Proposed course names:

* Introduction to Deep Learning
* Basics of Deep Learning
* Deep Learning for beginners
* Deep Learning with Keras

This course is intended for wide audience and aims to introduce Deep Learning as a field of computer science with theoretical and experimental frameworks, rather than “black box” machine which magically solves the problems.

In this course, you will learn how to use state-of-the-art deep learning methods with the programming language Python. We will discuss key concepts of deep learning, such as artificial neural networks, data augmentation and transfer learning in a hands-on fashion. By the end of the course you will be familiar with main principles of deep learning and will be able to build simple neural networks and apply them to your own specific task.

The course material is in the form of [Python notebooks](https://github.com/alexjungaalto/ResearchPublic/blob/master/ANN_Demo/Round1_ANN.ipynb" \t "_blank) that contain code snippets along with their explanations. We will be mainly using Keras python library to build our models. The grading is based on coding assignments and student projects.

The notebook with accompanying material can be downloaded from <https://github.com/alexjungaalto/DeepLearningPython>.

The course is heavily inspired by the excellent book "Deep Learning with Python" by F. Chollet[, https://aalto.finna.fi/Record/alli.833878](https://aalto.finna.fi/Record/alli.833878" \t "_blank)

Workload of this course: 2 credits (approx. 60 hours of work); Grading is pass/fail.

Difficulty level: beginner

Prerequisites: high-school mathematics, basic Python skills (recommended, but not obligatory).

You can get a [digital badge](https://fitech.io/en/studying-at-fitech/study-credits-and-digital-badges/) after completing this course.

**Note!** Computer science, engineer students and other students with basic knowledge of linear algebra, probability theory and statistics are recommended to take more advanced course “Deep Learning XXXXX”.

Course syllabus

1. **Data, hypothesis space (model) and loss function – three components of Machine Learning.**

Specific topics:

* data, features, labels
* predictor (model), hyp.space
* loss function
* Deep Learning as a sub-filed of Machine Learning

Teaching material: lecture (Alex), optional notebooks (python intro, basic math – function, vectors, matmuls, derivative)

Assignments: Quiz

1. **Introduction to Artificial Neural Network**

Specific topics:

* Perceptron
* introducing non-linearity with activation functions
* Representing functions with ANNs, stacking neurons in layer, stacking layers
* Loss functions – MSE, categorical cross-entropy (brief)
* ANN with Keras

Teaching material: lecture (Alex?), exercise session (TAs), notebook

Assignments: Quiz, Coding

1. **Gradient Descent – the engine of Artificial Neural Networks**

Specific topics:

* Loss function re-cup
* MSE in detail
* Batch GD for linear predictor with MSE loss
* SGD, mini-batch GD
* GD variants (e.g. momentum, Adam)

Teaching material: lecture (Alex?), exercise session (TAs), notebook

Assignments: Quiz, Coding

1. **Introduction to Convolutional Neural Networks**

Specific topics:

* Convolution operation, kernel, receptive field
* introducing non-linearity with activation functions
* pooling layers
* stacking con.layers, receptive field, hierarchical representation
* CNN with Keras

Teaching material: lecture (Alex?), exercise session (TAs), notebook

Assignments: Quiz, Coding

1. **Battle overfitting – Image Augmentation and Transfer Learning**

Specific topics:

* Overfitting in DNN
* Image Augmentation
* TL
* IA and TF with Keras

Teaching material: lecture (Alex?), exercise session (TAs), notebook

Assignments: Quiz

1. **When Art meets Science - Neural Style Transfer (optional)**

Teaching material: exercise session (TAs), notebook

Assignments: no assignment