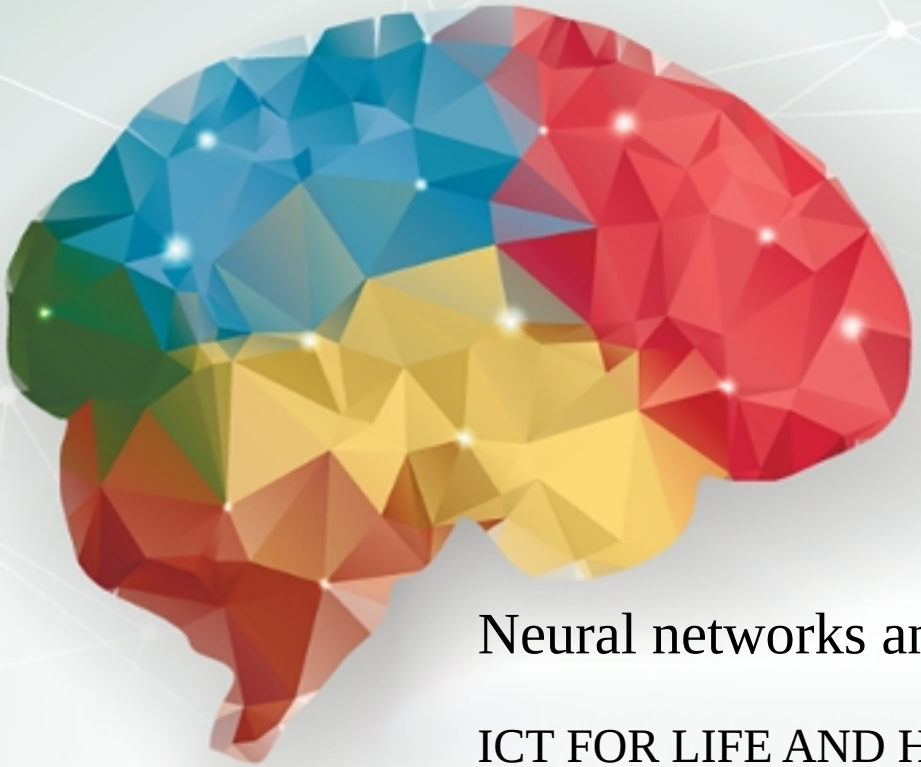

Neural networks and deep learning

ICT FOR LIFE AND HEALTH - Department of Information Engineering

PHYSICS OF DATA - Department of Physics and Astronomy
COGNITIVE NEUROSCIENCE AND CLINICAL NEUROPSYCHOLOGY - Department of Psychology

A.A. 2019/20 (6 CFU)

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Lab resources

- DEI GitLab
  - Web user interface: https://gitlab.dei.unipd.it/
  - SSH: git@gitlab.dei.unipd.it:chiariot/nndl_1920.git
  - HTTPS: https://gitlab.dei.unipd.it/chiariot/nndl_1920.git
- Access with your DEI account
  - Please verify your access to the server login.dei.unipd.it
    - ssh deiuser@login.dei.unipd.it
- You can also create your own project to safely store your code
- Useful commands
  - git clone https://gitlab.dei.unipd.it/chiariot/nndl_1920.git
  - git pull

