# Online Machine Learning Lecture

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- **Week 1: Overview of Machine Learning**

  - Part 1: Data And Terms
    - Lecture introdution.
    - What Is Machine Learning?
    - Why Estimate $f$?
    - Types of Learning.
    - Data Types And Datasets.
    - Model Performance.
  - Part 2: Regression Models and Linear Regression
    - What is Linear Regression problem?
    - Defining loss function.
    - Interpretation of loss function and estimating parameters.
    - Finding minima with gradient descent algorithm.
  - Part 3: Regression Models and Logistic Regression
    - Decision theory.
    - What is Logistic Regression problem?
    - Defining loss function.
    - Interpretation of loss function and estimating parameters.

- **Week 2: Model's Performance**

  - Part 1: Train - Validate - Test
    - Why we need to evaluate the model?
    - Splitting the dataset.
    - Definitions of datasets.
  - Part 2: Evaluating Regression Models.
    - Evaluating Linear Regression.
    - Evaluating Logistic Regression: Misclassification Error.
    - Evaluating Logistic Regression: Confusion Matrix.
  - Part 3: The Problem of Overfitting
    - Bias - Variance Trade off.
    - Hyperparameters.
    - Homework 1.

- **Week 3: Introduction To Deep Learning**

  - Part 1: Perceptrons and Forward Propagation
    - Why Deep Learning?
    - Single-layer Perceptrons.
    - Activation Functions.
    - Multi-layer Perceptrons.
  - Part 2: Computational Graphs And Backpropagation
    - Defining Computational Graph.
    - Mathematics of Backpropagation.
    - Multi-layer Perceptrons.
  - Part 3: Model & Loss & Optimizer
    - Common Deep Learning Architectures.
    - Other Loss Functions.
    - Optimizers In Deep Learning.
    - Homework 2.

- **Week 4: Images And Convolutional Neural Networks**

  - Part 1: Basic Image Processing
    - Representation Of An Image And Color Space.
    - Kernels.
    - Morphological Operations.
  - Part 2: Convolutional Neural Networks
    - Convolution Operator.
    - Feature Extraction and Classification.
    - History Of Computer Vision.
  - Part 3: Computer Vision Tasks
    - Object Detection.
    - Image Segmentation.
    - Homework 3.

- **Week 5: Texts And Sequential Models**

  - Part 1: Vanilla Recurrent Neural Networks
    - Main Idea Behind RNNs.
    - RNN With Examples.
    - Backpropagation Through Time.
    - Multilayer & Bidirectional RNNs.
  - Part 2: Canonical Recurrent Neural Networks
    - Vanishing And Exploding Gradients.
    - Types Of Canonical RNNs: LSTM, GRU, Echo State.
  - Part 3: Introduction To Natural Language Processing.
    - Representation Of Text.
    - Tokenization, Stemming, Lemmatization.
    - N-Grams and Markov Assumption.
    - Homework 4.

- **Week 6: Generative Models**

  - Part 1: Autoencoders
    - ○ Main Idea Behind Autoencoders.
    - ○ Sparse Autoencoders, Denoising Autoencoders.
    - ○ Variational Autoencoders.
  - Part 2: Generative Adversarial Networks
    - ○ GANs.
    - ○ DCGANs.
  - Part 3: Summary And Discussion
    - ○ Papers And Textbooks.
    - ○ Academics And Companies.
    - ○ Softwares.