While Machine Learning appears in all application areas, one should pay careful attention in
their adoption when addressing a vast spectrum of technical challenges. Building on the
achievements of Artificial Neural Networks and Convolutional Neural Networks, we will use an
arsenal of principles from Neuro/Cognitive Science, Probability, Information Theory and
Representation Theory (functional Analysis) to explore various state of the art Machine Learning
tools spanning Generative models (e.g., Generative Adversarial Networks-GANS) to Implicit
Neural Networks to Transformers inching closer towards primate Learning.

Pre-req: Some background in NN/CNN, linear algebra, and Calculus and probability is
assumed. Course will be project-oriented (60%), Homework/Participation (20%) , and 1
mid-term (20%).

Topics: High-Level-Description

- Introduction to ML, Problems, task learning, Pac-Learning
- Regression: Linear regression, Linear Regression models, Non-linear regression models
- CNN-review
- Energy-based learning networks and other (e.g. VNN).
- Sparse and Robust Learning Networks
- Generalization and latent model learning
  - Meta-learning
  - Auto-encoder and VAE
  - Domain adaptation..
- Neural Tangent Kernel Learning
- Generative Models
  - Generative Adversarial Networks (GANs), DC-GANs, f-GANs, ....
  - Normalizing flowa
- Bayesian Neural Networks
- Learning Dynamic and time series (RNN, LSTM).
- Transformer Neural networks