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MASTER'S THESIS PRESENTATION

# Topological Regularization in Deep Learning

**WHEN**
**February, 22, 2022**
**2:00 PM, CST**

**WHERE**
**Via ZOOM**
ZOOM information will be provided in the email announcement for this seminar.

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Topological Data Analysis (TDA) has started to be used in deep learning problems, not only on analyzing the mechanisms of deep neural networks but on regularizing the learning processes. In this work, we will introduce the fundamental theories of persistent homology, followed by their applications in deep learning. Starting from classification problems, we summarize the topological viewpoints and introduce the efficacy of topological regularization on unsupervised classification. Afterward, the work will focus on applying topological regularization to dense prediction problems, such as depth perception and semantic segmentation, which are important applications in computer vision. Dense prediction problems have a concrete topological description in terms of partitioning an image into connected components or estimating a function with a small number of local extrema corresponding to objects in the image. Experimental results show that the output topology can also appear in the internal activations of trained neural networks which allow for novel use of topological regularization to the internal states of neural networks during training, reducing the computational cost of the regularization. We demonstrate that this topological regularization of internal activations leads to improved convergence and test benchmarks on several problems and architectures. At the end of this work, we will provide

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