

# Python Complete Course - Comprehensive Guide

## From Basics to Advanced (Django & Machine Learning)

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## Part 1: Python Fundamentals

### 1. Getting Started with Python

#### What is Python?

Python is a high-level, interpreted programming language known for its:

- **Simplicity:** Easy to read and write
- **Versatility:** Web development, data science, ML, automation
- **Large Ecosystem:** Millions of packages available

#### Setting Up Development Environment

##### #### Install Python

1. Download from [python.org](https://www.python.org)

2. Install Python 3.7+

3. Verify installation:

```
python --version
```

##### #### Install VS Code

1. Download from [code.visualstudio.com](https://code.visualstudio.com)

2. Install Python extension

3. Install Pylint (linter)

4. Install autopep8 (formatter)

#### Your First Python Program

```
# app.py print("Hello World")
```

**Run the program:**

```
python app.py
```

## Output:

```
Hello World
```

## VS Code Features for Python

Feature	Purpose	Shortcut
<b>Linting</b>	Find errors in code	Auto (Pylint)
<b>Formatting</b>	Auto-format code	Shift+Alt+F
<b>Debugging</b>	Step through code	F5
<b>IntelliSense</b>	Auto-completion	Ctrl+Space
<b>Code Snippets</b>	Quick templates	Type + Tab

## Code Formatting (PEP 8)

PEP 8 is the style guide for Python code.

### Bad Code:

```
x=1 y=2 unit_price=3
```

### Good Code (PEP 8 Compliant):

```
x = 1 y = 2 unit_price = 3
```

**Auto-format:** Save file with autopep8 enabled.

---

## 2. Variables

### What is a Variable?

A variable is a label for a memory location that stores data.

```
# Declaring variables students_count = 1000 rating = 4.99 is_published = True course_name = "Python Programming"
```

### Variable Naming Rules

#### ■ DO:

```
student_count = 100 # Use lowercase first_name = "John" # Use underscores age2 = 25 # Can contain numbers
```

#### ■ DON'T:

```
2age = 25 # Can't start with number first-name = "John" # Can't use hyphens class = "Math" # Can't use keywords
```

### Variable Naming Conventions

```
# Snake case (Python convention) student_count = 1000 first_name = "John" is_published = True # camelCase  
(Not typical in Python) studentCount = 1000 firstName = "John"
```

## Multiple Assignment

```
# Assign same value to multiple variables x = y = z = 0 # Assign different values x, y, z = 1, 2, 3  
print(f"x={x}, y={y}, z={z}") # Output: x=1, y=2, z=3
```

---

## 3. Primitive Data Types

### Python Built-in Primitive Types

Python has three main primitive types:

1. **Numbers** (int, float, complex)
2. **Strings** (str)
3. **Booleans** (bool)

### Integers

```
# Whole numbers age = 25 students_count = 1000 temperature = -10 print(type(age)) # Output: <class 'int'>
```

### Floats

```
# Numbers with decimal points rating = 4.99 temperature = 98.6 pi = 3.14159 print(type(rating)) # Output:  
<class 'float'>
```

### Booleans

```
# True or False values is_published = True is_active = False print(type(is_published)) # Output: <class  
'bool'>
```

### Strings

```
# Text data course = "Python Programming" name = 'John Doe' message = """Multi-line string using triple  
quotes"" print(type(course)) # Output: <class 'str'>
```

## Checking Type

```
x = 5 print(type(x)) # <class 'int'> y = 5.0 print(type(y)) # <class 'float'> name = "John"  
print(type(name)) # <class 'str'>
```

---

## 4. Strings

### Creating Strings

```
# Single quotes course = 'Python Programming' # Double quotes name = "John Doe" # Triple quotes  
(multi-line) message = """ Hi John, This is a multi-line string. Best regards, Admin """
```

## Escape Sequences

```
# Newline message = "Line 1\nLine 2" print(message) # Output: # Line 1 # Line 2 # Tab message =  
"Name:\tJohn" print(message) # Name: John # Backslash path = "C:\\Users\\John" print(path) # C:\\Users\\John  
# Quote inside string message = "He said, \"Hello!\" print(message) # He said, "Hello!"
```

