# Python for Absolute Beginners

## Learn Python Programming in Simple Language with Practical Examples

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Thanks for reading this book. If you are interested in learning AI, check the AI Course at [rajamanickam.com](rajamanickam.com)

This book is written for absolute beginners who want a practical, clear, and reliable introduction to Python. Although the content is general-purpose, examples and exercises are chosen to be useful for people who plan to work with data or move into machine learning and AI. The emphasis is on explaining concepts without assuming prior programming experience.

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## Chapter 1 — Introduction to Python

### Why Learn Python?

Python is one of the most popular and beginner-friendly programming languages in the world. It is used by students, professionals, and researchers in diverse fields — from web development to data analysis, automation, and machine learning.

**Reasons to learn Python:**

- Easy to Read and Write: Python uses English-like syntax, making it simple to understand.
- Versatile: You can use Python for web apps, data analysis, machine learning, automation, or even games.
- Large Community: Millions of developers use Python, so tutorials and help are widely available.
- Extensive Libraries: Thousands of built-in and third-party libraries make programming faster.
- Cross-Platform: Python runs on Windows, macOS, and Linux without changes to code.

### What You Can Do with Python

Python can be used in many ways. Examples include:

- **Web Development**: Building websites using Django or Flask.
- **Data Science**: Analyzing and visualizing data using Pandas and Matplotlib.
- **Machine Learning**: Building intelligent systems with TensorFlow or scikit-learn.
- **Automation**: Automating repetitive office tasks or system scripts.

- **Game Development**: Creating simple games using Pygame.
- **IoT and Robotics**: Controlling devices with Raspberry Pi.

Even if you are new to programming, Python allows you to build useful projects quickly.

**Installing Python**

To start writing Python code, you need to install it.

*For Windows:*

1. Go to https://www.python.org/downloads/
2. Download the latest Python 3 version.
3. Run the installer and check **Add Python to PATH**.
4. Click **Install Now**.

*For macOS:*
Python 3 may already be installed. Check with the Terminal command: `python3 --version`.
If not installed, download from the Python website or install via Homebrew: `brew install python`.

*For Linux:*
Python is often pre-installed. Check: `python3 --version`.
If not, install via package manager (Ubuntu example):

```
sudo apt update

sudo apt install python3
```

**Running Python Code**

There are several ways to run Python:

1. **Interactive Mode (REPL):** Open Terminal or Command Prompt and type `python` or `python3`. You'll see a prompt (`>>>`) where you can type commands directly.
   Example:

   ```
   >>> print("Hello, Python!")
   ```

```
Hello, Python!
```

2. **Script File:** Write code in a file, e.g., `hello.py`, and run:

```
python hello.py
```

3. **Using an IDE or Editor:**
    - IDLE (comes with Python)
    - VS Code
    - PyCharm
    - Jupyter Notebook

**Your First Python Program**

```
print("Hello, World!")
```

Output:

```
Hello, World!
```

The `print()` function displays text on the screen.

**Basic Concepts**

**Comments:** Notes for humans. Start with `#`.

```
# This is a comment
print("Hello!")  # Inline comment
```

**Variables:** Store data in containers.

```
name = "Alice"
age = 25
print(name)
print(age)
```

**Indentation:** Python uses spaces at the beginning of lines to define code blocks.

```
if 5 > 3:
   print("Five is greater than three!")
```

**Saving and Running a Script**

Example: `greeting.py`

```
name = input("Enter your name: ")
print("Hello, " + name + "! Welcome to Python.")
```

Run:

```
python greeting.py
```

Sample output:

```
Enter your name: Raj

Hello, Raj! Welcome to Python.
```

**Understanding Errors**

Errors are normal while learning. Python provides clear messages to help you fix mistakes.
Example:

```
print("Hello"
```

Output:

```
SyntaxError: unexpected EOF while parsing
```

This indicates a missing closing parenthesis.

**Summary**

- Python is simple, versatile, and powerful.
- Install the latest version from the official website.
- Code can be run interactively or from `.py` files.
- Comments (`#`) explain your code.

- Variables store data; indentation defines structure.
- Errors are part of learning; read them carefully.

**Exercises**

1. Install Python and check the version.
2. Write a program to print your name and favorite color.
3. Create a script asking two numbers and printing their sum.
4. Use comments in your code.
5. Try running Python interactively and from a file.
6. Introduce a small syntax error and read the error message.

## Chapter 2 — Understanding Variables, Data Storage, and Basic Data Types

### What Are Variables?

In Python, a **variable** is a container that stores information. Think of it like a labeled box — you can put something inside it, and later you can read or change it. Variables allow your program to remember data and perform calculations.

### Creating Variables

You can create a variable by giving it a name and assigning a value using the `=` sign:

```
name = "Alice"
age = 25
height = 5.7
is_student = True
```

Here:

- `name` stores text (string)
- `age` stores a whole number (integer)

- `height` stores a decimal number (float)
- `is_student` stores a truth value (Boolean)

Python automatically determines the type of variable based on the value.

**Rules for Naming Variables**

1. Must start with a letter or underscore (`_`).
2. Can contain letters, numbers, or underscores.
3. Cannot use Python reserved keywords like `for`, `if`, `class`.
4. Use descriptive names: `user_age` is better than `x`.

**Examples of valid and invalid variable names:**

Valid:

```
user_name = "Raj"
score1 = 100
_is_active = True
```

Invalid:

```
1name = "Alice"   # Cannot start with a number
for = 5           # 'for' is a reserved keyword
```

**Basic Data Types**

Python has several built-in types. The most common are:

1. **Integers (`int`)**: Whole numbers, positive or negative.

```
x = 10
y = -5
print(type(x))  # <class 'int'>
```

2. **Floating-point numbers (`float`)**: Numbers with decimals.

```
pi = 3.14159
print(type(pi))  # <class 'float'>
```

3. **Strings (`str`)**: Text enclosed in quotes.

```
message = "Hello, Python!"
print(type(message))  # <class 'str'>
```

4. **Boolean (`bool`)**: True or False values.

```
is_valid = True
is_active = False
print(type(is_valid))  # <class 'bool'>
```

**Displaying Values**

Use the `print()` function to display information:

```
name = "Alice"
age = 25
print("Name:", name)
print("Age:", age)
```

Output:

```
Name: Alice

Age: 25
```

**Combining Text and Variables**

Python allows combining strings and other types using **f-strings** (Python 3.6+):

```
name = "Raj"
age = 48
print(f"{name} is {age} years old.")
```

Output:

```
Raj is 48 years old.
```

**Type Conversion (Casting)**

Sometimes you need to convert data from one type to another.

```
x = "123"       # string
y = int(x)      # convert to integer
print(y + 1)    # 124

z = 3           # integer
w = float(z)    # convert to float
print(w)        # 3.0
```

Invalid conversions will raise errors:

```
int("Python")  # ValueError
```

**Using Input from Users**

The `input()` function lets your program take input from the user. By default, input is a string:

```
name = input("Enter your name: ")
print(f"Hello, {name}!")
```

To perform calculations, convert input to numbers:

```
num1 = int(input("Enter first number: "))
num2 = int(input("Enter second number: "))
print(f"Sum: {num1 + num2}")
```

**Common Beginner Mistakes**

1. Forgetting to convert input strings to numbers.
2. Using variable names that conflict with Python keywords.
3. Mixing data types incorrectly:

```
age = 25
```

```
print("Age: " + age)  # Error: cannot concatenate str and int
```

Correct way:

```
print("Age: " + str(age))  # Convert int to str
```

**Quick Reference of Types**

| Type | Example |
|---|---|
| int | 5, -3, 1000 |
| float | 3.14, -0.5 |
| str | "Hello", 'Python' |
| bool | True, False |

**Summary**

- Variables store information for later use.
- Python automatically determines the type, but you can convert types as needed.
- Use descriptive names and follow naming rules.
- Input from users is always a string; convert when needed for calculations.
- Use f-strings to combine text and variables easily.

**Exercises**

1. Create variables for your name, age, height, and student status. Print each with its type.
2. Write a program to ask the user for two numbers and print their sum, difference, and product.
3. Take input from the user for radius of a circle and calculate the area (use `float` conversion).
4. Experiment with invalid variable names and observe the errors.
5. Convert a string `'45.6'` to a float and add 4.4 to it.

## Chapter 3 — Operators and Expressions

### What Are Operators?

Operators are special symbols that perform operations on values or variables. They allow you to calculate numbers, compare values, and combine data. Understanding operators is essential to writing useful Python programs.

