Create a *Python Virtual Environment* (PVE)

Learning outcomes:
- Learn to install Python with *miniconda*.
- Learn to create and use a Python Virtual Environment with the *conda* command.

Expected duration:
- 30-45 minutes (depending on your Internet connection).

Summary

▸ Interest

The state of the art in Python programming (Data processing, Machine Learning…) is to work within a **Python Virtual Environment** (PVE) to encapsulate each project in a dedicated and persistent environment. Each PVE provides a dedicated computing environment containing a specific installation of Python:

- independent of other Python installations likely to coexist on the same machine,
- independent of computer updates.

A PVE is based on a dedicated disk tree that houses the version of the Python interpreter and modules that you need for your project. You can create, delete and re-create a PVE very easily, without impacting other Python installations possibly present on your computer.

▸ Tools

The two most often used tools to create PVE are:

- the `conda` command, available if you have installed miniconda or Anaconda on your computer
- the `venv` Python module (see venv).

The advantage of *miniconda* for numerical computation is that it transparently installs the MKL library which provides Intel processors optimization for linear algebra libraries (BLAS, LAPACK …) that determine the performance modules like *numpy*.

Another advantage of *miniconda* is that you can create PVE of any version : for example with the last *miniconda Python 3.9* version you can create a “Python 3.8 PVE”, or a “Python 3.7 PVE” or even a “Python 2.7 PVE”… and they can all coexist on the same computer!

▸ Understanding how to create a PVE with conda

Prior to the creation of a PVE, you will have to install the *miniconda* package on your computer. You will see this later in the present document, in the section [Work do to] for your operating system. For now the goal is just to understand the main steps of creating a PVE. With *miniconda* installed on your computer, you can create & configure as many PVE as you want following the 3 steps procedure explained bellow.

> Don't do the job **now**!
> just understand the commands syntax and arguments, do the job **later** for real in the section [Work do to].

1/ How to create a PVE

```
conda create -n <pve_name> pip python=<version>
```

- <pve_name> is the (free) name of your PVE, often a mnemonic like *pyml*(for *Python machine learning*) or *tf2* (for a project under tensorflow2)…
- <version> is the version of Python you want to install in your PVE (for example *3.6* or *3.6.8* or *3.8*…)

2/ How to activate a PVE

```
conda activate <pve_name>
```

- Activating PVE results in the prompt being prefixed with the string (<pve_name>).
  For example under Windows, if the current prompt is C:\Users\\LOGNAME$, activating the PVE named pyml modifies the prompt which becomes: (pyml) C:\Users\LOGNAME$.
  Under GNU/Linux, a prompt like logname@host $ becomes (pyml) logname@host $ and under MacOS a prompt like Mac:~ logname$ becomes (pyml) Mac:~ logname$.

3/ How to add Python modules to the PVE

```
conda install <module>
conda install <module==version>                    if you want to force the module version
```

- this command downloads and installs the Python module named <module> within the activated PVE. Not all the Python modules have a conda version.

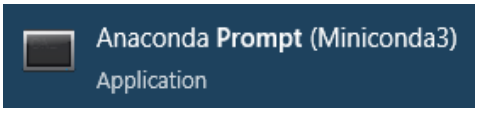
```
pip install <module>
pip install <module==version>                      if you want to force the module version
```

- this command downloads and installs the Python module named <module> in your PVE. All the Python modules are available with the pip installer.

> The important point is that your PVE must be activated!

▸ Install a PVE under Windows

If you don't find the Anaconda Prompt application when searching "anaconda prompt" in the Windows search bar, then you need to install the *miniconda3* package else you can skip the *miniconda* installation.



▸ How does a Virtual Environment work

The installation of the *miniconda3* package under Windows creates a specific version of the terminal (*aka* the "*command windows*") named Anaconda Prompt. In this terminal, the PATH environment variable is modified to first reference the directory containing the conda executable: C:\Users\LOGNAME\Miniconda3\condabin.

