

Programming Foundations in Python

Prepared by Dr. Hamada I. AbdulWakel

Lecture 10





File Handling and Graphical User Interface

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RECAP: LECTURE 9

- The operator overloading.
- Inheritance and polymorphism.

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LECTURE MAIN POINTS

- The meaning of file handling.
- The file operations.
- The Command-line vs. Graphical-user interfaces.
- The GUI module in python.

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FILES

- Since RAM is volatile (which loses its data when the computer is turned off).
- **Files** are named locations on disk to store related information.
- They are used to permanently store data in a non-volatile memory (e.g. hard disk).



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FILE OPENING

- The syntax of opening a file is:
`File_object_name = open(filename, mode)`
- The "filename" is a **string** argument which specify filename along with its path.
- The mode is a **string** argument which used to specify how file will be used.
 - The reading mode represented by "r".
 - The writing mode represented by "w".
 - The appending mode represented by "a".

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FILE CLOSING

- When we are done with performing operations on the file, we need to properly close the file.
- Closing a file will free up the resources that were tied with the file.
- The syntax for closing a file is:

```
File_object_name.close()
```

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FILE CLOSING

Cont'd

- If an exception occurs when we are performing some operation with the file, the code exits without closing the file. So, we use **try .. finally** statement.

```
try:
```

```
    File_object_name = open(filename, mode)
```

```
finally:
```

```
    File_object_name.close()
```

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FILE CLOSING

Cont'd

- The best way to close a file is by using the **with** statement.
- This ensures that the file is closed when the block inside the with statement is exited.
- If an exception occurs before the end of the block, it will close the file before the exception is caught.

```
with open(filename, mode) as f:  
    #file operations
```

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FILE READING DATA

- We must open the file in reading **r** mode.
- To read data back from the file you need one of these methods:
 - **read([number])**: return specified number of characters from the file.
 - If the number is omitted, it will read the entire content.
 - **readline()**: returns the next line of the file.
 - **readlines()**: read all the lines as a list of strings.
- **FileNotFoundError** is the error generated if the file you try to read is not exists.

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FILE READING DATA

Cont'd

• Code:

```
f = open("myfile.txt", "r")    # open file in current directory
f = open("D:\\path\\to\\myfile.txt", "r")    # specifying full path in Windows
f = open("/path/to/myfile.txt", "r")    # specifying full path in Linux
# return the file name
print( f.name )
# return the file opening mode
print( f.mode )
# check if the file close or not
print( f.closed )
```

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FILE READING DATA

Cont'd

• Code:

```
f = open("myfile.txt", "r")  
f = open("D:\\path\\to\\myfile.txt", "r") # Windows  
f = open("/path/to/myfile.txt", "r") # Linux  
print( f.read(10) )  
print( f.read() )  
print( f.readline() )  
lines = f.readlines()  
for i in lines:  
    print(i)  
f.close()
```

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FILE READING DATA

Cont'd

• Code:

The screenshot displays a Python IDE environment with three main components:

- Editor (test.py):** Contains the following Python code:

```
1 f = open("D:\\test\\test.txt", "r")
2 print(f.read())
3 f.close()
```
- File Explorer:** Shows the directory structure with the 'test' folder selected under 'Local Disk (D:)'. The 'test' folder contains a file named 'test.txt' (4 bytes).
- Terminal:** Shows the execution of the script using Windows PowerShell:

```
PS D:\python> & C:/Users/pc/AppData/Local/Programs/Python/Python313/python.exe d:/python/test.py
test
PS D:\python>
```

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FILE WRITING DATA

Cont'd

- We need to open it in write w, append a or exclusive creation x mode.
- We need to be careful with the w mode, as it will overwrite into the file if it already exists.
- Code:

```
import os
```

```
os.chdir("D:\\path\\to\\the\\folder")
```



```
chdir("/path/to/the/folder/")
```

```
f.write("My Name: Hamada I.")
```

```
f.write("I'm a teacher at \n" )
```



```
with open("myfile.txt", "w") as f:
```