## String Length

```
course = "Python Programming" length = len(course) print(length) # Output: 18
```

## String Indexing

```
course = "Python" # Access individual characters (0-indexed) print(course[0]) # P print(course[1]) # y  
print(course[-1]) # n (last character) print(course[-2]) # o (second-to-last)
```

## String Slicing

```
course = "Python Programming" # [start:end] - end is exclusive print(course[0:6]) # Python  
print(course[:6]) # Python (start omitted = 0) print(course[7:]) # Programming (end omitted = till end)  
print(course[:]) # Python Programming (entire string) # Negative indices print(course[0:-1]) # Python  
Programmin (excludes last char)
```

## String Methods

```
course = " Python Programming " # Convert to uppercase print(course.upper()) # " PYTHON PROGRAMMING " #  
Convert to lowercase print(course.lower()) # " python programming " # Title case print(course.title()) # "  
Python Programming " # Strip whitespace print(course.strip()) # "Python Programming"  
print(course.lstrip()) # "Python Programming " print(course.rstrip()) # " Python Programming "  
  
# Find substring print(course.find("Pro")) # 9 (index where "Pro" starts) print(course.find("xyz")) # -1  
(not found) # Replace substring print(course.replace("Python", "Java")) # " Java Programming " # Check if  
substring exists print("Python" in course) # True print("Java" in course) # False print("Python" not in  
course) # False
```

**Important:** String methods return NEW strings. Original string is unchanged.

```
course = "python" print(course.upper()) # PYTHON print(course) # python (original unchanged)
```

## String Concatenation

```
# Using + operator first = "John" last = "Doe" full = first + " " + last print(full) # John Doe # Using  
f-strings (recommended) full = f"{first} {last}" print(full) # John Doe
```

## Formatted Strings (f-strings)

```
name = "John" age = 25 # Old way (format method) message = "Hi, I'm {} and I'm {} years old".format(name,  
age) # New way (f-strings) - Python 3.6+ message = f"Hi, I'm {name} and I'm {age} years old"  
print(message) # Hi, I'm John and I'm 25 years old # Expressions in f-strings x = 10 y = 20 print(f"Sum:  
{x + y}") # Sum: 30 print(f"Length: {len(name)}") # Length: 4
```

## 5. Numbers

## Number Types

```
# Integer x = 10 print(type(x)) # <class 'int'> # Float y = 10.5 print(type(y)) # <class 'float'> #
Complex (rarely used) z = 1 + 2j print(type(z)) # <class 'complex'>
```

## Built-in Math Functions

```
# Round print(round(2.9)) # 3 print(round(2.5)) # 2 # Absolute value print(abs(-10)) # 10 print(abs(10)) #
10
```

## Math Module

```
import math # Ceiling (round up) print(math.ceil(2.2)) # 3 # Floor (round down) print(math.floor(2.9)) # 2
# Square root print(math.sqrt(16)) # 4.0 # Power print(math.pow(2, 3)) # 8.0 # Constants

print(math.pi) # 3.141592653589793 print(math.e) # 2.718281828459045
```

## Getting User Input

```
# input() always returns a string name = input("What is your name? ") print(f"Hello {name}") # Get number
# need to convert age = input("How old are you? ") age = int(age) # Convert string to int print(f"You are
{age} years old")
```

---

## 6. Type Conversion

### Type Conversion Functions

Function	Purpose	Example
----- ----- -----		
<font name="Courier">int()</font>   Convert to integer   <font name="Courier">int("10")</font> → <font name="Courier">10</font>		
<font name="Courier">float()</font>   Convert to float   <font name="Courier">float("10.5")</font> → <font name="Courier">10.5</font>		
<font name="Courier">bool()</font>   Convert to boolean   <font name="Courier">bool(1)</font> → <font name="Courier">True</font>		
<font name="Courier">str()</font>   Convert to string   <font name="Courier">str(10)</font> → <font name="Courier">"10"</font>		