When you activate the PVE pve_name, The PATH environment variable is modified to first reference the PVE root directory C:\Users\LOGNAME\Miniconda3\envs\pve_name:

- all the Python-related commands (*python*, *pip* …) are first searched under the PVE root directory tree,
- any installation of a Python module with *conda* or *pip* installs the module under the PVE root directory.

Work to do in 3 steps

▸ 1 – Installation of `miniconda3`

Download the last version of *miniconda3* from doc.conda.io (take care to choose the 64 bits version, unless your PC is a 32 bits one… which is very unlikely).

Pay attention to these points:

- Miniconda3 directory path must not contain spaces or accented characters (the default path on Windows is: C:\Users\LOGNAME\Miniconda3\). See this frequently asked question here :

> **In what folder should I install Anaconda on Windows?**
>
> We recommend installing Anaconda or Miniconda into a directory that contains only 7-bit ASCII characters and no spaces, such as `C:\anaconda`. Do not install into paths that contain spaces such as `C:\Program Files` or that include `Unicode` characters outside the 7-bit ASCII character set. This helps ensure correct operation and no errors when using any open-source tools in either Python 3 or Python 2 conda environments.

- Install *miniconda3* *"just for me"*.
- Keep unchecked the option "*Add Miniconda to my PATH environment variable*".
- If you don't have any other version of Python installed on your computer you can check the option "*Register Miniconda3 as my default Python ...*" else uncheck this option.
- At the end of the installation answer *yes* to the question *"Do you wish the installer to initialize Miniconda3 by running conda init? [yes | no]"*
- Advice: you can disable the automatic launch of the PVE (base) by typing the command in a terminal (an Anaconda Prompt window):

```
conda config --set auto_activate_base false
```

Now it's done. If you want to check your installation, launch a new terminal and try the command 'conda info': you should get no error in return and see informations on your *miniconda3* displayed on the screen.

▸ 2 – Create a PVE dedicated to `tensorflow2`

With *conda* available on your computer, create and activate the PVE named pyml-pm to work with Python 3.8 :

```
(base) C:\Users\LOGNAME$ conda  create  -n  pyml-pm  pip  python=3.8
...some stuff ... answer 'y'  to proceed to the installation...

(base) C:\Users\LOGNAME$ conda  update  -n base  -c  defaults conda
... some stuff…

(base) C:\Users\LOGNAME$ conda activate pyml-pm
(pyml-pm) C:\Users\LOGNAME$
```

Now install the Python modules required for this course :

- Open the Git repository https://github.com/cjlux/AI-Machine_Learning_at_ENSPIMA
- Download the ZIP archive with the button 

- Extract the directory AI-Machine_Learning_at_ENSPIMA-master from the ZIP archive somewhere in your working tree
- Rename AI-Machine_Learning_at_ENSPIMA-master as AI-Machine_Learning_at_ENSPIMA
- install all the modules with these commands:

```
(pyml-pm) C:\Users\LOGNAME$ cd  <path_of_folder AI-Machine_Learning_at_ENSPIMA>
(pyml-pm) C:\Users\LOGNAME$ pip install -r requirements.txt
(pyml-pm) C:\Users\LOGNAME$ conda install numpy pydot pydotplus
```

▸ 3 – Install the *idlex* minimalist IDE

In the terminal with the pyml-pm PVE activated type in the command:

```
(pyml-pm) C:\Users\LOGNAME$ pip  install  idlex
```

Now you will create a shortcut that runs idlex.py within the activated pyml-pm PVE:

- Right-click on the Windows desktop.
- Move your mouse cursor over New > ShortCut in the pop-up menu and browse to select the file C:\Users\LOGNAME\Miniconda3\envs\pyml-pm\Scripts\idlex.py
- Name the short-cut as (pyml-pm) idlex.py
- Find the icon (pyml-pm) idlex.py on your desktop and righ-click on it to edit its properties :
- in the field Target, copy the string:
  C:\Users\LOGNAME\Miniconda3\condabin\conda.bat activate pyml-pm & C:\Users\LOGNAME\Miniconda3\envs\pyml-pm\python.exe C:\Users\LOGNAME\Miniconda3\envs\pyml-pm\Scripts\idlex.py
  replacing C:\Users\LOGNAME by the actual path of the Miniconda3 directory on your computer.

