

## ✓ Module 2 Lab Exercise: Tools Used in Machine Learning

### Learning Objectives

By the end of this lab, you will be able to:

- Set up and navigate Jupyter Notebook, Google Colab, and VS Code environments
- Install and import essential Python libraries for machine learning
- Create and format professional documentation using Markdown
- Initialize a GitHub repository for your ML projects
- Understand the basic workflow of data science tools

### Prerequisites

- Basic understanding of what machine learning is (Module 1)
  - Access to internet for downloading tools and datasets
  - A Google account (for Colab) or local Python installation
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## Part 1: Environment Setup and Tool Overview

What are the main tools we'll use in this course?

**Jupyter Notebook/Google Colab:** Interactive computing environments where you can write code, see results immediately, and document your work with text and visualizations.

**Python Libraries:** Pre-written code packages that make machine learning tasks easier:

- **Pandas:** For working with data (like Excel, but more powerful)
- **NumPy:** For mathematical operations on arrays of numbers
- **Matplotlib:** For creating charts and graphs
- **Scikit-learn:** The main library for machine learning algorithms

**GitHub:** A platform to store, share, and collaborate on code projects

**VS Code:** A powerful text editor for writing and debugging code

Let's start by setting up our environment!

## ✓ Environment Setup Instructions

### Option 1: Google Colab (Recommended for Beginners)

1. Go to [colab.research.google.com](https://colab.research.google.com)
2. Sign in with your Google account
3. Click "New Notebook"
4. You're ready to go! Libraries are pre-installed.

## Option 2: Local Jupyter Notebook

1. Install Python from [python.org](https://python.org)
2. Open terminal/command prompt
3. Run: `pip install jupyter pandas numpy matplotlib scikit-learn`
4. Run: `jupyter notebook`
5. Create a new notebook

## Option 3: VS Code

1. Download VS Code from [code.visualstudio.com](https://code.visualstudio.com)
2. Install Python extension
3. Install Jupyter extension
4. Create a new .ipynb file

**For this lab, we recommend starting with Google Colab as it requires no installation.**

```
# Install required libraries (uncomment if needed)
# !pip install pandas numpy matplotlib scikit-learn

# Import libraries with standard aliases
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn import datasets
import warnings
warnings.filterwarnings('ignore') # Hide warning messages for cleaner output

print("✅ All libraries imported successfully!")
print(f"Pandas version: {pd.__version__}")
print(f"NumPy version: {np.__version__}")

✅ All libraries imported successfully!
Pandas version: 2.2.2
NumPy version: 2.0.2
```

## ✓ Part 2: Loading and Exploring Your First Dataset

We'll use the famous Iris dataset - a classic dataset for beginners. It contains measurements of iris flowers from three different species.

```
# Load a simple dataset (Iris flowers - a classic beginner dataset)
from sklearn.datasets import load_iris

# Load the data
iris = load_iris()
print("Dataset loaded successfully!")
print(f"Dataset shape: {iris.data.shape}")
print(f"Features: {iris.feature_names}")
print(f"Target classes: {iris.target_names}")
```

```
Dataset loaded successfully!
Dataset shape: (150, 4)
Features: ['sepal length (cm)', 'sepal width (cm)', 'petal length (cm)', 'petal
Target classes: ['setosa' 'versicolor' 'virginica']
```

```
# Convert to pandas DataFrame for easier handling
import pandas as pd
df = pd.DataFrame(iris.data, columns=iris.feature_names)
df['species'] = iris.target_names[iris.target]

# Display first few rows
print("First 5 rows of our dataset:")
print(df.head())

print("\nDataset info:")
print(df.info())
```

```
First 5 rows of our dataset:
   sepal length (cm)  sepal width (cm)  petal length (cm)  petal width (cm)  \
0                5.1                3.5                1.4                0.2
1                4.9                3.0                1.4                0.2
2                4.7                3.2                1.3                0.2
3                4.6                3.1                1.5                0.2
4                5.0                3.6                1.4                0.2
```

```
   species
0  setosa
1  setosa
2  setosa
3  setosa
4  setosa
```

Dataset info:

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 150 entries, 0 to 149
```

```
Data columns (total 5 columns):
```

#	Column	Non-Null Count	Dtype
0	sepal length (cm)	150 non-null	float64
1	sepal width (cm)	150 non-null	float64
2	petal length (cm)	150 non-null	float64