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FILE WRITING DATA

Cont'd

- Code:



```
import os  
os.chdir("D:\\path\\to\\the\\folder")  
with open("myfile.txt", "a") as f:  
    f.write("Midocean University")
```



```
os.chdir("/path/to/the/folder/")
```

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FILE RENAMING AND DELETING

- The os module provides methods that help to perform file-processing operations, such as renaming and deleting.
- To rename an existing file, rename() method is used.
- It takes two arguments, current file name and new file name.
- Syntax:

```
os.rename(current_file_name, new_file_name)
```

```
os.remove(filename)
```

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COMMAND LINE INTERFACE

- **The command-line interface (CLI):** takes input from the user via text commands entered in a terminal or console window.
- **CLI features:**
 - Based on commands a user inputs in the terminal.
 - More efficient and faster since it doesn't require much memory or processing power as the entire interaction is performed in a terminal window.
 - Requires memorizing commands, which sometimes have complex syntax and many arguments.
 - Takes input from the keyboard.
 - Users cannot change CLI's appearance.

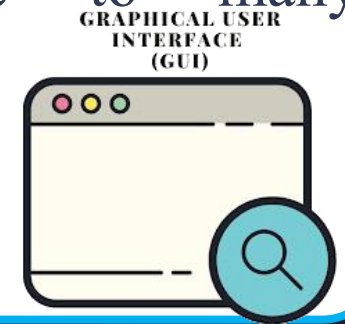


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GRAPHICAL USER INTERFACE

- **The graphical-user interface (GUI) version:** based on graphics and visual elements, allowing users to interact with the system using a keyboard and a mouse.
- **GUI features:**
 - Based on visual elements such as icons, buttons, windows, dialog boxes, etc.
 - Requires more memory and processing power due to many graphical components that need to be loaded.
 - Icons method reduces the required knowledge level.
 - Takes input from the mouse and keyboard.
 - Appearance can be modified to suit the users' needs.

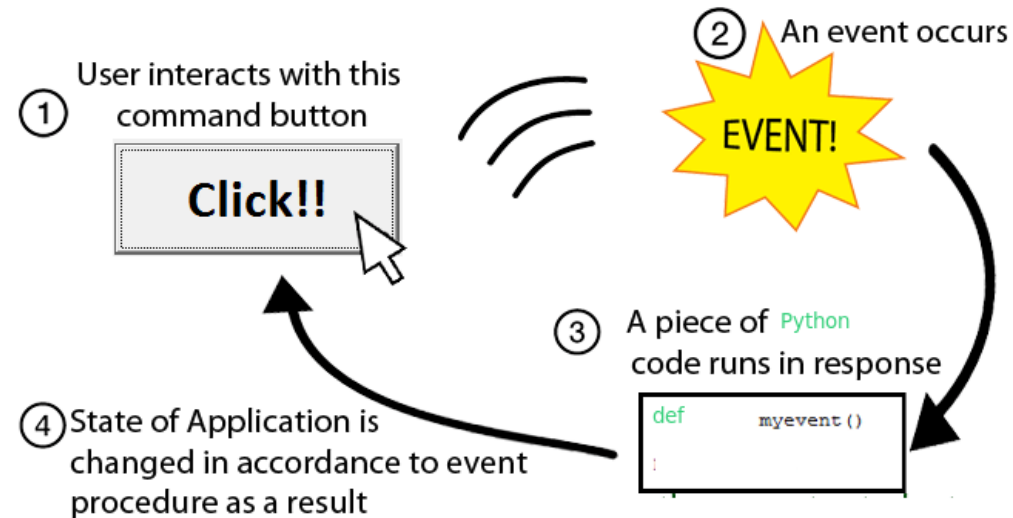


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EVENT-DRIVEN PROGRAMMING

- In GUI, the user-generated events (i.e., mouse clicks, button clicks) trigger operations in the program to respond by pulling in inputs, processing them, and displaying results.