### Examples

```
# String to int x = input("Enter a number: ") # Returns string x = int(x) # Convert to integer y = x + 1
print(f"x={x}, y={y}") # String to float price = input("Enter price: ") price = float(price) total = price
* 1.1 # Add 10% tax print(f"Total: {total}") # Number to string age = 25 message = "I am " + str(age) +
" years old"

print(message) # Or use f-string (auto-converts) message = f"I am {age} years old" print(message)
```

### Falsy andTruthy Values

**Falsy Values** (evaluate to False):

```
print(bool(0)) # False print(bool("")) # False (empty string) print(bool(None)) # False print(bool([])) # False (empty list) print(bool({})) # False (empty dict)
```

## Truthy Values (evaluate to True):

```
print(bool(1)) # True print(bool(-1)) # True print(bool("hello")) # True print(bool([1, 2])) # True  
print(bool("False")) # True (non-empty string!)
```

# 7. Arithmetic Operations

## Basic Operators

```
x = 10 y = 3 # Addition print(x + y) # 13 # Subtraction print(x - y) # 7 # Multiplication print(x * y) # 30  
# Division (always returns float) print(x / y) # 3.333333333333335  
  
# Floor division (returns int) print(x // y) # 3 # Modulus (remainder) print(x % y) # 1 # Exponentiation  
(power) print(x ** y) # 1000 (10^3)
```

## Augmented Assignment Operators

```
x = 10 # Instead of: x = x + 3 x += 3 # x is now 13 x -= 3 # x = x - 3 x *= 3 # x = x * 3 x /= 3 # x = x / 3  
x //= 3 # x = x // 3 x %= 3 # x = x % 3 x **= 3 # x = x ** 3
```

## Operator Precedence

```
# PEMDAS: Parentheses, Exponents, Multiplication/Division, Addition/Subtraction x = 10 + 3 * 2 # 16 (not  
26) x = (10 + 3) * 2 # 26 x = 10 ** 2 * 3 # 300 (exponent first) x = (10 ** 2) * 3 # 300 (same)
```

# 8. Comparison Operators

## Comparison Operators

```
x = 10 y = 20 # Greater than print(x > y) # False # Greater than or equal print(x >= y) # False # Less than  
print(x < y) # True # Less than or equal print(x <= y) # True  
  
# Equal to print(x == y) # False # Not equal to print(x != y) # True
```

## Comparing Strings

```
# Lexicographical comparison (dictionary order) print("apple" < "banana") # True print("apple" == "Apple")  
# False (case-sensitive) # Compare lengths name1 = "John" name2 = "Alexander" print(len(name1) <  
len(name2)) # True
```

# 9. Logical Operators

## Logical Operators

```
# AND - both must be True print(True and True) # True print(True and False) # False print(False and False)
# False # OR - at least one must be True print(True or False) # True print(False or False) # False # NOT -
inverts the value print(not True) # False print(not False) # True
```

## Practical Examples

```
age = 25 has_license = True # Check if can drive can_drive = age >= 18 and has_license print(f"Can drive: {can_drive}") # Can drive: True # Check eligibility is_student = True is_senior = False discount = is_student or is_senior print(f"Eligible for discount: {discount}") # True # Negate condition is_premium = False

is_free_user = not is_premium print(f"Free user: {is_free_user}") # True
```

## Short-circuit Evaluation

```
# AND stops at first False result = False and print("This won't execute") # OR stops at first True result = True or print("This won't execute")
```

---

## 10. If Statements

### Basic If Statement

```
age = 18 if age >= 18: print("You are an adult") print("You can vote")
```

### If-Else Statement

```
age = 16 if age >= 18: print("You are an adult") else: print("You are a minor")
```

### If-Elif-Else Statement

```
age = 15 if age >= 18: print("Adult") elif age >= 13: print("Teenager") else: print("Child")
```

### Nested If Statements

```
age = 25 has_license = True if age >= 18: if has_license: print("You can drive") else: print("You need a license") else: print("You're too young to drive")
```

### Multiple Conditions

```
age = 25 is_student = True # Using AND if age >= 18 and is_student: print("Student discount available") # Using OR if age < 18 or age > 65: print("Special pricing") # Complex conditions temperature = 30 is_hot = temperature > 30 is_cold = temperature < 10

if is_hot: print("It's hot") elif is_cold: print("It's cold") else: print("It's moderate")
```

