

Power Systems Resilience Analysis during Extreme Weather Software Implementation: Python Packages Installation Instruction

The resilience analysis of regional power systems under extreme events is prevalent due to the crippling social impacts and substantial economic losses caused by bulk power outages. The study of hurricane's impact on the power system infrastructure helps find the weak links in the system and helps in clarifying the efficient restoration and recovery procedures. To evaluate the performance of the power systems under hurricane events, a data generation engine is developed using Python programming language. Using the developed Python scripts, some necessary packages, software are needed. This Python package installation instruction aimed at providing guidelines to successfully running the scripts.

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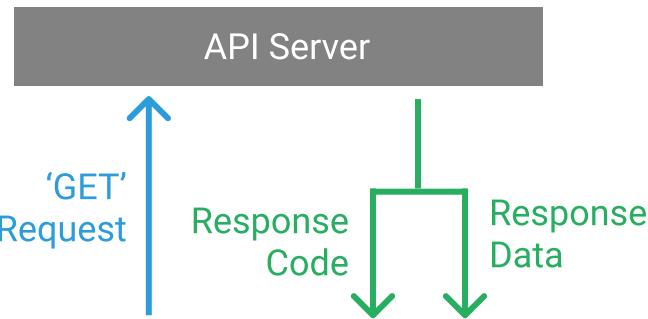
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Basic Python Programming Language Terminology

In this section, a few Python Programming language terminologies will be introduced to help understand the Python basics. The full Python programming language introduction can be found at [Python Introduction](#).

- **Python version:** [python.org](https://www.python.org) will release different version of Python every year. Even though the main functionality is the same, each version of Python has slightly different functionalities. The Python version is important when some libraries (packages) only support specific versions of Python. If Python has been installed, the version of Python can be checked by:
 - Windows: Open PowerShell and type `python --version`
 - Mac: Open Terminal and type `python --version`

- **IDE:** IDE is short for Integrated Development Environment. Python built-in IDLE is useful for running simple codes. But using IDEs, larger and more complex programming projects can be easily handled. In the market, there are lots of free and proprietary IDEs, for example ([Pycharm](#), [Spider](#)). All IDEs can help manage and organize the project, the preference is based on personal choice.
- **Virtual Environment:** Python virtual environment is a tool used for Python package management and project isolation. It allows Python packages to be installed locally in a separate directory for a particular project.
- **Packages:** A python packages consists of several modules. A module is a Python program that is a reusable code that serves particular purpose. In essence, Python packages contains a cluster of functions that can be used repeatedly.
- **API:** API is short for Application Programming Interface. It is a server that the user can use to retrieve and send data via code. The interaction between the code and API is illustrated in the following figure. The full Python API introduction can be found at [Python API tutorial: Getting Started with APIs](#).



Python Installation

This software supports Python version Python3.6 or above. If the users has installed Python version 3.6 or above, this section can be skipped.

- Go to [Python.org](#) to download the latest Python version.

The screenshot shows the Python.org homepage. At the top, there are navigation links for Python, PSF, Docs, PyPI, Jobs, and Community. Below the header is the Python logo and a search bar with a magnifying glass icon. There are buttons for 'Donate' and 'GO'. A 'Socialize' link is also present. The main content area has a blue header with tabs for About, Downloads, Documentation, Community, Success Stories, News, and Events. The 'Downloads' tab is active. A sidebar on the left contains a snippet of Python code and a list of download options: All releases, Source code, Windows, macOS, Other Platforms, License, and Alternative Implementations. The main content area features a large image of a computer monitor displaying the Python code. To the right of the image, there is a section titled 'Download for Windows' which highlights Python 3.10.6. It includes a note that Python 3.9+ cannot be used on Windows 7 or earlier, and a link to view the full list of downloads.

- Click the downloaded .exe for Windows or .dmg file for Mac and follow up the default settings.
- Check whether Python has been successfully installed:
 - **Windows:** Open PowerShell and type `python --version`
 - **Mac:** Open Terminal and type `python --version`

Python IDEs

Python IDE is an editor that helps manage large, complex Python projects. In the market, there are lots of free and charged IDEs, for example ([Pycharm](#) and [Spider](#)). In this instruction, [Pycharm](#) is used as a demonstration for the current and latter instructions. For other user-preferred IDEs, the user can visit their website to know the details about installation.