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TKINTER GUI MODULES

- For GUI, there are a number of modules used to create UI:
 - PyGUI.
 - Wax.
 - Pyforms.
 - PySimpleGUI.
 - Tkinter.
 -, and more

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TKINTER MODULE

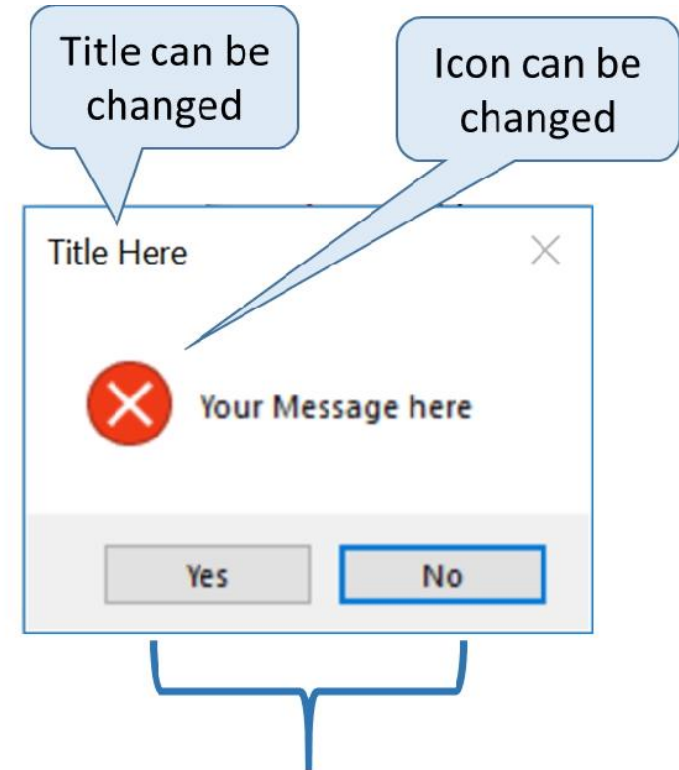
- Tkinter is the standard GUI library for Python.
- Tkinter provides a fast and easy way to create GUI applications.
- Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit.
- Tkinter is included with Python as a library.
- To use it: `from tkinter import *`

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TKINTER MESSAGE BOXES

- The messagebox module is used to display the message boxes in the python applications.
- There are the various functions which are used to display the relevant messages depending upon the application requirements.



Default selection of button can be changed.

TKINTER MESSAGE BOXES

Cont'd

- To create a messagebox:
`messagebox.function_name(title, message [, options])`
 - **function_name:** It represents an appropriate message box function.
 - **title:** It is a string which is shown as a title of a message box.
 - **message:** It is the string to be displayed as a message on the message box.
 - **options:** There are various options which can be used to configure the message dialog box.

TKINTER MESSAGE BOXES

Cont'd

- Code:

```
from tkinter import messagebox
```

```
messagebox.showinfo("title","Information")
```

```
messagebox.showwarning("title","Warning")
```

```
messagebox.showerror("title","Error")
```

```
messagebox.askquestion("title", "Do you love GUI?")
```

```
response = messagebox.askyesnocancel("title", "Do you love GUI?")
```

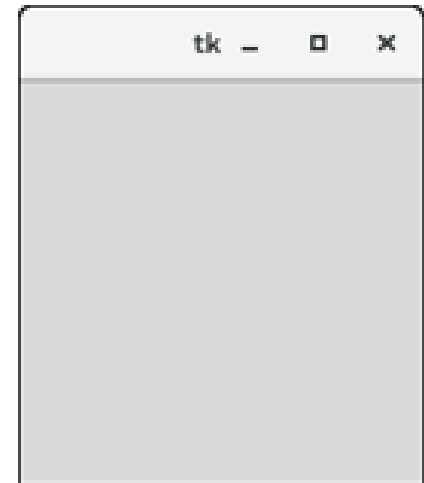
```
print(response)
```

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TKINTER FRAME

- A frame is a rectangular region on the screen.
- It is used to organize a group of widgets.
- An empty Tkinter top-level window can be created by using the following steps:
 - import the Tkinter module.
 - Create the main application window.
 - Add the widgets like labels, buttons, frames, etc.
 - Call the main event loop so that listening to the events and perform the actions on the frame.