## Ternary Operator

```
age = 20 # Long form if age >= 18: message = "Adult" else: message = "Minor" # Short form (ternary)
message = "Adult" if age >= 18 else "Minor" print(message)
```

---

## 11. While Loops

### Basic While Loop

```
i = 1 while i <= 5: print(i) i += 1 # Output: 1 2 3 4 5
```

### Infinite Loop (with break)

```
i = 1 while True: print(i) if i >= 5: break # Exit loop i += 1
```

### While Loop with Else

```
i = 1 while i <= 3: print(i) i += 1 else: print("Loop completed") # Output: # 1 # 2 # 3 # Loop completed
```

### Practical Example: Guessing Game

```
secret = 5 guess_count = 0 max_tries = 3 while guess_count < max_tries: guess = int(input("Guess: "))  
guess_count += 1 if guess == secret: print("You won!") break else: print("Try again") else: print("You lost!")
```

---

## 12. For Loops

### Basic For Loop

```
# Iterate over a string for char in "Python": print(char) # Output: P y t h o n (each on new line)
```

### For Loop with Lists

```
names = ["John", "Mary", "Bob"] for name in names: print(f"Hello {name}") # Output: # Hello John # Hello  
Mary # Hello Bob
```

### Range Function

```
# range(stop) for i in range(5): print(i) # Output: 0 1 2 3 4 # range(start, stop) for i in range(2, 7):  
print(i) # Output: 2 3 4 5 6 # range(start, stop, step) for i in range(0, 10, 2): print(i) # Output: 0 2 4  
6 8
```

### For-Else Statement

```
for i in range(3): print(i) else: print("Loop completed") # Output: # 0 # 1 # 2 # Loop completed
```

### Nested For Loops

```
for i in range(3): for j in range(2): print(f"({i}, {j})") # Output: # (0, 0) # (0, 1) # (1, 0) # (1, 1) #  
(2, 0) # (2, 1)
```

### Break and Continue

```
# Break - exit loop for i in range(10): if i == 5: break print(i) # Output: 0 1 2 3 4 # Continue - skip to next iteration for i in range(5): if i == 2: continue print(i) # Output: 0 1 3 4
```

## 13. Functions

### Why Functions?

Functions help you:

- **Organize code** into reusable blocks
- **Avoid repetition** (DRY principle)
- **Improve readability**
- **Easier to test and maintain**

### Defining a Function

```
def greet(): print("Hello") print("Welcome!") # Call the function greet() # Output: # Hello # Welcome!
```

### Function Naming Conventions

```
# Good names (snake_case) def calculate_total(): pass def get_user_name(): pass def is_valid(): pass # Bad names def CalculateTotal(): # PascalCase (used for classes) pass def a(): # Not descriptive
```

```
pass
```

## 14. Parameters & Arguments

### Parameters

```
# Function with parameters def greet(name): print(f"Hello {name}") # Call with argument greet("John") # Hello John greet("Mary") # Hello Mary
```

### Multiple Parameters

```
def greet(first_name, last_name): print(f"Hello {first_name} {last_name}") greet("John", "Doe") # Hello John Doe
```

### Positional vs Keyword Arguments

```
def greet(first_name, last_name): print(f"Hello {first_name} {last_name}") # Positional arguments (order matters) greet("John", "Doe") # Keyword arguments (order doesn't matter) greet(last_name="Doe", first_name="John") # Mix (positional first, then keyword) greet("John", last_name="Doe")
```

### Default Parameters

```
def greet(name="Guest"): print(f"Hello {name}") greet("John") # Hello John greet() # Hello Guest
```

## Multiple Default Parameters

```
def calculate_total(price, tax=0.1, shipping=5): total = price + (price * tax) + shipping return total
print(calculate_total(100)) # 115.0 print(calculate_total(100, 0.2)) # 125.0 print(calculate_total(100, 0.2, 10)) # 130.0 print(calculate_total(100, shipping=0)) # 110.0
```