Setting up Anaconda

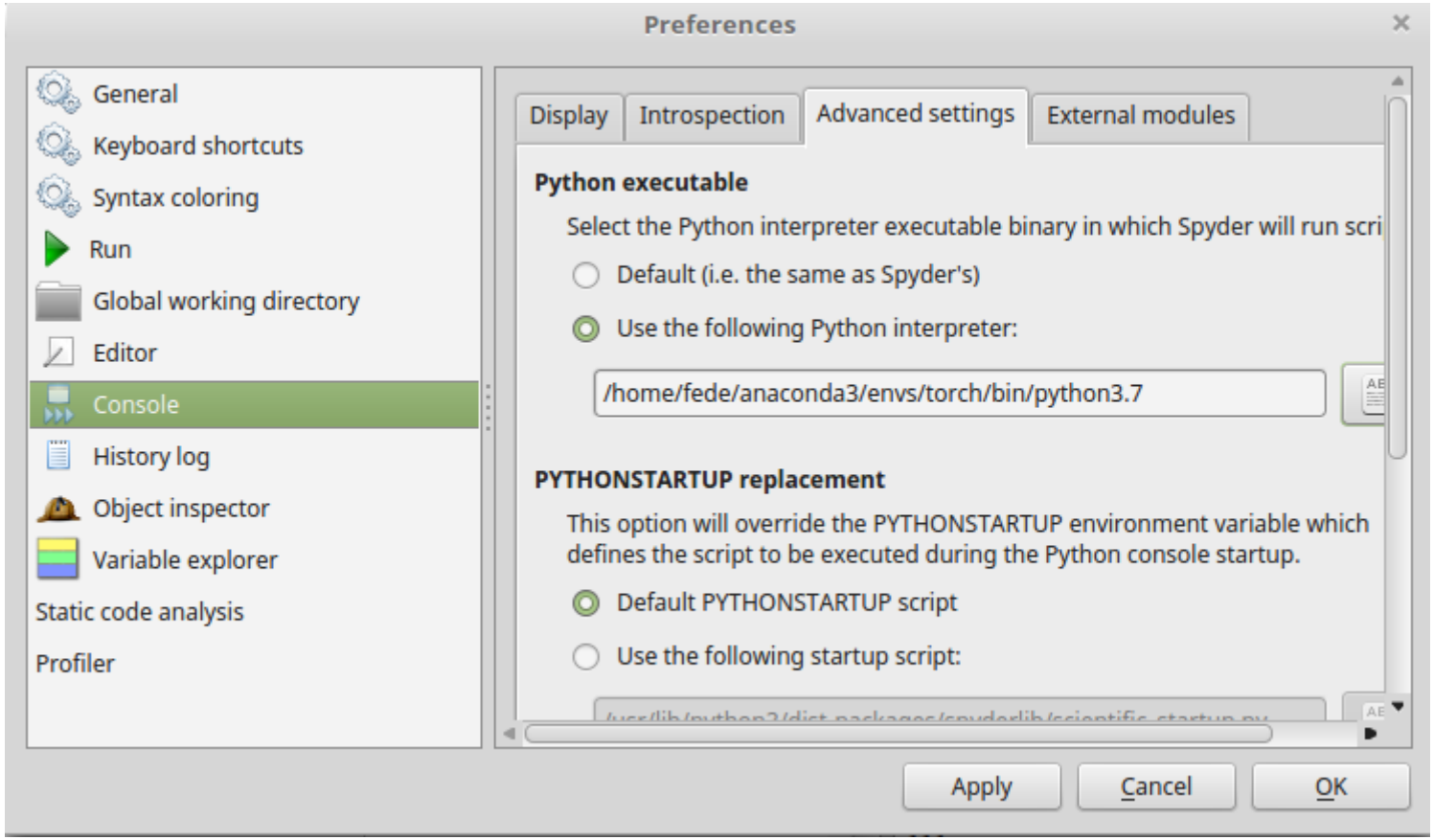
1. Install Anaconda from the website: https://www.anaconda.com/

2. Set up pytorch environment

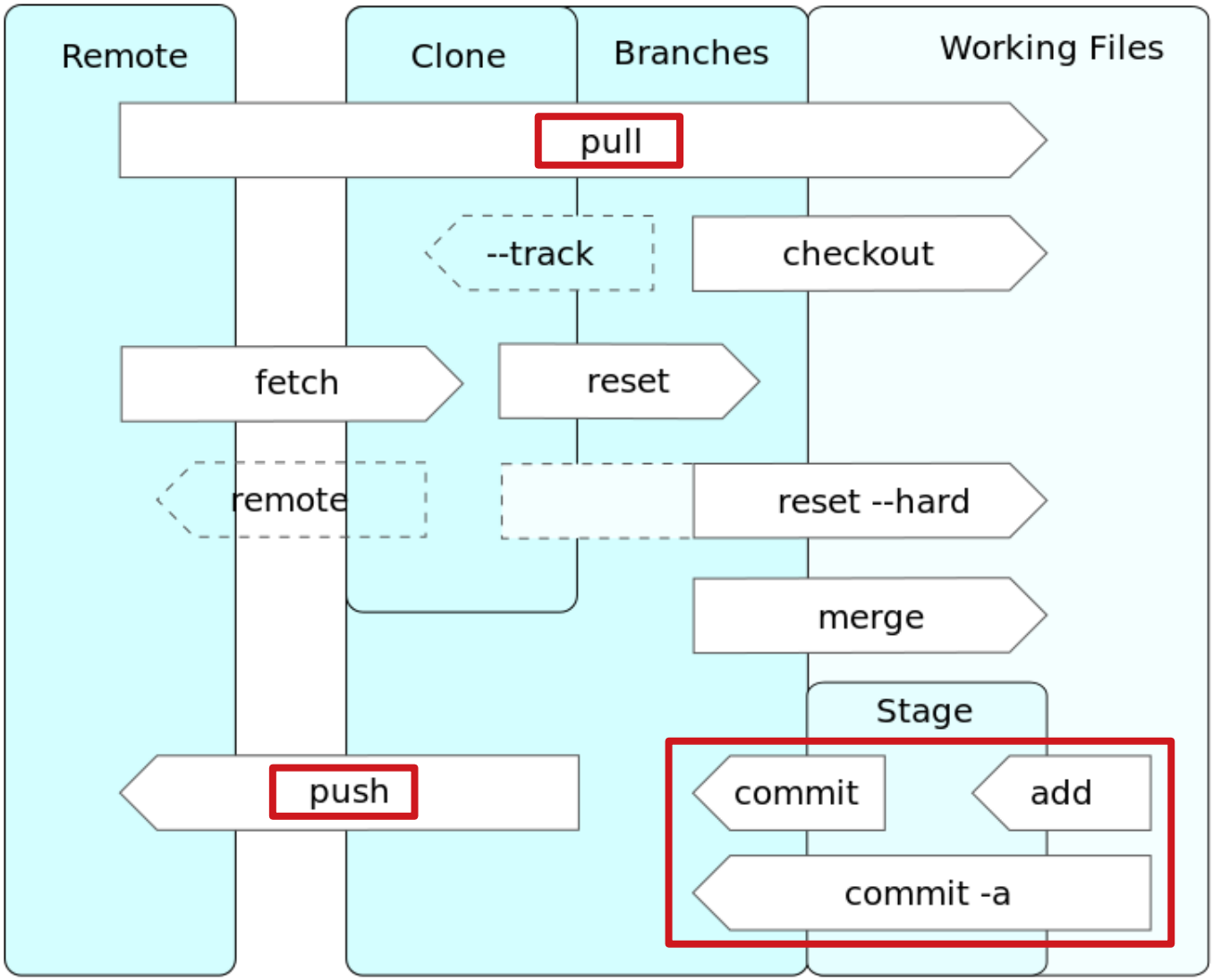
```
~$ conda create --name torch
~$ conda info --envs
~$ conda install -n torch pytorch
~$ conda list
~$ conda search pytorch
~$ conda install -n torch pytorch torchvision cudatoolkit=10.0 -c pytorch
~$ conda list -n torch
~$ source activate torch
```