### Types of Operators in Python

1. **Arithmetic Operators** – perform mathematical operations
2. **Comparison Operators** – compare values
3. **Assignment Operators** – assign or modify values
4. **Logical Operators** – combine conditions
5. **Membership Operators** – check for membership in sequences
6. **Identity Operators** – compare object identity

---

### 1. Arithmetic Operators

| Operator | Meaning | Example | Output |
|---|---|---|---|
| `+` | Addition | `5 + 3` | 8 |

| | | | |
|---|---|---|---|
| `-` | Subtraction | `5 - 3` | 2 |
| `*` | Multiplication | `5 * 3` | 15 |
| `/` | Division | `5 / 2` | 2.5 |
| `//` | Floor Division | `5 // 2` | 2 |
| `%` | Modulus | `5 % 2` | 1 |
| `**` | Exponentiation | `5 ** 2` | 25 |

**Examples:**

```
a = 10
b = 3

print(a + b)   # 13
print(a - b)   # 7
print(a * b)   # 30
print(a / b)   # 3.3333333333333335
print(a // b)  # 3
print(a % b)   # 1
print(a ** b)  # 1000
```

---

**2. Comparison Operators**

Comparison operators check the relationship between values and return **True** or **False**.

| Operator | Meaning | Example | Output |
|---|---|---|---|
| `==` | Equal | `5 == 5` | True |
| `!=` | Not equal | `5 != 3` | True |
| `>` | Greater than | `5 > 3` | True |
| `<` | Less than | `5 < 3` | False |
| `>=` | Greater or equal | `5 >= 5` | True |

| | | | |
|---|---|---|---|
| `<=` | Less or equal | `3 <= 5` | True |

**Example:**

```
x = 10
y = 7

print(x > y)   # True
print(x == y)  # False
print(x != y)  # True
```

---

### 3. Assignment Operators

Assignment operators are used to store or update values in variables.

| Operator | Example | Meaning |
|---|---|---|
| `=` | `x = 5` | Assign 5 to x |
| `+=` | `x += 3` | x = x + 3 |
| `-=` | `x -= 2` | x = x - 2 |
| `*=` | `x *= 4` | x = x * 4 |
| `/=` | `x /= 2` | x = x / 2 |
| `%=` | `x %= 3` | x = x % 3 |
| `**=` | `x **= 2` | x = x ** 2 |
| `//=` | `x //= 2` | x = x // 2 |

**Example:**

```
x = 10
x += 5
print(x)  # 15

x *= 2
```

```
print(x)  # 30
```

---

### 4. Logical Operators

Logical operators are used to combine Boolean conditions.

| Operator | Meaning | Example | Output |
|---|---|---|---|
| `and` | True if both True | `True and False` | False |
| `or` | True if any True | `True or False` | True |
| `not` | Inverts value | `not True` | False |

**Example:**

```
age = 20
has_ticket = True

if age >= 18 and has_ticket:
    print("You can enter the concert.")  # This will print

if age < 18 or not has_ticket:
    print("You cannot enter.")
```

---

### 5. Membership Operators

Membership operators check if a value exists in a sequence like a list, tuple, or string.

| Operator | Meaning | Example | Output |
|---|---|---|---|
| `in` | True if value exists | `3 in [1,2,3]` | True |
| `not in` | True if value does not exist | `5 not in [1,2,3]` | True |

**Example:**

```
fruits = ["apple", "banana", "cherry"]

print("apple" in fruits)     # True
print("mango" not in fruits) # True
```

---

### 6. Identity Operators

Identity operators check if two objects are the **same object** in memory.

| Operator | Meaning | Example | Output |
|---|---|---|---|
| `is` | True if same object | `x is y` | True/False |
| `is not` | True if different | `x is not y` | True/False |

**Example:**

```
x = [1,2,3]
y = x
z = [1,2,3]

print(x is y)     # True
print(x is z)     # False
print(x is not z) # True
```

---

### Expressions

An **expression** is a combination of values, variables, and operators that produces a result.

```
a = 5
b = 10
c = a + b * 2   # Multiplication first, then addition
print(c)        # 25
```

Python follows standard **order of operations** (PEMDAS): Parentheses → Exponents → Multiplication/Division → Addition/Subtraction.

```
result = (2 + 3) * 4
print(result)  # 20
```

---

**Summary**

- Operators let you perform arithmetic, comparisons, assignments, logic, membership, and identity checks.
- Expressions combine values and operators to compute results.
- Parentheses can control the order of operations.
- Logical and comparison operators are crucial for making decisions in programs.

---

**Exercises**

1. Write a program to calculate the sum, difference, product, division, and remainder of two numbers.
2. Check if a number entered by the user is even or odd using the modulus operator.
3. Write an expression using multiple operators and parentheses to get a correct result.
4. Create two Boolean variables and experiment with `and`, `or`, and `not`.
5. Check if an element exists in a list using `in` and `not in`.

## Chapter 4 — Data Types and Type Conversion

**Introduction to Data Types**

In Python, every value belongs to a **data type**. A data type tells Python what kind of value it is and what operations are allowed. Knowing data types helps avoid errors and write correct programs.

Python automatically detects the type when you assign a value to a variable.

**Common Data Types**

1. **Integers (`int`)** – Whole numbers, positive or negative
2. **Floating-point numbers (`float`)** – Numbers with decimals
3. **Strings (`str`)** – Text enclosed in quotes
4. **Booleans (`bool`)** – True or False values
5. **NoneType (`None`)** – Represents no value

**Examples:**

```
age = 25              # int
height = 5.9          # float
name = "Alice"        # str
is_student = True     # bool
nothing = None        # NoneType

print(type(age))      # <class 'int'>
print(type(height))   # <class 'float'>
print(type(name))     # <class 'str'>
print(type(is_student)) # <class 'bool'>
print(type(nothing))  # <class 'NoneType'>
```

---

**Working with Integers and Floats**

You can perform mathematical operations:

```
a = 10
b = 3

print(a + b)   # 13
print(a - b)   # 7
print(a * b)   # 30
print(a / b)   # 3.3333333333333335 (division always returns float)
print(a // b)  # 3 (floor division)
print(a % b)   # 1 (remainder)
print(a ** b)  # 1000 (exponentiation)
```

**Tip for Beginners:** Use parentheses to control the order of operations:

```
result = (a + b) * 2
print(result)  # 26
```

---

### Strings

Strings are sequences of characters. You can use single quotes ' ' or double quotes " ":

```
greeting = 'Hello'
name = "Raj"
message = greeting + ' ' + name
print(message)  # Hello Raj
```

Strings support **indexing** and **slicing**:

```
text = "Python"
print(text[0])    # P (first character)
print(text[-1])   # n (last character)
print(text[1:4])  # yth (substring from index 1 to 3)
```

Repeat strings and check their length:

```
print("Hi! " * 3)    # Hi! Hi! Hi!
print(len("Python"))  # 6
```

---

### Boolean Type

Booleans represent **True** or **False** and are useful in comparisons and conditions.

```
x = 5
y = 10

print(x < y)   # True
print(x == y)  # False
```

```
print(x != y)  # True
```

Python treats certain values as **False**:

- `0`, `0.0`
- `''` (empty string)
- `[]`, `{}`, `set()` (empty collections)
- `None`

Everything else is considered **True**.

---

**Type Conversion (Casting)**

Sometimes you need to convert one type to another. Python provides built-in functions:

- `int()` – convert to integer
- `float()` – convert to float
- `str()` – convert to string
- `bool()` – convert to Boolean

**Examples:**

```
x = 5.8
y = int(x)   # 5
print(y)

text = "123"
num = int(text)
print(num + 1)  # 124

n = 100
print(str(n))  # '100'
```

```
print(bool(0))   # False
print(bool(5))   # True
```

**Invalid Conversion**

```
int("Python")  # ValueError: invalid literal for int()
```

**Checking Types**

Use `type()` to see a variable's type:

```
value = 3.14
print(type(value))  # <class 'float'>
```

Use `isinstance()` to check for a specific type:

```
if isinstance(value, float):
    print("value is a float")
```

---

**Working with User Input**

The `input()` function reads data from the user as a string:

```
name = input("Enter your name: ")
print(f"Hello, {name}!")
```

If you want to use the input as a number:

```
num = int(input("Enter a number: "))
print(num * 2)
```

Invalid input will raise an error, e.g., typing letters when converting to int.

---

**Summary**

- Python has several data types: `int`, `float`, `str`, `bool`, `NoneType`.
- Use `type()` and `isinstance()` to check data types.
- Use casting functions to convert between types.
- User input is always a string and may need conversion.
- Certain values are automatically interpreted as False in Boolean context.

---

**Exercises**

1. Create variables for an integer, a float, a string, and a Boolean. Print their values and types.
2. Write a program to read two numbers from the user and print their sum, difference, and product.
3. Convert the string `'45.6'` to a float and add 4.4.
4. Check the Boolean value of `0`, `''`, `'hello'`, and `123`.
5. Take input from the user and convert it to an integer before performing calculations.
6. Try converting an invalid string like `'Python'` to int and observe the error.

## Chapter 5 — Lists, Tuples, and Collections

**Introduction to Collections**

In Python, **collections** are data structures that can store multiple values in a single variable. They allow you to organize and manage data efficiently. The most commonly used collections are:

- **List** – ordered, changeable collection
- **Tuple** – ordered, unchangeable collection
- **Set** – unordered, unique collection

- **Dictionary** – key-value pairs collection

---

### 1. Lists

A **list** is an ordered collection of items. You can store numbers, strings, or even other lists inside a list. Lists are **changeable**, meaning you can modify their content.