## \*args (Variable Arguments)

```
def sum_all(*numbers): total = 0 for num in numbers: total += num return total print(sum_all(1, 2, 3)) # 6
print(sum_all(1, 2, 3, 4, 5)) # 15
```

## \*\*kwargs (Keyword Arguments)

```
def save_user(**details): print(details) save_user(name="John", age=25, city="NYC") # Output: {'name': 'John', 'age': 25, 'city': 'NYC'}
```

## 15. Return Values

### Functions That Return Values

```
def square(x): return x * x result = square(5) print(result) # 25
```

### Functions Without Return

```
def greet(name): print(f"Hello {name}") # Returns None by default result = greet("John") print(result) # None
```

### Multiple Return Values

```
def get_coordinates(): return 10, 20 # Returns tuple x, y = get_coordinates() print(f"x={x}, y={y}") # x=10, y=20
```

### Early Return

```
def is_even(number): if number % 2 == 0: return True return False print(is_even(4)) # True
print(is_even(5)) # False
```

### Practical Examples

```
# Calculate area def calculate_area(length, width): return length * width area = calculate_area(5, 3)
print(f"Area: {area}") # Area: 15 # Convert temperature def celsius_to_fahrenheit(celsius): return
(celsius * 9/5) + 32 temp_f = celsius_to_fahrenheit(25) print(f"{temp_f}°F") # 77.0°F # Find maximum

def find_max(a, b): if a > b: return a return b print(find_max(10, 20)) # 20
```

## 16. Lists

### Creating Lists

```
# Empty list numbers = [] # List with items numbers = [1, 2, 3, 4, 5] names = ["John", "Mary", "Bob"]
mixed = [1, "Hello", True, 3.14] print(numbers) # [1, 2, 3, 4, 5]
```

## Accessing Items

```
names = ["John", "Mary", "Bob"] # Index (0-based) print(names[0]) # John print(names[1]) # Mary
print(names[-1]) # Bob (last item) print(names[-2]) # Mary (second-to-last)
```

## Modifying Lists

```
numbers = [1, 2, 3] # Change item numbers[0] = 10 print(numbers) # [10, 2, 3] # Add item (end)
numbers.append(4) print(numbers) # [10, 2, 3, 4] # Insert item (at index) numbers.insert(1, 20)
print(numbers) # [10, 20, 2, 3, 4] # Remove item

numbers.remove(2) # Remove by value print(numbers) # [10, 20, 3, 4] # Remove by index numbers.pop(0)
print(numbers) # [20, 3, 4] # Remove last item numbers.pop() print(numbers) # [20, 3] # Clear all items
numbers.clear() print(numbers) # []
```

## List Methods

```
numbers = [3, 1, 4, 1, 5, 9, 2] # Sort (modifies original) numbers.sort() print(numbers) # [1, 1, 2, 3, 4,
5, 9] # Reverse numbers.reverse() print(numbers) # [9, 5, 4, 3, 2, 1, 1] # Count occurrences
print(numbers.count(1)) # 2 # Find index print(numbers.index(5)) # 1

# Check if exists print(5 in numbers) # True print(10 in numbers) # False # Length print(len(numbers)) # 7
```

## List Slicing

```
numbers = [1, 2, 3, 4, 5] print(numbers[0:3]) # [1, 2, 3] print(numbers[:3]) # [1, 2, 3]
print(numbers[2:]) # [3, 4, 5] print(numbers[::-2]) # [1, 3, 5] (every 2nd) print(numbers[::-1]) # [5, 4,
3, 2, 1] (reverse)
```

## List Comprehension

```
# Create list of squares numbers = [1, 2, 3, 4, 5] squares = [n * n for n in numbers] print(squares) # [1,
4, 9, 16, 25] # With condition even_squares = [n * n for n in numbers if n % 2 == 0] print(even_squares) # [4, 16]
```

## 2D Lists (Matrices)

```
matrix = [[1, 2, 3], [4, 5, 6], [7, 8, 9]] print(matrix[0]) # [1, 2, 3] print(matrix[0][0]) # 1
print(matrix[1][2]) # 6
```

