

#DLUPC

Day 4 Lab 3

Image Classification



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Multiclass classification

Dataset: [MNIST](#)

- Database of handwritten digits
- Training set of 60,000 examples
- Testing set of 10,000 examples

There are 10 different categories, as there are 10 different digits.

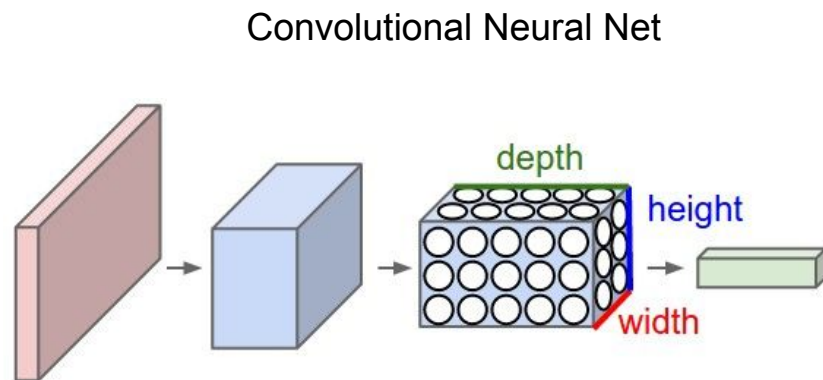
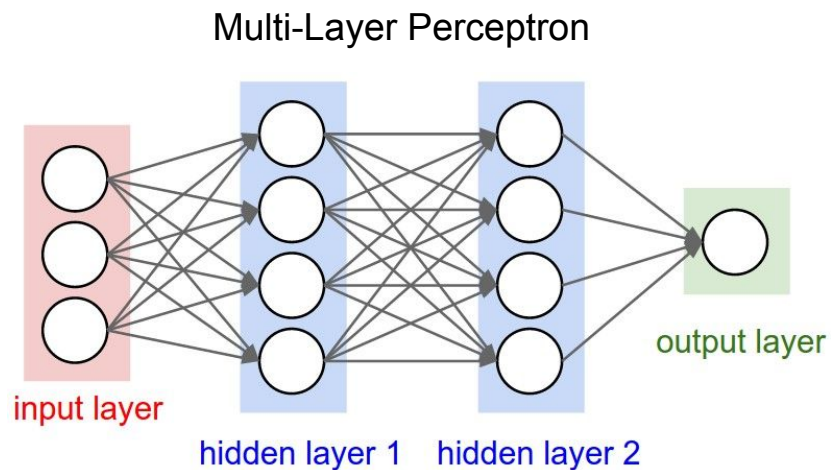


Today's objectives

- Work with two different architectures
 - Multi-Layer Perceptrons (MLPs)
 - Convolutional Neural Networks (CNNs)
- We'll work with Keras



Little Recap: ConvNets Architecture



[Figures Credit, CS231 Course](#)

Key Concepts

- **Loss:** We will use the **Categorical Cross Entropy**:

$$CE = - \sum_x p(x) \log q(x)$$

Key Concepts

- **Optimizer:**

- This is the mechanism through which the network will update itself based on the data it sees and its loss function. We will use **RMSprop**, which is an adaptive mechanism, that considers previous gradients to compute the current one

Original Gradient descent

$$w^{t+1} \leftarrow w^t - \eta g^t$$

Algorithm 1 RMSProp Stochastic Gradient Descent

Input: $f(\theta), \theta_0, \alpha, \beta, \gamma, \epsilon$

$\mathbf{m}_0 \leftarrow \mathbf{0}$

$\mathbf{b}_0 \leftarrow \mathbf{0}$

for $t \leftarrow 1$ **to** T **do**

$\mathbf{g} \leftarrow \nabla_{\theta} f(\theta_{t-1})$ stochastic gradient vector

$\mathbf{m}_t[i] \leftarrow \gamma \mathbf{m}_{t-1}[i] + (1 - \gamma) \mathbf{g}[i]^2$ $i = 1 \dots N$

$\mathbf{b}_t[i] \leftarrow \beta \mathbf{b}_{t-1}[i] + \alpha \left(\frac{\mathbf{g}[i]}{\sqrt{(\mathbf{m}_t[i] + \epsilon)}} \right)$ $i = 1 \dots N$

$\theta_t \leftarrow \theta_{t-1} - \mathbf{b}$

end for

Google Colab

The screenshot displays the Google Colaboratory web interface. At the top, there's a header with the 'co' logo and the text 'Hello, Colaboratory'. Below this is a navigation bar with options like 'Archivo', 'Editar', 'Vista', 'Insertar', 'Entorno de ejecución', 'Herramientas', and 'Ayuda'. A secondary bar contains 'CÓDIGO', 'TEXTO', 'CELDA', and 'COPIAR EN DRIVE'. On the right side of the header, there are links for 'COMPARTIR', 'CONECTAR', and 'EDICIÓN'. The left sidebar features a table of contents with links to 'Índice', 'Fragmentos de código', 'Welcome to Colaboratory!', 'Local runtime support', 'Python 3', 'TensorFlow execution', 'Visualization', 'Forms', 'Examples', and 'For more information:'. The main content area shows a 'Welcome to Colaboratory!' message, explaining that it's a Google research project for disseminating machine learning education and research, running entirely in the cloud. It mentions that notebooks are stored in Google Drive and can be shared like Google Docs or Sheets. Below this, there's a section for 'Local runtime support' and a section for 'Python 3' which states that Colaboratory supports both Python2 and Python3. A code cell is shown with the following code:

```
[ ] import sys
print('Hello, Colaboratory from Python {}'.format(sys.version_info[0]))
```