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TKINTER FRAME

Cont'd

- Code:

```
from tkinter import *
```

```
mainFrame = Tk()
```

```
mainFrame.title("The main frame title")
```

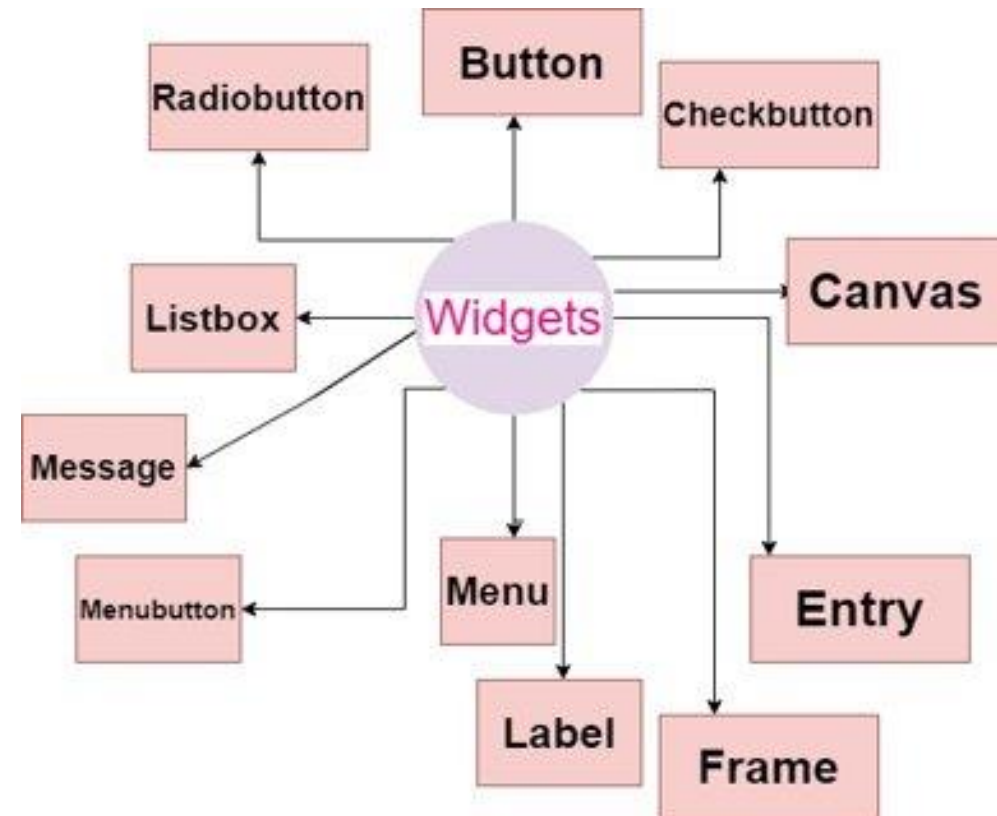
```
mainFrame.geometry("300x300")
```

```
mainFrame.mainloop() #listens for events
```

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TKINTER WIDGETS



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TKINTER WIDGETS

Cont'd

- A widget is a graphical component on the screen.
- Any widget can be added using this syntax:

```
widget_var_name = widgetName(parent, option = placeholder)
```

Where **parent** is the argument for the parent frame while **option** is a placeholder that can have various values differ from widget to the other.

- **Label widget:**
 - Display box where you can place text or images.
 - The text displayed by this widget can be updated at any time you want.

```
label = Label(root, text = "Label text" )
```

- **Button widget:**
 - Used to perform an action when clicked.
 - You can attach a function or a method to a button, which is called automatically when you click the button.

```
btnOk = Button(root, text="Ok", fg="red", bd=2, bg="light blue")
```

- **Entry widget:**

- Used to accept single-line text strings from a user.

```
usName = Entry(root, width=20)
```

- **Checkbutton widget:**

- Used to display a number of options to a user as toggle buttons.

```
var1 = IntVar()
```

```
var2 = IntVar()
```

```
CBtn1 = Checkbutton(root, text="Option 1", variable=var1, onvalue=1, offvalue=0)
```

```
CBtn2 = Checkbutton(root, text="Option 2", variable=var2, onvalue=1, offvalue=0)
```