---

## 17. Tuples

### Creating Tuples

```
# Tuples are immutable (cannot be changed) coordinates = (1, 2, 3) print(coordinates) # (1, 2, 3) # Single
item tuple (need comma) single = (1,) print(type(single)) # <class 'tuple'>
```

### Accessing Tuple Items

```
coordinates = (10, 20, 30) print(coordinates[0]) # 10 print(coordinates[-1]) # 30
```

## Unpacking Tuples

```
coordinates = (10, 20) x, y = coordinates print(f"x={x}, y={y}") # x=10, y=20
```

## Tuples vs Lists

Feature	List	Tuple
----- ----- -----		
<b>Mutable</b>	Yes	No
<b>Syntax</b>	<font name="Courier">[1, 2, 3]</font>	<font name="Courier">(1, 2, 3)</font>
<b>Performance</b>	Slower	Faster
<b>Use Case</b>	Dynamic data	Fixed data
# List (mutable) numbers = [1, 2, 3] numbers[0] = 10 # ✓ Works # Tuple (immutable) coordinates = (1, 2, 3)		
# coordinates[0] = 10 # ✗ Error!		

---

## 18. Dictionaries

### Creating Dictionaries

```
# Empty dictionary person = {} # Dictionary with data person = { "name": "John", "age": 25, "city": "NYC"} print(person)
```

### Accessing Values

```
person = { "name": "John", "age": 25} # Using square brackets print(person["name"]) # John # Using get() method (safer) print(person.get("name")) # John print(person.get("email")) # None (no error) print(person.get("email", "N/A")) # N/A (default value)
```

### Modifying Dictionaries

```
person = { "name": "John", "age": 25} # Update existing key person["age"] = 26 # Add new key person["email"] = "john@example.com" print(person) # { 'name': 'John', 'age': 26, 'email': 'john@example.com'} # Remove key del person["email"] print(person) # { 'name': 'John', 'age': 26}
```

### Dictionary Methods

```
person = { "name": "John", "age": 25, "city": "NYC"} # Get all keys print(person.keys()) # dict_keys(['name', 'age', 'city']) # Get all values print(person.values()) # dict_values(['John', 25, 'NYC']) # Get all items (key-value pairs) print(person.items()) # dict_items([('name', 'John'), ('age', 25), ('city', 'NYC')]) # Check if key exists print("name" in person) # True print("email" in person) # False
```

  

```
# Clear all items person.clear() print(person) # {}
```

### Looping Through Dictionaries

```
person = { "name": "John", "age": 25, "city": "NYC"} # Loop through keys for key in person: print(key) # Loop through values for value in person.values(): print(value) # Loop through key-value pairs for key, value in person.items(): print(f"{key}: {value}") # Output:
```

```
# name: John # age: 25 # city: NYC
```

## 19. Exception Handling

### Try-Except

```
try: age = int(input("Age: ")) income = 20000 risk = income / age print(f"Risk: {risk}") except ValueError: print("Invalid age!") except ZeroDivisionError: print("Age cannot be 0!")
```

### Catching All Exceptions

```
try: age = int(input("Age: ")) risk = 20000 / age except Exception as ex: print(f"Error: {ex}")
```

### Try-Except-Else-Finally

```
try: file = open("data.txt") age = int(file.read()) except FileNotFoundError: print("File not found") except ValueError: print("Invalid data") else: print("File read successfully") finally: print("This always executes")
```

### Raising Exceptions

```
def calculate_xfactor(age): if age <= 0: raise ValueError("Age cannot be 0 or less") return 10 / age try: calculate_xfactor(-1) except ValueError as error: print(error)
```

---

## 20. Classes & Objects

### What is a Class?

A class is a blueprint for creating objects.

```
# Define a class class Point: def __init__(self, x, y): self.x = x self.y = y def move(self): print("Moving") def draw(self): print("Drawing") # Create object (instance) point1 = Point(10, 20) print(point1.x) # 10 point1.move() # Moving
```

### Constructor (`__init__`)

```
class Person: def __init__(self, name, age): self.name = name self.age = age def greet(self): print(f"Hi, I'm {self.name}") # Create instances john = Person("John", 25) mary = Person("Mary", 30) john.greet() # Hi, I'm John mary.greet() # Hi, I'm Mary
```

