks because the design of stellarators has been considered impractical. However, there has been a renewed interest in stellarator designs because (1) the advancement of computer aided design tools now allows for complex stellarator magnet construction, and (2) the stellarator is considered more stable than tokamaks.

According to Dr. Meiss, the tokamak is an axisymmetric torus (bagel-shaped) and uses two magnetic fields to contain the plasma: toroidal (long axis) fields, and poloidal (short axis) fields. The toroidal fields are created by external coils while the poloidal fields arise from the contained plasma's current. These currents can't be easily maintained at steady state and also lead to instabilities of the plasma. The stellarator, on the other hand, is not axisymmetric: it is shaped more like a French cruller. The plasma-confining magnetic field is mostly created by external coils, meaning the stellarator has the potential to continuously produce power while avoiding the plasma current-based instabilities of the tokamak. Optimally designing the external coils of the stellarator is one question that Dr. Meiss and other collaborators on the Simons grant plan to answer.

The Research

According to Dr. Meiss, he and Dr. Robert MacKay (University of Warwick) lead the portion of the project focusing on the use of magnetic fields in the stellarator to confine charged particles geometrically (focusing on imposing approximate symmetries) and dynamically (focusing on the drifting of particles from magnetic surfaces). Given its shape, the fieldlines in the stellarator vary in strength and direction. This variation means particles can drift across magnetic field lines; however, such drifts can be minimized by careful design. According to Dr. Meiss, "if the strength of the magnetic field has a symmetry (even if its direction does not), then Noether's theorem gives an invariant. We call this 'quasi-symmetry.'"

Overall, the research on stellarators, as funded by the Simons Foundation grant, plans to answer questions such as, "how do approximate symmetries and quasi-symmetries interact?" "Are there other hidden symmetries that can lead to invariants?" "How can the external coils of the stellarator be optimally designed?"

RECENT GRADUATE DR. MEREDITH PLUMLEY RECEIVES TURCOTTE AWARD FOR OUTSTANDING DISSERTATION RESEARCH

According to the AGU website, the Turcotte Award is given annually to one honoree in recognition of outstanding dissertation research that contributes directly to nonlinear geophysics. The primary criteria for choosing an awardee is the impact or potential impact of the research on the field of nonlinear geophysics. So far, Dr. Plumley's dissertation has resulted in four peer-reviewed publications in top-tier journals and one manuscript currently under preparation.

In 2015 Dr. Meredith Plumley successfully competed for a NASA Earth and Space Science Graduate Fellowship, which was used to support her dissertation research. Now, Dr. Plumley has been awarded the 2018 AGU Donald L. Turcotte Award for outstanding dissertation research. Dr. Plumley completed her dissertation, "investigations of asymptotic models for convection-driven flows in geophysical and astrophysical fluid systems," with Professor Keith Julien in Spring 2018. Since the creation of the Turcotte Award in 2008, Dr. Plumley has been the second APPM graduate student to ever receive the award.

This Fall Dr. Plumley will present a talk on her dissertation at the Fall 2018 AGU meeting She also recently successfully competed for a postdoctoral fellowship at ETH Zurich Switzerland and will be joining the geophysics group of Professor Andy Jackson this fall. APPM congratulates Dr. Meredith Plumley.

ARMEEN TAEB

APPM Alum Speaks Highly of His Time at CU and How it Prepared Him for Graduate School

Armeen Taeb graduated from CU Boulder four years ago (2013) with undergraduate degrees in both Electrical Engineering (EE) and Applied Mathematics. He has since been working toward his PhD at Caltech's Electrical Engineering Department, and expects to graduate in June 2019. His research focuses on statistics, and developing statistical models that account for noise/variance in observational data. He has also had some research collaborations with the Jet Propulsion Laboratory (JPL) including a project in which a statistical model Taeb developed was used to understand how reservoirs in California respond to drought conditions. Taeb speaks very highly of his undergraduate education at CU Boulder, saying that the classes he took and relationships he formed helped prepare him for graduate school, and still help him presently.

HOW WELL HAS YOUR UNDERGRADUATE EDUCATION PREPARED YOU FOR GRADUATE SCHOOL?

The classes I took in APPM have been tremendously helpful for graduate school. These courses gave me strong mathematical foundations, but more importantly, taught me how to think analytically and logically. I think that is such a great service, and one that will continue to help me in my career.

WHAT ARE SOME OF YOUR FONDEST MEMORIES FROM CU BOULDER?