- Go to [Pycharm](#) and click download button. The download button is on the upper-right in the website.
- In the downloading page, choose which operational system (Windows, Mac, Linux) the current machine is used and choose *Community* version.



Version: 2022.2.1
Build: 222.3739.56
16 August 2022

[System requirements](#)
[Installation instructions](#)
[Other versions](#)
[Third-party software](#)

Download PyCharm

[Windows](#) [macOS](#) [Linux](#)

Professional

For both Scientific and Web Python development. With HTML, JS, and SQL support.

[Download](#)

Free 30-day trial available

Machine Operational System

Community

For pure Python development

Free Version

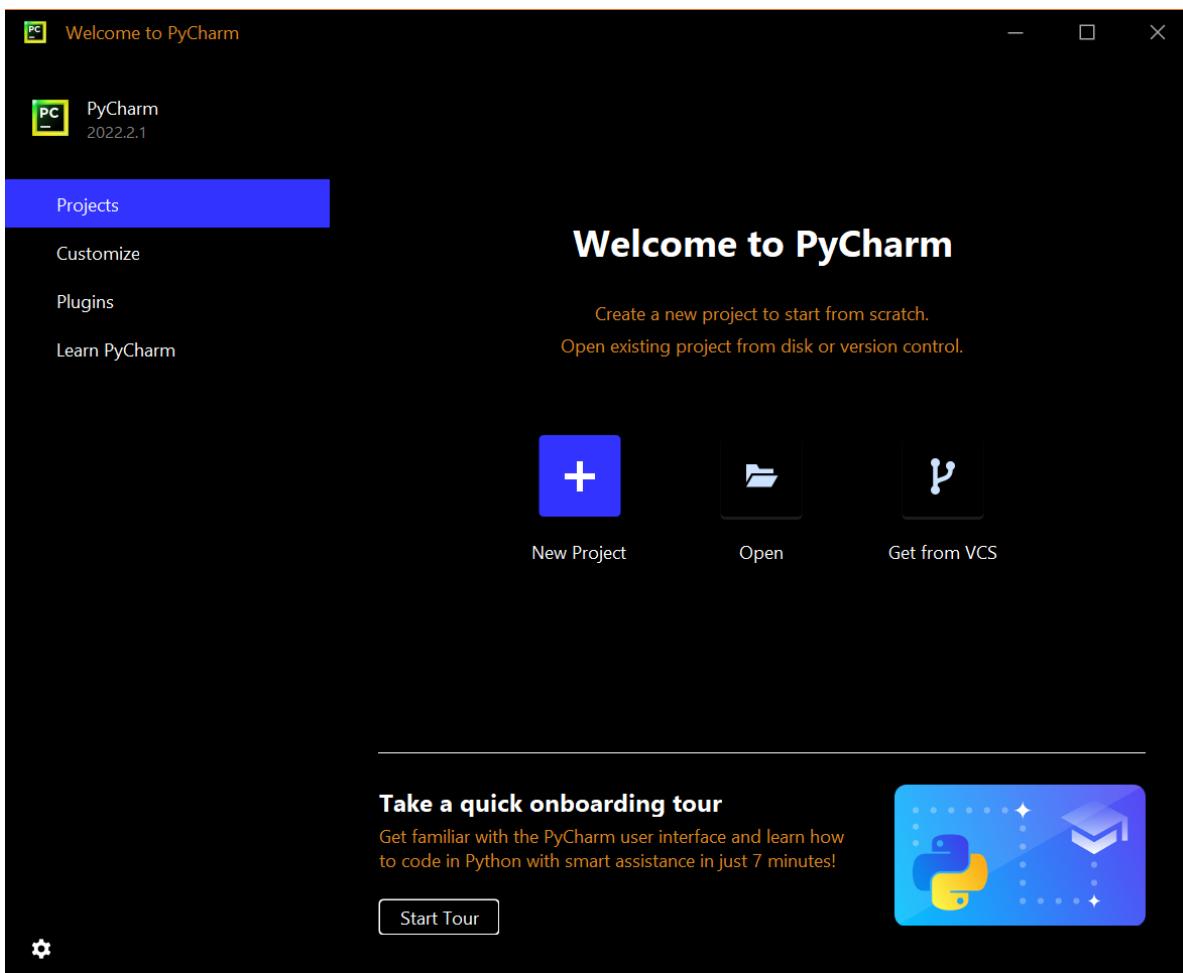
[Download](#)