 The output of the code cell is 'Hello, Colaboratory from Python 3!'. The bottom of the interface shows the URL <https://colab.research.google.com/>.

co Hello, Colaboratory

Archivo Editar Vista Insertar Entorno de ejecución Herramientas Ayuda

CÓDIGO TEXTO CELDA CELDA COPIAR EN DRIVE

COMPARTIR CONECTAR EDICIÓN

Índice Fragmentos de código

Welcome to Colaboratory!

Local runtime support

Python 3

TensorFlow execution

Visualization

Forms

Examples

For more information:

SECCIÓN

Welcome to Colaboratory!

Colaboratory is a Google research project created to help disseminate machine learning education and research. It's a Jupyter notebook environment that requires no setup to use and runs entirely in the cloud.

Colaboratory notebooks are stored in [Google Drive](#) and can be shared just as you would with Google Docs or Sheets. Colaboratory is free to use.

For more information, see our [FAQ](#).

Local runtime support

Colab also supports connecting to a Jupyter runtime on your local machine. For more information, see our [documentation](#).

Python 3

Colaboratory supports both Python2 and Python3 for code execution.

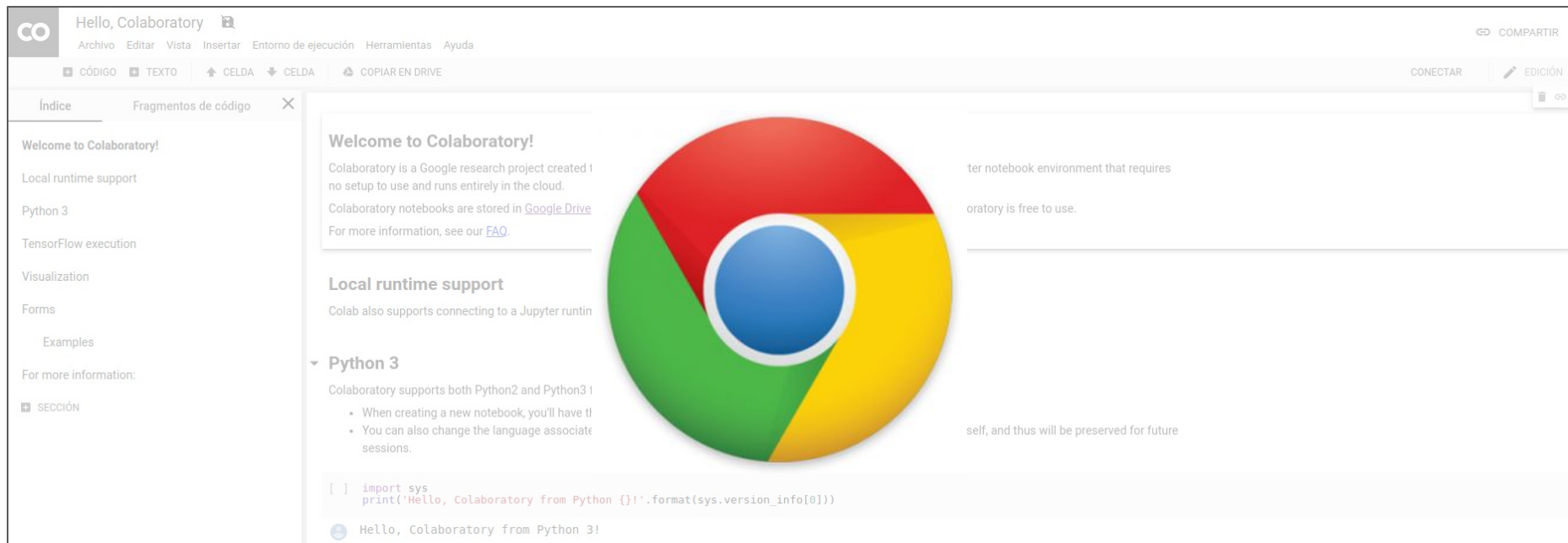
- When creating a new notebook, you'll have the choice between Python 2 and Python 3.
- You can also change the language associated with a notebook; this information will be written into the .ipynb file itself, and thus will be preserved for future sessions.

```
[ ] import sys
print('Hello, Colaboratory from Python {}'.format(sys.version_info[0]))
```

Hello, Colaboratory from Python 3!