#### Creating a List

```
fruits = ["apple", "banana", "cherry"]
numbers = [1, 2, 3, 4, 5]
mixed = ["apple", 1, True, 3.14]
```

#### Accessing List Items

```
print(fruits[0])    # apple (first item)
print(fruits[-1])   # cherry (last item)
print(fruits[1:3])  # ['banana', 'cherry'] (slice)
```

#### Modifying Lists

```
fruits[1] = "blueberry"
print(fruits)  # ['apple', 'blueberry', 'cherry']
```

#### Adding Items

```
fruits.append("mango")   # add at the end
fruits.insert(1, "orange")  # add at index 1
print(fruits)
```

#### Removing Items

```
fruits.remove("apple")  # remove by value
del fruits[0]           # remove by index
popped_item = fruits.pop()  # remove last item and return it
```

```
print(fruits)
```

### List Operations

```
numbers = [1, 2, 3]
more_numbers = [4, 5, 6]
all_numbers = numbers + more_numbers   # concatenation
print(all_numbers)                     # [1,2,3,4,5,6]

numbers *= 2
print(numbers)  # [1,2,3,1,2,3]
```

### Useful List Functions

```
nums = [5, 2, 9, 1]
print(len(nums))     # 4
print(max(nums))     # 9
print(min(nums))     # 1
print(sum(nums))     # 17
nums.sort()          # ascending
print(nums)          # [1,2,5,9]
nums.reverse()
print(nums)          # [9,5,2,1]
```

---

## 2. Tuples

A **tuple** is similar to a list, but it is **immutable**, meaning you cannot modify its contents after creation.

### Creating a Tuple

```
person = ("Alice", 25, "Engineer")
print(person[0])  # Alice
```

### Operations on Tuples

- Access items by index and slicing

- Cannot change, add, or remove items
- Can concatenate with other tuples

```
t1 = (1,2,3)
t2 = (4,5)
t3 = t1 + t2
print(t3)  # (1,2,3,4,5)
```

**Why Use Tuples?**
Tuples are faster than lists and are useful when you want to ensure the data should not be changed.

---

**3. Sets**

A **set** is an unordered collection of **unique** items. Sets are mutable but do not support indexing or slicing.

**Creating a Set**

```
fruits = {"apple", "banana", "cherry", "apple"}  # duplicate 'apple' is
removed
print(fruits)  # {'apple', 'banana', 'cherry'}
```

**Set Operations**

```
A = {1,2,3,4}
B = {3,4,5,6}

print(A.union(B))      # {1,2,3,4,5,6}
print(A.intersection(B)) # {3,4}
print(A.difference(B))   # {1,2}
```

**Adding and Removing Items**

```
fruits.add("mango")
fruits.remove("banana")
```

```
print(fruits)
```

---

### 4. Dictionaries

A **dictionary** stores data in **key-value pairs**. Keys must be unique and immutable (strings, numbers, tuples). Values can be any type.

#### Creating a Dictionary

```
person = {"name": "Alice", "age": 25, "city": "New York"}
print(person["name"])  # Alice
```

#### Modifying a Dictionary

```
person["age"] = 26
person["job"] = "Engineer"
print(person)
```

#### Removing Items

```
del person["city"]
job = person.pop("job")
print(person)
```

#### Useful Dictionary Methods

```
print(person.keys())   # dict_keys(['name', 'age'])
print(person.values()) # dict_values(['Alice', 26])
print(person.items())  # dict_items([('name','Alice'),('age',26)])
```

---

#### Summary

- **List** – ordered, changeable collection

- **Tuple** – ordered, unchangeable collection
- **Set** – unordered, unique collection
- **Dictionary** – key-value pairs

Collections are powerful tools for storing and managing multiple pieces of information efficiently. Choose the collection type based on whether you need order, uniqueness, or mutability.

---

**Exercises**

1. Create a list of your favorite fruits. Add a new fruit, remove one, and print the result.
2. Create a tuple of your birthdate (year, month, day). Try changing one value and observe the error.
3. Create two sets of numbers. Perform union, intersection, and difference operations.
4. Create a dictionary to store a student's name, age, and grade. Update the grade and print all key-value pairs.
5. Experiment by nesting collections: a list of tuples, a dictionary with lists, etc.

## Chapter 6 — Conditional Statements and Loops

**Introduction**

Conditional statements and loops allow your program to make decisions and repeat tasks. They are essential for creating dynamic, flexible programs.

---

**1. Conditional Statements (if, elif, else)**

Conditional statements let your program perform different actions depending on whether a condition is True or False.

**Syntax:**

```
if condition:
    # code to execute if condition is True
elif another_condition:
```

```
    # code if another_condition is True
else:
    # code if none of the above conditions are True
```

**Example 1: Checking Age**

```
age = 18

if age >= 18:
    print("You are an adult.")
else:
    print("You are a minor.")
```

Output:

```
You are an adult.
```

**Example 2: Multiple Conditions**

```
marks = 85

if marks >= 90:
    print("Grade: A")
elif marks >= 75:
    print("Grade: B")
elif marks >= 60:
    print("Grade: C")
else:
    print("Grade: F")
```

**Tips for Beginners:**

- Indentation is critical; Python will throw an error if you don't indent properly.
- You can combine conditions using `and`, `or`, and `not`.

```
age = 20
```

```
has_ticket = True

if age >= 18 and has_ticket:
    print("You can enter the concert.")
```

---

**2. Loops**

Loops allow you to repeat actions multiple times without writing the same code again.

a) `for` Loops

Used to iterate over sequences like lists, tuples, strings, or ranges.

**Example 1: Loop through a list**

```
fruits = ["apple", "banana", "cherry"]
for fruit in fruits:
    print(fruit)
```

Output:

```
apple
banana
cherry
```

**Example 2: Loop through a range of numbers**

```
for i in range(5):  # 0 to 4
    print(i)
```

Output:

```
0
1
2
3
4
```

**Example 3: Using `range()` with start, stop, step**

```
for i in range(1, 10, 2):
    print(i)
```

Output:

```
1
3
5
7
9
```

---

b) `while` Loops

`while` loops continue executing as long as a condition is True.

**Example: Counting numbers**

```
count = 0
while count < 5:
    print(count)
    count += 1
```

Output:

```
0
1
2
3
4
```

**Tip:** Avoid infinite loops! Make sure the condition will eventually become False.

---

**3. Loop Control Statements**

- **`break`** – exits the loop immediately
- **`continue`** – skips the current iteration and moves to the next
- **`pass`** – does nothing; useful as a placeholder

**Example with `break` and `continue`:**

```
for i in range(1, 6):
    if i == 3:
        continue   # skip 3
    if i == 5:
        break      # stop the loop
    print(i)
```

Output:

```
1
2
4
```

---

**4. Nested Loops**

You can place one loop inside another. Useful for grids, tables, or complex patterns.

**Example: Multiplication Table**

```
for i in range(1, 4):
    for j in range(1, 4):
        print(f"{i} x {j} = {i*j}")
    print("------")
```

Output:

```
1 x 1 = 1
1 x 2 = 2
1 x 3 = 3
------
```

```
2 x 1 = 2
2 x 2 = 4
2 x 3 = 6
------
3 x 1 = 3
3 x 2 = 6
3 x 3 = 9
------
```

---

**Summary**

- **`if`, `elif`, `else`**: Make decisions based on conditions.
- **`for` loop**: Iterate over sequences or ranges.
- **`while` loop**: Repeat as long as a condition is True.
- **`break`**: Exit a loop.
- **`continue`**: Skip the current iteration.
- **Nested loops**: Loops inside loops for complex tasks.

---

**Exercises**

1. Write a program to check if a number entered by the user is positive, negative, or zero.
2. Print all even numbers between 1 and 20 using a `for` loop.
3. Use a `while` loop to count down from 10 to 1.
4. Write a program that asks the user for 5 numbers and prints the sum.
5. Create a nested loop to print a 3x3 grid of stars (`*`).
6. Experiment with `break` and `continue` in a loop of numbers from 1 to 10.

## Chapter 7 — Functions and Modules

### Introduction

Functions and modules are essential for writing **organized, reusable, and readable code**. Instead of repeating the same code multiple times, you can define a function once and use it wherever needed. Modules allow you to organize functions and variables into separate files for better structure.

---

### 1. Functions

A **function** is a block of reusable code that performs a specific task. You can **call** the function whenever you need it.

#### Defining a Function

```
def greet():
    print("Hello, welcome to Python!")
```

#### Calling a Function

```
greet()
```

Output:

```
Hello, welcome to Python!
```

---

### 2. Functions with Parameters

Parameters allow you to pass information into a function.

```
def greet_user(name):
    print(f"Hello, {name}!")

greet_user("Alice")
```

```
greet_user("Raj")
```

Output:

```
Hello, Alice!

Hello, Raj!
```

---

### 3. Functions with Return Values

A function can send a value back to the part of the program that called it using `return`.

```
def add_numbers(a, b):
    return a + b

result = add_numbers(5, 3)
print(result)  # 8
```

---

### 4. Default and Keyword Arguments

You can give parameters default values. If a value is not provided, the default is used.

```
def greet(name="Guest"):
    print(f"Hello, {name}!")

greet()          # Hello, Guest!
greet("Alice")   # Hello, Alice!
```

Keyword arguments allow specifying the parameter name while calling a function:

```
def describe_person(name, age):
    print(f"{name} is {age} years old.")
```

```
describe_person(age=25, name="Raj")
```

---

### 5. Variable Scope

Variables can be **local** (inside a function) or **global** (outside a function).

```
x = 10  # global variable

def show_number():
    y = 5  # local variable
    print("Inside function:", y)

show_number()
print("Outside function:", x)
```

- Local variables exist only inside the function.
- Global variables can be accessed anywhere in the program.

**Tip:** Avoid using too many global variables to prevent confusion.

---

### 6. Modules

A **module** is a file containing Python code (functions, variables, classes) that you can **import** and use in another program.

