

CS 611: Story Proposal

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Topological data mining (TDM) refers to the process of extracting information from data sets using methods from the field of topology. In particular, the subfields of abstract and differential topology have given scientists many tools for analyzing data sets in novel ways. In recent years, TDM has grown in popularity due to the availability of large data sets and the development of new algorithms, software, and hardware. This increased interest and arsenal of tools has led to the creation of many new applications of TDM, which include applications in the fields of biology, chemistry, physics, and artificial intelligence, to name a few.

With this surge in literature my goal is to tell the story of the current state of TDM and how it arrived at where it is. This primarily begins with the inception of abstract topology and its advancement to topological data analysis (TDA). I will focus on the applications of TDA to various fields, and will discuss the current state of the field in terms of algorithms and experimental results. I will also discuss the challenges that TDA faces in the future, and will discuss possible solutions to these challenges.

The motivation behind studying TDA is primarily due to its applicability to a wide variety of fields, however, I am particularly interested in its application to deep learning as a novel method for analyzing DNNs themselves. Novel research in this area has the potential to lead to new insights into the inner workings of DNNs, which could lead to new ways to improve their performance. One particular tool from TDA that I am interested in is persistent homology (PH), which is a method for analyzing the topology of data sets. In recent years PH has been used to analyze the topology of DNNs, and I am interested in learning more about this application and what it can reveal.