Chapter – 1

**CS230:**

**Deep Learning**

**Introduction to**

**Deep Learning**

**1.1 About This course**

<https://cs230.stanford.edu/>

<https://cs230.stanford.edu/syllabus/>

<https://cs230.stanford.edu/files/>

<https://github.com/maxim5/cs230-2018-autumn>

<https://mattdeitke.com/notes/cs230>

You will learn the ***foundations of Deep Learning***, understand how to ***build Neural Networks***, and learn how to lead successful ***machine*** ***learning projects***. You will learn about *Convolutional networks*, *RNNs*, *LSTM*, *Adam*, *Dropout*, *BatchNorm*, *Xavier/He* initialization, and more.

* Prerequisites: Students are expected to have the following background.
* Knowledge of basic computer science principles and skills, at a level sufficient to write a reasonably non-trivial computer program. This corresponds to a Developing level (or badge) in the “Algorithmic Coding” section on Workera.
* Familiarity with the Probability Theory (CS 109 or STATS 116), which students can assess by taking the “**Data Science**” section on Workera.
* Familiarity with Linear Algebra (MATH 51), which students can assess by taking the “Mathematics” section on Workera.

**Lecture 1:**

* Topics:
* Class introduction
* Examples of deep learning projects
* Course details
* Online Modules: No online modules.
* Materials and Assignments: No assignments.

**Neural Networks and Deep Learning (Course 1)**

**Lecture 2**

* Topics: Deep Learning Intuition
* Online modules:
* C1M1: Introduction to deep learning (slides)
* C1M2: Neural Network Basics (slides)
* Optional Video
* Batch Normalization videos from C2M3 will be useful for the in-class lecture.
* Materials and Assignments:
* Quizzes: Right before lecture
* Introduction to deep learning
* Neural Networks Basics
* Programming Assignments: Right before lecture
* Python Basics with Numpy (Optional)
* Logistic Regression with a neural network mindset

**Lecture 3**

* Topics: Adversarial examples - GANs (slides)
* Attacking neural networks with Adversarial Examples and Generative Adversarial Networks
* Optional Readings:

1. Explaining and Harnessing Adversarial Examples,
2. Generative Adversarial Nets,
3. Conditional GAN,
4. Super-Resolution GAN,
5. CycleGAN

* Online modules:
* C1M3: Shallow Neural Network (slides)
* C1M4: Deep Neural Networks (slides)
* Materials and Assignments:
* Quizzes: Right before lecture
* Shallow Neural Networks
* Key concepts on Deep Neural Networks
* Programming Assignments: Right before lecture
* Planar data classification with a hidden layer
* Building your Deep Neural Network: step by step
* Deep Neural Network – Application

**Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization (Course 2)**

**Lecture 4**

* Topics: AI and Healthcare.
* Online modules:
* C2M1: Practical aspects of deep learning (slides)
* C2M2: Optimization algorithms (slides)
* Materials and Assignments:
* Quizzes:
* Practical aspects of deep learning
* Optimization Algorithms
* Programming Assignments:
* Initialization
* Regularization
* Gradient Checking
* Optimization

**Structuring Machine Learning Projects (Course 3)**

**Lecture 5**

* Topics: Full-cycle of a Deep Learning Project (no slides)
* Online modules:
* C2M3: Hyperparameter Tuning, Batch Normalization (slides)
* C3M1: ML Strategy (1) (slides)
* C3M2: ML Strategy (2) (slides)
* Materials and Assignments:
* Quizzes:
* Hyperparameter tuning, Batch Normalization, Programming Frameworks
* Bird recognition in the city of Peacetopia (case study)
* Autonomous driving (case study)
* Programming Assignments:
* Tensorflow

**Convolutional Neural Networks (Course 4)**

**Lecture 6**

* Topics: Deep Learning Strategy (no slides)
* Optional Reading:

1. A guide to convolution arithmetic for deep learning,
2. Is the deconvolution layer the same as a convolutional layer?,
3. Visualizing and Understanding Convolutional Networks,
4. Deep Inside Convolutional Networks: Visualizing Image Classification Models and Saliency Maps,
5. Understanding Neural Networks Through Deep Visualization,
6. Learning Deep Features for Discriminative Localization

* Online modules:
* C4M1: Foundations of Convolutional Neural Network (slides)
* C4M2: Deep Convolutional Models (slides)
* Materials and Assignments:
* Quizzes:
* The basics of ConvNets
* Deep convolutional models
* Programming Assignments:
* Convolutional Model: step by step
* Convolutional Model: application
* Residual Networks
* Transfer Learning with MobileNet

**Lecture 7**

* Topics: Interpretability of Neural Networks (slides)
* Online modules:
* C4M3: ConvNets Applications (1) (slides)
* C4M4: ConvNets Applications (2) (slides)
* Materials and Assignments:
* Quizzes:
* Detection Algorithms
* Special Applications: Face Recognition & Neural Style Transfer
* Programming Assignments:
* Car Detection with YOLO
* Image Segmentation with U-Net
* Art Generation with Neural Style Transfer
* Face Recognition

**Sequence Models (Course 5)**

**Lecture 8**

* Topics:
* Career Advice
* Reading Research Papers
* Optional Reading:

1. **Dropout:** A Simple Way to Prevent Neural Networks from Overfitting
2. **DenseNet:** Densely Connected Convolutional Networks

* Online modules:
* C5M1: Recurrent Neural Networks (slides)
* Materials and Assignments:
* Quizzes:
* Recurrent Neural Networks
* Programming Assignments:
* Building a Recurrent Neural Network - Step by Step
* Dinosaur Land -- Character-level Language Modeling
* Jazz improvisation with LSTM

**Lecture 9**

* Topics: Deep Reinforcement Learning
* Optional Reading:
* Human-level control through deep reinforcement learning
* Mastering the Game of Go without Human Knowledge
* Online modules:
* C5M2: Natural Language Processing and Word Embeddings (slides)
* C5M3: Sequence-to-Sequence Models (slides)
* C5M4: Transformer Network (Optional)
* Materials and Assignments:
* Quizzes:
* Natural Language Processing and Word Embeddings
* Sequence Models and Attention Mechanism
* Transformers (Optional)
* Programming Assignments:
* Operations on Word Vectors - Debiasing
* Emojify!
* Neural Machine Translation with Attention
* Trigger Word Detection
* Transformers Architecture with TensorFlow (Optional)
* Transformer Pre-processing (Optional)
* Transformer Network Application: Named-Entity Recognition (Optional)
* Transformer Network Application: Question Answering (Optional)

**Lecture 10**

* Class wrap-up
* What's next?