#### Creating a Module

Create a file `mymodule.py`:

```
def greet(name):
    print(f"Hello, {name}!")
```

**Using the Module**

```
import mymodule

mymodule.greet("Alice")
```

Output:

```
Hello, Alice!
```

You can also import specific functions:

```
from mymodule import greet

greet("Raj")
```

---

**7. Built-in Modules**

Python provides many **built-in modules** for common tasks:

- `math` – mathematical functions
- `random` – generate random numbers
- `datetime` – work with dates and times

**Examples:**

```
import math
print(math.sqrt(16))  # 4.0

import random
print(random.randint(1, 10))  # random number between 1 and 10

from datetime import datetime
```

```
print(datetime.now())  # current date and time
```

---

**8. Organizing Code with Functions and Modules**

- Break your program into small, reusable functions.
- Group related functions into modules.
- Use meaningful names for functions and modules.

This makes programs easier to read, maintain, and debug.

---

**Summary**

- Functions allow code reuse and organization.
- Parameters and return values make functions flexible.
- Default and keyword arguments simplify function calls.
- Local and global variables control where data is accessible.
- Modules allow organizing code into separate files.
- Built-in modules save time by providing ready-made functionality.

---

**Exercises**

1. Write a function that takes a number and returns its square.
2. Create a function to greet a user with their name and age.
3. Write a program that imports the `math` module and calculates the factorial of a number.
4. Create a module with two functions: one to add numbers, another to subtract numbers. Import it and test both functions.

5. Write a function with a default parameter and call it with and without arguments.

## Chapter 8 — Working with Strings

### Introduction

Strings are one of the most commonly used data types in Python. A **string** is a sequence of characters enclosed in single `' '` or double `" "` quotes. Strings allow you to store and manipulate text, display messages, and interact with users.

---

### 1. Creating Strings

```
text1 = 'Hello'
text2 = "Python"
```

Both single and double quotes work the same way. Triple quotes (`''' '''` or `""" """`) are used for **multi-line strings**:

```
long_text = """This is
a multi-line
string."""
print(long_text)
```

---

### 2. Accessing Characters

You can access individual characters in a string using **indexing**:

```
text = "Python"
print(text[0])   # P (first character)
print(text[-1])  # n (last character)
```

### Slicing Strings

```
text = "Python"
print(text[0:4])   # Pyth (from index 0 to 3)
```

```
print(text[2:])    # thon (from index 2 to end)
print(text[:4])    # Pyth (from start to index 3)
print(text[-4:-1]) # tho (from index -4 to -2)
```

---

### 3. String Operations

- **Concatenation** (combine strings):

```
first = "Hello"
second = "World"
message = first + " " + second
print(message)  # Hello World
```

- **Repetition** (repeat strings):

```
print("Hi! " * 3)  # Hi! Hi! Hi!
```

- **Length of a string**:

```
text = "Python"
print(len(text))  # 6
```

---

### 4. String Methods

Python provides many built-in string methods to manipulate text:

| Method | Example | Output |
|---|---|---|
| `.upper()` | `"hello".upper()` | "HELLO" |
| `.lower()` | `"HELLO".lower()` | "hello" |
| `.capitalize()` | `"python".capitalize()` | "Python" |

| | | |
|---|---|---|
| `.title()` | `"hello world".title()` | "Hello World" |
| `.strip()` | `" hello ".strip()` | "hello" |
| `.replace()` | `"hello".replace('h','H')` | "Hello" |
| `.split()` | `"a,b,c".split(',')` | ['a','b','c'] |
| `.join()` | `'-'.join(['a','b','c'])` | "a-b-c" |

**Examples:**

```
text = "  python  "
print(text.strip())        # "python"
print(text.upper())        # "  PYTHON  "
print(text.replace("python","Python"))  # "  Python  "

words = "apple,banana,cherry"
list_of_words = words.split(',')
print(list_of_words)  # ['apple','banana','cherry']

joined = "-".join(list_of_words)
print(joined)  # apple-banana-cherry
```

---

### 5. String Formatting

You can insert variables into strings using **f-strings**, **format()**, or % operator.

- **F-strings (Python 3.6+)**

```
name = "Alice"
age = 25
print(f"{name} is {age} years old.")  # Alice is 25 years old.
```

- **Using `.format()`**

```
print("{} is {} years old.".format(name, age))
```

- **Using `%` formatting**

```
print("%s is %d years old." % (name, age))
```

**Tip:** F-strings are preferred for readability and simplicity.

---

### 6. Escape Characters

Some characters have special meanings. Use a backslash `\` to escape them:

| Escape | Meaning | Example |
|---|---|---|
| `\n` | New line | `"Hello\nWorld"` |
| `\t` | Tab | `"Hello\tWorld"` |
| `\\` | Backslash | `"C:\\Users"` |
| `\"` | Double quote | `"She said, \"Hi\""` |
| `\'` | Single quote | `'It\'s fine'` |

---

### 7. Checking and Searching Strings

Python provides methods to check and search text:

```
text = "Python programming"

print(text.startswith("Python"))  # True
print(text.endswith("programming"))  # True
print("program" in text)           # True
print("java" not in text)          # True
```

---

### 8. Combining Strings and User Input

```
name = input("Enter your name: ")
greeting = f"Hello, {name}! Welcome to Python."
print(greeting)
```

**Tip:** Always convert non-string input to string before concatenation:

```
age = int(input("Enter your age: "))
print("You are " + str(age) + " years old.")
```

---

**Summary**

- Strings store text and are enclosed in quotes.
- Access characters using indexing; extract substrings with slicing.
- Use concatenation, repetition, and length for basic operations.
- Built-in string methods simplify text manipulation.
- Use f-strings or `.format()` to insert variables.
- Escape characters allow special symbols and formatting.
- Strings can be combined with user input for interactive programs.

---

**Exercises**

1. Create a string with your full name and print the first and last characters.
2. Use slicing to extract the first three letters of a word.
3. Convert a string to uppercase, lowercase, and title case.
4. Split the sentence `"Python is fun"` into words and join them with a dash (`-`).

5. Write a program to take your name as input and greet the user using an f-string.

6. Experiment with escape characters to create a multi-line message with tabs.

## Chapter 9 — File Handling in Python

### Introduction

Files allow programs to **store and retrieve data** permanently. Python provides built-in functions to **read from, write to, and manipulate files**. Understanding file handling is essential for saving data, logging information, or working with external datasets.

---

### 1. Opening a File

Use the `open()` function to open a file. The syntax is:

```
file = open("filename", "mode")
```

**Modes**:

| Mode | Description |
|---|---|
| `'r'` | Read (default) |
| `'w'` | Write (creates a new file or overwrites) |
| `'a'` | Append (adds to the end of the file) |
| `'x'` | Create (fails if file exists) |
| `'b'` | Binary mode (for non-text files, e.g., images) |
| `'+'` | Read and write |

**Example: Opening a file for reading**

```
file = open("example.txt", "r")
```

---

### 2. Reading Files

- **Read the entire file**:

```
file = open("example.txt", "r")
content = file.read()
print(content)
file.close()
```

- **Read line by line**:

```
file = open("example.txt", "r")
line = file.readline()  # reads first line
print(line)
file.close()
```

- **Read all lines as a list**:

```
file = open("example.txt", "r")
lines = file.readlines()
print(lines)
file.close()
```

**Tip:** Always close the file using `file.close()` to free system resources.

---

**3. Writing to Files**

- **Write new content (overwrites existing content)**:

```
file = open("example.txt", "w")
file.write("Hello, Python!\n")
file.write("This is a new file.")
file.close()
```

- **Append content to a file**:

```
file = open("example.txt", "a")
file.write("\nAppending this line.")
file.close()
```

---

#### 4. Using `with` Statement

Python's `with` statement automatically closes files, even if errors occur.

```
with open("example.txt", "r") as file:
    content = file.read()
    print(content)

with open("example.txt", "a") as file:
    file.write("\nAnother appended line.")
```

---

#### 5. Working with Binary Files

For non-text files like images or PDFs, use **binary mode** `'b'`.

```
with open("image.png", "rb") as file:
    data = file.read()
    print(type(data))  # <class 'bytes'>
```

- `'wb'` – write in binary mode
- `'ab'` – append in binary mode

---

#### 6. File Operations and Methods

| Method | Description |
|---|---|

| | |
|---|---|
| `file.read(size)` | Read `size` characters |
| `file.readline()` | Read one line |
| `file.readlines()` | Read all lines into a list |
| `file.write()` | Write string to file |
| `file.seek(pos)` | Move file pointer to a position |
| `file.tell()` | Get current position of file pointer |
| `file.close()` | Close the file |

**Example: Reading first 10 characters**

```
with open("example.txt", "r") as file:
    content = file.read(10)
    print(content)
```

---

**7. Checking if a File Exists**

Use the `os` module to check if a file exists before reading or writing:

```
import os

if os.path.exists("example.txt"):
    print("File exists.")
else:
    print("File does not exist.")
```

---

**8. Practical Example: Logging**

```
def log_message(message):
    with open("log.txt", "a") as log_file:
        log_file.write(message + "\n")
```

```
log_message("Program started.")
log_message("User entered data.")
```

This creates a simple log file that keeps all messages.

