

INTEGRATED SCIENCE AND MATHEMATICS GROUP (iSciMATH)



Goals

The Integrated Science and Mathematics Group (iSciMath) goals are:

🔗 **TO BUILD AN IDEAL ENVIRONMENT** to train and inspire **graduate students** to solve problems using deep mathematical insight. The goal is to create a strong community where graduate students interact passionately, sharing their work. Through the program, students will be taught a common “language” and mathematical background to facilitate efficient and effective communication. Ease of interaction – open doors – will make the hard work needed to solve important problems fun. This environment will be **highly productive**, identifying the essence of both problems and tools without the distraction of extraneous details. This essence is useful, and without the cruff, can be easily applied in diverse contexts.

🔗 **DITTO FOR FACULTY**. A silo-free collaborative environment where faculty are encouraged to work on important interdisciplinary projects. Faculty will participate as needed in educational aspects so they too develop a common language. Faculty will be drawn from across the university, including **mathematics, physics, statistics, economics, engineering, computer science, chemistry** – essentially anyone interested in using modern mathematical methods. In the broader iSchool, alternate metrics for impact will allow faculty to be appropriately rewarded for impact beyond the standard model of publications and funding, and with appropriate compensation for teaching for both faculty and their departments.

🔗 **SEMINARS, ADVANCED CLASSES**, frequent teas, and an vigorous visitor program. Develop an ecosystem that consistently inspires and connects those within the iSciMath and beyond.

🔗 **COMPUTATIONAL COLLABORATIVE MAKERSPACES** for immediate exploration, validation, and communication of ideas. By providing tools such as CoCalc for rapid but realistic prototyping, participants can ground their understanding by ensuring convergence of theory and computational analysis. Interactive exploration enables rapid but deep exploration of complex ideas with many alternative creative strategies.

i.e. common notations and concepts.

Simple but not simplistic. I.e. covariant metric- and coordinate-free formulations without index gymnastics.

The cocalc.com platform provides a full computing environment (virtual machines) hosted on the cloud allowing for real-time collaborative analysis.

- ☞ **HONEST OUTREACH.** Members of the iSciMath community will become full participants in the Complexity, Data, and Learning Group (CDLG) immersive education project providing honest outreach to the community from elementary school to the general public. Explain sophisticated concepts in simple terms without compromising the integrity or utility of the idea. Ideally the audience will be able to actually use these ideas. Pursuing this goal will enable the reduction of problems and tools to their essence (goal 1).
- ☞ **RECRUITING AND RETAINING TALENT.** These goals will make it possible to recruit and keep very motivated and inspired (and therefore inspiring) students and faculty.
- ☞ **INTERDISCIPLINARY IMPACT.** This environment will lead to a high level of productivity solving important problems without boundaries. The interdisciplinary and creative nature of the group will generate significant impact, and be able to attract significant **funding**, especially from sources that are traditionally difficult to access from within silos. Original cool stuff will happen.

The Initial Plan

To get the iSciMath started, we will implement the following:

- ☞ **SEMINARS:** A carefully designed seminar series to expose members of the group to cutting-edge ideas, but expressed in an accessible manner. Two series will be run:
 - 1 **Overviews (1-3 lectures/topic):** Overview of ideas or fields, establishing a common language for the iSciMath community. These talks should be accessible to everyone in the group, providing “pigeon holes”. May provide practical tools where possible. (Pre-lecture preparation is minimal.)
 - 2 **In-essence (5-20 lectures each):** More in-depth analyses, still accessible, but with teeth. These lectures will fill the “pigeon holes”, and provide the audience with real tools that can be used to solve problems. Interactive participation is required (readings, assignments, computations, etc.)
- ☞ **WEEKLY TEA:** General social interactions over tea, coffee, or after work cocktail hours, book clubs etc. within the wider CDLG family and with visitors. These interactions should be frequent, casual, and unstructured to encourage serendipitous discovery. These envi-

*Edward Tufte has enlightening
discussions about effectively
communicating data:
www.edwardtufte.com/tufte*

ronments must be friendly so that one can turn off judgement - a requirement for creativity.

🔗 **CoCALC MAKERSPACE:** Setup and define workflows. Intro. Videos to enable people to quickly get started. Tools like mercurial.

🔗 **VIRTUAL COLLABORATION SPACE:** Large screen for Zoom, good camera capable of seeing board, microphones, etc.

🔗 **TOPICS:** These initial topics reflect current expertise in the iSciMath group, and represents some of the core material we feel is essential to our research.

1 **Data Driven Inference + Geometric Analysis:** Geometric Measure Theory, Topological Data Analysis, inference of geometry from measurements

Kevin Vixie, Bala Krishnamoorthy

2 **Quantum Computing:** NQN, WSU Quantum Initiative

Michael Forbes

3 **QFT/Stat Mech Problems:** CFT, Duality, Perturbation theory and convergence, Asymptotic series, etc.

Michael Forbes, Fred Gittes

4 **Computational GR:** Covariant formulations of fluid mechanics, relativity etc. Klein-Gordon equation, Green's Functions.

Matthew Duez

5 **Computational Chemistry:** Modeling and Simulation of Complex, Multicomponent Solutions and Their Interfaces

Aurora Clark

6 **Mathematical Economics:** Microeconomic Theory, Game Theory and Industrial Organization, Public and Environmental Economics

Felix Munoz-Garcia

🔗 **PARTICIPATION IN WIDER CDLG/iSCHOOL PROJECTS:** The iSciMath is embedded in the CDLG which is focused on an even wider exploration of interdisciplinary projects.

🔗 **START RECRUITING TOP STUDENTS** from colleges we have connections to or can travel to very easily.

Top in terms of motivation, desire to work hard, explore new ideas.

1 Travel to high-quality small colleges to speak with junior and senior students (last two years) to hook them.

Not just traditional metrics like GRE scores.

2 Visible web/social media presence.

a Video Lectures and Notes online.

3 Summer workshops.

a 1-8 weeks as a recruitment tool.

b Future - Physics/Math Olympiads? Similar competitions?

c Nesin Mathematics Village.

[en.wikipedia.org/wiki/](https://en.wikipedia.org/wiki/Nesin_Mathematics_Village)

4 Career paths (Networking):

[Nesin_Mathematics_Village](https://en.wikipedia.org/wiki/Nesin_Mathematics_Village)

a Academia/Labs

b Industry

c Internships?