



INTRODUCTION: GOOGLE COLAB

ECS7022P COMPUTATIONAL CREATIVITY





I. WHAT IS GOOGLE COLABORATORY?



BASICS

- Google Colaboratory (Colab for short) is a platform allowing for Python code to be executed in the browser with free external resources (GPUs) in an interactive environment. Easy to set up and easy to share.
- Colab files are Jupyter notebooks: a modular and flexible method to programming in Python
 - Code and text (simple Markdown/HTML support) are split into **cells** that can be run individually. Cells can be thought of as *functions*, grouping together a block of code. The flow through the program can be automatic from top to bottom, or manually controlled (by running cells in the desired order).
 - All cells are connected, e.g. import statements can all be done in one cell, and subsequent cells can use the files imported.
 - A cell must be executed for its contents to take effect (e.g. for files to be imported, variable values set etc.).
 - Cells have individual output, which can be text, images, interactive widgets etc.
 - Parameters for the code can be set, and code hidden, so that the notebook displays an interactive and easy to use application with no coding required.
- More information, tutorials etc. <https://colab.research.google.com/notebooks/intro.ipynb>

ADVANTAGES

- Easy to set up and share code that runs in the browser.
- Notebooks are automatically saved to Google Drive, so progress is not lost.
- Notebook cells are flexible and support many features, such as markdown text, parameters and interactive widgets.
- Each cell can also have comments/notes attached.
- Nice integration with GitHub — you can save notebooks directly to GitHub repositories:
<https://colab.research.google.com/github/googlecolab/colabtools/blob/master/notebooks/colab-github-demo.ipynb>
- Access to free GPUs and TPUs, good for deep learning applications.
- Two notebooks can be run simultaneously, but they share resources, sessions need to be managed appropriately.

LIMITATIONS (I)

- Run time is limited: 12h continuous run time maximum (24h for Pro)
- Sessions are also interrupted when inactivity is detected (kicks you out of session after ~90 minutes)
 - The web page running a notebook needs to be active for the whole session
- Limited memory available (~11GB)
 - Producing small artefacts is advised, e.g., tiny images
 - Produce larger artefacts from smaller ones, e.g., by collaging or neural scaling
 - Reduce the size of the model architectures to fit better into the memory available
- Requires a Google account, and uses GDrive storage space. Owned by Google, so not available in China

LIMITATIONS (2)

- Exceeding resource limits can lead to account temporarily locked out (hours/days). Terminating sessions manually or setting up timeout/memory usage conditions in the program is recommended.
 - Prioritize training models as early as possible
 - Run notebooks on the CPU while preparing, debugging, etc., and only turn on the GPU when ready to train the model for real
 - Connect to local machine if a suitable GPU is available
 - Develop notebooks on small models and only scale up when ready
 - Get into the habit of regularly saving the trained models during the training process – these can be loaded back in and continue training
- Keyboard shortcuts are not the same as in Jupyter Notebook, switching platforms is therefore not very intuitive

OTHER THINGS TO LOOK OUT FOR

- Google Drive management
 - When things are deleted in the Google Drive (or overwritten and the old version deleted), the deleted item is moved to trash, which still takes up space.
 - All Google services share the same space allocation, filling up the Drive might affect other services (e.g. Gmail)

SETTING UP A GOOGLE COLAB NOTEBOOK

Requirements:

- Google account
- A web browser

Two ways to set up Google Colab:

1. Navigate to <https://colab.research.google.com/notebooks/intro.ipynb>, choose File -> “New notebook” from the menu at the top-left, or use the pop-up menu. This will be saved in a “Colab Notebooks” folder in your GDrive home.
 - **Note:** Google sign-in is required.
 - To upload a Jupyter notebook in GDrive compatible with Colab, use the “Upload” tab in the pop-up from the link above.
2. ~~Connect to the Google Colaboratory app in your Google Drive to easily store notebooks (automatically saving changes) and access other data. The next few slides explain the steps for this in more detail.~~