My fondest memories are the classes I took and the relationships I developed with the faculty. During my sophomore year, I took Professor Ablowitz's Fourier Series and Boundary Value Problems, which changed my academic career. I realized that I loved mathematics and its applications to real world problems, including electrical engineering. I developed a mentorship bond with Professor Ablowitz that continues to this day! In so many ways, these experiences led me to the path of graduate school, and I'm forever grateful for that.

WHAT DID YOU LIKE THE MOST ABOUT THE APPLIED MATH DEPARTMENT AT CU BOULDER? WHY?

I think the undergraduate APPM program is outstanding! The courses were without an exception excellent. All the professors deeply cared about their subjects and cared about students. Further, Professor Dougherty (the undergraduate representative), who is by the way another excellent teacher, provided a

lot of guidance for the students in the department to flourish. All in all, APPM was a stimulating environment where I saw myself really develop as an academic.

WHY DID YOU DECIDE TO DO YOUR GRADUATE WORK IN ELECTRICAL AND COMPUTER ENGINEERING?

I always saw myself more as an applied mathematician than an engineer. During my undergraduate years, I conducted research in the field of mathematical signal processing with Professor Shannon Hughes (in the electrical engineering department). Even though this research area comprises of statistics and optimization, it falls in the EE department in most universities. So when it came to apply to grad school, I targeted faculty who were doing similar research and those usually ended up being in the EE department.

CAN YOU EXPAND UPON WHAT YOUR GRADUATE WORK IS ABOUT?

Broadly speaking, my research is on developing statistical methodologies to characterize large and messy datasets. As an applied mathematician, I like to work both on theory and applications. I've realized that my favorite mode of research is to start with an interesting but challenging application, understand the nuisances of the physical problem, develop a statistical methodology that would explain what we observe, and finally prove mathematically that my approach does what we expect.

WHY DID YOU DECIDE TO RESEARCH STATISTICS?

I found statistics to be a heaven for an applied mathematician, it is both rigorous and is widely applicable! Most of the measurement devices in physical processes introduce noise in the observations. Statistics provides a principled way to account for the uncertainty of noise while modeling the underlying phenomena. Further, the theory of mathematical statistics is very rich and often provides justification for techniques that we come up with.

CAN YOU EXPAND ON YOUR RESEARCH AND ITS IMPORTANCE?

Much of my PhD research has focused on developing statistical models that account for the presence and effect of latent variables (unobserved phenomena) in observational data. In the current age of using data to characterize physical phenomena, my area of research has become increasingly relevant since we often do not have measurements of everything that may contribute to the behavior of the underlying system. In addition to developing latent variable modeling techniques, I recently proposed a statistical procedure to provide confidence for these models.

WHY DO YOU FEEL APPLIED MATH (OR STATISTICS) IS AN IMPORTANT FIELD?

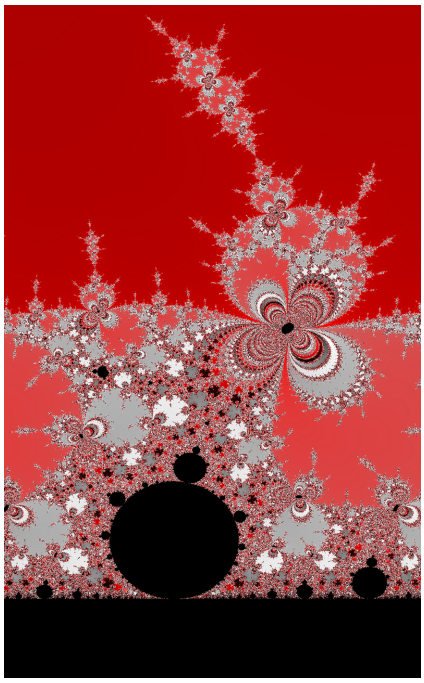
We live in an era where it's often cheap to extract data from a system we wish to understand, so data is plentiful! I often interact with scientists at Caltech who have collected data from experiments and are faced with understanding this data to develop/confirm a hypothesis. Statistics provides a principled approach to deal with data. I strongly believe that every engineer/scientist should have some training in fundamentals of statistics, as it can be tremendously useful.

CAN YOU EXPAND ON SOME OF YOUR COLLABORATIONS WITH THE JET PROPULSION LABORATORY (JPL)?

JPL has been a source of many interesting applications! A few years ago, I began a very fruitful collaboration with a hydrologist and statistician at JPL on modeling the California reservoir system. We applied the latent variable modeling techniques that I had developed to identify the first model of the statewide California reservoir system and used it to characterize how reservoirs respond to drought conditions. We published our work in a premier water resources journal. Just recently, I began collaborating on another project that employs spatial statistical models for detecting signatures (e.g. methane gas emission) from hyperspectral imaging data.

