Math

Research

Demystified

February 25, 2021, 5:15 pm

... on the ZOOM

CU Math Club and Diversity Committee

You'll hear from...

- Me
  - What is math research?
- Faculty
  - Information on our REU/G
  - Math lab
  - More about research at the undergraduate level
- Graduate students participating in this summer's REU
- Graduate students who participated in the virtual REU/G last summer

What is math research?

- First
  - Reading current research papers on the topic
- Next
  - Working out examples to look for a general pattern
  - Bouncing ideas off each other: Making friends and working together
- Then
  - Creating 3D models and computer visualizations
  - Programming the computer to collect data
  - Proving new theorems!
- Finally
  - Writing exposition/results in a math editor

Tips for collaborating effectively with others:

- Be respectful of different backgrounds
- Maintain a growth mindset
- Plan out each day
- Listen to each other
- Stay focused and take breaks

"Math research is like starting with a slab of marble and knowing that somewhere inside is a sculpture. You think you might know what lies inside, but then you start chipping away and you run into a block you can't get through, so you get diverted and try to go around, but then you get diverted again, and again, and again....each time chipping where you can. **Eventually, after way longer than expected and having navigated all the unexpected twists and turns, you end up with something beautiful. It's probably not the sculpture you thought you'd end up with, but it's beautiful nonetheless.**" - Levi Lorenzo

When I am doing research, I am **working examples** and **drawing pictures**, trying to find intuitions that lead to a proof.

For me, doing math research is about trying to solve unsolved problems / open questions. This involves **trying to come up with novel methods** of problem solving, as well as trying to **modify what others have done to fit my own situation**.

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Doing my own math feels a bit like doing homework problems. Sometimes it's **toying with the idea** in your head, sometimes it's figuring out how to express something that you feel like must be true, sometimes it's **talking to people** about it, and sometimes it's **tedious computations**.

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Computing examples until I feel like I really do know what's going on, asking my advisor a million questions, and **explaining what I'm working on to my friends** – they ask questions that will get me thinking in a new way, especially if I'm stuck.

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I think about something I sorta understand. I think about **what would happen if I change the hypotheses** and the setting of the thing I sorta understand. Then I search to **see if anyone has answered this question.**

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Working on **understanding proven results/examples** and generalizing them to **new situations**.

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Other opportunities:

- https://sites.google.com/view/mathreu
  - "This page contains a listing of the Research Experience for Undergraduates (REUs) aimed at mathematics students that will run in the summer of 2021."
- Leadership Alliance Summer Research Early Identification Program (SR-EIP)
  - "The Summer Research Early Identification Program (SR-EIP) is a fully paid summer internship that provides undergraduates with training and mentoring in the principles underlying the conduct of research and prepares them to pursue competitive applications to PhD or MD-PhD programs."

CU Math REU Summer 2021:

Projects

- Computing invariants for expansive dynamical systems
- Invertibility of Randomly Perturbed Matrices
- Topological Data Analysis and Applications to the Sciences
- What is an n-dimensional shuffle?
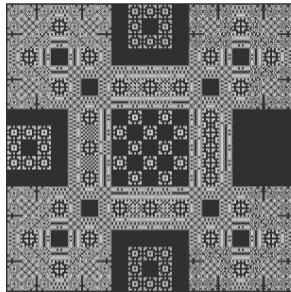- Stability conditions for genus 2 curves
- Derived Poisson Structure on sl_2

For more info and to apply, go to

http://math.colorado.edu/~thiemn/InternalMRE/MathRE.html
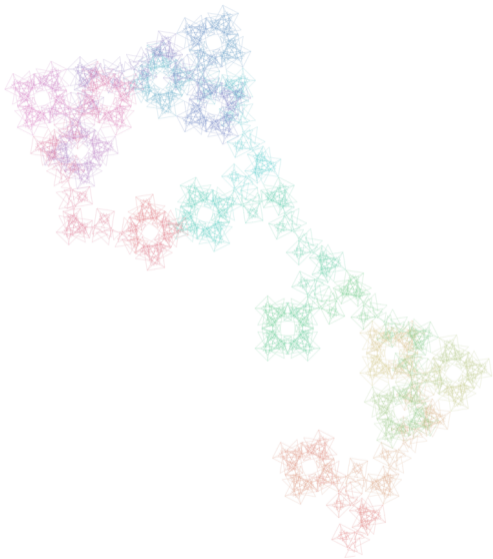
Math Research
at XML

Experimental Mathematics Lab at CU Boulder

Part of a growing movement of Geometry Labs United.

Outreach, experimentation, computation, visualization, pedagogy, research.

