The robustness of a mathematical method determines its utility. Just imagine designing a communication network that fails to account for topological perturbations, or modeling an epidemic with strictly deterministic differential equations. My goal, broadly, is to research robust mathematical methods and their implementations in Multiscale Analysis and Computations or Algebraic Geometry.

For example, consider training an AI to distinguish the tone signature of different musical instruments. Applying persistent homology, we associate holes in an audio recording's time-delay phase-space with a sample statistic: the persistent rank function (PRF). Corresponding with Nikki Sanderson at CU Boulder, I learned a computer trained on PRFs more accurately classifies tone signatures than one trained on Fast Fourier Transforms. Here, computational topology is a more robust method than frequency analysis in answering the question "which instrument?"

My research interest stems from (i) my exposure to topology and its applications as a college senior, and (ii) insight from two years of service work since graduating.

Advised by Dr. Jonny Comes, my senior independent study[1] examined how Galois theory constrains the solution space of Fuchsian-type DiffEqs. Following Michio Kuga, we developed a correspondence between the fundamental group on $D = \mathbf{C} \setminus \{x_1, \ldots, x_n\}$ and this region's universal covering space $\tilde{D}$. Exploiting the representation of the group of covering transformations $\Gamma(\tilde{D} \to \tilde{D})$ as a group of linear automorphisms, I parameterized solutions to the hypergeometric DiffEq. For interesting cases, I found the monodromy representation at singular points, and generated plots. I presented my method, its history, and an application to fluid flow at The College of Idaho's 2016 student research conference. At the same time, I studied point-set topology under Dr. Dave Rosoff. He led seminar in a modified Moore method. I reasoned from topological counter examples, finding errata in our notes by discovering non-intuitive spaces, e.g., the space X whose open sets are those sets with countable complements. We explored category theory and progressed to connectivity and compactness. I am enthusiastic to build from this ground to higher results, one of which I reached in my senior study, another of which Nikki Sanderson demonstrated ahead of me.

I gained insight to the necessity of *applications* (esp. with positive societal impact) by completing two years of service work with people who have been displaced as a result of their beliefs, minority status, or lack of income. In Houston, under Shaoli Bhadra, I developed scalable resources for refugee case management. I crowd-sourced a map of clinics and languages spoken with the Google Maps API. I wrote bug reports for the implementation of a SQL case-notes database, and, when Texas cut funding for Refugee Medical Assistance, I contributed to a data management plan for the small refugee population transitioning from state to federal medical care. In Olympia, I am coordinating the volunteer program for a 24/7 homeless shelter. I rely on a distributed workflow—with `git` for version control and pandoc markdown for administrivia. I built volunteer.fscss.org to maintain a schedule of events and to "reply all" to volunteers. As we rely on interns and work-studies, I am also collaborating with the Evergreen State College to write service-learning syllabi.

I am serious, however, to pursue math as my vocation. To prepare for graduate study, I have enrolled in correspondence courses at the University of Idaho. By May 2018, I will have reviewed Differential Equations, Probability and Numerical Analysis. I am also reading from Hatcher's *Algebraic Topology*, surveying topics in Gower's *Companion to Mathematics*, and building a base of computing skills in the UNIX philosophy.

Though I am open to a variety of research at the University of Utah, my experience with scientific computing and my attentiveness to detail in abstract reasoning leads naturally into either Multiscale Analysis and Computations (MAC) or Algebraic Geometry (AG). Having read through their webpages and recent publications, I would gladly collaborate with Profs Epshteyn and Hohenegger in MAC or Profs Schwede and Honigs in AG. I see fruitful work to be done in both applied (e.g., modelling the dispersion of contaminants in groundwater) and pure (e.g., understanding the moduli space of Riemannian surfaces) mathematics. I feel that I would strongly contribute in either setting as a doctoral student at the University of Utah.

Thank you for your consideration.

[1] C. Grainger, Applications of Galois Theory: Monodromy Groups and Fuchsian DiffEqs, College of Idaho SRC, 2016.