- In the field Start In copy the path of your directory C:\Users\LOGNAME (replacing LOGNAME by the actual value on your computer).
- Click on the Change icon button and browse to select C:\Users\LOGNAME\Miniconda3\Lib\idlelib\Icons\idle.ico

Now you can double-click on the (pyml-pm) idlex icon : you get the *Interpreter window* and with the menu File > New File, you get the *Editor windows*.

All the work made with this icon is done within the (pyml-pm) PVE.

▸ Install a PVE under MacOS

If you cannot run the miniconda command in a terminal then you need to install the *miniconda3* package else you can skip the *miniconda3* installation.

▸ How does a Virtual Environment work

The installation of *miniconda3* modifies the .bashrc file in your home directory. The PATH environment variable is modified to mention first the directory containing the conda command: /Users/<logname>/opt/miniconda3/condabin).

When you activate the PVE pve_name, The PATH variable is modified again to reference first the PVE root directory /Users/<logname>/opt/miniconda3/envs/pve_name:

- all the Python-related commands (*python*, *pip* …) are first searched under the PVE root directory tree,
- any installation of a Python module with *conda* or *pip* installs the files under the PVE root directory.

Work to do in 3 steps

▸ 1 – Installation of *miniconda3*

Download and install miniconda on your computer from https://docs.conda.io/en/latest/miniconda.html. Pay attention to these points:

- the *installation path* of the miniconda3 directory must not contain any spaces or accentuated character. (the default installation path on MacOs is: /Users/<logname>/opt/miniconda3)
- At the end of the installation answer *yes* to the question *"Do you wish the installer to initialize Miniconda3 by running conda init? [yes | no]"*
- Start a new terminal or type the command source ~/.bashrc to inherit changes from your .bashrc file: the conda command now becomes available in the terminal.
- Advice: you can disable the automatic launch of the PVE (base) by typing the command:

```
conda config --set auto_activate_base false
```

Now it's done. If you want to check your installation, launch a new terminal and try the command conda info: you should get no error in return and see information on your *miniconda3* displayed on the screen.

2 – Create a PVE dedicated to `tensorflow2`

With *conda* available on your computer, create and activate the PVE named pyml-pm to work with Python 3.8 :

```
(base) Mac:~ logname$ conda create -n pyml-pm pip python=3.8
...some stuff ... answer 'y' to proceed to the installation…

(base) Mac:~ logname$ conda update -n base -c defaults conda
... some stuff…

(base) Mac:~ logname$ conda activate pyml-pm
(pyml-pm) Mac:~ logname$
```

Now install the Python modules required for this course :

- Open the Git repository https://github.com/cjlux/AI-Machine_Learning_at_ENSPIMA
- Download the ZIP archive with the button 

- Extract the directory AI-Machine_Learning_at_ENSPIMA-master from the ZIP archive somewhere in your working tree
- Rename AI-Machine_Learning_at_ENSPIMA-master as AI-Machine_Learning_at_ENSPIMA
- install all the modules with these commands:

```
(pyml-pm) C:\Users\LOGNAME$ cd  <path_of_folder AI-Machine_Learning_at_ENSPIMA>
(pyml-pm) C:\Users\LOGNAME$ pip install -r requirements.txt
(pyml-pm) C:\Users\LOGNAME$ conda install numpy pydot pydotplus
```

If you get an error like "*No matching distribution found tensorflow==2.6*" try to lower the tensorflow version to the highest one mentioned in the error message (2.5.4, 2.4.3 ?) and retry the installation with this version number.

The installation of the module opencv-python on some MacOS laptop may require *Xcode* to compile the source code of the module. Install the *Xcode* development workbench on your laptop and retry the installation of the module, it takes a very long time to compile the module, don't worry, be patient….