---

**Summary**

- Use `open()` to read, write, or append files.
- Always close files, or use `with` for automatic closing.
- Text files are opened in `'r'`, `'w'`, or `'a'` modes.
- Binary files use `'b'` mode.
- Use `os.path.exists()` to check if a file exists before operations.
- Files are essential for saving data permanently and logging.

---

**Exercises**

1. Create a file named `data.txt` and write 5 lines of text to it.
2. Read the contents of `data.txt` and print them line by line.
3. Append a new line to `data.txt` without deleting the existing content.
4. Write a program that reads a file and counts the number of words in it.
5. Create a simple log file that records the current date and time each time the program runs.
6. Experiment with reading only a part of a file using `read(size)`.

## Chapter 10 — Error Handling and Exceptions

**Introduction**

Errors are common in programming. When a program encounters an **error**, it stops running and shows a message. Python provides a mechanism called **exception handling** to catch errors and allow the program to continue running. Learning to handle errors makes your code more robust and user-friendly.

---

**1. Types of Errors**

**Syntax Errors** – Mistakes in the code structure

```
print("Hello"  # Missing closing parenthesis
```

**Runtime Errors** – Errors that occur during program execution

```
print(5 / 0)  # Division by zero
```

**Logical Errors** – Code runs but produces incorrect results

```
total = 5 + 2 * 3  # You expected 21 but got 11
```

---

**2. Try and Except**

Use `try` and `except` blocks to handle exceptions.

```
try:
    num = int(input("Enter a number: "))
    print(10 / num)
except ZeroDivisionError:
    print("Cannot divide by zero!")
except ValueError:
    print("Invalid input! Please enter a number.")
```

- **try:** Contains code that might raise an exception
- **except:** Executes if an exception occurs

**Example: Handling multiple exceptions**

```
try:
```

```
    x = int(input("Enter a number: "))
    y = int(input("Enter another number: "))
    print(x / y)
except ZeroDivisionError:
    print("Cannot divide by zero!")
except ValueError:
    print("Invalid input! Please enter integers.")
```

---

### 3. The Else Clause

The `else` block runs if no exception occurs.

```
try:
    x = int(input("Enter a number: "))
    y = int(input("Enter another number: "))
    result = x / y
except ZeroDivisionError:
    print("Cannot divide by zero!")
else:
    print("Division successful. Result:", result)
```

---

### 4. The Finally Clause

The `finally` block always runs, whether an exception occurred or not. It is commonly used to release resources.

```
try:
    file = open("data.txt", "r")
    content = file.read()
except FileNotFoundError:
    print("File not found!")
finally:
    file.close()
    print("File closed.")
```

---

### 5. Raising Exceptions

You can raise your own exceptions using `raise`. This is useful to enforce rules in your program.

```
def check_age(age):
    if age < 0:
        raise ValueError("Age cannot be negative.")
    else:
        print(f"Age is {age}")

check_age(25)  # Age is 25
# check_age(-5) would raise ValueError
```

---

### 6. Common Built-in Exceptions

| Exception | Description |
|---|---|
| `ZeroDivisionError` | Division by zero |
| `ValueError` | Invalid value type |
| `TypeError` | Operation on incompatible types |
| `FileNotFoundError` | File does not exist |
| `IndexError` | Index out of range in sequences |
| `KeyError` | Key not found in dictionary |
| `AttributeError` | Attribute not found for an object |

---

### 7. Best Practices for Exception Handling

- Catch only the exceptions you expect.
- Avoid using bare `except:` without specifying the exception type.
- Use `finally` to release resources like files or network connections.

- Provide helpful messages for the user.

---

**8. Practical Example: Safe Division**

```
def safe_divide(a, b):
    try:
        return a / b
    except ZeroDivisionError:
        return "Cannot divide by zero!"

print(safe_divide(10, 2))  # 5.0
print(safe_divide(10, 0))  # Cannot divide by zero!
```

---

**Summary**

- Exceptions allow programs to handle errors gracefully.
- Use `try`, `except`, `else`, and `finally` to manage errors.
- Raise exceptions to enforce program rules.
- Handle common exceptions like `ZeroDivisionError`, `ValueError`, `FileNotFoundError`.
- Exception handling improves program reliability and user experience.

---

**Exercises**

1. Write a program that asks the user for a number and prints its square. Handle invalid inputs gracefully.
2. Create a program to read a file. Handle the case when the file does not exist.
3. Write a function that calculates the division of two numbers. Handle division by zero.
4. Raise a `ValueError` if the user enters a negative number for age.

5. Experiment with `try`, `except`, `else`, and `finally` in a program that reads user input and performs arithmetic operations.

## Chapter 11 — Object-Oriented Programming (OOP) in Python

### Introduction

Object-Oriented Programming (OOP) is a programming style that organizes code using **objects**. An object represents a real-world entity with **attributes** (data) and **methods** (functions). OOP helps write **organized, reusable, and scalable** code.

Python supports OOP with **classes** and **objects**.

---

### 1. Classes and Objects

- **Class**: A blueprint for creating objects.
- **Object**: An instance of a class.

**Example:**

```
class Dog:
    # Class attribute
    species = "Canine"

    # Constructor method
    def __init__(self, name, age):
        self.name = name  # instance attribute
        self.age = age    # instance attribute

    # Method
    def bark(self):
        print(f"{self.name} is barking!")

# Creating objects
dog1 = Dog("Buddy", 3)
dog2 = Dog("Lucy", 5)

print(dog1.name)  # Buddy
print(dog2.age)   # 5
dog1.bark()       # Buddy is barking!
```

---

### 2. Instance vs Class Attributes

- **Instance attributes** belong to a specific object.
- **Class attributes** are shared among all objects.

```
class Dog:
    species = "Canine"  # class attribute

    def __init__(self, name):
        self.name = name  # instance attribute

dog1 = Dog("Buddy")
dog2 = Dog("Lucy")

print(dog1.species)  # Canine
print(dog2.species)  # Canine

Dog.species = "Dog"
print(dog1.species)  # Dog
```

---

### 3. Methods

Methods are functions defined inside a class.

```
class Circle:
    def __init__(self, radius):
        self.radius = radius

    def area(self):
        return 3.14 * self.radius ** 2

circle1 = Circle(5)
print(circle1.area())  # 78.5
```

**Tip:** `self` refers to the object itself.

---

**4. Inheritance**

Inheritance allows a class (child) to **inherit attributes and methods** from another class (parent).

```
class Animal:
    def __init__(self, name):
        self.name = name

    def speak(self):
        print(f"{self.name} makes a sound.")

class Dog(Animal):
    def speak(self):
        print(f"{self.name} barks.")

animal = Animal("Generic Animal")
animal.speak()  # Generic Animal makes a sound.

dog = Dog("Buddy")
dog.speak()     # Buddy barks.
```

Explanation:

Animal class is the parent class (or base class).

It has an __init__ method that assigns the name attribute.

It has a speak() method that prints a general message.

Dog class is the child class (or subclass).

Dog inherits from Animal, so it automatically gets the __init__ method from Animal.

Dog overrides the speak() method to provide a more specific behavior: printing that the dog barks.

Creating objects:

animal = Animal("Generic Animal") → object of parent class

dog = Dog("Buddy") → object of child class, uses parent's __init__ but its own speak()

Key Points for Beginners:

If a child class doesn't define __init__, Python uses the parent's __init__.

If a child class defines a method with the same name as a parent method, it overrides it.

You can also call the parent method explicitly using super():

```
class Dog(Animal):
    def speak(self):
        super().speak()  # Call parent method
        print(f"{self.name} barks.")
```

Output:

Buddy makes a sound.

Buddy barks.

**Tip:** Inheritance helps **reuse code** and create **hierarchies**.

---

**5. Encapsulation**

Encapsulation hides internal data of an object. Use **private attributes** with a leading underscore `_` or double underscore `__`.

```
class Person:
    def __init__(self, name, age):
        self.name = name
        self.__age = age  # private attribute

    def get_age(self):
        return self.__age

person = Person("Alice", 25)
print(person.name)      # Alice
# print(person.__age)   # Error
print(person.get_age()) # 25
```

---

### 6. Polymorphism

Polymorphism allows objects of different classes to **use the same method name**.

```
class Cat:
    def speak(self):
        print("Meow")

class Dog:
    def speak(self):
        print("Bark")

animals = [Cat(), Dog()]
for animal in animals:
    animal.speak()
```

Output:

```
Meow
Bark
```

---

### 7. Special Methods (Magic Methods)

Python has **special methods** that start and end with double underscores (`__`). They customize object behavior.

- `__init__` – constructor
- `__str__` – string representation

```
class Book:
    def __init__(self, title, author):
        self.title = title
        self.author = author

    def __str__(self):
        return f"{self.title} by {self.author}"

book = Book("Python Basics", "Raj")
```

```
print(book)  # Python Basics by Raj
```

---

**Summary**

- OOP organizes code using **classes and objects**.
- **Attributes** store data, **methods** define behavior.
- **Inheritance** allows code reuse.
- **Encapsulation** hides internal data.
- **Polymorphism** enables flexible method usage.
- **Special methods** customize object behavior.

---

**Exercises**

1. Create a `Car` class with attributes `brand` and `model`, and a method `drive()`.
2. Create two objects of the `Car` class and call their methods.
3. Create a `Shape` class with a method `area()`. Inherit `Rectangle` and `Circle` classes and implement `area()` for each.
4. Make a class with a private attribute and provide a method to access it.
5. Experiment with `__str__` in a custom class to display readable object information.