WHAT ARE YOUR THOUGHTS ON CU BOULDER'S NEW STATISTICS AND DATA SCIENCES MAJOR?

I am extremely delighted that the applied math program is offering this major! I wish it had existed when I was a student at CU Boulder. Most departments in computer science and the data sciences have expanded tremendously over the past few years; a large factor in this growth is due to the sudden surge in Machine Learning. However, from my experience and impressions from applied math in Boulder, I am certain that the department will be one of few that focuses on theoretically grounded foundations of data science. I am proud to have been a part of a department that strives for understanding fundamental problems in computational and applied mathematics.



ANNE DOUGHERTY RECEIVES DOUG FAIRES AWARD

Earlier this August, Anne Dougherty was presented with the Doug Faires award during the Mathematical Association of America's (MCM) annual meeting - the 2018 MathFest. She received this award for her years of dedicated participation, recruitment, and coaching of teams in the MCM/ICM contest.

The Doug Faires award is presented by COMAP, and according to their press release, it's meant to recognize advisors' efforts to start modeling teams, and to encourage current advisors to recruit and mentor new advisors. COMAP hopes the presentation of these awards will promote the formation of local groups with an interest in mathematical modeling.

CU BOULDER HAS

"SOME OF THE BEST STUDENTS IN THE WORLD"

- ANNE DOUGHERTY

Anne Dougherty has been with the CU Applied Math Department since 1994, and currently serves as a Senior Instructor and the department's Associate Chair. She "particularly enjoys working with undergraduate students and watching them grow and develop." Throughout the courses she's taught, she has always tried to provide her students with the motivation and desire to think for themselves. As such, Dougherty has been a strong advocate for student participation in the MCM/ICM for over twenty years. According to Anne, "the spirit of MCM/ICM resonates with my own beliefs on what constitutes a strong undergraduate Applied Math education, and I would love to see more participants."

Over the years, other CU faculty have joined Anne in her efforts to recruit MCM/ICM participants and

train the teams. Professors Bengt Fornberg and Manuel Lladser have worked with various teams to help them prepare for the contest. Every year before the MCM/ICM contest, there are 4-6 training sessions in which the rules and main steps (e.g. picking a problem, the process of solving it, etc) of the contest are reviewed. Additionally, Professor Scot Douglass, the Director of the Engineering Honors Program, has been instrumental in recruiting students from a wide variety of majors and STEM disciplines. Over time, they have found that the strongest teams are comprised of students from different majors and with different interests and skills. Given everyone's combined effort, CU Boulder's participation in the MCM/ICM contest has increased from 3-5 teams to over 15 teams in just the past few years.

"THE SPIRIT OF MCM/ICM RESONATES WITH MY OWN BELIEFS ON WHAT CONSTITUTES A STRONG UNDERGRADUATE APPLIED MATH EDUCATION, AND I WOULD LOVE TO SEE MORE PARTICIPANTS."

- ANNE DOUGHERTY

The participating teams have continually found their participation in the contest both challenging and rewarding. The MCM/ICM is an intense compressed research project in which students are required to selected a problem, research its history, create mathematical and numerical models of the problem, analyze the sensitivity of their results, and then write a written report- in only four days. The collaborative nature of the contest allows the participating students to present a final product which is usually superior to that which would have been produced by the students working individually.

Anne thoroughly enjoys working with the students on all aspects of contest preparation; according to her, "when I first learned about the MCM/ICM, I thought this was a perfect venue for our students to showcase their mathematical, computational, and communication skills." Dougherty believes that the current tradition of excellence in the MCM/ICM is due to the university having "some of the best students in the world" who are then well trained through rigorous coursework.

All in all, Anne Dougherty deserves to be recognized for both her continuing recruitment and training of MCM/ICM participants, and the encouragement of other faculty to recruit and train MCM/ICM participants. She recruited her first two teams in 1997 (both of which received a Meritorious ranking), and some of the original participating students are now faculty at other institutions and have begun to recruit and train their own teams.

Below you can see Anne and this years MCM Outstanding Team at MathFest2018. From left to right: Marc Thomson, Christine Reilly, Anne Dougherty, Derek Gorthy, and the President-elect of the MAA.

GRADUATE APPLIED MATHEMATICS STUDENT AWARDED

FIGUEROA FAMILY FELLOWSHIP

Graduate Applied Mathematics Student, Zofia Stanley, was recently awarded the Figueroa Family Fellowship- a $1,500 scholarship given to students that have shown outstanding commitment to creating a diverse student body and improving the state of the world and its people. The university has awarded Zofia Stanley this fellowship to express its admiration for the impact she has made and the impact that she will continue to make.

