

## MIDTERM GUIDE

The first half the class concentrated on the following three modules:

1. Basics of Artificial Neural Networks
2. Convolutional Neural Networks
3. Recurrent Neural Networks

Hence, the midterm exam will cover all materials contained in the lectures. Topics covered in the lectures are listed in detail below:

### Basics of Artificial Neural Networks

- Lecture 1: Introduction to Deep Learning  
*compositionality, end-to-end learning, distributed representations*
- Lecture 2: Machine Learning Overview  
*linear models, loss functions, linear regression, gradient descent, overfitting and generalization, regularization, cross-validation, bias-variance tradeoff, maximum likelihood estimation*
- Lecture 3: Multi-layer Perceptrons  
*feed-forward neural networks, activation functions, chain rule, backpropagation, computational graph, automatic differentiation, distributed word representations*
- Lecture 4: Training Deep Neural Networks  
*data preprocessing, weight initialization, normalization, regularization, model ensembles, dropout, optimization methods*

### Convolutional Neural Networks

- Lecture 5: Convolutional Neural Networks  
*convolution layer, pooling layer, evolution of depth, design guidelines, residual connections, semantic segmentation networks, object detection networks, backpropagation in CNNs*
- Lecture 6: Understanding and Visualizing Convolutional Neural Networks  
*transfer learning, interpretability, visualizing neuron activations, visualizing class activations, pre-images, adversarial examples, adversarial training*

### Recurrent Neural Networks

- Lecture 7: Recurrent Neural Networks  
*sequence modeling, recurrent neural networks (RNNs), RNN applications, vanilla RNN, training RNNs, long short-term memory (LSTM), LSTM variants, gated recurrent unit (GRU)*
- Lecture 8: Attention and Memory  
*content-based attention, location-based attention, soft vs. hard attention, self-attention, attention for image captioning, transformer networks*