### Class vs Instance Attributes

```
class Person: # Class attribute (shared by all instances) species = "Human" def __init__(self, name): # Instance attribute (unique to each instance) self.name = name p1 = Person("John") p2 = Person("Mary") print(p1.species) # Human print(p2.species) # Human print(p1.name) # John print(p2.name) # Mary
```

## Class Methods

```
class Person: def __init__(self, name): self.name = name def greet(self): print(f"Hello, I'm {self.name}")  
@classmethod def from_birth_year(cls, name, birth_year): age = 2025 - birth_year return cls(name) # Regular instantiation p1 = Person("John")  
  
# Using class method p2 = Person.from_birth_year("Mary", 1995)
```

## Magic Methods

```
class Point: def __init__(self, x, y): self.x = x self.y = y def __str__(self): return f"({self.x}, {self.y})" def __eq__(self, other): return self.x == other.x and self.y == other.y p1 = Point(1, 2) p2 = Point(1, 2) print(p1 == p2) # True
```

---

## 21. Inheritance

### Basic Inheritance

```
# Parent class class Animal: def __init__(self, name): self.name = name def eat(self): print(f"{self.name} is eating") # Child class class Dog(Animal): def bark(self): print("Woof!") # Usage dog = Dog("Buddy")  
  
dog.eat() # Buddy is eating dog.bark() # Woof!
```

### Method Overriding

```
class Animal: def make_sound(self): print("Some sound") class Dog(Animal): def make_sound(self): print("Woof!") class Cat(Animal): def make_sound(self): print("Meow!") dog = Dog() cat = Cat()  
  
dog.make_sound() # Woof! cat.make_sound() # Meow!
```

### Super() Function

```
class Animal: def __init__(self, name): self.name = name class Dog(Animal): def __init__(self, name, breed): super().__init__(name) # Call parent constructor self.breed = breed dog = Dog("Buddy", "Golden Retriever") print(dog.name) # Buddy print(dog.breed) # Golden Retriever
```

---

## 22. Modules

### What is a Module?

A module is a file containing Python code (functions, classes, variables).

### Creating a Module

```
# converters.py def kg_to_lbs(kg): return kg * 2.20462 def lbs_to_kg(lbs): return lbs / 2.20462
```

### Importing a Module

```
# app.py import converters weight_kg = 70 weight_lbs = converters.kg_to_lbs(weight_kg) print(weight_lbs) #
154.3234
```

## Import Specific Functions

```
from converters import kg_to_lbs weight_lbs = kg_to_lbs(70) print(weight_lbs)
```

## Import with Alias

```
import converters as conv weight_lbs = conv.kg_to_lbs(70) print(weight_lbs)
```

## Built-in Modules

```
# Math module import math print(math.sqrt(16)) # 4.0 print(math.pi) # 3.141592653589793 # Random module
import random print(random.randint(1, 10)) # Random number 1-10 print(random.choice([1, 2, 3, 4, 5])) # Random choice
# Datetime module from datetime import datetime now = datetime.now() print(now) # Current date and time
```

---

# Part 2: Django Web Development

## 23. Django Introduction

### What is Django?

Django is a high-level Python web framework for building web applications quickly.

#### Key Features:

- **Fast development:** Less code, more features
- **Secure:** Built-in protection against common attacks
- **Scalable:** Used by Instagram, Pinterest, NASA
- **Batteries included:** Admin panel, ORM, authentication

### Installing Django

```
# Create virtual environment python -m venv venv # Activate (Windows) venv\Scripts\activate # Activate
(Mac/Linux) source venv/bin/activate # Install Django pip install django
```

### Creating a Django Project

```
# Create project django-admin startproject vidly # Project structure vidly/ ████ manage.py # Command-line
utility ████ vidly/ # Main project package █ ████ __init__.py █ ████ settings.py # Project settings █ ████
urls.py # URL routing █ ████ wsgi.py # Web server gateway
```

### Running Development Server

```
cd vidly python manage.py runserver # Visit: http://127.0.0.1:8000
```

## Creating an App

```
python manage.py startapp movies # App structure movies/ ____ __init__.py ____ admin.py # Admin configuration ____ apps.py # App configuration ____ models.py # Database models ____ views.py # View functions ____ tests.py # Tests ____ migrations/ # Database migrations
```