Free, built on open-source



Get the Toolbox App to download PyCharm and its future updates with ease

- Check the installation. If Pycharm has been successfully installed, after opening it, Pycharm will look like:

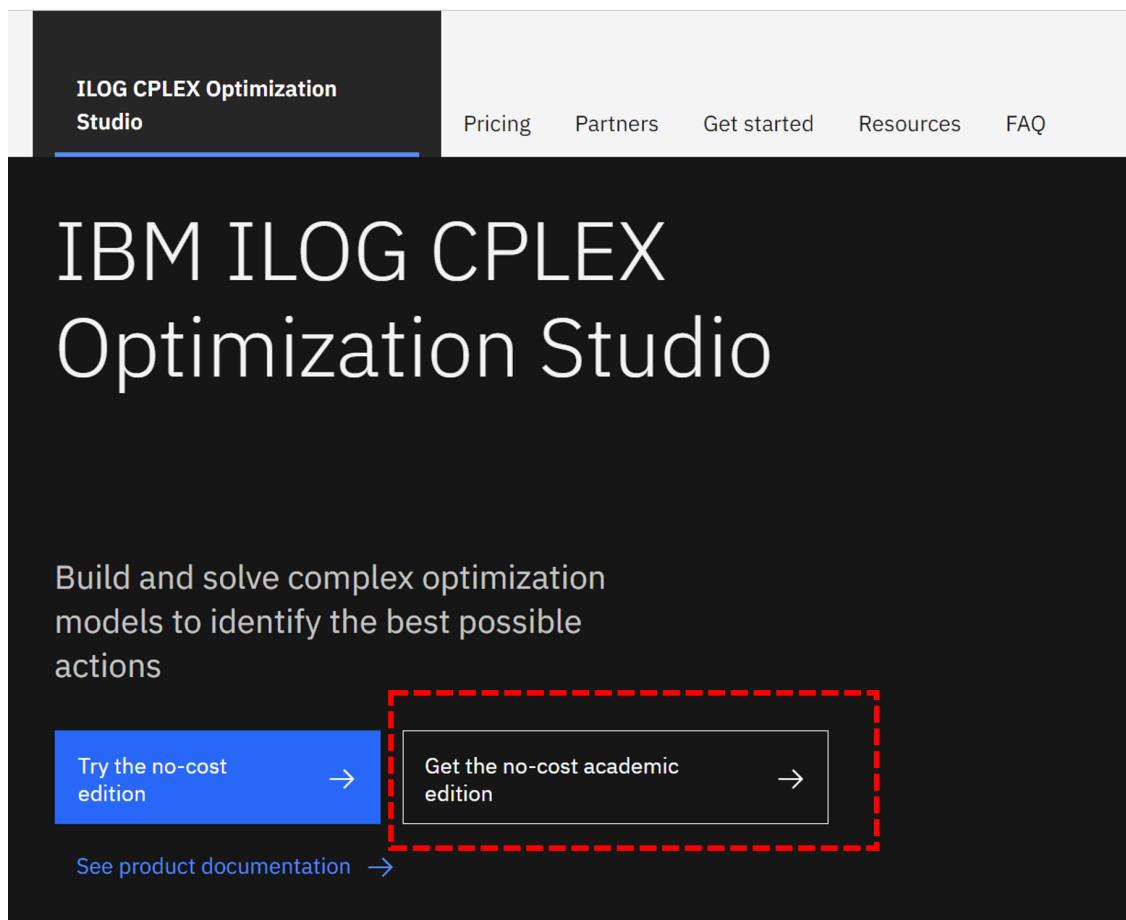


- Install Anaconda:** In this software, the virtual environment will be created using Anaconda. Therefore, the users need to install Anaconda. The Anaconda downloading page can be found at [Anaconda](#).