## Chapter 12 — Working with Libraries and Packages

**Introduction**

Python has thousands of **libraries** and **packages** that provide pre-written code to perform common tasks. Using libraries saves time, avoids reinventing the wheel, and makes your programs more powerful. This chapter introduces how to use **built-in** and **external libraries**.

---

### 1. What is a Library and a Package?

- **Library**: A collection of modules (Python files) containing functions, classes, and variables.
- **Package**: A folder containing multiple modules, organized with an `__init__.py` file.

**Example:**

- `math` is a library (contains mathematical functions).
- `numpy` is a package (contains multiple modules for numerical computations).

---

### 2. Importing Libraries

Python provides the `import` statement to use libraries.

**Example: Using the math library**

```
import math

print(math.sqrt(16))     # 4.0
print(math.factorial(5)) # 120
```

**Import specific functions**

```
from math import sqrt, factorial

print(sqrt(25))       # 5.0
print(factorial(4))   # 24
```

**Alias for Libraries**

```
import numpy as np

array = np.array([1, 2, 3])
print(array)
```

---

### 3. Installing External Libraries

Python comes with **built-in libraries**, but you can also install external libraries using **pip** (Python's package manager).

```
pip install requests
```

**Example: Using `requests` library to fetch web content**

```
import requests

response = requests.get("https://www.rajamanickam.com")
print(response.status_code)
print(response.text[:100])  # print first 100 characters
```

---

### 4. Commonly Used Built-in Libraries

| Library | Purpose | Example Use |
|---|---|---|
| `math` | Mathematical functions | `math.sqrt(16)` |
| `random` | Generate random numbers | `random.randint(1,10)` |
| `datetime` | Work with dates and times | `datetime.now()` |
| `os` | Interact with operating system | `os.listdir()` |
| `sys` | Access Python runtime environment | `sys.version` |
| `json` | Work with JSON data | `json.loads()` |
| `re` | Regular expressions | `re.match()` |

---

### 5. Using a Package with Multiple Modules

**Example: NumPy package for numerical computations**

```python
import numpy as np

# Create arrays
a = np.array([1, 2, 3])
b = np.array([4, 5, 6])

# Array operations
print(a + b)  # [5 7 9]
print(a * 2)  # [2 4 6]

# Mean and sum
print(np.mean(a))  # 2.0
print(np.sum(b))   # 15
```

---

### 6. Creating Your Own Module

You can organize your code into **modules** and reuse it in multiple programs.

1. Create a file `mymodule.py`:

```python
def greet(name):
    return f"Hello, {name}!"

def add(a, b):
    return a + b
```

2. Import and use the module:

```python
import mymodule

print(mymodule.greet("Alice"))  # Hello, Alice!
print(mymodule.add(5, 3))       # 8
```

---

### 7. Exploring Libraries

- Use `dir(library_name)` to see all functions and attributes in a library.
- Use `help(function_or_library)` to get documentation.

```
import math
print(dir(math))
help(math.sqrt)
```

---

**8. Best Practices**

- Always check if a library is **built-in** or needs installation.
- Use **aliases** (`import numpy as np`) for readability.
- Keep a **requirements file** (`requirements.txt`) to list all external libraries for your project:

```
numpy
requests
pandas
```

- Update libraries regularly using `pip install --upgrade library_name`.

---

**Summary**

- Libraries and packages provide pre-written code to simplify tasks.
- Use `import` to access libraries; install external libraries with `pip`.
- Explore built-in libraries like `math`, `random`, `datetime`, `os`.
- Organize your code into custom modules for reusability.

---

### Exercises

1. Import the `random` library and generate a random number between 1 and 100.
2. Use the `datetime` library to print today's date in the format `YYYY-MM-DD`.
3. Install the `requests` library and fetch content from any website.
4. Create a module with two functions: one that multiplies numbers and another that subtracts numbers. Import it and test the functions.
5. Explore the `os` library to list all files in a folder and check if a specific file exists.

## Chapter 13 — Working with Data: Lists, Dictionaries, CSV, and JSON

### Introduction

Python provides powerful tools to **store, organize, and manipulate data**. In this chapter, we explore **lists, dictionaries**, and how to work with **CSV** and **JSON files**, which are common formats for storing structured data.

---

### 1. Lists

A **list** is an **ordered collection of items**. Lists are mutable, meaning you can **change, add, or remove items**.

#### Creating Lists

```
fruits = ["apple", "banana", "cherry"]
numbers = [1, 2, 3, 4, 5]
mixed = ["apple", 10, True]
```

#### Accessing Items

```
print(fruits[0])   # apple
print(fruits[-1])  # cherry
```

#### Modifying Lists

```
fruits[1] = "blueberry"
fruits.append("orange")
fruits.insert(1, "mango")
fruits.remove("apple")
print(fruits)
```

### Looping Through Lists

```
for fruit in fruits:
    print(fruit)
```

### List Methods

- `append()`, `insert()`, `remove()`, `pop()`
- `sort()`, `reverse()`, `len()`, `count()`

```
numbers = [5, 2, 9, 1]
numbers.sort()
print(numbers)  # [1, 2, 5, 9]
numbers.reverse()
print(numbers)  # [9, 5, 2, 1]
```

---

### 2. Dictionaries

A **dictionary** stores data in **key-value pairs**. Keys are unique, and values can be any type.

### Creating Dictionaries

```
person = {"name": "Alice", "age": 25, "city": "Paris"}
```

### Accessing Values

```
print(person["name"])   # Alice
print(person.get("age")) # 25
```

### Modifying Dictionaries

```
person["age"] = 26
person["profession"] = "Engineer"
person.pop("city")
print(person)
```

### Looping Through Dictionaries

```
for key, value in person.items():
    print(key, ":", value)
```

---

### 3. Working with CSV Files

**CSV (Comma-Separated Values)** files store tabular data. Python provides the `csv` module to read and write CSV files.

### Reading CSV Files

```
import csv

with open("data.csv", "r") as file:
    reader = csv.reader(file)
    for row in reader:
        print(row)
```

### Writing CSV Files

```
import csv

data = [["Name", "Age"], ["Alice", 25], ["Bob", 30]]

with open("data.csv", "w", newline="") as file:
    writer = csv.writer(file)
    writer.writerows(data)
```

**Tip:** Always use `newline=""` when writing CSV files to avoid extra blank lines.

---

### 4. Working with JSON Files

**JSON (JavaScript Object Notation)** is a popular format to store structured data. Python provides the `json` module.

#### Reading JSON

```
import json

with open("data.json", "r") as file:
    data = json.load(file)
    print(data)
```

#### Writing JSON

```
import json

person = {"name": "Alice", "age": 25, "city": "Paris"}

with open("data.json", "w") as file:
    json.dump(person, file, indent=4)
```

**Tip:** `indent=4` makes the JSON file readable.

---

### 5. Converting Between JSON and Python Objects

- **Python dict → JSON string**: `json.dumps()`
- **JSON string → Python dict**: `json.loads()`

```
import json

person = {"name": "Bob", "age": 30}
json_str = json.dumps(person)
print(json_str)  # {"name": "Bob", "age": 30}
```

```
python_obj = json.loads(json_str)
print(python_obj["name"])  # Bob
```

---

**Summary**

- **Lists**: Ordered, mutable collection of items.
- **Dictionaries**: Key-value pairs, fast access by key.
- **CSV files**: Store tabular data; use `csv` module to read/write.
- **JSON files**: Store structured data; use `json` module to read/write.
- Python makes it easy to **store, retrieve, and manipulate data** in multiple formats.

---

**Exercises**

1. Create a list of your favorite movies and print them using a loop.
2. Create a dictionary to store your friends' names and their ages. Print all keys and values.
3. Write a program to save a list of students' names and scores in a CSV file.
4. Read the CSV file you created and print each student's name and score.
5. Save a dictionary of your profile (name, age, city, profession) to a JSON file.
6. Read the JSON file and print the city from the data.

## Chapter 14 — Introduction to NumPy and Pandas for Data Handling

**Introduction**

For professional applications like AI, data analysis, or scientific computing, Python's built-in data structures are sometimes **not enough**. Libraries like **NumPy** and **Pandas** make working with large datasets **efficient, fast, and convenient**. This chapter introduces these libraries and their basic usage.

---

### 1. NumPy: Numerical Python

**NumPy** provides **arrays**, which are faster and more memory-efficient than Python lists. It also offers many functions for **mathematical operations**.