```
3   petal width (cm)    150 non-null    float64
4   species             150 non-null    object
dtypes: float64(4), object(1)
memory usage: 6.0+ KB
None
```

## ✓ Part 3: Creating Your First Visualization

Data visualization is crucial in machine learning. Let's create a simple plot to understand our data.

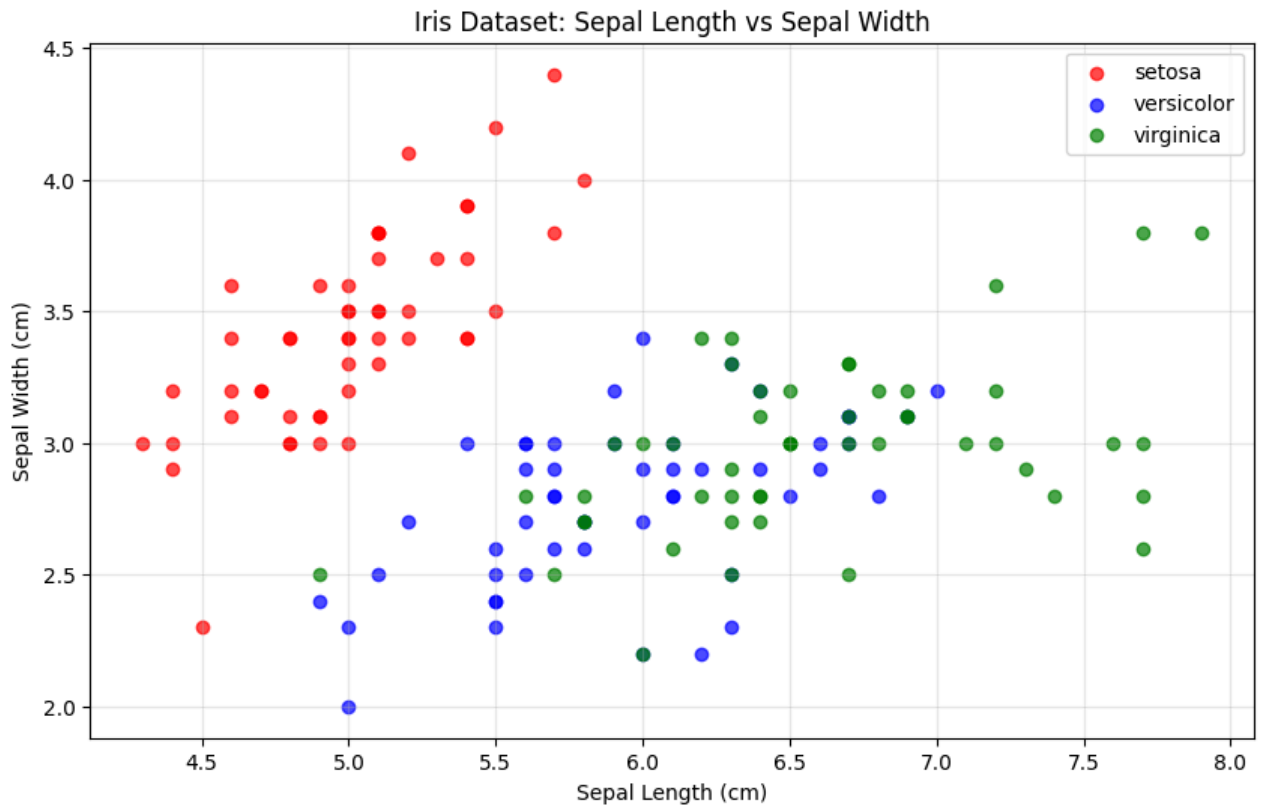
```
# Create a simple scatter plot
import matplotlib.pyplot as plt
plt.figure(figsize=(10, 6))

# Plot sepal length vs sepal width, colored by species
species_colors = {'setosa': 'red', 'versicolor': 'blue', 'virginica': 'green'}

for species in df['species'].unique():
    species_data = df[df['species'] == species]
    plt.scatter(species_data['sepal length (cm)'],
                species_data['sepal width (cm)'],
                c=species_colors[species],
                label=species,
                alpha=0.7)

plt.xlabel('Sepal Length (cm)')
plt.ylabel('Sepal Width (cm)')
plt.title('Iris Dataset: Sepal Length vs Sepal Width')
plt.legend()
plt.grid(True, alpha=0.3)
plt.show()

print("🎉 Congratulations! You've created your first data visualization!")
```



🎉 Congratulations! You've created your first data visualization!

## ✓ Part 4: Practice with Basic Data Operations

Let's practice some basic data analysis operations that you'll use throughout the course.