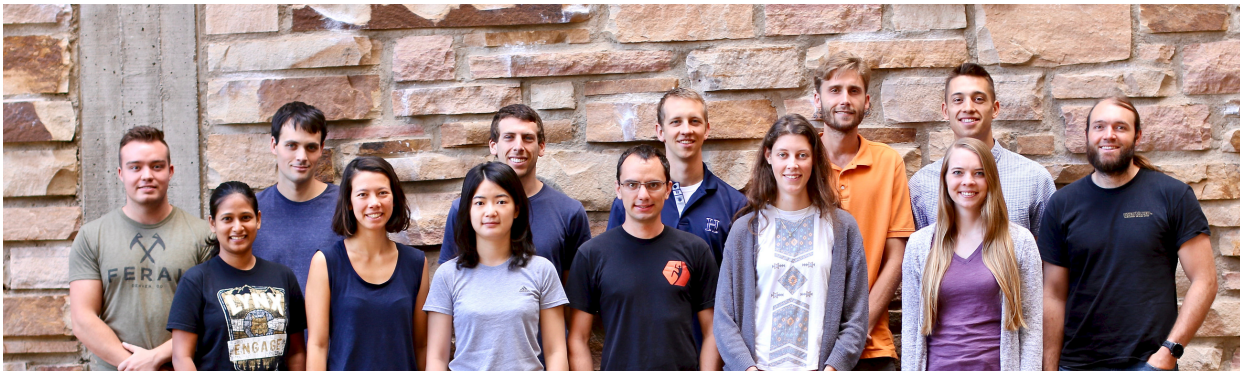
Stanley is currently a vice president of the Association for Women in Mathematics and is a presenter for a few LISA (Laboratory for Interdisciplinary Statistical Analysis) short-courses (Data Visualization in R, and Statistics in R). LISA short-courses arise from collaborations between statisticians and biologists with the aim of teaching useful statistical techniques to anyone.

The Figueroa Family Fellowship is made possible by generous donations from Frank Figueroa.

FALL 2018 APPM GRADUATE STUDENTS PREPARE FOR TA POSITIONS

ON AUGUST 23RD, THE APPLIED MATH DEPARTMENT'S FIRST-YEAR GRADUATE STUDENTS WERE BUSY LEARNING AND PREPARING FOR THEIR NEW TA POSITIONS. DURING THE MEETING, EACH NEW TA PRESENTED A PREVIOUSLY PREPARED AND PRACTICED FIVE-MINUTE MINI-LECTURE TO THEIR FELLOW FIRST-YEAR GRADUATE STUDENTS.

THE TOPICS PRESENTED COVERED TRIGONOMETRY (HOW TO USE SOH CAH TOA, AND CONSTRUCTING THE UNIT CIRCLE), CALCULUS (DELTA-EPSILON DEFINITION OF A LIMIT, L'HOSPITAL'S RULE, CHAIN RULE, AND THE QUOTIENT RULE), AND PHYSICS (ANALYZING PROJECTILE MOTION USING INTEGRALS).

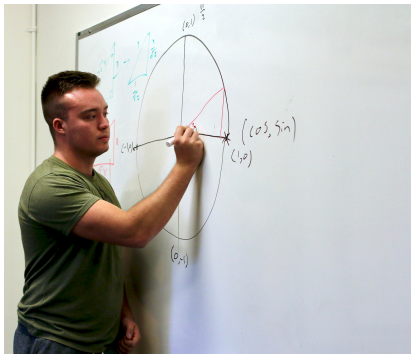


Top Row, Left to Right: Evan Gorman, TJ McMorrow, Abe Ellison, Samuel Ryskamp, Douglas Brunson, Nicholas Varberg, Matt Watwood.
Bottom Row, Left to Right: Shalini Mahanthege, Kiera VanDerSande, Yifeng Mao, Nick Barendregt, Shay Gilpin, Callie Duque.

Every presenter was given compliments and criticisms from the other first-years about their lecture. Many comments centered on increasing student engagement and focus, how to be comfortable when speaking in front of others, and how to properly interact with students. Other comments emphasized the importance of using different examples, giving thorough explanations, and using language that won't undermine the confidence of some students (for example, some new TAs were advised not to say in lecture, "we all know that..." as to not make some students feel behind in the class). Another heavily emphasized comment was about making sure the new TAs have good board-work. A lot of planning goes into organizing the lecture and board such that all necessary information remains on the board at once, while still writing and drawing large enough for everyone to see without running out of space. Every mini-lecture was video-taped so the first-years could compliment and

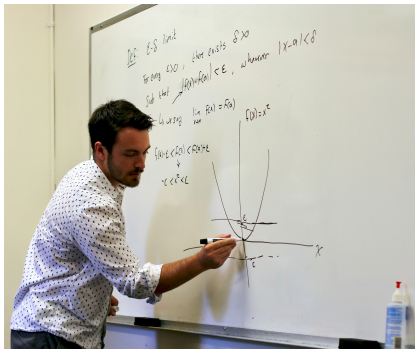
EVAN GORMAN

Practicing a lecture on constructing the Unit Circle.



