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

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
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
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
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.

```python
# 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 message

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.

```python
# Load a simple dataset (Iris flowers - a classic beginne
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
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)
0                5.1               3.5                1.4
1                4.9               3.0                1.4
2                4.7               3.2                1.3
3                4.6               3.1                1.5
4                5.0               3.6                1.4

   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
plt.figure(figsize=(10, 6))

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

for species in df['species'].unique():
    species_data = df[df['species'] == species]
    plt.scatter(species_data['sepal length (cm)'],
```

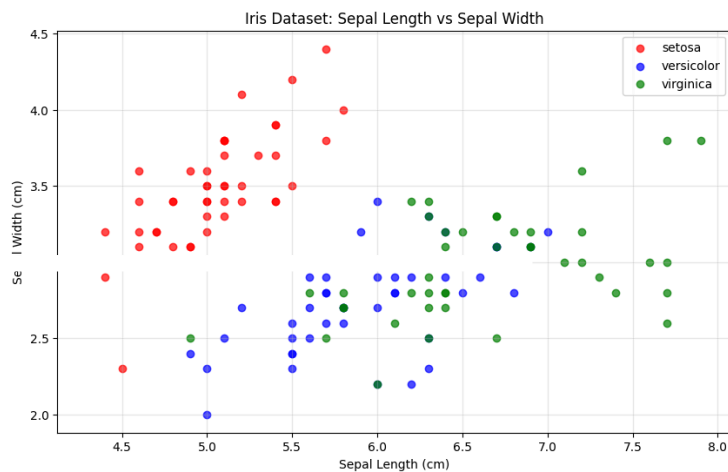```
                species_data['sepal width (cm)'],
                c=species_colors[species],
                label=species,
                alpha=0.7)

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
```



Iris Dataset: Sepal Length vs Sepal Width

🎉 Congratulations! You've created your first data visuali

## 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 len
species
setosa                5.006             3.428
versicolor            5.936             2.770
virginica             6.588             2.974

          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.

Njeh Ababio
7:14 AM Today
here I added the line import numpy as np

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 leng
import numpy as np

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))
assert isinstance(std_sepal_length, (float, np.floating))
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 count
species_counts = df['species'].value_counts()

plt.figure(figsize=(8, 5))
plt.bar(species_counts.index, species_counts.values, colo
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!")
```


Number of Samples per Species
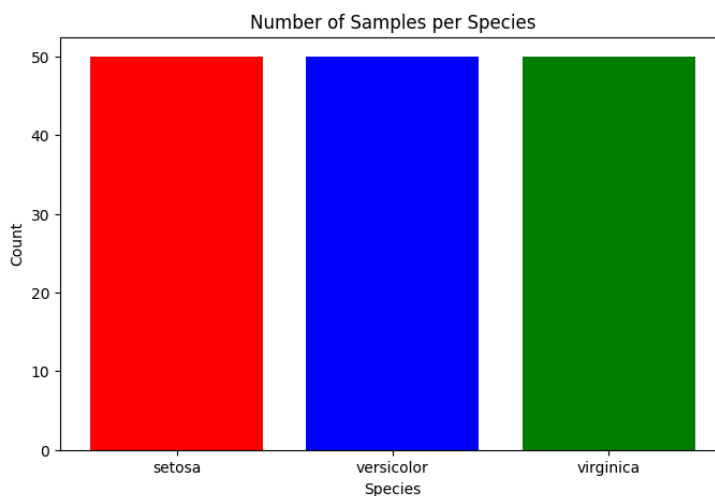
```
Species distribution: {'setosa': np.int64(50), 'versicolor
✅ Task 2 completed successfully!
```

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: [3]
- Number of features: [4]
- Number of classes: [3]

Key Findings from the Visualization:

1. [When working on the scatter plot I noticed the a species can have 3 different width for one length. For the code on this one I need to change the line number 2 plt.figure= (figsize(10.6)), which help me run the code.]
2. [For the setosa species, they have a minimum width of 3.0 and a maximum of 4.4. Their feartures places them a little smaller than the two other species.]
3. [The versicolor and virginica species appear to have similar dimensions, each exhibiting a length-to-width ratio of 5.5 for length to 6.8 for width. Additionally, these species are slightly smaller than the two other species.]

Questions for Further Investigation:

- [I would like to know, what is the number polinasor for each plant?]
- [How often do they reproduce a year?]

Reflection: *From these tools, I learned some key lines and programs to run for a graphic. And I learned how to import data from a database. Even though I still need some training in data manipulation,with graphic contrustion coding. *

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](#)

Great job completing Module 2! You're now equipped with the essential tools for machine learning. 🎉