NO LONGER AVAILABLE

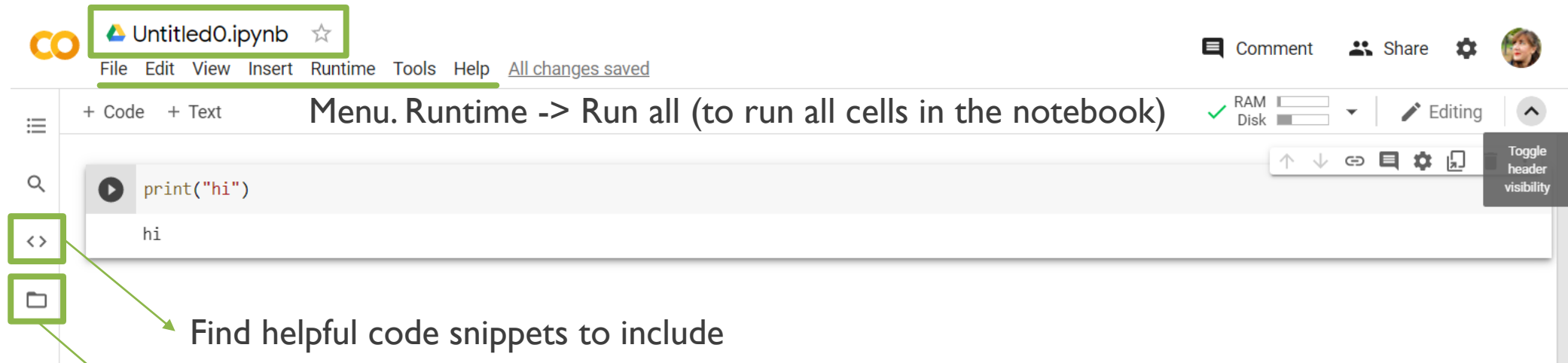


3. GOOGLE COLAB NOTEBOOKS



GOOGLE COLAB GENERAL INTERFACE

Rename and/or star file



The screenshot shows the Google Colab interface. At the top left, the Colab logo is next to the file name 'Untitled0.ipynb', which is highlighted with a green box and a star icon. Below the file name is a menu bar with options: File, Edit, View, Insert, Runtime, Tools, Help, and a link 'All changes saved'. To the right of the menu bar are icons for Comment, Share, Settings, and a user profile picture. Below the menu bar, there are buttons for '+ Code' and '+ Text'. The main area of the interface shows a code cell with the text 'print("hi")' and its output 'hi'. On the left side, there is a sidebar with a search icon and a file icon. The file icon is highlighted with a green box, and an arrow points from it to the text 'Files available for the session'. Another arrow points from the file icon to the text 'Find helpful code snippets to include'. The text 'Menu. Runtime -> Run all (to run all cells in the notebook)' is written in the center of the interface. On the right side, there are status indicators for RAM and Disk usage, and a 'Toggle header visibility' button.

Files available for the session

Find helpful code snippets to include

SHARING YOUR NOTEBOOK

Share -> Change to anyone with the link -> Viewer/Editor -> Copy link -> Done

Colab

Untitled0.ipynb ☆

File Edit View Insert Runtime Tools Help [All changes saved](#)

+ Code + Text

```
print("hi")
```

hi

RAM ☐ Disk ☐ Editing

↑ ↓ ↻ ⌨ ⚙ 📄 Toggle header visibility

Share with people and groups

Add people and groups

Raluca Gaina (you)
ralucagaina2009@gmail.com *Owner*

[Send feedback to Google](#) **Done**

Get link

Restricted Only people added can open with this link

[Change to anyone with the link](#) [Copy link](#)

Share with people and groups

No one has been added yet

Get link

<https://colab.research.google.com/drive/1Do0fbwBC41b-DmQFHMg9mvhF...> [Copy link](#)

Anyone with the link ▼
Anyone on the Internet with this link can edit

[Send feedback to Google](#) **Done**

Editor ▼

SHARING YOUR NOTEBOOK

- With limited permissions / in sandbox mode:
 - Retrieve the ID of the file from the link obtained via method on previous slide, e.g. if link is
 - <https://colab.research.google.com/drive/IvJAsVQ0KQ3kLk64ux-fsD7TmZRS3-OO7?usp=sharing>
 - Then the file ID is
 - IYRr3irMjlfj7gd0n4E9dENIE6CIRnvet
 - Replace the ID in this link format (instead of xxxxxxxx):
 - <https://colab.research.google.com/drive/xxxxxxx#offline=true&sandboxMode=true>

