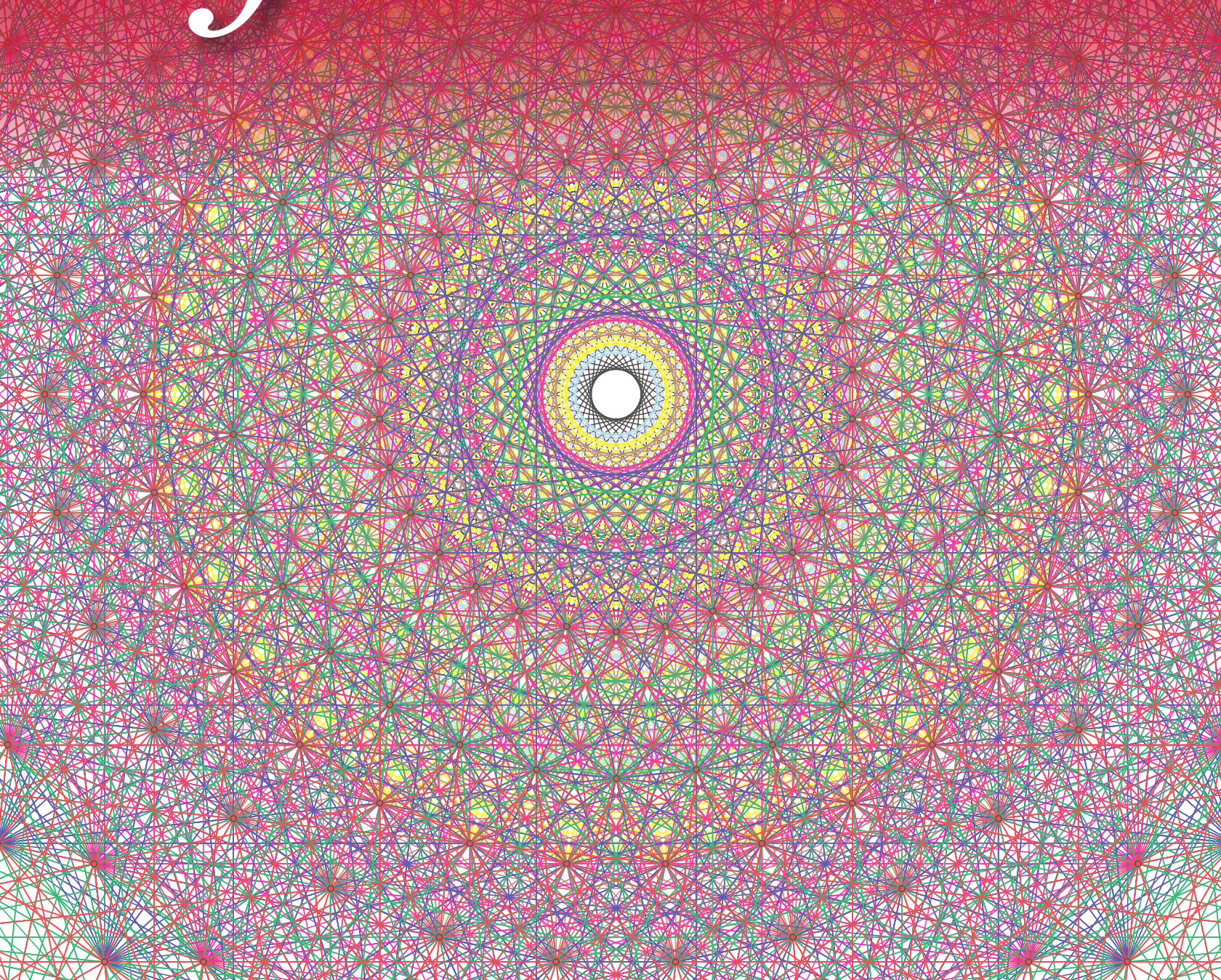


AfterMATH

DEPARTMENT OF MATHEMATICS

BIANNUAL NEWSLETTER | SPRING 2017 | VOLUME 16, ISSUE 2



COVER IMAGE:
2-D PROJECTION OF THE E_8 ROOT SYSTEM (SEE PAGE 7).
(c) JOHN STEMBRIDGE, UNIVERSITY OF MICHIGAN.