```
# Basic statistical analysis
print("Basic Statistics for Iris Dataset:")
print("=" * 40)

# Calculate mean values for each species
species_means = df.groupby('species').mean()
print("\nMean values by species:")
print(species_means)

# Count samples per species
species_counts = df['species'].value_counts()
print("\nSamples per species:")
print(species_counts)
```

### Basic Statistics for Iris Dataset:

=====

#### Mean values by species:

	sepal length (cm)	sepal width (cm)	petal length (cm)	\
species				
setosa	5.006	3.428	1.462	
versicolor	5.936	2.770	4.260	
virginica	6.588	2.974	5.552	

	petal width (cm)
species	
setosa	0.246
versicolor	1.326
virginica	2.026

#### Samples per species:

species	
setosa	50
versicolor	50
virginica	50

Name: count, dtype: int64

## Part 5: GitHub and Documentation Best Practices

### Why GitHub for Machine Learning?

- **Version Control:** Track changes to your code and data
- **Collaboration:** Work with others on projects
- **Portfolio:** Showcase your work to potential employers
- **Backup:** Never lose your work

### Basic GitHub Workflow:

1. **Create Repository:** A folder for your project
2. **Clone/Download:** Get the project on your computer
3. **Add Files:** Put your notebooks and data
4. **Commit:** Save a snapshot of your changes
5. **Push:** Upload changes to GitHub

### For This Course:

- Create a repository named "ITAI-1371-ML-Labs"
- Upload each lab notebook as you complete it
- Include a README.md file describing your projects

**Action Item:** After this lab, create your GitHub account and repository.

## ✓ Assessment: Tool Familiarity Check

Complete the following tasks to demonstrate your understanding of the tools:

```
# Task 1: Create a simple calculation using NumPy
# Calculate the mean and standard deviation of sepal length

import numpy as np # Import numpy

sepal_lengths = df['sepal length (cm)']

# Your code here:
mean_sepal_length = np.mean(sepal_lengths)
std_sepal_length = np.std(sepal_lengths)

print(f"Mean sepal length: {mean_sepal_length:.2f} cm")
print(f"Standard deviation: {std_sepal_length:.2f} cm")

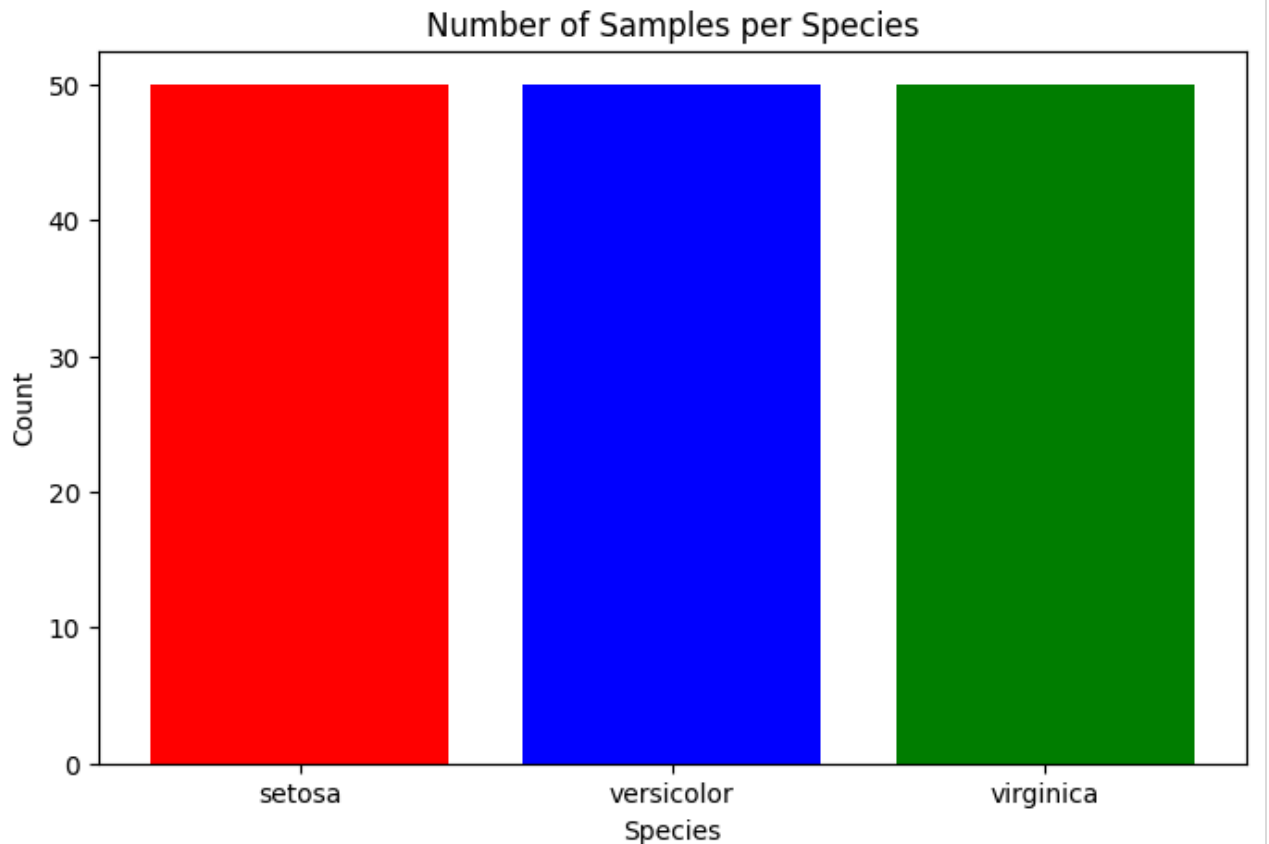
# Verification (don't modify)
assert isinstance(mean_sepal_length, (float, np.floating)), "Mean should be a number"
assert isinstance(std_sepal_length, (float, np.floating)), "Std should be a number"
print("✅ Task 1 completed successfully!")
```

