

# MSCS



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Department of Mathematics, Statistics, and Computer Science  
St. Olaf College, Northfield, MN 55057  
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## Research Seminar

Title: **Network Embeddings for Potential Energy Landscapes**  
Speaker: Prof. Paula Mercurio  
Date: 2/17/23, 3:30pm  
Place: RNS 204



Networks provide a natural framework for many real-world systems, including a variety of chemical and biochemical applications. Network embeddings aim to represent each node of a given network as a vector in a low-dimensional vector space, so that information about the relationships between nodes is retained. Specifically, nodes that are similar to each other according to some measure in the original graph should also have similar representations in the embedding space. This talk will introduce an efficient method for network embedding based on commute time distances, using sparse approximations of a random walk. It will also include an application of networks and network embeddings for analyzing molecular structures. The behavior of many biochemical systems depends on the potential energy landscape, and by modeling these energy landscapes with networks, network embeddings can be used to analyze and understand the molecular systems involved in processes like protein folding and DNA structure.

## Colloquium

Title: **Introduction to CURI**  
Speakers: CURI Researchers  
Date: 2/13/23, 3:30pm  
Place: RNS 310

Hear from Math, Statistics, and Computer Science faculty about their on-campus summer research projects through [CURI](#) (Center for Undergraduate Research and Inquiry). We will also give general information about the CURI program and the application process! To see a bit more about the projects, see the *CURI Project Descriptions* section of this issue. To learn more about any of these projects, you're welcome to check out the CURI [Elevator Page](#) or email the professor leads.

All are welcome, whether you are thinking about summer research this year or in the future, or just want to see what work your professors do outside the classroom!

## CURI Project Descriptions

To read more about each project, please see the [Elevator Page](#) or the [CURI Page](#). To learn even more about each project you're welcome to email or visit the professor lead!

- **Spatial Statistics Analysis of Glacier Loss**

**Lead: Prof. Laura Boehm Vock**

In this project, we will apply the latest techniques for missing data imputation, propagation of error, and uncertainty estimation (accounting for spatial correlation!) to investigate ice volume loss on a Swedish glacier. If you would like more details about this project, email boehm@stolaf.edu or stop by RNS 400 with questions!

- **Mathematical modeling of mast seeding**

**Lead: Prof. Sara Clifton**

Trees within a forest coordinate boom-or-bust production of seeds (called “mast”) every year. Using mathematical models, we will attempt to understand what the primary drivers of mast seeding are, what determines the masting period and crop, and how climate change may affect mast seeding. If you would like more details about this project, email clifto2@stolaf.edu or stop by RNS 303 with questions!

- **Towards a classification of trialgebras**

**Lead: Prof. Erik Mainellis**

Any student of abstract algebra knows that you can add and multiply the elements of a ring. But what if there were two different ways to multiply those elements? What if there were three ways? In this project, we set out to describe, or classify, some “trialgebras,” which are structures with three multiplications. The first two weeks of the project will be introducing some of the tools we will be using for this project. If you would like more details about this project, email mainell1@stolaf.edu or stop by RNS 406 with questions!

- **Mathematical Models for Transport Networks in Fungi**

**Lead: Prof. Paula Mercurio**

As they grow, fungi naturally form networks that serve a variety of functions such as absorption and transport of nutrients, and can also interact with the roots of plants, creating an underground network connecting plants and trees. The aim of this project is to use network analysis techniques to improve on existing models of fungal network development. The first two weeks will provide background on networks and any necessary mathematical background. If you would like more details about this project, email mercur1@stolaf.edu or stop by RNS 304 with questions!

- **Goal Operations for Intelligent Autonomous Agents**

**Lead: Prof. Sravya Kondrakunta**

In this project, our aim is to develop robust autonomous agents for coordinating multiple robots in completing a mission in the real world. These agents should possess the ability to adapt to dynamic environmental situations and manage their goals independently, without human intervention. This will be achieved through the use of a sub-branch of artificial intelligence known as goal reasoning. If you would like more details about this project, email sravya1@stolaf.edu or stop by RNS 409 with questions!

- **Mandelbrot Breadcrumbs**

**Lead: Prof. Daniel Stoertz**

The Mandelbrot set is one of the most famous fractals ever discovered. It arises from the study of the behavior of iterates of the complex-valued quadratic mapping  $f(z; c) = z^2 + c$ . Recently, identical copies of the Mandelbrot set have been observed while studying certain members of the much more complicated function family  $R(z; a, c) = z^n + a/(z^n) + c$ . In this

project, we will investigate more members of this family in order to find more copies of the Mandelbrot set, and hopefully we will contribute to the greater understanding of how and why it appears where it does. The first week or two of the project will be a crash course

on complex analysis, complex dynamics, and the kinds of visualization algorithms we'll be using. If you would like more details about this project, email [stort1@stolaf.edu](mailto:stort1@stolaf.edu) or stop by RNS 509 with questions!

## Volunteer/Experience Opportunities

### REUs: Summer Research in MSCS

If you are interested in being paid to collaborate on a research project with students from around the country off campus this summer, keep reading! To look through the programs available for Research Experiences for Undergraduates (REU's), check out this [link](#)! Most of them are done over the course of 8 – 10 weeks during the summer and include stipends around \$4,000. Applications will open in November and most will be due between late January and early March.

Read the eligibility for each because many are restricted to certain years in school, certain majors, or US citizenship. The website has a variety of tabs at the top to help you find programs that apply to you! In particular, there are lots available for international as well as domestic students!

Most applications require a personal statement about why you would like to participate in the REU as well as letters of recommendation, so start looking into these sooner rather than later.

Make sure to reach out to us ([mercur1@stolaf.edu](mailto:mercur1@stolaf.edu) and [mainell1@stolaf.edu](mailto:mainell1@stolaf.edu)) if you have any questions!

### CS Undergraduate Research

St. Olaf CS invites applicants for undergraduate research student work during Spring '23, for work on projects involving cloud computing or Raspberry Pi units, as part of the CSin-Parallel research group. Specifically, the work relates to (1) “Runestone Backend”, an automated containerized parallel/cluster computations on Google Cloud using Kubernetes, and (2) the Self-Organizing Cluster system for the Raspberry Pi, including system image development. Qualifications depend on the particular project, as described in the application details. Both are ongoing projects with flexible expectations for hours per week, and strong applicants who may have partial qualifications are encouraged to apply for one or both projects. **Please apply [here](#), applications will be accepted and considered until further notice.**

*To submit an article, event, or anything else for publication in the Mess, email [hilst1@stolaf.edu](mailto:hilst1@stolaf.edu); to receive the Mess digitally each Friday, email [habero1@stolaf.edu](mailto:habero1@stolaf.edu); visit <http://wp.stolaf.edu/mscs/mcs-mess/> for a digital archive of previous MSCS Mess issues.*

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