MESSAGE FROM THE CHAIR

PHOTO CREDIT: MIKE SCHMIDT

Dear Alumni and Friends,

This marks my final message in this space: after two terms, I will step down from being Chair at the end of June.

Looking back, one of the most gratifying aspects of the job has been faculty recruiting: ten new faculty members joined our ranks during my tenure (with two searches still active as I write this), nearly a quarter of the department. These outstanding researchers will ensure that the trajectory of our department continues to bend upward. At the same time, we have elevated the quality and experience of the students we serve, both at the undergraduate and graduate level, with many ongoing efforts to improve student success.

It has been a personal and professional pleasure serving these last six years. I look forward to working with my successor (still to be named) in the months ahead.

Peter E. Trapa
Department Chair

GIVE TODAY



By giving any amount to our scholarships, you are making a difference and opening doors of opportunity for our students. For more information, to donate, or to establish an endowed scholarship, please contact:

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OR visit umarket.utah.edu/ugive and in the search box type “mathematics” to make a donation.

NEW TO THE DEPARTMENT



PHOTO CREDIT:
MIKE SCHMIDT

We would like to welcome **Kristina (Chi) Ong** to our department! Chi is our new Grants/Contracts Officer, and has been with us since October 2016. She has been a great addition to our staff, and we are excited to have her here.

Chi is originally from Hong Kong and moved to Salt Lake City, Utah 30 years ago with her family. She is the second youngest of four children.

She graduated from the University of Utah with a Bachelor of Science in Sociology. After graduation she went to work for the Pharmaceuticals Department at the University of Utah for five years.

In Chi's spare time she enjoys reading, gardening, hiking, and spending time with family.

FACULTY DISTINCTIONS



AARON J. BERTRAM
PROFESSOR

Dr. Bertram was selected to be a *Fellow of the American Math Society*. According to the AMS website, “The Fellows of the American Math Society program recognizes members who have made outstanding contributions to the creation, exposition, advancement, communication and utilization of mathematics”.



WILLIAM H. NESSE
ASSISTANT PROFESSOR
(LECTURER)

Dr. Nesse, was awarded the *College of Science Teaching and Mentoring Award*, by the University of Utah’s College of Science.



PAUL C. BRESSLOFF
PROFESSOR

Dr. Bressloff, was awarded the *Distinguished Scholarly and Creative Research Award*, by the University of Utah.



KENNETH M. GOLDEN
PROFESSOR

Dr. Golden was promoted to Distinguished Professor. He joins Mladen Bestvina, Christopher D. Hacon, James P. Keener and Graeme W. Milton as Distinguished Professors in the department.

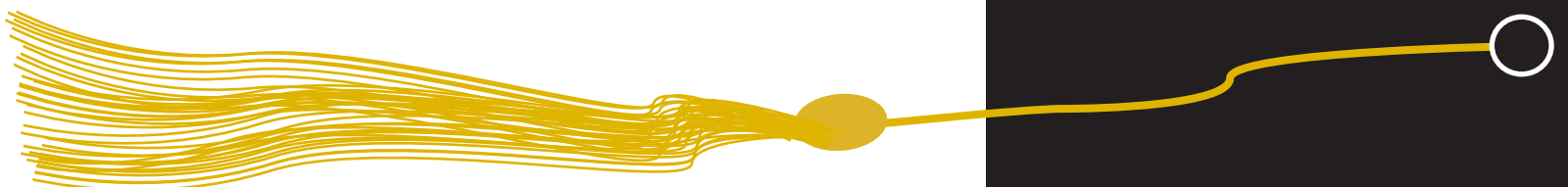
GRADUATE NEWS

This academic year we will have approximately 85 undergraduate mathematics majors receiving a baccalaureate degree, and 16 students receiving a masters degree. Students who will be receiving a Ph. D from our department are:

