

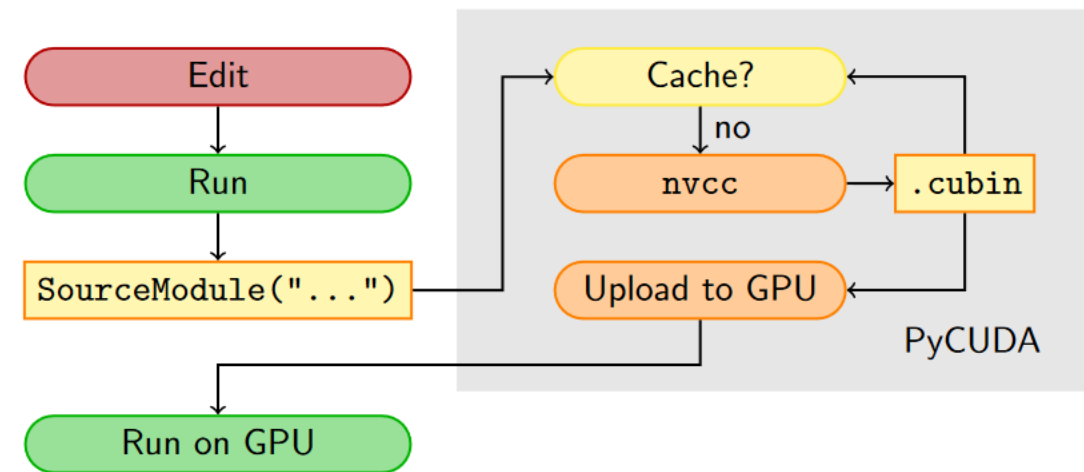
# Introduction to GPU computing (3)

Computing Methods for Experimental Physics and Data Analysis  
Hands-on: Lecture 5

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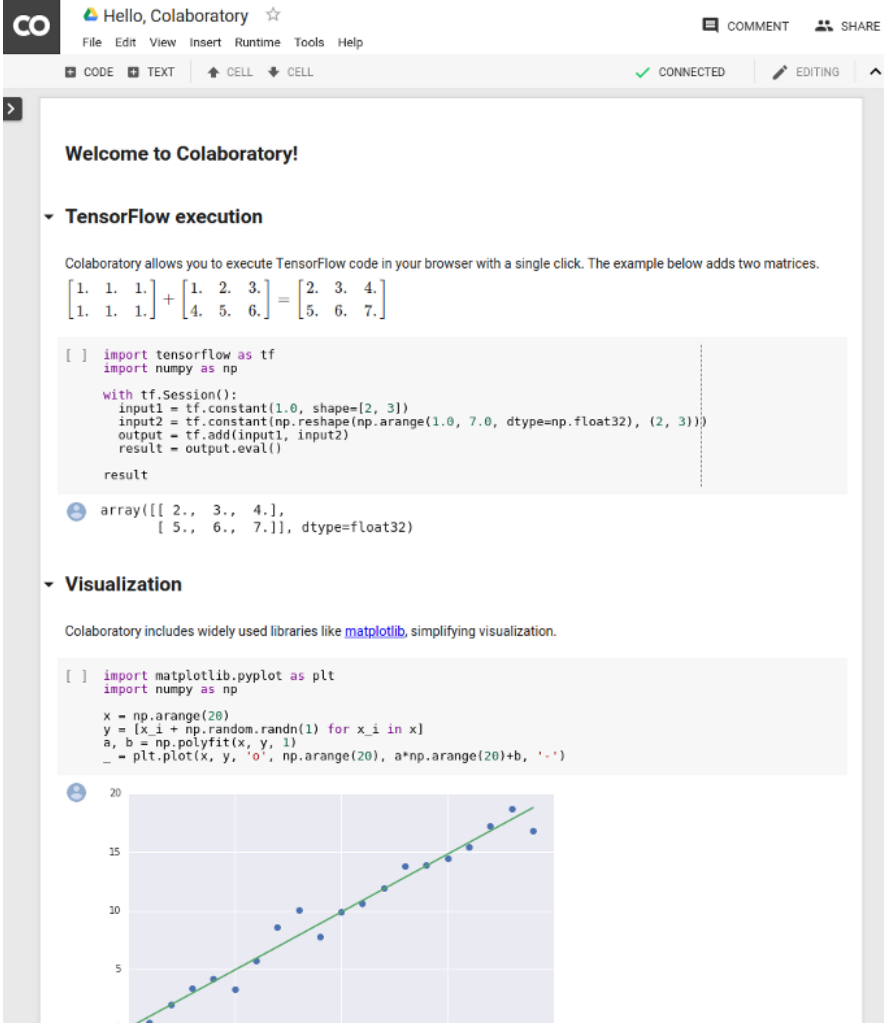
# PyCuda Module

- PyCUDA lets you access Nvidia's CUDA parallel computation API from Python
  - All the CUDA features can be accessed through pyCUDA
- Supports Just-in-time compilation of the CUDA kernels in C
- Small overhead with respect to the C implementation to the GPU part
- Several additional features
  - Example: cuda exceptions translated to python exception
- One of the virtues of PyCUDA is that it allows us to use the class **GPUArray**
- <https://pypi.org/project/pycuda/>
- <https://documen.tician.de/pycuda/>



# Colab

- Also known as *Colaboratory*, is free *Jupyter* notebook running on Google Cloud
  - The notebooks are stored in Google Drive
  - <http://colab.research.google.com>
- The notebooks are environment to write text and run code based on Python2 (supported until January 2020) and Python3
  - It's possible to run on cloud computers housing GPUs
- Thanks to the IPython library it's possible to run shell commands (including compilers) on the cloud filesystem
- Possibility to add modules in the development environment



The screenshot displays the Google Colaboratory web interface. At the top, there's a navigation bar with the Colab logo, a greeting "Hello, Colaboratory", and links for "COMMENT" and "SHARE". Below this is a menu bar with options: "File", "Edit", "View", "Insert", "Runtime", "Tools", and "Help". A status bar indicates "CONNECTED" and "EDITING".