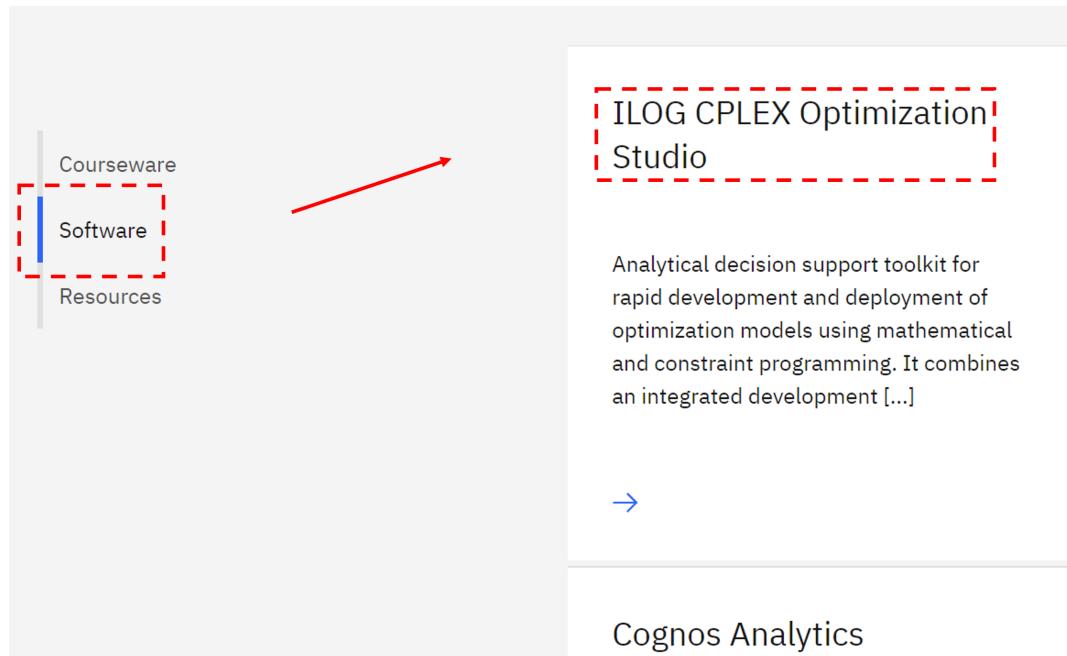
IBM CPLEX Optimization software installation

One objective of this project is to find the optimal dispatch strategy during hurricane events. Therefore, optimization package is needed to perform such tasks. In this project, IBM CPLEX package is used. The installation of IBM CPLEX is as follow:

- **Java:** Check whether Java is installed in the computer by:
 - **Windows:** Open PowerShell and type `java -version`
 - **Mac:** Open Terminal and type `java -version`If java is not installed, visit [Java](#) to download the latest version.
- **IBM CPLEX:** Go to [IBM CPLEX Optimization Studio](#) official website.
 - In the website, choose the no-cost academic edition as shown in the dashed-red box figure below.



- In the `Data Science` page, click `Login` if you have IBM account. Otherwise click `Register`.
- After login, scroll down to find `software` option and find `ILOG CPLEX optimization Studio`.



- In the downloading page, choose **Download Director** and the version for current machine operational system.

The screenshot shows a search interface for part numbers. The search bar contains "G05VZML". Below it, there are two radio buttons: "Download Director" (selected) and "HTTP". A blue "Search" button is visible. To the right, the search results for "eAssemblies (1)" are displayed, showing a single entry for "IBM ILOG CPLEX Optimization Studio V22.1.0 Multiplatform Multilingual eAssembly". Below this, a table lists several other versions and their details:

Image	Description	Date posted	Size (MB)
	IBM ILOG CPLEX Optimization Studio V22.1.0 for Linux on System i(p)	3/18/2022	258
	IBM ILOG CPLEX Optimization Studio V22.1.0 for Linux x86-64	3/18/2022	625
	IBM ILOG CPLEX Optimization Studio V22.1.0 for OSX	3/18/2022	698
	IBM ILOG CPLEX Optimization Studio V22.1.0 for Windows x86-64	3/18/2022	712
	IBM ILOG CPLEX Optimization Studio V22.1.0 Quick Start Guide	3/18/2022	2