Jason Albright
Patrick Bardsley
Andrew Basinski
Pavel Bezdek
Parker Childs
Sung Chan Choi

Joseph Eason
Honglu Fan
Thomas Goller
Radhika Gupta
Drew Johnson
Bhargav Karamched

Tony Lam
Shiu-Tang Li
Haydee Lindo
Yuan Wang
Alan Watson
Bin Xu



DISTINGUISHED ST

CHURCHILL SCHOLAR

BY MICHELLE TALIAFERRO, DISTINGUISHED
SCHOLARSHIP AND SENIOR ACADEMIC
ADVISOR, HONORS COLLEGE

FIRST PUBLISHED IN @THEU
PHOTO CREDIT: MIKE SCHMIDT



Michael Zhao, Salt Lake City native and senior in mathematics pursuing an honors degree at the University of Utah, has received the prestigious Churchill Scholarship to study at the University of Cambridge in the United Kingdom. Zhao becomes one of only 15 students nationally to receive this award and is the second Churchill Scholar for the U.

The Churchill Scholarship, established in 1963 at the request of Winston Churchill, provides undergraduates with outstanding academic achievement in the science, technology, engineering and math fields the opportunity to complete a one-year master's program at the University of Cambridge. Students go through a rigorous endorsement process in order to apply, but only after their home institution has been vetted with the Churchill Foundation. The U was recently added to the foundation in spring 2014, and last spring it received its first Churchill Scholar, Mackenzie Simper, also a mathematician. The scholarship has been called "the most academically challenging of the U.K. scholarships."

"It's a common perception that skill in mathematics is only due to talent, but hard work counts for much more," said Zhao. "Having mentors is also extremely helpful, and I am indebted to many faculty members, graduate students and engineers for their guidance and encouragement."

Zhao was drawn to math at an early age. Through an Art of Problem Solving online course he was introduced to number theory. He likens this first encounter to how the Hubble Space Telescope revealed thousands of ancient galaxies in what appeared to be a small, blank patch of the night sky.

In his freshman year, Zhao took a yearlong reading course exploring algebraic number theory with Gordan Savin, professor in mathematics. He continued his studies by taking reading courses with Dragan Milicic, professor in mathematics, and graduate courses in algebraic geometry, number theory and representation theory.

"We often have discussions on various topics related to these courses. I was always impressed that talking to Mike feels more

like talking with a colleague and not a student," said Milicic.

Zhao has also done research in computer science. In the summer of 2015, he participated in the Research in Industrial Projects for Students Program held on the campus of the Hong Kong University of Science and Technology. His project used computer vision techniques to create a logo recognition application for Android phones. In spring 2016 he was awarded the prestigious Barry Goldwater scholarship for excellence in STEM research.

This past summer, Zhao was an intern at Google. He developed a software-testing framework that allowed engineers to select exactly the servers they needed to handle login action in their software tests, reducing computer memory usage and server startup times.

"He is on a path to becoming a very powerful figure in whatever industry he chooses," said Tyler Sellmayer, Zhao's supervisor at Google. "His superpower is the ability to hold an enormous abstract structure in his head, and to speak intelligently about any aspect of it at any time."

Currently, Zhao is working on his honor's thesis in number theory. His thesis advisor Savin, professor in mathematics, says of Zhao, "Mike is one the strongest undergraduate students we have had since I have been at the University of Utah, more than 20 years. For someone his age, he already has an incredible level of maturity and mathematical knowledge."

Zhao will use the Churchill Scholarship to pursue a Master of Advanced Study in Pure Mathematics at Cambridge starting in the fall. Upon completion, Zhao plans to come back to the U.S. to complete his doctorate in mathematics focusing on number theory.

"It wasn't easy to choose in what area I wanted to specialize, even within computer science and mathematics, since they were all very exciting. Only by trying many different things—an internship and several research projects—was I able to make a decision," said Zhao.

Zhao aspires to become a professor, and hopes to make contributions to pure mathematics through research and teaching.