<https://colab.research.google.com/>

Google Colab



The screenshot displays the Google Colaboratory web interface. At the top, the header includes the 'co' logo, the title 'Hello, Colaboratory', and a menu with options like 'Archivo', 'Editar', 'Vista', 'Insertar', 'Entorno de ejecución', 'Herramientas', and 'Ayuda'. Below the header, there are tabs for 'CÓDIGO', 'TEXTO', 'CELDA', and 'COPIAR EN DRIVE'. The main content area is divided into a left sidebar with a table of contents (Índice) and a main workspace. The workspace shows a 'Welcome to Colaboratory!' message, a 'Local runtime support' section, and a 'Python 3' section. A large, colorful circular logo is centered in the workspace. Below the logo, there is a code cell with the following code:

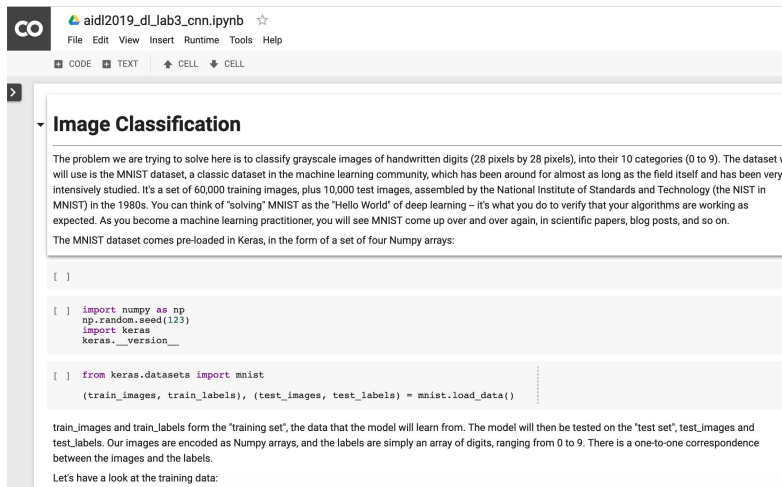
```
[ ] import sys
print('Hello, Colaboratory from Python {}'.format(sys.version_info[0]))
```

The output of the code cell is 'Hello, Colaboratory from Python 3!'. The interface also includes a 'CONECTAR' button and an 'EDICIÓN' button in the top right corner.

<https://colab.research.google.com/>

Google Colab

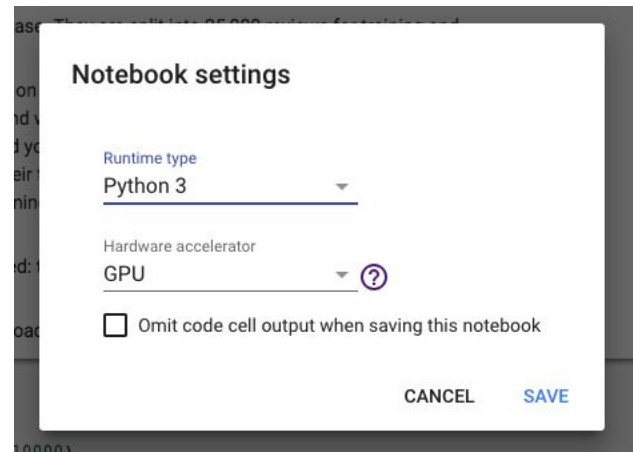
1. Login in [Colab](#) with a Google account: yours or aidlupc2019@gmail.com (talentcenter)
2. Open [the notebook](#) of this lab session.
3. Copy this notebook to your Drive to be able to run it (or open in draft mode if using aidlupc2019@gmail.com)
4. Change runtime type to work with GPU! Your trainings will be much faster :)



The screenshot shows a Google Colab notebook interface. At the top, the title bar reads 'aidl2019_dl_lab3_cnn.ipynb'. Below it are tabs for 'CODE', 'TEXT', 'CELL', and 'CELL'. The main content area is titled 'Image Classification' and contains a paragraph of text explaining the MNIST dataset. Below the text is a code cell with the following Python code:

```
[ ]  
  
[ ] import numpy as np  
    np.random.seed(123)  
    import keras  
    keras.__version__  
  
[ ] from keras.datasets import mnist  
    (train_images, train_labels), (test_images, test_labels) = mnist.load_data()
```

Below the code cell, there is a paragraph of text explaining the training and testing process.



The screenshot shows the 'Notebook settings' dialog box. It has a title bar 'Notebook settings'. Inside, there are two dropdown menus: 'Runtime type' set to 'Python 3' and 'Hardware accelerator' set to 'GPU'. There is a checkbox labeled 'Omit code cell output when saving this notebook' which is currently unchecked. At the bottom right, there are two buttons: 'CANCEL' and 'SAVE'.

Final Questions

Undergradese

What undergrads ask vs. what they're REALLY asking

"Is it going to be an open book exam?"

Translation: "I don't have to actually memorize anything, do I?"

"Hmm, what do you mean by that?"

Translation: "What's the answer so we can all go home."

"Are you going to have office hours today?"

Translation: "Can I do my homework in your office?"

"Can i get an extension?"

Translation: "Can you re-arrange your life around mine?"

"Is this going to be on the test?"

Translation: "Tell us what's going to be on the test."

"Is grading going to be curved?"

Translation: "Can I do a mediocre job and still get an A?"

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