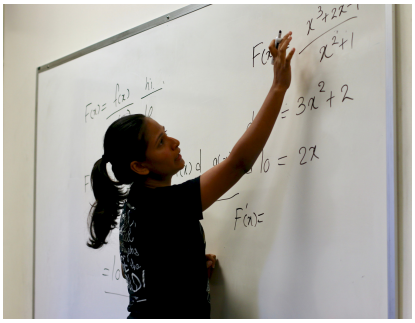
JOE CASTAGNERI

Practicing a lecture on the Delta-Epsilon definition of a limit.



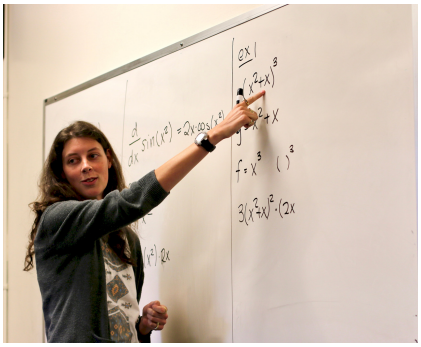
SHALINI MAHANTHEGE

Practicing a lecture on the Quotient Rule.



SHAY GILPIN

Practicing a lecture on the Chain Rule.



criticize their own presentation and see how to fix any other mistakes they may have made.

After the meeting, Joe Castagneri, pictured on the left lecturing on the Delta-Epsilon definition of a limit, was interviewed. Castagneri is in his final year of the five year BS/MS Applied Math program, and this will be his first year as a TA. During the interview, Castagneri said he found the meeting very helpful, and jokingly remarked that the best way to prepare for presenting a topic and not being nervous during the presentation, is by presenting to a room of people that know exactly what you're talking about and could easily catch your mistakes. Currently, Castagneri is working towards his BS/MS in Applied Math with interests in statistics, numerical analysis, and especially in Artificial Intelligence and Machine Learning. He grew up near campus and has been very happy with the decision to pursue his studies at CU Boulder's Applied Mathematics Department. At the time of this meeting, Castagneri was preparing to teach a Calculus 1 or 2 recitation.

TAs are a very important part of the Applied Mathematics Department. They teach, lead recitations, grade, and make themselves available to students who would appreciate extra instruction on certain topics. The Applied Mathematics Department holds these training sessions for the first-year graduate students before the start of the fall semester to ensure that they are well prepared for the workload of being a TA, and even better prepared to help their undergraduate students with their studies.

Professor Ablowitz

RECEIVES HONORARY DEGREE

On July 19, 2018, Applied Mathematics professor, Mark Ablowitz (pictured in the right bottom two photos), received an honorary Doctor of Science degree, honoris causa, from the University of Kent, Canterbury, UK. The honorary degree was awarded for Ablowitz' "exceptional contributions to the science of nonlinear phenomena." According to Ablowitz' website, he has made a multitude of significant contributions to the field. ISI (Institute for Scientific Information) Web of Science considers him to be one of the most highly cited researchers in Mathematics.

In receiving his honorary degree, Ablowitz presented a talk to the graduates of the Kent Mathematics Department (pictured on the right). Albowitz was introduced by Peter A. Clarkson (pictured in the top right), Professor of Mathematics at Kent University, and his talk was titled 'Turning Points – Life Decisions.' In honor of this event, the Kent Mathematics Department organized a meeting on nonlinear mathematics.

Ablowitz moved to the University of Colorado, Boulder in 1989 to begin a new Program in Applied Math. The Program began with 4 tenure track faculty and a few instructors; it became a Department in 1996. Today the Applied Math Department has 22 tenure track faculty, 9 instructors, and more than 70 graduate students and 200 undergraduate majors.