STUDENT AWARDS

HERTZ FELLOWSHIP

BY MICHELLE TALIAFERRO, DISTINGUISHED
SCHOLARSHIP AND SENIOR ACADEMIC
ADVISOR, HONORS COLLEGE

FIRST PUBLISHED IN @THEU
PHOTO CREDIT: MIKE SCHMIDT



Ethan Lake, an undergraduate student in physics and math at the University of Utah, has received the prestigious and highly competitive Hertz Fellowship, a \$250,000 grant for up to five years of graduate study in the STEM fields. Lake is one of only 12 students nationally to receive this award and the second Hertz Fellow for the U. The first Hertz fellow was in 1989, when Eric Kelson received the award.

“Ethan’s receipt of the Hertz Fellowship has opened the door for other U students to follow in his footsteps,” said Ruth Watkins, senior vice president for Academic Affairs at the U. “We have no doubt Ethan will continue to make a significant contribution to research and be an excellent representative of our university and state.”

The Hertz Fellowship, established in 1963 by the Fannie and John Hertz Foundation, seeks to support America’s most promising students in the applied physical, biological and engineering sciences who possess technical talent and the potential to solve difficult, real world problems. This year, 721 students applied and went through a rigorous merit-based process. The top 150 applicants were invited for an in-depth technical interview and of those, 40 were invited back for a second interview, with each interview increasing in difficulty.

“I found the application process, especially the interviews, to be intellectually rewarding and very enjoyable,” said Lake. “I would definitely encourage other students to apply.”

Lake’s passion for science began a world away in astrophysics. In his first year at the U, he joined professor Zheng Zheng’s computational astrophysics group where he studied the environments surrounding galaxies in the early universe and the gravitational microlensing of extrasolar asteroid belts.

In the summer following his second year, Lake made an impulsive decision to switch to condensed matter theory, and began working on a problem in theoretical superconductivity with professors Dima Pesin and Oleg Starykh.

“Ethan has progressed steadily from a theoretical physics novice learning such basic theory as unitary transformations and second quantization to an expert in exotic p-wave superconductivity and many-body perturbation theory,” said

Starykh. “This progress is truly amazing and in my experience, unprecedented.”

In fall 2015, Lake joined professor Yong-Shi Wu’s group to study topological quantum matter and in spring 2016 Lake was awarded the prestigious Barry Goldwater scholarship for excellence in STEM research. This past summer he attended the premier summer school on topological quantum matter at the University of Colorado at Boulder. In the school’s 17-year history, Lake was one of only three undergraduate students invited to participate. He also participated in a National Science Foundation Research Experience for Undergrads program with Michael Hermele, associate professor of physics, also at the University of Colorado at Boulder.

“His strong interpersonal and collaborative skills are extraordinary for someone who has advanced to the frontiers of science so early in his career,” said Hermele. “Ethan is on a trajectory to become one of the leading lights of theoretical physics in the 21st century.”

During his undergraduate career, Lake has written six first-author publications with another three papers either submitted or in progress. Through his research, he has collaborated with scholars at various institutions around the world, including Princeton University, Caltech, CU Boulder, Peking University and Tokyo University.

“I’m very grateful to the mentors I’ve worked with for their constant patience, and I appreciate the freedom they’ve given me to explore and think about research problems independently,” added Lake.

Lake is currently studying the role that topology plays in condensed matter theory and quantum information theory. In this field, he has found a balance between his aptitude for abstract mathematics and his desire to work on problems that can be tested by experiment. He plans to perform related work in graduate school, while pursuing a doctorate in theoretical physics.

“I’m psyched to use the freedom this fellowship grants me to explore different areas of theoretical physics. Graduate school is going to be a ton of fun,” said Lake.