Past Projects

- 3d-printing complex functions for display in Gemmill library
- programming software to visualize integer sequences and other mathematical objects
- investigating randomness in the primes through statistical tests
- programming community-developed math software for researchers
- investigating the binomial transform
- mathematical models of redistricting
- modelling of COVID

What Participation Looks Like

Experimental Mathematics Lab

- ▶ During academic semester, around 5 hrs/week
- ▶ Academic independent study credit in MATH, CS, maybe others, possible
- ▶ Hourly salary, possible
- ▶ Teams of 3-5 students with faculty and grad student advisors

Application Process

Visit **math.colorado.edu > Undergraduate Program > Resources**

Experimental Mathematics Lab
- ▶ Get on our email list!
- ▶ Website lists projects.
- ▶ August deadlines for Fall; Winter Break deadlines for Spring.

Application Tips

- Your research topic doesn't have to determine your field of research forever!
- Apply early and often!
- If you are missing pre-requisites this year, consider next year.
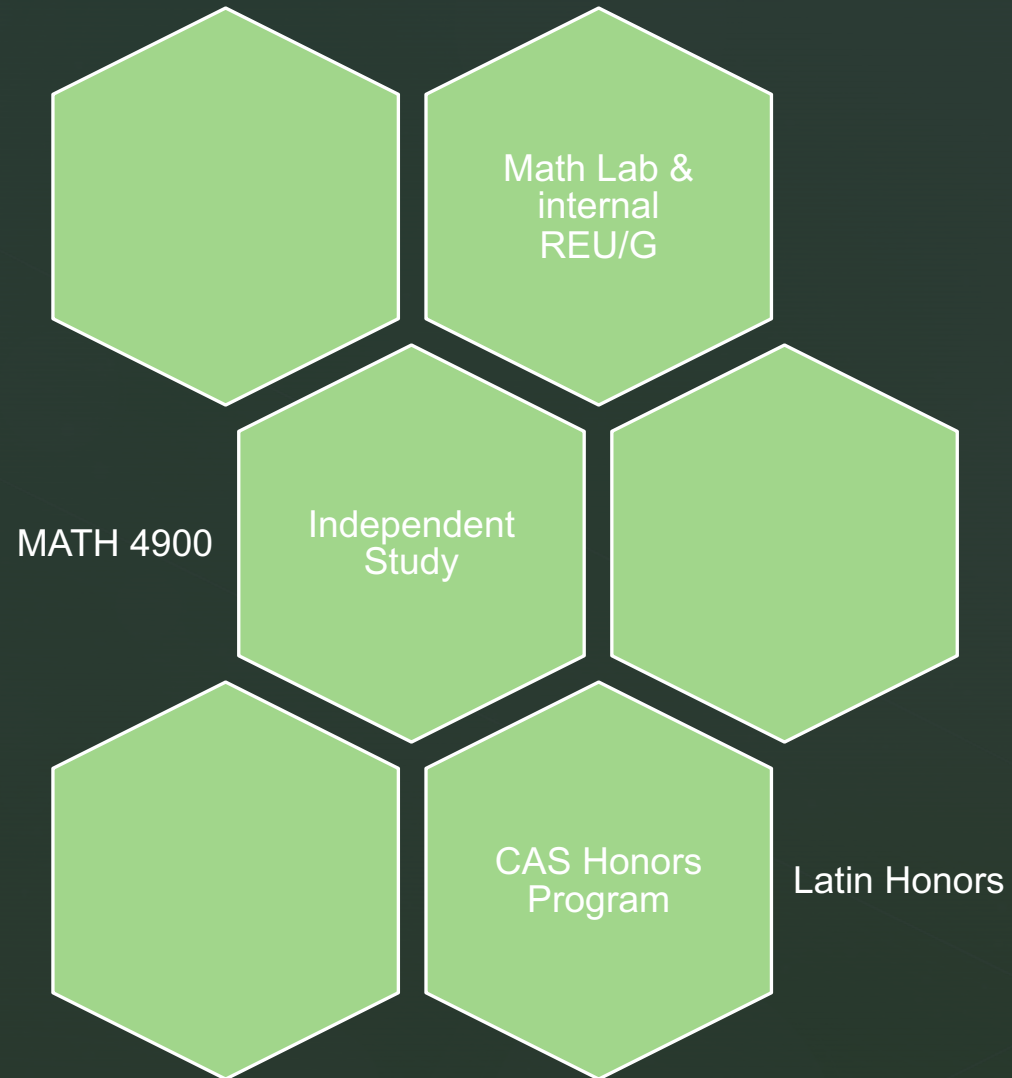- Do a little googling to find out more about the topic, or ask the advisor; show initiative.

CU Boulder Mathematics

Undergraduate Research

Internal (CU-Boulder) Research

Math Lab & internal REU/G

MATH 4900

Independent Study

CAS Honors Program

Latin Honors

External Summer Research

NSF REU
- Mathematical Sciences
- nsf.gov
- 50 REU sites
- January 31 deadline

SUAMI
- Carnegie Mellon
- June 7 – July 30, 2021
- $3,500 stipend

External Academic-Year Programs

BSM
- Summer semester – March 1
- Fall semester – April 1

Smith College (MA)
- Fall semester – July 1
- Spring semester – Nov 15

MASS (PennState)
- Fall semester – April 15

Resources

www.colorado.edu/math/

www.maa.org/

sections.maa.org/rockymt/

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