WELCOME

Assistant Professor Nancy Rodriguez

Nancy Rodriguez was recently hired as an Assistant Professor in the Applied Mathematics department- the Spring 2019 semester was her first semester here. Rodriguez has an impressive educational background; she attended graduate school at UCLA, did postdoctoral work at Stanford, and was previously an Assistant Professor of Mathematics at UNC Chapel Hill. Presently, Rodriguez is interested in researching the use of "PDE models to untangle the factors leading to various phenomena in ecology and sociology." Rodriguez enjoys how the partial differential equations that arise from modeling such phenomena not only offer information about the systems being modeled, but also involve "beautiful theory."

Last semester she taught a Graduate Applied Analysis course and enjoyed her students' level of motivation. Rodriguez feels it's important for all students to attend "office hours, ask questions, [and] learn some computational skills and analysis regardless of" major. In addition to teaching, Rodriguez hopes to "build a research group which [will] encompass many interests including mathematical modeling, numerical analysis of solutions, theoretical analysis of solutions, and model verification with data incorporation." She also hopes to "develop a network for students in order to help foster their success."

She was drawn to CU Boulder because our Applied Mathematics department "is a great department in the best location for outdoor activities." Rodriguez enjoys many outdoor activities including biking, running, hiking, skiing, tennis, etc.

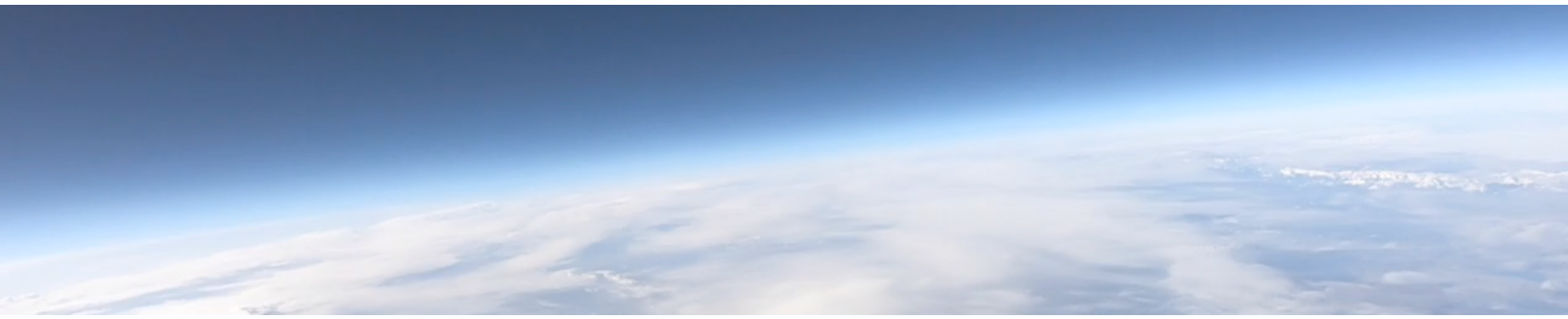
If you would like to learn more about Dr. Rodriguez, check out her Profile in Applied Mathematics on the Applied Mathematics website.

CU BOULDER'S APPLIED MATHEMATICS DEPARTMENT "IS A GREAT DEPARTMENT IN THE BEST LOCATION TO DO OUTDOOR ACTIVITY."

Nancy Rodriguez

GRADUATE STUDENT SHAY GILPIN AWARDED

BEST STUDENT PRESENTATION



Applied Mathematics graduate student, Shay Gilpin, was awarded Best Student Presentation at the 23rd Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface (IOAS-AOLS) Conference at the 2019 American Meteorological Society (AMS) Annual Meeting for her presentation titled "Reducing Representativeness Errors during Radio Occultation-Radiosonde Comparisons."

This year's annual AMS IOAS-AOLS Conference was held during January 5-11, in Phoenix Arizona. Presenters were evaluated on the quality of slides and delivery, innovation, maturity, and a deep understanding of the research. According to one of

"SHAY EXCELLED IN [THE QUALITY OF HER SLIDES AND DELIVERY, INNOVATION, MATURITY, AND UNDERSTANDING OF HER RESEARCH]."

2019 AMS IOAS-AOLS Conference Chair,
Sharan Majumdar

the conference program chairs, Sharan Majumdar, "Shay excelled in all of these!"

The work Gilpin presented was based on findings from her and her co-authors' recent paper, "Reducing Representativeness Errors during Radio Occultation-Radiosonde Comparisons," published in Atmospheric Measurement Techniques in May 2018. The paper discusses various methods the authors tested and found to reduce representativeness errors that occur during radio occultation and radiosonde comparisons. Instruments that observe Earth's atmosphere play an important role in our everyday lives- they collect data that help predict the weather. These predictions are used in the weather apps on our phones and to predict severe weather events like hurricanes and winter storms. Comparing these instruments with each other is crucial in ensuring the accuracy of these instruments and can ultimately better our understanding of our atmosphere.