ALUMNI SPOTLIGHT

DR. JAMES D. WALKER

BY DANIEL LEE

PHOTO CREDIT: SWRI.ORG

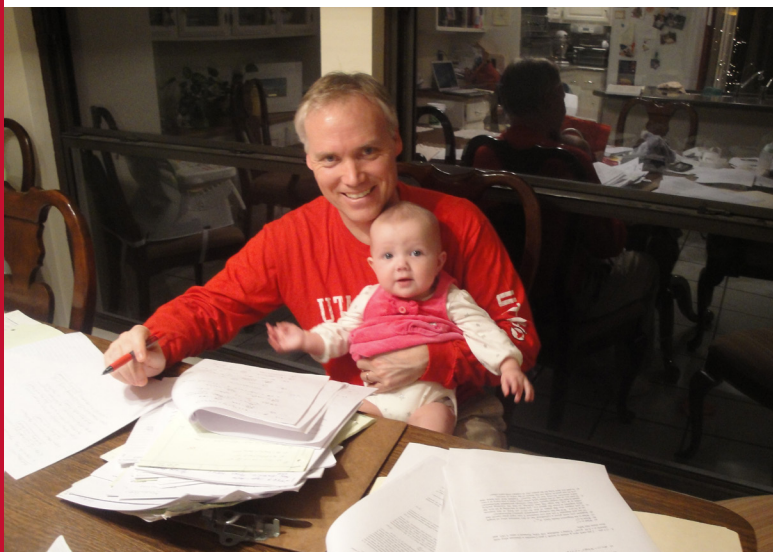
On February 1, 2003, a large piece of foam insulation broke off from the Columbia space shuttle's external tank, breaching the left wing. The world watched in horror as the spacecraft disintegrated on re-entry into Earth's atmosphere, killing all seven members of the crew. When the dust cleared and NASA began investigating the incident, it sought out the expertise of renowned scientist, and University of Utah alumnus, Dr. James D. Walker (B.S. Mathematics with a Minor in Physics, 1983; PhD Mathematics, 1988, advisor: Tim Foliias). His groundbreaking work on impact physics was instrumental in determining the root causes of the catastrophe.

When James was four years old, his family moved from southern California to Utah where his father took up a faculty position in the Mathematics Department at BYU. At an early age, it was apparent that James had an extraordinary talent for math and science. In fact, the precocious student skipped his final year of high school to start undergraduate studies at the U – so naturally, he would tell people that he was a high school dropout. That is until 2005 when he was honored with the Murray High School Outstanding Alumnus Award – an award that was accompanied by a diploma.

Although James initially wanted to pursue chemistry and had even gone through an NSF-sponsored summer chemistry program at the U for high school students, it became clear that to satisfy his insatiable curiosity, he would have to explore other disciplines. James explains, "I kept hearing the chemists say, 'To really understand this, you need to talk to the physicists,' and I kept hearing the physicists say, 'To really understand this, you need to talk to the mathematicians.'" And thus began a young man's journey to enlightenment. After graduating from the U in two years at the ripe old age of 18, James served an LDS mission from September 1983 to August 1985 in Wisconsin, some in the inner city of Milwaukee. Upon his return, he was offered a fellowship from the U's Department of Mathematics where he studied under now-emeritus professor Tim Foliias and graduated in just three years. They remain close to this day, and both of their families try to get together every year when James and his family come to visit the Salt Lake City area to see relatives.

James serves as Director of the Engineering Dynamics Department [management chain] of the Mechanical Engineering Division of Southwest Research Institute, where he researches high-force

collisions that occur in mere fractions of a second; he is also an acting Institute Scientist [highest rung on the technical ladder – there are 30 Institute Scientists and Engineers at SwRI]. SwRI is a non-profit R&D center with 2700



employees on a 1200 acre facility in San Antonio, Texas. James still works for his first employer after receiving his Ph.D. He has worked on body armor worn by soldiers and police, armoring for ground vehicles, ballistic and blast protection, and shielding against hypervelocity impact by orbital debris for the International Space Station. James is particularly well-known for developing the Walker-Anderson model, an analytic model for the penetration of projectiles into metal armors that is now ubiquitous in the defense industry.

