## Course outline:

1. **Deep Feedforward Networks**
   - a. Supervised learning recap
   - b. Feedforward networks in the context of function approximation
   - c. Simple recipes for building deep networks
   - d. Deep nets vs Kernel methods
   - e. How deep networks came back

2. **Technical Issues with Deep Networks**
   - a. Mathematical optimization recap
   - b. Automatic differentiation, implementations in Python
   - c. First order stochastic gradient methods
   - d. Regularization techniques
   - e. Technical tricks

3. **Convolutional Networks**
   - a. From fixed feature extractors to convolutional networks
   - b. Composing filters and functions
   - c. Applications in computer vision and speech processing
   - d. Transfer Learning
4. **Reinforcement Learning**
   a. Reinforcement Learning fundamentals
   b. Basic Q-Learning, enhancements, and generalizability
   c. Injecting function approximators into the Q-Learning scheme
   d. Policy gradient method
   e. Applications to automatic control and Atari game AI

5. **Recurrent Networks**
   a. Recurrence relations
   b. Parameterized recurrence relations and feedforward networks
   c. Deriving vanilla recurrent networks
   d. Popular architectures, Long-Short-Term-Memory
   e. Applications in NLP and speech recognition

6. **Deep Representation Learning**
   a. Unsupervised learning recap
   b. Nonlinear extensions of PCA, autoencoders
   c. Unsupervised generative models

**Prerequisites:** Prior machine learning experience (e.g. an introductory machine learning course EECS 395/495 or EECS 349 or a similar course), a thorough understanding of Linear Algebra and Vector Calculus, and strong familiarity with the Python programming language (e.g., basic data manipulation libraries, how to construct functions and classes, etc.). **Python will be used for all coding assignments. No other language can be used to complete programming assignments.**

**Course hand-outs:** This course has no required textbook. Handouts authored by the instructors will be made freely available to students for notes. In addition a small number of relevant sections from the author’s textbook **Machine Learning Refined** (Cambridge University Press) will be made freely available to students.

**Problem Sets:** 6-7 problem sets will be assigned and graded.

**Course project:** There will be one course project worth 25% of the final grade.

**Course Grade:** Final grades for the course are based on homework (75%) and course project (25%)