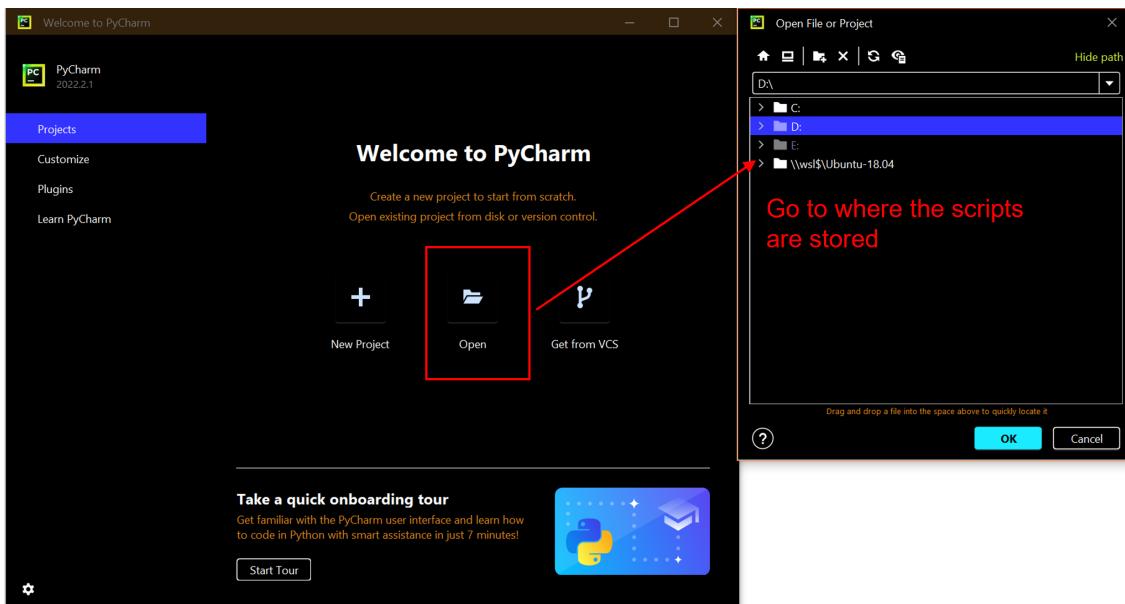
- After downloading the IBM CPLEX software, follow the default setting to install. If the user wants to install in non-default way, please remember the PATH for installed CPLEX directory.

Setup IBM CPLEX Python API

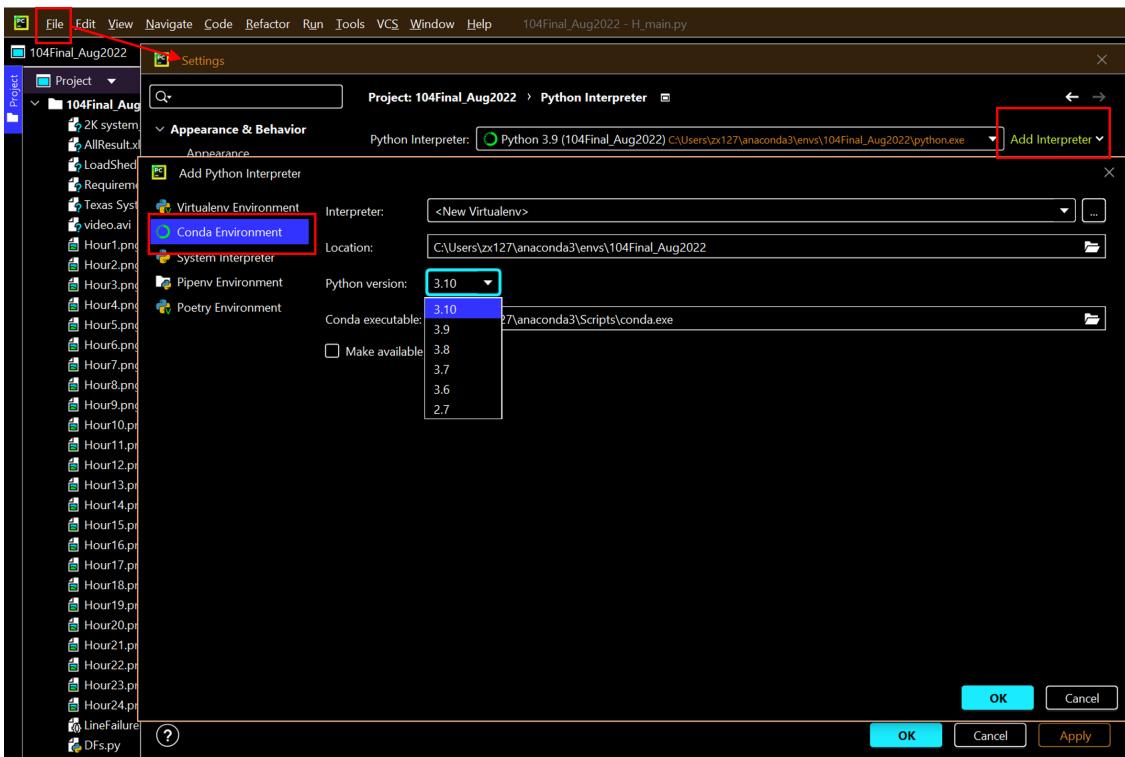
Even though IBM CPLEX has been installed, to use this optimizer in Python, the users need to set up CPLEX Python API so that Python can find and use CPLEX. To setup IBM CPLEX Python API, the instructions on Windows and Mac system will be illustrated separately.