Radiosondes (RS), instruments attached to weather balloons, are considered as a standard observing system due to their long history (since the 1930s) of measuring atmospheric quantities, such as temperature, pressure, and relative humidity. Radio occultation (RO), a relatively new method of atmospheric measurement started in the 1990s, observes the atmosphere through the use of Global Positioning System (GPS) and low-Earth orbiting satellites, obtaining observations in the ionosphere, stratosphere, and troposphere. Comparisons between RO and RS are conducted to characterize the errors of both observing systems and allow for a better understanding of our atmosphere. During such comparisons, RO and RS observations are not taken at the exact same time or location, introducing "sampling errors," errors caused by the observations sampling different atmospheric states. Differences in observation type also contribute in the form of "representativeness errors," differences in how the RO and RS observations represent the atmosphere they are measuring. Both sampling and representativeness errors accrue during RO-RS comparisons and can inhibit the overall error analysis. This paper, and the presentation, detail three methods Gilpin and her co-authors developed to reduce sampling and representativeness errors during RO-RS comparisons. The methods developed have applications beyond RO-RS comparisons and can be used to reduce sampling and representativeness errors in comparisons between other observing systems.

Given the outstanding presentation of her research, Shay Gilpin was selected as the winner of the Best Student Presentation award, comprising of a certificate and small monetary prize.

Associate Professor Daniel Appelo to be Visiting Professor at Top Swedish University

Associate Professor Daniel Appelo is one of four researchers chosen by the Knut and Alice Wallenburgs Foundation to be a visiting professor at a University in Sweden.

The Knut and Alice Wallenburgs Foundation started a research program in mathematics in 2014. They created this program because, according to the chairman, Peter Wallenburg Jr., “new mathematics helps us to understand the links between genetics and disease, for example, or how climate change affects life on Earth. Mathematical development and knowledge are also decisive if Sweden is to keep up with the ongoing digital revolution, including artificial intelligence and automation.” Given the important applications of mathematics, the foundation funds mathematical research and allows top researchers at Sweden to explore different parts of the world while allowing foreign top mathematics researchers to explore Sweden. The foundation believes that this will facilitate the exchange of ideas, knowledge, and concepts which will prove integral to the advancement of mathematics.

Daniel Appelo was one of four chosen to be a visiting professor at Uppsala University – which is ranked among the world’s top 100 Universities and is the oldest University in Sweden (founded in 1477). Appelo will be researching computer models for wave propagation at Uppsala. Such models can be used to determine, for instance, the amount of ground movement during an earthquake in a place where a bridge will be built, or to describe the seabed in shallow waters. While high accuracy is desired for such important applications, increasing accuracy makes for increasingly complicated equations. Complications are compounded when considering buildings, topography, or the differences in sound propagation velocity caused by variations in air temperature or water salinity. Appelo will teach about and research these topics at Uppsala over the summer, and Uppsala will fund his housing and travel.

“new mathematics helps us to understand the links between genetics and disease, for example, or how climate change affects life on Earth."

- Peter Wallenburg Jr., Knut and Alice Wallenburgs Foundation Chairman

PROFESSOR ABLOWITZ RECEIVES

DISTINGUISHED FELLOWSHIP

From the Newton Institute for Mathematical Sciences

Professor Ablowitz recently received a Rothschild Distinguished Fellowship from the Newton Institute for Mathematical Sciences, Cambridge England, UK. Part of the upcoming summer and fall Ablowitz will be me a member of the program on Complex Analysis: techniques, applications, and computations. During the program he will give a keynote lecture and attend other programs and activities for four weeks.

The Isaac Newton Institute of Mathematics is devoted to the advancement of mathematics "in the broadest sense." To achieve this, they employ strict criterion for program selection. According to their website, programs are selected by the extent to which the topic is "interdisciplinary, bringing together research workers with very different backgrounds and expertise." Since the institute opened in July 1992, 27 Fields Medalists, 9 Nobel Laureates, 23 Wolf Prize winners, and 12 Abel Prize winners have attended programs at the institute.

The Institute of Mathematics is able to award fellowships through generous donations. The fellowship awarded to Ablowitz was made possible by donations from NM Rothschild and Sons. The institute has also received donations from Hewlett-Packard, the Dill Faulkes Foundation, Leverhulme Trust, CNRS, Rosenbaum Foundation, PF Charitable Trust, London Mathematical Society, Prudential Corporation plc and the Clay Mathematics Institute.