The main content area is titled "Welcome to Colaboratory!". It features a section for "TensorFlow execution" with a text block explaining that Colab allows executing TensorFlow code in the browser with a single click. Below this text is a mathematical equation showing the addition of two 2x3 matrices:

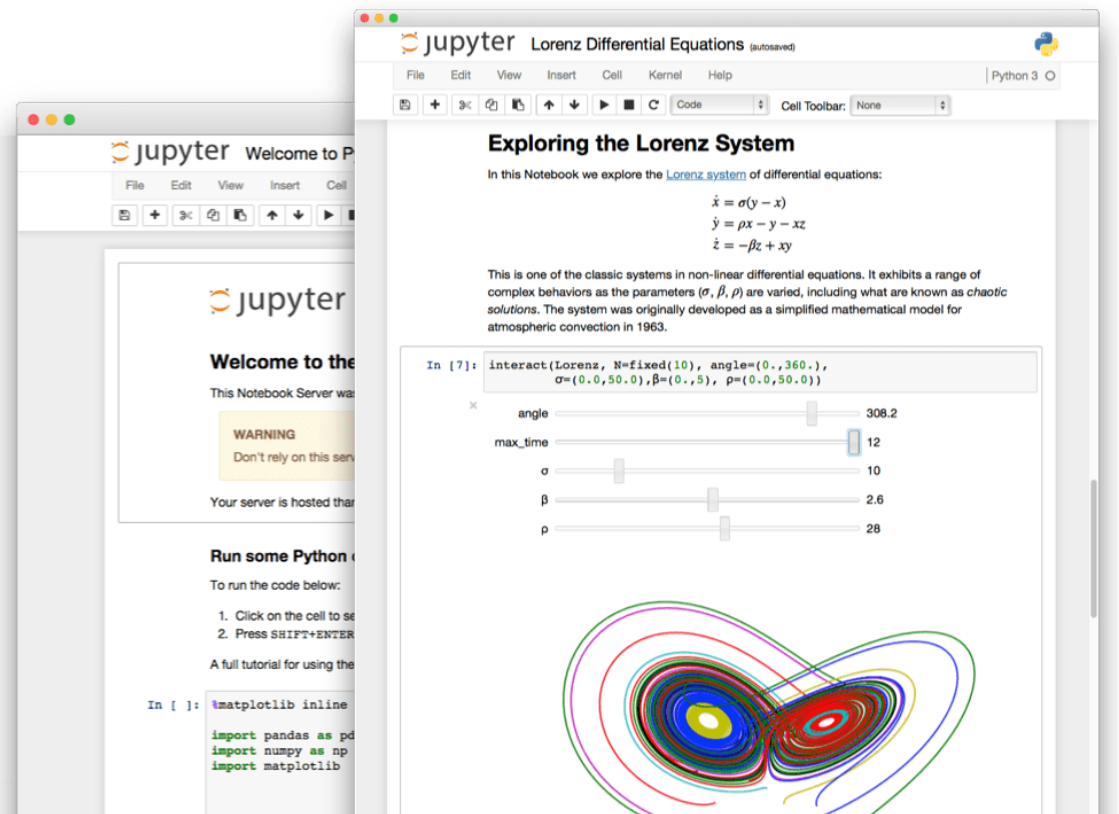
$$\begin{bmatrix} 1. & 1. & 1. \\ 1. & 1. & 1. \end{bmatrix} + \begin{bmatrix} 1. & 2. & 3. \\ 4. & 5. & 6. \end{bmatrix} = \begin{bmatrix} 2. & 3. & 4. \\ 5. & 6. & 7. \end{bmatrix}$$

Below the equation is a code cell containing TensorFlow and NumPy code. The output of the code is displayed as a NumPy array:

```
array([[ 2.,  3.,  4.],
       [ 5.,  6.,  7.]], dtype=float32)
```

The next section is "Visualization", which states that Colab includes libraries like `matplotlib` for simplifying visualization. It shows a code cell that generates a scatter plot with a linear regression line. The plot shows approximately 20 data points (blue dots) and a green line of best fit. The x-axis ranges from 0 to 20, and the y-axis ranges from 0 to 20.

# Jupyter



- Colab implement a cloud version of the Jupyter notebook  
→ <https://jupyter.org/>
- A Jupyter Notebook document is a JSON document  
→ ordered list of input/output cells  
→ can contain code, text, latex, mathematics, plots and media  
→ ".ipynb" extension.
- It's free and open-source
- It implements a language shell (aka interactive toplevel) environment built on IPython library  
→ IPython is command shell for interactive python  
→ Jupyter is a web-based, graphics implementation of IPython
- Other programming languages (49) are supported including R, Matlab, Julia, etc.



# Now Hands-on

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- The rest of the lecture is «hands-on»