To set up CPLEX Python API, the user need to set up the Python Virtual Environment First.

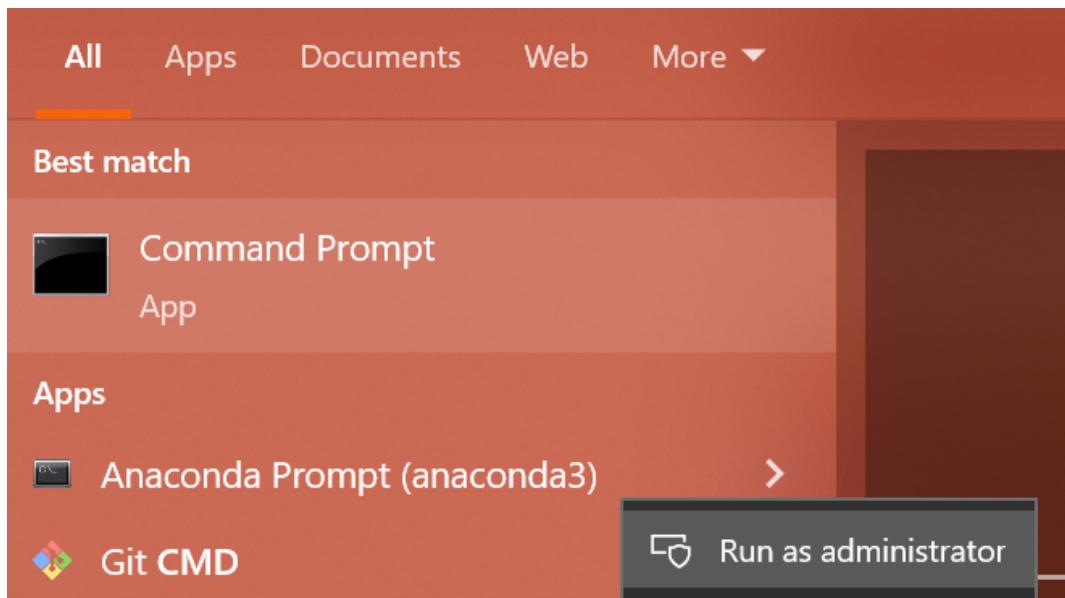
- Creating Virtual Environment
 - Open Pycharm → Open where the Python scripts are stored



- Open setting in Pycharm ribbon → Settings → Interpreter → Add local interpreter → `Conda Environment`. In the `Conda Environment` select the Python version no latter than 3.6 and click `OK`.



- Setup CPLEX Python API
 - Windows:
 - in the search bar type `cmd` → choose `Anaconda Prompt (anaconda3)` and run as an administrator



- In PowerShell type the following commands to activate the local virtual environment

```
conda env list  
conda activate 'user created virtual Environment name'
```

In the figure below, the * mean the current working Virtual Environment. If the current working Virtual Environment is base, change to user created virtual environment name. If the local virtual environment is activated, it should appear in the front of the director shown in the figure below.

```
(base) PS C:\Program Files> conda env list  
# conda environments:  
#  
#  
base * C:\Users\zx127\anaconda3  
104Final_Aug2022 C:\Users\zx127\anaconda3\envs\104Final_Aug2022  
  
(base) PS C:\Program Files> conda activate 104Final_Aug2022  
(104Final_Aug2022) PS C:\Program Files>
```

A screenshot of a PowerShell window titled 'Administrator: Anaconda Powershell Prompt (anaconda3)'. The command 'conda env list' is run, showing a list of environments. The 'base' environment is marked with an asterisk (*), indicating it is the current working environment. The command 'conda activate 104Final_Aug2022' is then run, and the prompt changes to '(104Final_Aug2022) PS C:\Program Files>', where '(104Final_Aug2022)' is highlighted with a red box.

