Department of Mathematics

September 29, 2025

UNDERGRADUATE MATH SEMINAR

Professor Felix Ye

The next math seminar on the term will ***BE AT A DIFFERENT TIME AND LOCATION*** than usual!

DATE: **THURSDAY, October 2**

Time & **3:30 –** Refreshments in **Bailey 204**

Location: **4:00 – 5:00** Seminar in **Bailey 201**

In this seminar, **Professor Felix Ye**, a mathematician from the University of Albany whose research interests lie at the intersection of Machine Learning and Dynamical Systems will present the following talk.

Title: Robust Differentiation for Regularized Optimal Transport

Abstract: Applications such as unbalanced and fully shuffled regression can be approached by optimizing regularized optimal transport (OT) distances, such as the entropic OT and Sinkhorn distances. A common approach for this optimization is to use a first-order optimizer, which requires the gradient of the OT distance. For faster convergence, one might also resort to a second-order optimizer, which additionally requires the Hessian. The computations of these derivatives are crucial for efficient and accurate optimization. However, they present significant challenges in terms of memory consumption and numerical instability, especially for large datasets and small regularization strengths. We circumvent these issues by analytically computing the gradients for OT distances and the Hessian for the entropic OT distance, which was not previously used due to intricate tensor-wise calculations and the complex dependency on parameters within the bi-level loss function. Through analytical derivation and spectral analysis, we identify and resolve the numerical instability caused by the singularity and ill-posedness of a key linear system. Consequently, we achieve scalable and stable computation of the Hessian, enabling the implementation of the stochastic gradient descent (SGD)-Newton methods. Tests on shuffled regression examples demonstrate that the second stage of the SGD-Newton method converges orders of magnitude faster than the gradient descent-only method while achieving significantly more accurate parameter estimations.

Where Was Professor Jauregui?

Professor Jeff Jauregui traveled to the Simons Center for Geometry and Physics during the week of September 15th and gave a talk titled "Capacity, semicontinuity, and general relativistic mass." This was presented as part of a workshop bringing together experts in geometric measure theory (which, for example, includes tools to help understand area-minimizing surfaces, even when they are not smooth) and physics (including Einstein's theory of general relativity).

The photo was taken in front of the Simon Center's two-story wall that was engraved with some of the most famous equations in geometry and physics. Prof. Jauregui is pictured next to the formula for the Schwarzschild radius of a black hole.

Prof. Jauregui at the Simons Center. Look carefully near the top of the photo for a famous equation!

Calculus Help Center: free peer tutoring in calculus

Sunday through Thursday nights, 7:30-10:00pm, Sorum House Seminar Room