

Introduction to AI-Driven High Energy Physics

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Exercise Style:

set01_name.zip >>>>>> send to: mohammadjalali313@gmail.com & ansarifard@ipm.ir

Introduction to Python

Python Interactive Shell

```
python or python3
```

python package managers:

1. **pip** is the **official package manager for Python**, used to install, upgrade, and remove Python packages from the **Python Package Index (PyPI)**.
 2. **conda** is both a **package manager** and an **environment manager**. It's developed by **Anaconda Inc.** and is central to the Anaconda distribution.
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Jupyter Notebook

[Video link](#)

Jupyter Notebook is a **web-based interactive computing environment** that lets you mix **code, text, equations, and visualizations** in one document.

Key Features

1. Cell-based Execution

- Code is organized into cells — you can run each cell separately.
- Output appears directly below the cell (plots, tables, HTML, etc.).

2. Supports Markdown & LaTeX

- Create formatted text, mathematics, and headings using Markdown.

3. Interactive Output

- Display charts, maps, or even interactive widgets inline.
- Works well for Matplotlib, Plotly, Bokeh, etc.

4. Language Support via Kernels

- Default: Python (usually via IPython kernel).
- Others: R, Julia, and more with custom kernels.

5. Mix Code with Narrative

- Ideal for tutorials, research notes, and reports.
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Workflow

1. Install Jupyter:

- Via pip: `pip install notebook`
- Via conda: `conda install jupyter`

2. Launch Notebook Server:

```
jupyter notebook
```

1. Write & Run:

- Create `.ipynb` file → Add cells with code or text.

2. Export:

- Save as HTML, PDF, or Python script.
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Advantages

- **Interactive coding:** Immediate feedback with inline output.
- **Rich visualization:** Perfect for plotting and showing results in the same document.
- **Reproducible documents:** Code + data + results together.
- **Integration:** Works smoothly with pandas, NumPy, matplotlib, and machine learning libraries.

Visual Studio (VS) Code

[Website](#)

Key Features

1. Intelligent Code Editing

- Syntax highlighting
- Code autocompletion
- Multi-language support
- Real-time error detection

2. Extensions Marketplace

- Thousands of extensions: Python tools, Jupyter Notebook integration, Git, Docker, etc.
- You can install for specific needs (e.g., `Python` extension from Microsoft).

3. Integrated Terminal

- Run commands directly inside VS Code without switching to a separate terminal.

4. Debugging Tools

- Set breakpoints, step through code, watch variables.
- Supports Python debugging with the Python extension.

5. Version Control Built-in

- Git integration — commit, pull, push from inside VS Code.

6. Customizable Interface

- Themes, layouts, and keyboard shortcuts can be personalized.

Python Workflow in VS Code

1. **Install VS Code** → Download from official website.

2. **Install Python Extension:**

- Go to Extensions view → Search `Python` → Install from Microsoft.

3. **Set Interpreter:**

- Select your Python version or conda environment.

4. **Run & Debug:**

- Use the “Run” button or F5 after setting up a debug configuration.

5. **Integrate Jupyter:**

- Install `Jupyter` extension → Open `.ipynb` files directly inside VS Code.

[Python in Visual Studio Code](#)

[Video link](#)

Anconda

Anaconda is a **free and open-source Python (and R) distribution** designed mainly for **data science, machine learning, and scientific computing**.

[Website](#)

Key Components:

- **Python/R Interpreter** → Comes ready to run.
- **conda** → The package and environment manager.
- **Pre-installed Libraries** → NumPy, Pandas, Matplotlib, SciPy, scikit-learn, etc.
- **Jupyter Notebook/Lab** → For interactive coding and visualization.
- **Spyder IDE** → A scientific IDE included in the package.

Advantages

- **No hassle installation:** Many heavy packages (like TensorFlow, PyTorch) come precompiled — no need to deal with C/C++ build issues.
- **Environment Management:** Easily isolate projects with different Python versions.
- **Cross-platform:** Works on Linux, macOS, and Windows the same way.
- **Rich ecosystem:** Includes visualization tools, interactive notebooks, performance libraries.

Virtual Environment

```
python3 -m venv test
```

```
source test/bin/activate
```

```
python3
```

```
import numpy as np
```

```
pip install numpy
```

```
pip install jupyter
```

```
pip install ipykernel
```

```
python -m ipykernel install --user --name=test --display-name "Python (test)"
```

Google Colaboratory (Colab)

Google Colab is a **free, cloud-based Jupyter Notebook environment** provided by Google.

It lets you write and run Python code in your browser without any installation, using Google's servers.

Key Features

1. Runs in the Cloud

- No need to install Python locally.
- Works on any device with a browser.

2. Pre-configured Environment

- Python, scientific libraries (NumPy, Pandas, Matplotlib, TensorFlow, PyTorch) already installed.
- No setup hassle — just start coding.

3. GPU / TPU Access

- Free access to NVIDIA GPUs and Google TPUs for machine learning tasks.
- Extremely useful for deep learning.

4. Integrated with Google Drive

- Save and load notebooks directly from your Google Drive.
- Easy sharing and collaboration.

5. Jupyter Notebook Interface

- Same cell-based execution as standard Jupyter.
- Supports code + markdown + LaTeX.

6. Easy Collaboration

- Share notebooks via a link.
 - Multiple people can edit/run cells together.
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Workflow

1. Go to: <https://colab.research.google.com>

2. Create Notebook

- `.ipynb` format, identical to Jupyter Notebook.

3. Run Code

- Choose CPU/GPU/TPU via **Runtime** → **Change runtime type**.

4. Manage Files

- Mount Google Drive to access your data:

```
from google.colab import drive
drive.mount('/content/drive')
```

Advantages

- **Zero installation**
- **Free computing resources**
- **Perfect for ML/DL experiments**
- **Easy sharing for teaching, demos, and collaboration**
- **Cross-platform** — works anywhere via browser.