

1 Introduction

I am applying to Tufts University with the intent of pursuing a PhD in Computer Science. In addition to studying Computer Science and Mathematics at the University of South Florida, I come from a diverse background of over 15 years experience in Music Performance. My primary research interests include Information Visualization, Topological Data Analysis, and Graph Drawing. Upon the completion of my PhD, I hope to (1) work with state-of-the-art technology to solve difficult real-world problems, and (2) positively impact the role of women in STEM.

I am very proud of the academic success I have found since switching from Music Performance to Computer Science. I am a recipient of the Dean’s List for three consecutive semesters and maintain a 3.9 GPA in the College of Engineering with a completed mathematics minor. I have been researching under my advisor Dr. Paul Rosen for 8 months now. In that short time, we have accomplished the following: (1) submitted a proposal to the Computing Research Association (accepted at \$3,000 stipend); (2) awarded a \$1,500 travel grant by the CRA-W; (3) submitted a proposal to the NCWIT Collegiate Award (in review as a Finalist at \$10,000 stipend); (4) presented a poster at the IEEE Visualization 2017 conference; (5) nominated as one of the top 5 information visualization posters at VIS 2017; and (6) submitted a paper to EuroVis 2018 for review.

2 Ongoing Visualization Research Using Topological Data Analysis

I have participated in three major research projects—one of which funded by the *Committee on the Status of Women in Computing Research*—in an effort to explore structural representations of data using Topological Data Analysis (TDA). My funded project, “Using Persistent Homology to Drive Interactive Graph Drawing”, was accepted as a poster at the IEEE Visualization 2017 conference – the top conference in our field. By leveraging TDA and *persistent homology*, I designed and presented software to help users interactively and easily explore entangled or messy data.

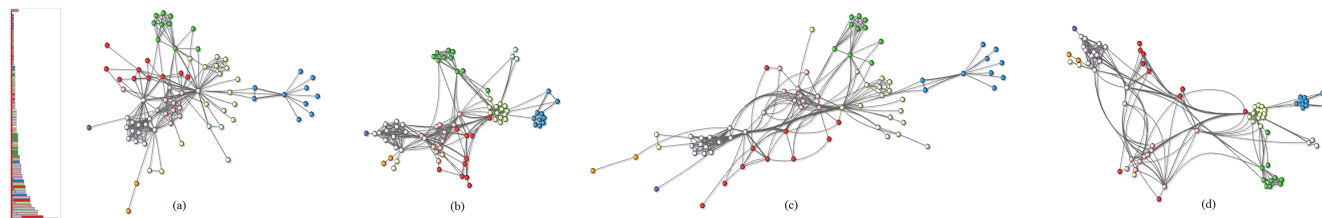


Figure 1: The *Les Misérables* co-occurrence dataset is drawn using a conventional force-directed layout (a). Using the barcode on the left, my approach (b), (c), (d) provides two mechanisms for interacting with the layout driven by persistent homology, a tool of TDA.

To help guide interactive graph exploration, a conventional force-directed layout is first drawn, seen in Figure 1(a). The user can then manipulate the graph by interacting with the barcode—a visual representation for topological features in the data—on the left. If the user slides the scrollbar highlighted in red to the right, we can collapse nodes (b) to form new groups. Individual bars in the barcode can also be selected to repulse nodes (c) and untangle “hairballs” in the graph. Finally, a combination of both the scrollbar and individual bar selection will effectively spread apart clustered components (d). The result is an intuitive, easy-to-use approach to exploring the underlying structure of data using a traditionally difficult method—topological data analysis.

This software is one of many graph drawing tools I am creating as part of an interactive design suite driven by TDA and persistent homology. I have been working closely with my advisor Dr. Paul Rosen and two collaborators Dr. Bei Wang and Dr. Carlos Scheidegger on two additional graph drawing tools: a topological preservation tool for detecting tunnels using random walks, and a topological simplification tool for reducing noise in 1-dimensional functions. We have recently submitted a paper on our work to the EuroVis 2018 conference and will submit two additional papers by the end of the upcoming semester. I plan to apply to the NSF Graduate Research Fellowship Program during my first year in graduate school to continue my investigations of TDA in Visualization.

3 A Call for Women in STEM

When applying to the CRA-W research program, I was faced with a unique challenge: the review committee preferred an application that included a student research group of at least two women (that is, myself and one other female-identifying student). After seeking another undergraduate woman to join in my project, I quickly realized that not only was I the only female student researching data visualization, but there were only a handful of women in our department conducting research at all. Although I was unable to find another research partner, I fortunately was still accepted into the CREU program, which has significantly better prepared me for graduate school.

My intention for obtaining a PhD is not just to research state-of-the-art technology. I would like to solve difficult, real-world problems, which must address the lack of women in STEM. It seems a challenging task to change how a male-dominated field encourages and uplifts women. One way I have found to combat this is by making computer science accessible to everyone; that is, by developing intuitive and engaging tools for those without a technical background. During my time as a Supplemental Instructor at the Hillsborough Community College, I designed interactive visualization tools for my students to drive discussion and mastery of course content. This software was built using d3.js, allowing them to plot, visualize, and explore functions through their web browser without prior knowledge of programming. I am extremely proud to have positively impacted the female students in my classes, many of which continued through the STEM pipeline to a four-year college. I hope to continue a mentorship of young women in STEM by becoming a researching faculty member.

4 Why Tufts?

I would like to continue my studies at Tufts University because of the strong and competitive Visual Analytics group. In particular, I am extremely interested in the applications of visualization research that Dr. Remco Chang works on. Dr. Chang is clearly very passionate about being a mentor for aspiring academics, and has graduated multiple students who have gone on to become professors. I am confident that with my experience creating interactive visualization tools, I can help Dr. Chang grow his lab at Tufts University to incorporate both experts in visual analytics and experts in graph analysis, and become a researching faculty member under his advisement.

5 Publications

I have one submitted first author paper for publication, “Driving Interactive Graph Exploration Using 0-D Persistent Homology Features.” This paper was submitted to the EuroVis 2018 conference with the following authors (listed in order of appearance): Ashley Suh, Mustafa Hajij, Bei Wang, Carlos Scheidegger, Paul Rosen.

I have one accepted first author poster to the IEEE Visualization 2017 conference for the same project, “Driving Interactive Graph Exploration Using 0-D Persistent Homology Features,” with the same ordering of authors. I presented this poster through a conference travel grant honored by CRA-W in September 2017.

6 Awards & Honors

I was chosen as a National CRA-W Research Scholar through the Collaborative Research Experience for Undergraduates program (\$3000 USD stipend) during the 2017-2018 academic year. I was honored \$1500 USD as a travel grant in 2017 by the CRA-W.

I have been awarded Dean’s List for three consecutive semesters from the College of Engineering at the University of South Florida (Fall 2016, Spring 2017, Fall 2017).

My research was accepted for presentation at the University of South Florida’s College of Engineering Annual Research Day as a poster for the 2017-2018 academic year.