#### Installing NumPy

```
pip install numpy
```

#### Importing NumPy

```
import numpy as np
```

#### Creating Arrays

```
arr = np.array([1, 2, 3, 4, 5])
print(arr)
```

#### Array Operations

```
a = np.array([1, 2, 3])
b = np.array([4, 5, 6])

print(a + b)  # [5 7 9]
print(a * 2)  # [2 4 6]
print(a ** 2) # [1 4 9]
```

#### Useful NumPy Functions

```
print(np.zeros(5))       # [0. 0. 0. 0. 0.]
print(np.ones(3))        # [1. 1. 1.]
print(np.arange(1, 10, 2)) # [1 3 5 7 9]
print(np.linspace(0, 1, 5)) # [0.   0.25 0.5  0.75 1. ]
print(np.mean(a))        # 2.0
print(np.sum(b))         # 15
```

#### Accessing Array Elements

```
arr = np.array([10, 20, 30, 40, 50])
print(arr[0])    # 10
print(arr[-1])   # 50
print(arr[1:4])  # [20 30 40]
```

---

### 2. Pandas: Data Analysis Made Easy

**Pandas** is used to **work with structured data**, such as spreadsheets or CSV files. It provides two main data structures:

- **Series**: One-dimensional labeled array
- **DataFrame**: Two-dimensional table with rows and columns

#### Installing Pandas

```
pip install pandas
```

#### Importing Pandas

```
import pandas as pd
```

---

### 3. Pandas Series

#### Creating a Series

```
import pandas as pd

data = [10, 20, 30, 40]
series = pd.Series(data)
print(series)
```

#### Custom Index

```
series = pd.Series(data, index=["a", "b", "c", "d"])
print(series)
```

### Accessing Elements

```
print(series[0])      # 10
print(series["b"])    # 20
```

---

### 4. Pandas DataFrame

### Creating a DataFrame

```
data = {
    "Name": ["Alice", "Bob", "Charlie"],
    "Age": [25, 30, 35],
    "City": ["Paris", "London", "New York"]
}

df = pd.DataFrame(data)
print(df)
```

### Accessing Columns

```
print(df["Name"])
print(df[["Name", "City"]])
```

### Accessing Rows

```
print(df.loc[0])   # by row label
print(df.iloc[1])  # by row index
```

### Basic Operations

```
print(df.describe())     # summary statistics for numerical columns
print(df.info())         # information about data types and missing values
print(df.head(2))        # first 2 rows
print(df.tail(2))        # last 2 rows
```

---

### 5. Reading and Writing Files with Pandas

#### Reading CSV Files

```
df = pd.read_csv("data.csv")
print(df.head())
```

#### Writing CSV Files

```
df.to_csv("output.csv", index=False)
```

#### Reading Excel Files

```
df = pd.read_excel("data.xlsx")
```

---

### 6. Combining NumPy and Pandas

NumPy arrays can be used inside Pandas DataFrames for fast computation.

```
import numpy as np
import pandas as pd

data = np.random.randint(1, 100, size=(5,3))
df = pd.DataFrame(data, columns=["A", "B", "C"])
print(df)
```

---

### Summary

- **NumPy**: Efficient arrays and numerical operations.
- **Pandas**: Structured data handling with Series and DataFrames.
- Reading/writing CSV and Excel files is easy with Pandas.

- NumPy and Pandas together are powerful for **data analysis and AI projects**.

---

**Exercises**

1. Create a NumPy array of numbers from 1 to 10 and print its mean and sum.
2. Create a Pandas Series with 5 random numbers and print the largest value.
3. Create a DataFrame with 3 columns (Name, Age, City) and 5 rows of sample data.
4. Read a CSV file using Pandas and print the first 5 rows.
5. Save a DataFrame to a new CSV file.
6. Use NumPy to create a 3x3 matrix and convert it into a Pandas DataFrame.

## Chapter 15 — Introduction to Matplotlib for Data Visualization

**Introduction**

Visualizing data helps us **understand patterns, trends, and relationships**. **Matplotlib** is a popular Python library for creating **graphs and plots**. This chapter introduces the basics of Matplotlib and how to create simple visualizations.

---

**1. Installing and Importing Matplotlib**

**Install Matplotlib using pip:**

```
pip install matplotlib
```

**Importing Matplotlib**

```
import matplotlib.pyplot as plt
```

**Tip:** `plt` is the commonly used alias for Matplotlib's `pyplot` module.

---

**2. Creating a Simple Line Plot**

```
# Sample data
x = [1, 2, 3, 4, 5]
y = [10, 20, 15, 25, 30]

# Create line plot
plt.plot(x, y)

# Add labels and title
plt.xlabel("X-axis")
plt.ylabel("Y-axis")
plt.title("Simple Line Plot")

# Show the plot
plt.show()
```

---

### 3. Plotting Multiple Lines

```
x = [1, 2, 3, 4, 5]
y1 = [10, 20, 15, 25, 30]
y2 = [5, 15, 10, 20, 25]

plt.plot(x, y1, label="Line 1", color="blue", marker="o")
plt.plot(x, y2, label="Line 2", color="red", marker="s")

plt.xlabel("X-axis")
plt.ylabel("Y-axis")
plt.title("Multiple Lines")
plt.legend()  # Show legend
plt.show()
```

---

### 4. Creating a Bar Chart

```
fruits = ["Apple", "Banana", "Cherry"]
quantity = [10, 15, 7]

plt.bar(fruits, quantity, color="green")
plt.xlabel("Fruits")
plt.ylabel("Quantity")
plt.title("Fruit Quantity")
```

```
plt.show()
```

**Horizontal Bar Chart**

```
plt.barh(fruits, quantity, color="orange")
plt.xlabel("Quantity")
plt.ylabel("Fruits")
plt.title("Fruit Quantity (Horizontal)")
plt.show()
```

---

**5. Creating a Pie Chart**

```
sizes = [40, 30, 20, 10]
labels = ["Python", "Java", "C++", "Other"]
colors = ["gold", "lightblue", "lightgreen", "pink"]

plt.pie(sizes, labels=labels, colors=colors, autopct="%1.1f%%",
startangle=90)
plt.title("Programming Language Popularity")
plt.show()
```

---

**6. Scatter Plot**

```
x = [5, 7, 8, 7, 2, 17, 2, 9]
y = [99, 86, 87, 88, 100, 86, 103, 87]

plt.scatter(x, y, color="red", marker="o")
plt.xlabel("X-axis")
plt.ylabel("Y-axis")
plt.title("Scatter Plot Example")
plt.show()
```

---

**7. Customizing Plots**

- **Line styles:** `'-'` solid, `'--'` dashed, `':'` dotted

- **Markers:** `'o'`, `'s'`, `'^'`, `'*'`
- **Colors:** `'red'`, `'blue'`, `'green'`, `'#FF5733'`

```
x = [1, 2, 3, 4, 5]
y = [10, 15, 13, 17, 20]

plt.plot(x, y, color="purple", linestyle="--", marker="*", linewidth=2,
markersize=10)
plt.title("Customized Line Plot")
plt.show()
```

---

**8. Subplots**

```
x = [1, 2, 3, 4, 5]
y1 = [10, 20, 15, 25, 30]
y2 = [5, 15, 10, 20, 25]

plt.subplot(2, 1, 1)  # 2 rows, 1 column, first plot
plt.plot(x, y1, color="blue")
plt.title("First Plot")

plt.subplot(2, 1, 2)  # second plot
plt.plot(x, y2, color="red")
plt.title("Second Plot")

plt.tight_layout()  # adjust spacing
plt.show()
```

---

**Summary**

- **Matplotlib** is used to create line, bar, pie, and scatter plots.
- Plots can be **customized** with colors, markers, and line styles.
- Use **subplots** to create multiple plots in one figure.

- Visualization helps in **understanding and presenting data effectively**.

---

**Exercises**

1. Create a line plot of your monthly expenses.
2. Create a bar chart showing the population of 5 countries.
3. Create a pie chart representing the percentage of time spent on daily activities.
4. Create a scatter plot of 10 random numbers for x and y.
5. Customize a line plot with a different color, marker, and line style.
6. Create two subplots: one line plot and one bar chart.

## Chapter 16 — Introduction to AI Libraries: scikit-learn and Basics of Machine Learning

**Introduction**

To build AI applications, Python provides powerful **libraries** that simplify tasks like data processing, model training, and predictions. One of the most widely used libraries is **scikit-learn**, which is beginner-friendly and great for learning **machine learning** concepts.

This chapter introduces **scikit-learn**, basic machine learning concepts, and simple examples.

---

**1. What is scikit-learn?**

- **scikit-learn** is a Python library for **machine learning**.
- It provides tools for:
    - **Classification** (predict categories)
    - **Regression** (predict numbers)
    - **Clustering** (group data)

    - **Preprocessing** (prepare data)

- scikit-learn is built on **NumPy**, **SciPy**, and **Matplotlib**.

**Installing scikit-learn**

```
pip install scikit-learn
```

**Importing scikit-learn**

```
import sklearn
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
```

---

**2. Basic Concepts of Machine Learning**

1. **Dataset** – Collection of data for training and testing.
2. **Features (X)** – Input variables used for prediction.
3. **Target (y)** – Output variable you want to predict.
4. **Training Set** – Portion of data used to train the model.
5. **Test Set** – Portion of data used to evaluate the model.
6. **Model** – Algorithm that learns patterns from data.

---

**3. Example 1: Linear Regression (Predicting Numbers)**

**Linear regression** predicts a **continuous value** (like house price, temperature, etc.).

```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression

# Sample data: hours studied vs marks
X = [[1], [2], [3], [4], [5]]  # hours
```

```
y = [2, 4, 6, 8, 10]           # marks

# Split data into training and testing
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,
random_state=42)

# Create and train model
model = LinearRegression()
model.fit(X_train, y_train)

# Predict
predictions = model.predict(X_test)
print("Predicted marks:", predictions)

# Model score (accuracy for regression)
print("Model score:", model.score(X_test, y_test))
```

---

#### 4. Example 2: Classification (Predict Categories)

**Classification** predicts a **category** (like spam or not spam, disease or healthy).

```
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier

# Load sample dataset
iris = load_iris()
X = iris.data    # features
y = iris.target  # labels

# Split data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,
random_state=42)

# Create and train model
clf = DecisionTreeClassifier()
clf.fit(X_train, y_train)

# Predict
predictions = clf.predict(X_test)
```

```
print("Predictions:", predictions)

# Accuracy
accuracy = clf.score(X_test, y_test)
print("Accuracy:", accuracy)
```

---

### 5. Preprocessing Data

Real-world data often needs **cleaning** before training.