- Setup CPLEX API

If user follows up default settings, the setup file should be located in `C:\Program Files\IBM\ILOG\CPLEX_Studio221\python`. In PowerShell type the following commands:

```
cd ..  
dir  
cd '.\Program Files\'  
python IBM\ILOG\CPLEX_studio221\python\setup.py install
```

Then the CPLEX API should be installed properly.

```
(104Final_Aug2022) PS C:\> cd ..
(104Final_Aug2022) PS C:\> dir

Directory: C:\

Mode LastWriteTime Length Name
---- ----- ----- 
d---- 2020/12/28 20:23 Autodesk
d---- 2020/4/6 22:21 Dell
d---- 2020/4/7 21:08 ESD
d---- 2022/9/4 11:04 Intel
d---- 2020/4/9 14:38 Octave
d---- 2019/12/7 4:14 PerfLogs
d---- 2022/9/2 16:39 Program Files
d-r-- 2022/9/1 18:30 Program Files (x86)
d-r-- 2022/8/19 9:47 Users
d---- 2022/8/31 18:08 Windows

(104Final_Aug2022) PS C:\> cd '..\Program Files\'  

(104Final_Aug2022) PS C:\Program Files> python IBM\ILOG\CPLEX_Studio221\python\setup.py install
```

- Mac
 - Open terminal and type

```
conda env list
conda activate 'user created virtual Environment name'
```

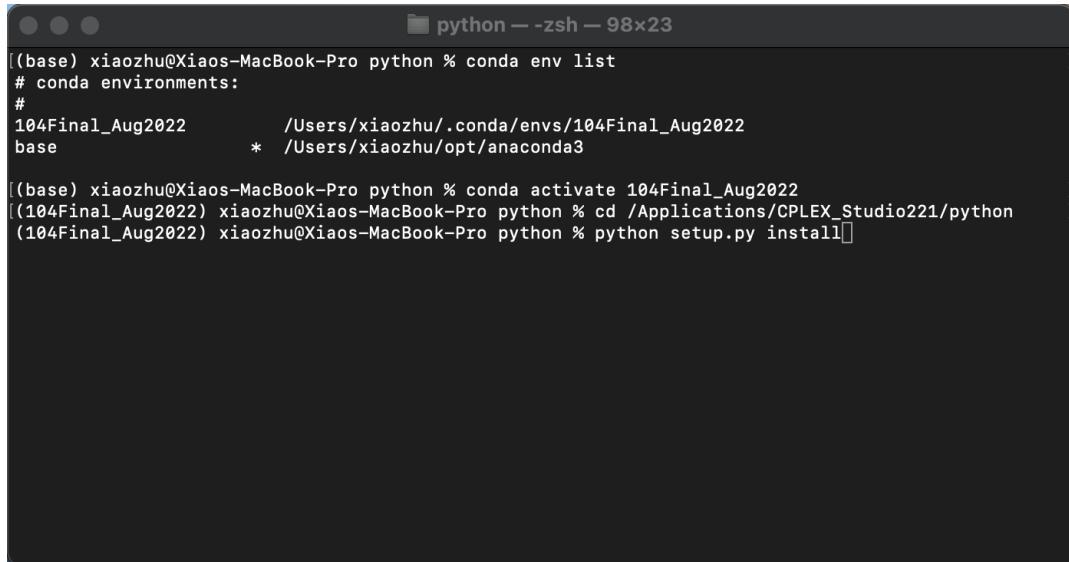
- Setup CPLEX API

If user follows up default settings, the setup file should be located in `/Application/CPLEX_Studio221/python`. In Terminal type the following commands:

```
cd `/Application/CPLEX_Studio221/python`  

python setup.py install
```

Then the CPLEX API should be installed properly.



```
(base) xiaozhu@Xiaos-MacBook-Pro python % conda env list
# conda environments:
#
104Final_Aug2022      /Users/xiaozhu/.conda/envs/104Final_Aug2022
base                  * /Users/xiaozhu/opt/anaconda3

(base) xiaozhu@Xiaos-MacBook-Pro python % conda activate 104Final_Aug2022
(104Final_Aug2022) xiaozhu@Xiaos-MacBook-Pro python % cd /Applications/CPLEX_Studio221/python
(104Final_Aug2022) xiaozhu@Xiaos-MacBook-Pro python % python setup.py install
```

Install Python Packages

After installing the IBM CPLEX API, the remaining Python packages can be installed automatically by running the following commands in the terminal:

```
pip install -r requirements.txt
```