▸ 3 – Install the *idlex* minimalist IDE

In the terminal with the pyml-pm PVE activated type in the command:

```
(pyml-pm)  Mac:~ logname$ pip  install  idlex
```

That's all. To run idlex, simply type:

```
(pyml-pm)  Mac:~ logname$ idlex
```

you get the *Interpreter window* and with the menu File > New File, you get the *Editor windows*.
All work done following this procedure is done in the pyml-pm PVE.

▸ Install a PVE under GNU/Linux

If you cannot run the miniconda command in a terminal then you need to install the *miniconda3* package else you can skip the installation.

▸ How does Virtual Environment work

The installation of *miniconda3* modifies the .bashrc file in your home directory. The PATH environment variable is modified to first reference the directory containing the conda command: /home/<logname>/miniconda3/condabin on Ubuntu.

When you activate the PVE pve_name, The PATH variable is modified again to first reference the PVE root directory /home/<logname>/miniconda3/envs/pve_name:

- all the Python-related commands (*python*, *pip* …) are first searched under the PVE root directory tree,
- any installation of a Python module with *conda* or *pip* installs the files under the PVE root directory.

Work to do in 3 steps

1 – Install `miniconda`

Download and install miniconda on your computer from https://docs.conda.io/en/latest/miniconda.html. Pay attention to these points:

- The *installation path* for the miniconda3 directory must not contain spaces or accentuated characters (the default installation path on Ubuntu is: /home/<logname>/miniconda3)
- At the end of the installation answer *yes* to the question *"Do you wish the installer to initialize Miniconda3 by running conda init? [yes | no]"*
- Start a new terminal or type the command source ~/.bashrc to inherit changes from your .bashrc file: the conda command now becomes available in the terminal.
- Advice: you can disable the automatic launch of the PVE (base) by typing the command:

```
conda config --set auto_activate_base false
```

Now it's done. If you want to check your installation launch, a new terminal and try the command conda info: you should get no error in return and see a information on *miniconda3* displayed on the screen.

2 – Create a PVE dedicated to `tensorflow2`

With *conda* available on your computer, create and activate the PVE named pyml-pm to work with Python 3.8 :

```
(base) logname@host $ conda create -n pyml-pm pip python=3.8
...some stuff ... answer 'y'  to proceed to the installation...
...
(base) logname@host $ conda update -n base -c defaults conda
... some stuff...

(base) logname@host $ conda activate pyml-pm
(pyml-pm) logname@host $
```

Now install the Python modules required for this course :

- Open the Git repository https://github.com/cjlux/AI-Machine_Learning_at_ENSPIMA
- Download the ZIP archive with the button 

- Extract the directory AI-Machine_Learning_at_ENSPIMA-master from the ZIP archive somewhere in your working tree
- Rename AI-Machine_Learning_at_ENSPIMA-master as AI-Machine_Learning_at_ENSPIMA
- install all the modules with these commands:

```
(pyml-pm) C:\Users\LOGNAME$ cd  <path_of_folder AI-Machine_Learning_at_ENSPIMA>
(pyml-pm) C:\Users\LOGNAME$ pip install -r requirements.txt
(pyml-pm) C:\Users\LOGNAME$ conda install numpy pydot pydotplus
```

▸ Install the *idlex* minimalist IDE

In the terminal with the pyml-pm PVE activated type in the command:

```
(pyml-pm) logname@host $ pip install idlex
```

That's all. To run idlex, simply type:

```
(pyml-pm) logname@host $ idlex
```

you get the *Interpreter window* and with the menu File > New File, you get the *Editor windows*.
All work done following this procedure is done in the pyml-pm PVE.

▸ Useful commands

command	*description*
conda info	Display informations about *conda*
conda env list	List the PVEs known by *conda*
conda deactivate	Deactivate the currenttly activated PVE
conda activate <pve_name>	Activate the PVE named <pve_name>
conda list	conda view of the list of installed packages for the activated PVE
pip list	pip view of the list of installed packages for the activated PVE
conda search <name>	Find versions of the Python module named <name> compatible with the activated PVE