- **Scaling** – Make features comparable in magnitude
- **Encoding** – Convert text into numbers

```
from sklearn.preprocessing import StandardScaler, LabelEncoder

# Scaling example
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Encoding example
labels = ["red", "blue", "red", "green"]
encoder = LabelEncoder()
y_encoded = encoder.fit_transform(labels)
print(y_encoded)  # [2 0 2 1]
```

---

### 6. Train-Test Split

Always split data into **training** and **testing** sets to avoid overfitting.

```
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,
random_state=42)
```

- `test_size=0.2` → 20% of data used for testing

- `random_state` → ensures reproducibility

---

**7. Summary**

- **scikit-learn** simplifies machine learning in Python.
- **Linear Regression** predicts numbers; **Decision Trees** predict categories.
- Split data into **training** and **test sets** for accurate evaluation.
- **Preprocessing** like scaling and encoding is essential for real-world data.
- With scikit-learn, even beginners can start building AI models quickly.

---

**Exercises**

1. Create a linear regression model to predict temperature based on hours of sunlight.
2. Load the `iris` dataset and train a classifier to predict flower species.
3. Encode a list of colors (`["red", "blue", "green"]`) using `LabelEncoder`.
4. Split a dataset into training and testing sets with 25% for testing.
5. Try scaling a sample dataset using `StandardScaler`.
6. Experiment with a different classifier like `KNeighborsClassifier` from scikit-learn.

## Chapter 17 — Introduction to AI Projects in Python

**Introduction**

After learning Python basics and AI libraries, it's time to **apply your knowledge**. Working on small projects helps you **understand concepts**, **gain confidence**, and **prepare for real-world applications**. This chapter introduces simple beginner-friendly AI projects using Python.

---

**1. Project 1: Predicting House Prices (Linear Regression)**

**Objective:** Predict house prices based on features like area, number of bedrooms, and age.

**Steps:**

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression

# Sample dataset
data = {
    "Area": [1000, 1500, 2000, 2500, 3000],
    "Bedrooms": [2, 3, 3, 4, 4],
    "Age": [5, 10, 15, 20, 25],
    "Price": [200000, 250000, 300000, 350000, 400000]
}

df = pd.DataFrame(data)

# Features and target
X = df[["Area", "Bedrooms", "Age"]]
y = df["Price"]

# Split data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,
random_state=42)

# Train model
model = LinearRegression()
model.fit(X_train, y_train)

# Predict
predictions = model.predict(X_test)
print("Predicted Prices:", predictions)
print("Model Score:", model.score(X_test, y_test))
```

---

### 2. Project 2: Iris Flower Classification (Decision Tree)

**Objective:** Predict the species of an iris flower based on features like petal length and sepal width.

```
from sklearn.datasets import load_iris
```

```
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier

# Load dataset
iris = load_iris()
X = iris.data
y = iris.target

# Split dataset
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,
random_state=42)

# Train classifier
clf = DecisionTreeClassifier()
clf.fit(X_train, y_train)

# Predict
predictions = clf.predict(X_test)
print("Predictions:", predictions)
print("Accuracy:", clf.score(X_test, y_test))
```

---

### 3. Project 3: Spam Email Detection (Text Classification)

**Objective:** Classify emails as spam or not spam using simple text features.

```
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import MultinomialNB

# Sample dataset
emails = ["Win money now", "Meeting at 10", "Free lottery tickets",
"Project deadline tomorrow"]
labels = [1, 0, 1, 0]  # 1 = spam, 0 = not spam

# Convert text to features
vectorizer = CountVectorizer()
X = vectorizer.fit_transform(emails)
y = labels

# Split data
```

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25,
random_state=42)

# Train classifier
clf = MultinomialNB()
clf.fit(X_train, y_train)

# Predict
predictions = clf.predict(X_test)
print("Predictions:", predictions)
print("Accuracy:", clf.score(X_test, y_test))
```

---

### 4. Project 4: Simple Recommendation System

**Objective:** Recommend items based on user ratings using a similarity approach.

```
import pandas as pd
from sklearn.metrics.pairwise import cosine_similarity

# Sample ratings data
data = {
    "Item1": [5, 4, 0, 3],
    "Item2": [3, 0, 5, 4],
    "Item3": [4, 3, 4, 5],
    "Item4": [0, 4, 3, 5]
}
df = pd.DataFrame(data, index=["User1", "User2", "User3", "User4"])

# Calculate similarity
similarity = cosine_similarity(df.fillna(0))
print("User Similarity Matrix:\n", similarity)
```

---

### 5. Best Practices for AI Projects

1. **Start small:** Use small datasets before moving to large ones.
2. **Preprocess data:** Handle missing values, scale features, and encode categorical data.

3. **Split data:** Always use training and testing sets to evaluate models.
4. **Experiment:** Try different algorithms and compare accuracy.
5. **Document your code:** Clear comments help you and others understand your project.
6. **Visualize results:** Use Matplotlib or Seaborn for graphs.

---

**Summary**

- Beginner AI projects help reinforce learning.
- Start with **predictive projects** like regression and classification.
- Explore **text classification** and **recommendation systems** for practical applications.
- Follow best practices: preprocess data, split datasets, experiment, and visualize.

---

**Exercises**

1. Modify the house price project to include more features like “Garage” or “Location”.
2. Train a different classifier (like `KNeighborsClassifier`) on the iris dataset.
3. Add more sample emails to the spam detection project and evaluate accuracy.
4. Create a small movie recommendation system with ratings from 3–5 users.
5. Use Matplotlib to visualize predictions from the house price or iris project.

## Chapter 18 — Final Tips, Debugging, and Next Steps for AI Learning

**Introduction**

By now, you have learned Python basics, data handling, visualization, and beginner-friendly AI projects. This chapter focuses on **best practices, debugging tips, and guidance for continuing your AI learning journey**.

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**1. Writing Clean and Readable Code**
Use **meaningful variable names**:

```
age = 25          # good
a = 25            # not descriptive
```

- Follow **PEP 8** guidelines for Python formatting:
    - Use 4 spaces for indentation
    - Keep lines under 79 characters
    - Add spaces around operators: `x = y + 2`

Comment your code:

```
 # Calculate the square of a number
square = x ** 2
```

---

**2. Debugging Tips**

1. **Read error messages carefully** – They usually indicate what went wrong.
2. **Print intermediate results** – Helps identify where the logic fails:

   ```
   print(variable)
   ```
3. **Use a debugger** – Tools like **VS Code**, **PyCharm**, or **Jupyter Notebook** allow step-by-step execution.
4. **Check data types** – Many errors occur because of unexpected data types:

   ```
   type(variable)
   ```
5. **Start small** – Test small parts of your code before combining everything.

---

**3. Handling Common Errors**

| Error Type | Example | Solution |
|---|---|---|

| | | |
|---|---|---|
| SyntaxError | `print("Hello` | Check missing quotes or parentheses |
| NameError | `print(age)` when age not defined | Ensure variable is defined before use |
| TypeError | `5 + "5"` | Convert to same type: `5 + int("5")` |
| IndexError | `list[5]` when list has 3 elements | Check list length before accessing |
| KeyError | `dict["name"]` when key doesn't exist | Use `dict.get("name")` or check key existence |

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**4. Best Practices for AI Projects**

1. **Understand your data** – Visualize and explore before modeling.
2. **Start simple** – Use simple algorithms before complex ones.
3. **Use train-test split** – Evaluate your model accurately.
4. **Preprocess data** – Handle missing values, scale features, encode categories.
5. **Experiment and iterate** – Try different algorithms and parameters.
6. **Document and save models** – Use `joblib` or `pickle` to save trained models:

```
import joblib
joblib.dump(model, "model.pkl")
model = joblib.load("model.pkl")
```

---

**5. Next Steps**

1. **Practice Regularly** – Solve small AI problems every day.
2. **Participate in Competitions** – Join Kaggle competitions to apply your skills.

3. **Work on Projects** – Build simple AI projects like recommendation systems, chatbots, or image classifiers.

4. **Learn Advanced Topics** – Neural networks, natural language processing (NLP), and computer vision.

5. **Keep Updated** – AI is evolving quickly; follow blogs, research papers, and library updates.

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**Summary**

- Writing **clean code**, **debugging carefully**, and **following best practices** are essential for success.

- Understanding data, preprocessing, and splitting datasets ensures accurate AI models.

- Regular practice, projects, and community involvement accelerate learning.

- With Python, NumPy, Pandas, Matplotlib, and scikit-learn, you have a solid foundation to **explore AI further**.

---

**Exercises**

1. Review a previous project and add meaningful comments to all code lines.

2. Intentionally introduce a small error in a program and practice debugging it.

3. Save a trained model using `joblib` and reload it for prediction.

4. Explore a new dataset online and try to analyze it using Pandas and Matplotlib.

5. Participate in a beginner-friendly Kaggle competition and share your solution.

Thanks for reading this book. If you are interested in learning AI, check the AI Course at rajamanickam.com