- **Radiobutton widget:**
 - implements a multiple-choice button, which let user choose only one of them.
 - In order to implement this functionality, each group of radiobuttons must be associated to the same variable.

```
var1 = StringVar()
```

```
RBttn1 = Radiobutton(root, text = "Option1", variable = var1, value = 1)
```

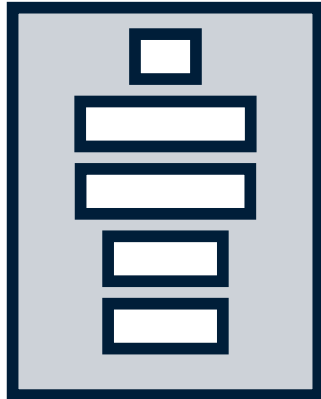
```
RBttn2 = Radiobutton(root, text = "Option2", variable = var1, value = 2)
```

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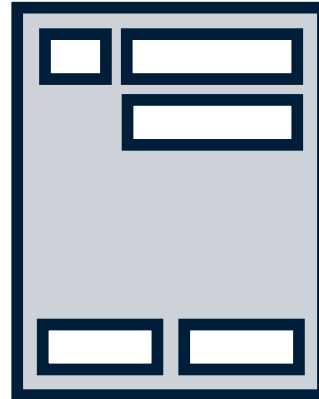
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TKINTER GEOMETRY MANAGER

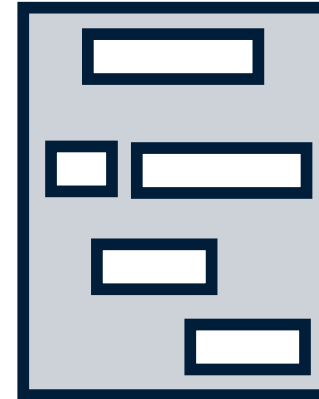
- The geometry measurements allow you to organize the widgets and throughout the parent frames or parent widget area.

**Pack**

One after another,
vertically or horizontally

**Grid**

Assigned to grid cells,
using rows and columns

**Place**

Put stuff anywhere,
using coordinates

TKINTER GEOMETRY MANAGER

Cont'd

- The geometry allows you to organize the widgets on the parent frames.
 - **pack()**: It organizes the widgets in a block manner, and the complete available width is occupied by it.
`widget.pack(options)`
 - **grid()**: It organizes the widgets in a table-like structure.
`widget.grid(options)`
 - **place()**: Its purpose is to place the widgets at a specific position as instructed by the user in the parent widget.
`widget.place(options)`

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TKINTER GEOMETRY MANAGER

Cont'd

- Code:

```
username = Label(root, text="User Name:").pack(side=TOP)
```

```
username = Label(root, text="User Name:").grid(row=0)
```

```
username = Label(root, text="User Name:").place(x = 30, y = 50)
```

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BUTTON EXAMPLE

- Code:

```
import tkinter
from tkinter import messagebox
top = tkinter.Tk()
def helloCallBack():
    messagebox.showinfo( "Hello Python", "Hello World")

B = tkinter.Button(top, text ="Hello", command = helloCallBack)
B.pack()
top.mainloop()
```

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CALCULATOR EXAMPLE

- Code:

```
from tkinter import *  
expression = ""
```

```
def press(num):  
    global expression  
    expression = expression + str(num)  
    equation.set(expression)
```

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CALCULATOR EXAMPLE

Cont'd

- Code:

```
def equalpress():  
    global expression  
    total = str(eval(expression))  
    equation.set(total)  
    expression = ""  
  
def clear():  
    global expression  
    expression = ""  
    equation.set("")
```

CALCULATOR EXAMPLE

Cont'd

- Code:

```
gui = Tk()
gui.title("Simple Calculator")
gui.geometry("250x130")
equation = StringVar()
expression_field = Entry(gui, textvariable=equation)
expression_field.grid(columnspan=2)
button1 = Button(gui, text=' 1 ', fg='black', bg='red',
                  command=lambda: press(1), height=1, width=7)
button1.grid(row=2, column=0)
```

