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# Practice Lab: Neural Networks for Handwritten Digit Recognition, Binary

In this exercise, you will use a neural network to recognize the hand-written digits zero and one.

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## 1 - Packages

First, let's run the cell below to import all the packages that you will need during this assignment.

- [numpy \(https://numpy.org/\)](https://numpy.org/) is the fundamental package for scientific computing with Python.
- [matplotlib \(http://matplotlib.org\)](http://matplotlib.org) is a popular library to plot graphs in Python.
- [tensorflow \(https://www.tensorflow.org/\)](https://www.tensorflow.org/) a popular platform for machine learning.

```
In [102]: import numpy as np
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
import matplotlib.pyplot as plt
from utils import *
%matplotlib inline

import logging
logging.getLogger("tensorflow").setLevel(logging.ERROR)
tf.autograph.set_verbosity(0)
```

### Tensorflow and Keras

Tensorflow is a machine learning package developed by Google. In 2019, Google integrated Keras into Tensorflow and released Tensorflow 2.0. Keras is a framework developed independently by François Chollet that creates a simple, layer-centric interface to Tensorflow. This course will be using the Keras interface.

## 2 - Neural Networks

In Course 1, you implemented logistic regression. This was extended to handle non-linear boundaries using polynomial regression. For even more complex scenarios such as image recognition, neural networks are preferred.

### 2.1 Problem Statement

In this exercise, you will use a neural network to recognize two handwritten digits, zero and one. This is a binary classification task. Automated handwritten digit recognition is widely used today - from recognizing zip codes (postal codes) on mail envelopes to recognizing amounts written on bank checks. You will extend this network to recognize all 10 digits (0-9) in a future assignment.

This exercise will show you how the methods you have learned can be used for this classification task.

### 2.2 Dataset

You will start by loading the dataset for this task.

- The `load_data()` function shown below loads the data into variables `X` and `y`