Upon reflecting on his outstanding career and considerable achievements, James has some valuable jewels of wisdom to offer current graduate students:

1. Choose your thesis advisor wisely – This is the most important decision you will make! Sit in on professors' seminars and lectures and schedule appointments to talk with them about their research to see if there is a connection intellectually and personally. When you're looking for a job, your advisor's connections will get you interviews.
2. Broaden your perspective by taking courses outside of Mathematics – As a student, James took graduate courses in Physics, Chemical Engineering, and

Mechanical Engineering. Pay particular attention to the jargon that people in different fields use so that when you collaborate with them, you can communicate freely and fluently.

3. Attend conferences – You will get the opportunity to network with top experts and to give presentations about your own research. As a student, you are eligible for discounted entrance and even scholarships to a lot of these meetings.
4. Get very proficient at coding – In the very slim chance that you end up working outside academia (gasp!), many industries will expect that you can program extremely well. In particular, it would be helpful to know something about numerical methods.

Nowadays, James is an adjunct in Mechanical Engineering at the University of Texas at San Antonio. Some highlights of his career are: Distinguished Lecturer for the American Institute of Aeronautics and Astronautics (AIAA); chairman of the AIAA Weapon System Effectiveness Technical Committee; General Chair for the 2001 Forum on Weapon System Effectiveness and Co-



Chair of the 24th International Symposium on Ballistics (2008) and again for the 30th Symposium (2017); past president of the Hypervelocity Impact Society and on the board of the International Ballistics Society (IBS); Fellow of AIAA and ASME; and Ballistics Science Fellow of the IBS.

About the cover image: The E_8 root system is a collection of 240 vectors in eight-dimensional Euclidean space that admit a remarkable number of symmetries, 696,729,600 to be exact. The cover image is a two-dimensional projection of those 240 vectors (connected to their nearest neighbors by lines of various colors) in a cleverly chosen plane that captures many of those symmetries.



BY ARYN DEJULIS, DIRECTOR OF UNDERGRADUATE SERVICES AND SEAN MCAFFEE, GRADUATE STUDENT

The 10th Annual Calculus Carnival was held on November 2, 2016 in the Grand Ballroom of the A. Ray Olpin Student Union Building hosted by the Department of Mathematics.

The Calculus Carnival had its origins in the annual Calculus Challenge, an intense three-hour problem competition initiated by Utah mathematics professor James A. Carlson in 2000. While successful, the contest was geared towards more advanced undergraduates who had completed at least a full year of our calculus sequence. In an effort to appeal to a larger cross section of calculus students, and improve the undergraduate mathematical experience, then-postdoctoral scholar Dan Margalit (now a professor at Georgia Tech), with assistance from current Undergraduate Advisor Angie Gardiner, reworked the Calculus Challenge into the first Calculus Carnival. The concept was simple, entice undergraduates through participation in calculus-related party games such as “Pin the Nose on Isaac Newton” and “Calculus Jeopardy”. The first carnival was held on November 14, 2007 and upwards of 180 calculus students participated in this inaugural year. Angie continued to coordinate the carnival until passing the torch to Aryn DeJulis, Director of Undergraduate Services, in 2012.

Over the years the Calculus Carnival has been held in the math buildings with students meeting in the LeRoy Cowles Building’s (LCB) Dumke Loft and rotating through different rooms to take part in the various calculus integrated games. However, over the last few years

the enthusiasm of participation has grown to the point that we had outgrown our space here in LCB and James Widtsoe Building (JWB). This year, the carnival was moved to the Union Ballroom, and the extra space did not go to waste – as the 10th Annual Calculus Carnival was hands down, the most popular carnival yet with around 500 students participating!

The success of this year’s carnival would not have been possible without the support of our department members. Calculus teachers built up the most enthusiasm by advertising this event to their students (with the added incentive of extra credit for participation). In addition, keeping track of 500 students would not have been possible without the 22 volunteers from the department – volunteers came from faculty, graduate students, advanced undergraduate students, and staff.

The games played were: Bingo, Pictionary, and Trivial Pursuit – each with their own unique calculus twist that pushed students to test their knowledge of limits, derivatives, and more! We are excited to see the carnival reach its tenth year, and we hope it will continue to educate and entertain undergraduates for years to come.



AFTERMATH

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