Setting up Spyder

Set Anaconda interpreter in Spyder



Git


Remote
Clone
Branches
Working Files
pull
--track
checkout
fetch
reset
remote
reset --hard
merge
Stage
push
commit
add
commit -a

LOCAL

Git

FROM REMOTE TO LOCAL

- Clone remote repo to local
  `git clone https://gitlab.dei.unipd.it/gadaleta/compneuro.git`
- Update local repo (default branch)
  `git pull`

LOCAL

- Show the working tree status
  `git status`
- Stage a new or modified file to commit
  `add filepath`
- Stage all local files (new and modified) to commit
  `add -A`
- Commit staged files
  `commit -m “message”`
- Add modified files (not new) and commit in a single command
  `commit -am “message”`

FROM LOCAL TO REMOTE

- Upload staged changes to remote repo
  `git push`

EMERGENCY RESET
(same as new clone)

```
git fetch origin
git reset --hard origin/master
```

Ordinary Least Square

$$y = a + bx + cx^2 + \text{noise} \longrightarrow \mathbf{Y} = \mathbf{X}\boldsymbol{\beta} + \text{noise}$$

$$\boldsymbol{Y} = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix} \qquad \boldsymbol{X} = \begin{bmatrix} x_1^0 & x_1^1 & x_1^2 \\ x_2^0 & x_2^1 & x_2^2 \\ \vdots & \vdots & \vdots \\ x_N^0 & x_N^1 & x_N^2 \end{bmatrix} = \begin{bmatrix} 1 & x_1 & x_1^2 \\ 1 & x_2 & x_2^2 \\ \vdots & \vdots & \vdots \\ 1 & x_N & x_N^2 \end{bmatrix} \qquad \boldsymbol{\beta} = \begin{bmatrix} a \\ b \\ c \end{bmatrix}$$

$$\hat{\boldsymbol{\beta}} = \arg\min_{\boldsymbol{\beta}} \|\boldsymbol{Y} - \boldsymbol{X}\boldsymbol{\beta}\|^2 \longrightarrow \boxed{\hat{\boldsymbol{\beta}} = (\boldsymbol{X}^T\boldsymbol{X})^{-1}\boldsymbol{X}^T\boldsymbol{Y}}$$

Regularized Least Squares

Regularization term

$$\hat{\boldsymbol{\beta}} = \arg\min_{\boldsymbol{\beta}} \; \|\boldsymbol{Y} - \boldsymbol{X}\boldsymbol{\beta}\|^2 + \alpha \sum_{\beta \in \boldsymbol{\beta}} |\beta|^2$$

L2 penalty

$$\hat{\boldsymbol{\beta}} = (\boldsymbol{X}^T\boldsymbol{X} + \alpha\boldsymbol{I})^{-1}\boldsymbol{X}^T\boldsymbol{Y}$$