```
Mean sepal length: 5.84 cm
Standard deviation: 0.83 cm
✅ Task 1 completed successfully!
```

```
# Task 2: Create a simple bar chart showing species counts
species_counts = df['species'].value_counts()

plt.figure(figsize=(8, 5))
plt.bar(species_counts.index, species_counts.values, color=['red', 'blue', 'green'])
plt.title('Number of Samples per Species')
plt.xlabel('Species')
plt.ylabel('Count')
plt.show()

print(f"Species distribution: {dict(species_counts)}")
print("✅ Task 2 completed successfully!")
```



Species distribution: {'setosa': np.int64(50), 'versicolor': np.int64(50), 'virginica': np.int64(50)}

✅ Task 2 completed successfully!

## Your Analysis and Reflection

**Instructions:** Complete the analysis below by editing this markdown cell.

### My Observations About the Iris Dataset

#### Dataset Overview:

- Number of samples: 150
- Number of features: 4
- Number of classes: 3

#### Key Findings from the Visualization:

1. The Setosa have a clear contrast away from the other 2. Shorter length and wider width.
2. The Versicolor seem to sit in the middle, pertaining to length and width.
3. Virginica has the greatest length. Also, has a greater width than Versicolor, but still falls short from Setosa.



## Questions for Further Investigation:

- How much so would the environment manipulate the data?
- Why were these 3 particular species chosen for this?

**Reflection:** Honestly, this is still foreign to me. I'm learning about how the tools make the navigation and explanation much easier. However, I would still like it if there were other outside sources i could commit to for more of a familiarity in this.

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*Note: This is practice for documenting your machine learning projects professionally.*

## Lab Summary and Next Steps

### What You've Accomplished:

- ✓ Set up your machine learning development environment
- ✓ Imported and used essential Python libraries
- ✓ Loaded and explored your first dataset
- ✓ Created your first data visualization
- ✓ Practiced professional documentation with Markdown
- ✓ Learned about GitHub for project management

### Preparation for Module 3:

In the next lab, you'll:

- Learn about different types of machine learning
- Build your first simple classifier
- Understand the complete ML workflow
- Work with more complex datasets

### Action Items:

1. **Create your GitHub account** and repository
2. **Upload this completed notebook** to your repository
3. **Experiment** with different visualizations using the Iris dataset
4. **Practice** Markdown formatting in a new notebook

### Resources for Continued Learning:

- [Pandas Documentation](#)
- [Matplotlib Gallery](#)
- [GitHub Guides](#)

- [Jupyter Notebook Tips](#)