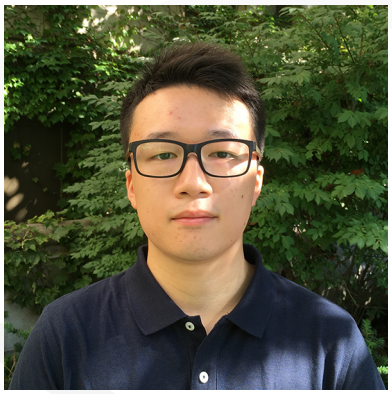
psd

MASTER'S THESIS PRESENTATION

Biologically Plausible Neural Networks with Contrastive Learning and Difference Target Propagation

WHEN
April 28, 2021
2:45 PM, CDT

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



Mufeng Tang, MS Candidate

We show that contrastive learning, an unsupervised learning method, combined with Difference Target Propagation (DTP), a learning rule based on layer-wise losses instead of backpropagated error signals, present a biologically plausible learning framework for deep neural networks. In particular, the unsupervised nature of contrastive learning and its learning of generic, global features make it a promising biologically plausible learning model. DTP trains network parameters using local losses and employs a Hebbian learning rule, thus overcoming the biologically implausible symmetric weight problem in backpropagation. We propose two biologically more plausible objective functions for contrastive learning, the l1 margin loss and the contrastive hinge loss, which produce simple error signals that can be computed using biological neural circuits. We also propose a modification to DTP, which circumvents the incompatibility of pooling layers to DTP, claimed by Bartunov et al. (2018). By training convolutional neural networks (CNNs) with contrastive learning and DTP, we find that our proposed framework achieves comparable performance in linear evaluation tasks to its backpropagation-based counterparts, and works significantly better than supervised networks in transfer learning tasks. We also study how contrastive learning changes the distance distributions in the embedding space. We find that the distances between positives are not necessarily decreased after training, pointing to possible refinements of the objective functions for contrastive learning.

stat.uchicago.edu

THE UNIVERSITY OF CHICAGO | DEPARTMENT OF STATISTICS