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CALCULATOR EXAMPLE

Cont'd

- Code:

```
button2 = Button(gui, text=' 2 ', fg='black', bg='red',  
                 command=lambda: press(2), height=1, width=7)  
button2.grid(row=2, column=1)  
plus = Button(gui, text=' + ', fg='black', bg='red',  
              command=lambda: press("+"), height=1, width=7)  
plus.grid(row=3, column=0)  
equal = Button(gui, text=' = ', fg='black', bg='red',  
               command=equalpress, height=1, width=7)  
equal.grid(row=3, column=1)
```

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CALCULATOR EXAMPLE

Cont'd

- Code:

```
clear = Button(gui, text='Clear', fg='black', bg='red',  
               command=clear, height=1, width=7)  
clear.grid(row=4, column=0)
```

```
# start the GUI  
gui.mainloop()
```

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QUESTIONS FOR ONLINE DISCUSSION

- Suppose we have this hours.txt data. Compute each worker's total hours and hours/day.
123 Suzy 9.5 8.1 7.6 3.1 3.2
456 Brad 7.0 9.6 6.5 4.9 8.8
789 Jenn 8.0 8.0 8.0 8.0 7.5
- Complete the calculator example with other arithmetic operators.

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PYTHON NEW UPDATES

- Performance is King:
 - The core team is deeply committed to making CPython faster without breaking existing code (the "Faster CPython" project).
- Developer Experience:
 - The focus on clearer error messages is a multi-year project that dramatically helps beginners and experts alike.
- Governance:
 - The language has a clear, community-driven direction with annual release cycles.

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PATTERN MATCHING

- Pattern Matching (or **match-case**) is a feature that allows you to check a value against a pattern and execute code based on that pattern.
- It is more powerful than traditional **switch-case** statements in other languages because it can destructure data types and match on patterns, not just values.

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PATTERN MATCHING

- Basic Syntax:

match value:

case pattern_1:

code executed if pattern 1 matches

case pattern_2:

code executed if pattern 2 matches

case _:

code executed if no pattern matches (like else)

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PATTERN MATCHING

- Example 1 (value matching):

```
def describe_day(day):
```

```
    match day:
```

```
        case "Saturday" | "Sunday":
```

```
            return "Weekend"
```

```
        case "Friday":
```

```
            return "Friday - blessed day"
```

```
        case _:
```

```
            return "Unknown day"
```

```
print(describe_day("Friday")) # Friday - blessed day
```

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PATTERN MATCHING

- Example 2 (extracting values from list):

```
def process_list(lst):
```

```
    match lst:
```

```
        case []:
```

```
            print("Empty list")
```

```
        case [single]:
```

```
            print(f"Single element list: {single}")
```

```
        case [first, second, *rest]:
```

```
            print(f"First: {first}")
```

```
            print(f"Second: {second}")
```

```
            print(f"Remaining: {rest}")
```

```
process_list([1, 2, 3, 4, 5])
```

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TYPE HINTS

- Type hints (or type annotations) are a way to add static type information to Python code.
- Benefits:
 - **Better IDE Support:** Autocomplete, jump to definition, refactoring
 - **Early Bug Detection:** Catch type errors before runtime
 - **Improved Documentation:** Types serve as documentation
 - **Better Architecture:** Forces you to think about data flow
 - **Easier Refactoring:** Safe to change code with type checking

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TYPE HINTS

- Annotations:

Variable annotations

x: int = 10

y: float = 3.14

name: str = "John"

is_valid: bool = True

data: bytes = b"hello"

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TYPE HINTS

- Annotations:

Collections annotations

```
numbers: list[int] = [1, 2, 3]
```

```
mixed_list: list[int | str] = [1, "two", 3]
```

```
point: tuple[int, int] = (10, 20) # Tuples (fixed size)
```

```
items: tuple[int, ...] = (1, 2, 3, 4) # Variable-length tuple
```

Dictionaries

```
person: dict[str, str | int] = {"name": "Alice", "age": 30}
```



Thank You