COLAB NOTEBOOK INTERFACE

Add a new
cell with code

Add a new
cell with text

+ Code

+ Text

Resource usage information

Code cell



```
text = "hello world" # @param{type:"string"}
print(text)
```

Code (left click to edit)

hello world

Output

Run cell

(CTRL/CMD + ENTER) = run

(SHIFT + ENTER) = run and move to next cell

(ALT + ENTER) = run and create code cell

text: "hello world"

Double-click white space
to show/hide code if using
parameters

Re-order cells, link to cell,
comment, delete etc.

Text cell

⌘

B

I

<>

🔗

🖼️

☰

☰

☰

⋮

⋮

This is some **text**

Markdown text

This is some text

Output

Double-click a text cell to edit


(SHIFT + ENTER) = apply text edits

ENABLING GPU

- Edit -> Notebook settings -> Hardware accelerator -> GPU -> Save

Notebook settings

Hardware accelerator

GPU 

None

GPU

TPU

lab, avoid using
ne. [Learn more](#)

☐ Omit code cell output when saving this notebook

CANCEL


SAVE

```
[1] import tensorflow as tf
```

```
print("TF Version: ", tf.__version__)  
print("GPU available: ", tf.config.list_physical_devices('GPU'))
```

```
TF Version: 2.3.0  
GPU available: [PhysicalDevice(name='/physical_device:GPU:0', device_type='GPU')]
```

INSERTING IMAGES

- The best option: use images saved in your GDrive.
- Right-click an image in your drive -> Get link -> Anyone with the link (Viewer) -> Copy link
 - <https://drive.google.com/file/d/IZ9PwlwUNjo9XIKxVHxCYe3YLcQboG6hq/view?usp=sharing>

image ID
- Copy the ID of the image in the following format:
 - ``
 - e.g. ``

MOUNTING YOUR GOOGLE DRIVE

- In order to read/write information to your drive, you will need to *mount* it.
- Add in a new code cell the following 2 lines:

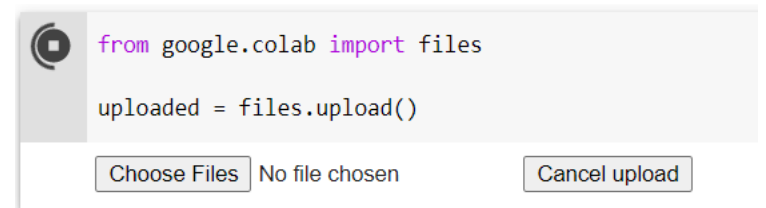
```
from google.colab import drive
drive.mount('/content/drive')
```
- Executing this code cell will produce an output with an external URL and an input space for an authentication code.
- Click on the link. This will lead you to a page where you will be asked to sign in with your Google account and allow access to your drive. After doing so, you will be given a code.
- Copy the code, return to the Google Colab tab and paste the code into the input space available.
- All set up! You can now work with files IO as normal in python, where the path to the root of your Google Drive is `'/content/drive/My Drive/`.
- `drive.flush_and_unmount()` function *unmounts* the drive and makes all changes visible.

READ/WRITE FILES FROM LOCAL

- If you prefer to upload files from your machine instead, or download them after execution (instead of working through the Google Drive), you can use the following code:

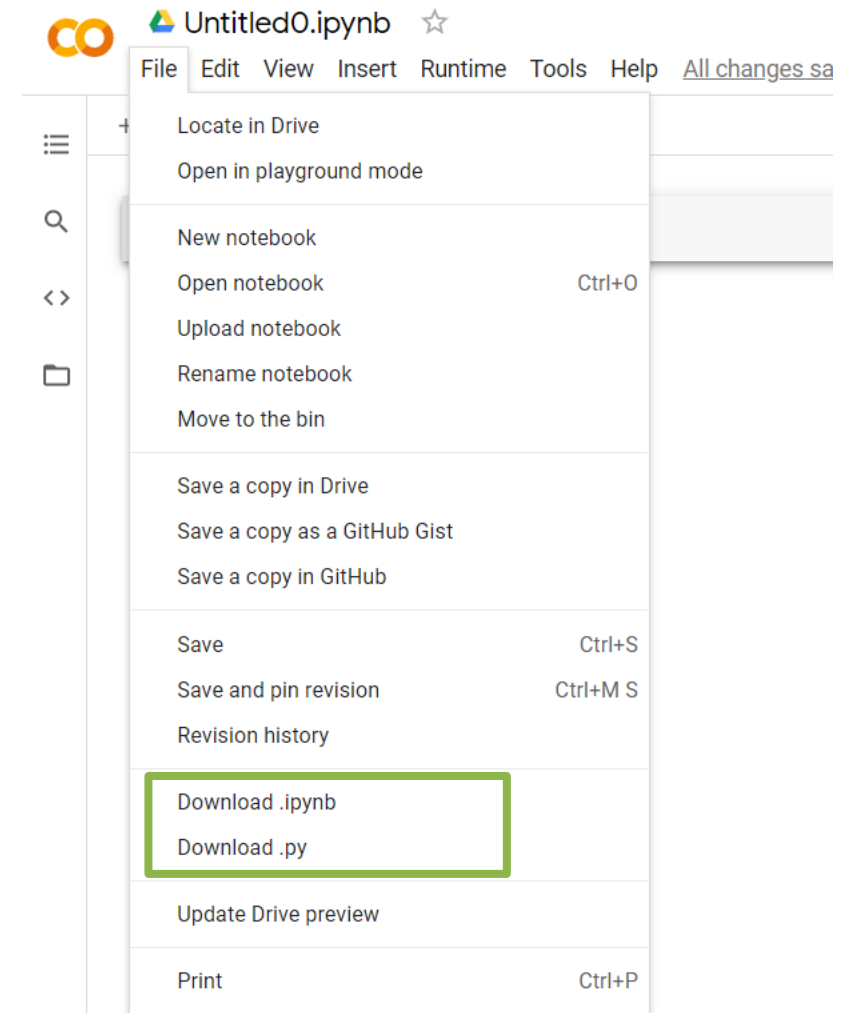
```
from google.colab import files
uploaded = files.upload()
```
- Running these lines will produce a file chooser widget as output. Clicking 'Choose Files' will open a dialogue allowing you to navigate your files and select those you wish to upload. Click 'Cancel upload' if you do not wish to upload anything.
- The '**uploaded**' variable will hold a dictionary of the files uploaded, mapping from *name* to *file*.
- To download files:

```
from google.colab import files
files.download('example.txt')
```



EXPORTING AS PYTHON FILE / JUPYTER NOTEBOOK

- Download Jupyter Notebook:
 - File -> Download .ipynb
- Download Python file (any non-code cells become comments, all notebook is merged into one file, with text/code in cell order):
 - File -> Download .py



RUNNING COMPUTATIONAL CREATIVITY NOTEBOOKS

- When you open a practical notebook and try to run a cell, you might be faced with a warning prompt:

Warning: This notebook was not authored by Google.

- This is safe to ignore and click “Run anyway”. If you’re attempting to run other external notebooks, make sure you understand what the code does before you run it to avoid running into privacy/security issues.
- The notebooks for this module open in sandbox mode. Make sure to click **File -> Save** (or **CTRL/CMD+S**) after you open it, and save to your own GDrive, so that any changes you make are not lost! Changes you make do not affect the original notebook. If you spot any errors that should be corrected for everyone, let us know!

Cannot save changes

This notebook is in playground mode. Changes will not be saved unless you make a copy of the notebook.

[CANCEL](#) [SAVE A COPY IN DRIVE](#)

MORE INFORMATION

- Colab forms / code parameters: <https://colab.research.google.com/notebooks/forms.ipynb>
- Widgets from code: <https://colab.research.google.com/notebooks/widgets.ipynb>
- File input/output: <https://colab.research.google.com/notebooks/io.ipynb>
- Markdown guide: https://colab.research.google.com/notebooks/markdown_guide.ipynb
- Other features: https://colab.research.google.com/notebooks/basic_features_overview.ipynb
- Tensorflow: <https://www.tensorflow.org/tutorials/>
- Colab intro and other resources: <https://colab.research.google.com/notebooks/intro.ipynb>