CHANCELLOR'S RECOGNITION AWARD WINNERS

The Applied Math Department would like to recognize and congratulate William Barham and Mingxuan Zhang for their achievements in receiving the Chancellor's Recognition Award. This award is saved for graduating students who have received a perfect 4.0 GPA over the span of their career in college.

Chancellor Philip P. DiStefano will be recognizing their outstanding achievement by presenting them with their awards at the Boulder Campus spring commencement ceremony on May 9th.

Congratulations on your amazing accomplishments, William and Mingxuan!

• ELLEN CONSIDINE •

AWARDED GOLDWATER SCHOLARSHIP

Congratulations to Ellen Considine for receiving a Goldwater Scholarship award for the 2019 – 2020 academic year! According to the Barry Goldwater scholarship website, Ellen, who is studying Mathematical Sciences, is striving to "advance the application of data science methods in environmental health monitoring, evaluation, and public policy implementation." Ellen has full intentions of receiving a PhD in biostatistics.

The Goldwater Scholarship is highly competitive, and in order to compete for the scholarship, you must be passionate in doing research, have done research that is beyond routine lab or lecture experiments, and have a desire to be part of the next generation of creative research leaders. The program searches for the Nation's most promising young researchers and rewards them with one of the most distinguished undergraduate awards in the Nation. Goldwater Scholars are beyond outstanding in that they have gained the attention of distinguished post-graduate fellowship programs, and alumni have gone onto "research that is helping defend the Nation, finding cures for catastrophic diseases and teaching future generations…" (Goldwater Foundation). Furthermore, some scholars have also been awarded Rhodes Scholarships, Churchill Scholarships, Marshall Awards, and Hertz Fellowships.

Ellen surely fits this description with her ambitions and goals, and the Applied Math Department extends their congratulations on this amazing achievement!

IN REMEMBRANCE OF JOSEPH EVANS

July 1998 - October 2018

"He was one student you will always remember. He was smart, funny, and unique with the confidence to wear it well."

- Ms. O'Dea, Joey's 5th grade teacher.

Joseph “Joey” Evans, was a friend, tutor, son, grandson, brother and CU student who died tragically on Monday, October 15, 2018. At 20, Joey was a senior in the Applied Mathematics Department working towards a dual degree in math and computer science.

Since high school Joey was known for his passion, interest, and exceptional ability in mathematics. Many of his fellow students, Boulder High School (BHS) teachers, and CU Professors recall his desire to learn about mathematics and his tendency to ask many, many questions. At the high school level, his freshman Algebra 1 teacher, Rose Ogilvie, recalls Joey asking very “high level questions,” suggesting he understood the material far beyond his peers. From there Joey was influential in the BHS mathematics club, and in May 2016 BHS awarded him “Special Recognition” - an award given only to BHS students that exhausted all mathematics courses available at BHS and who took mathematics courses at CU while still a student at BHS. Those who receive this award are considered “extremely accelerated, intelligent, and motivated” in the field of mathematics.

Joey continued his passion, hard work, and desire to learn mathematics into his full-time career at CU Boulder. Like his high school teachers, many of his instructors and professors recall him asking questions that helped other students in the class understand the material, in part, by getting instructors to explain the material in many different ways to answer his many questions. According to professor Harvey Segur, Joey's questions "helped me to recognize where students were having trouble...[and] helped me to understand where my answers had not addressed his concerns." Even outside of the classroom, Joey worked very hard to achieve his goals. According to fellow students, he worked hard - always picking up more jobs, and was very cognizant of his financial situation and future. One such job was as a tutor at the Mathematics Academic Resource Center (MARC). His co-workers and those he tutored recall him being very helpful, passionate, and knowledgeable. Dan Moritz, Joey’s mentor and MARC supervisor, has said that Joey was instrumental in putting the MARC on the map.

Given Joey’s diligence and dedication, it was no surprise that he received the Gordon Memorial Scholarship in Engineering for the 2018-2019 academic year. It was also no surprise that he was awarded two grants during his time as a student - the Colorado Student Grant and the CU Promise Grant.

Beyond his academic achievements, Joey was considered a great friend, student, brother, and son. Joey will be remembered as a bright light for friends and family. His cheerful smile and goofy tie seemed to brighten everyone’s day. Joey loved helping others excel and shared his passion for math and philosophy with everyone whose life he touched. He could often be seen cycling the Boulder bike paths seeing the beauty and wonder in the universe and everyone around him.

The family accepted a posthumous degree in Applied Mathematics on behalf of Joseph during the Spring 2019 commencement ceremony on May 9th, 2019.

UNIVERSITY OF COLORADO BOULDER,
APPLIED MATHEMATICS 2018-2019
NEWSLETTER

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