## Registering App

```
# settings.py INSTALLED_APPS = [ 'django.contrib.admin', 'django.contrib.auth', 'movies.apps.MoviesConfig', # Add this ]
```

## 24. Models & Databases

### Defining Models

```
# movies/models.py from django.db import models from django.utils import timezone class Genre(models.Model): name = models.CharField(max_length=255) def __str__(self): return self.name class Movie(models.Model): title = models.CharField(max_length=255) release_year = models.IntegerField() number_in_stock = models.IntegerField() daily_rate = models.FloatField()

genre = models.ForeignKey(Genre, on_delete=models.CASCADE) date_created = models.DateTimeField(default=timezone.now) def __str__(self): return self.title
```

### Field Types

Field Type	Description	Example
CharField	Short text	<font name="Courier">max_length=100</font>
TextField	Long text	Description
IntegerField	Integer	Age, Count
FloatField	Decimal	Price, Rating
BooleanField	True/False	<font name="Courier">is_active</font>
DateField	Date	Birth date
DateTimeField	Date + Time	Created at
ForeignKey	Relationship	Genre
EmailField	Email	<font name="Courier">user@example.com</font>

### Creating Migrations

```
# Create migrations python manage.py makemigrations # Apply migrations python manage.py migrate # View SQL
python manage.py sqlmigrate movies 0001
```

### Database Queries

```
# Get all movies movies = Movie.objects.all() # Filter movies movies =
Movie.objects.filter(release_year=2020) # Get single movie movie = Movie.objects.get(id=1) # Create movie
movie = Movie( title="Inception", release_year=2010, number_in_stock=10, daily_rate=4.99,
```

```
genre=genre_obj ) movie.save() # Update movie movie.title = "Inception 2" movie.save() # Delete movie  
movie.delete()
```

## 25. Admin Panel

### Creating Superuser

```
python manage.py createsuperuser # Username: admin # Password: ****
```

### Registering Models

```
# movies/admin.py from django.contrib import admin from .models import Genre, Movie # Basic registration  
admin.site.register(Genre) # Customized registration @admin.register(Movie) class  
MovieAdmin(admin.ModelAdmin): list_display = ('title', 'release_year', 'number_in_stock', 'daily_rate')  
list_filter = ('genre', 'release_year') search_fields = ('title',) exclude = ('date_created',)
```

### Admin Features

- ■ CRUD operations
- ■ Search and filtering
- ■ Sorting
- ■ Bulk actions
- ■ Inline editing

## 26. Views & Templates

### Creating Views

```
# movies/views.py from django.shortcuts import render, get_object_or_404 from .models import Movie def  
index(request): movies = Movie.objects.all() return render(request, 'movies/index.html', {'movies':  
movies}) def detail(request, movie_id): movie = get_object_or_404(Movie, pk=movie_id) return  
render(request, 'movies/detail.html', {'movie': movie})
```

### Creating Templates

#### Base Template (templates/base.html):

```
<!DOCTYPE html> <html> <head> <title>Vidly</title> <link rel="stylesheet"  
href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.0/dist/css/bootstrap.min.css"> </head> <body> <nav  
class="navbar navbar-dark bg-dark"> <a class="navbar-brand" href="/">Vidly</a> </nav> <main  
class="container mt-4"> {% block content %} {% endblock %} </main>  
  
</body> </html>
```

#### Index Template (templates/movies/index.html):

```
{% extends 'base.html' %} {% block content %} <h2>Movies</h2> <table class="table table-bordered  
table-hover"> <thead> <tr> <th>Title</th> <th>Genre</th> <th>Stock</th> <th>Daily Rate</th> </tr> </thead>  
<tbody> {% for movie in movies %}
```

```
<tr> <td> <a href="{% url 'movies:detail' movie.id %}"> {{ movie.title }} </a> </td> <td>{{ movie.genre }}</td> <td>{{ movie.number_in_stock }}</td> <td>${{ movie.daily_rate }}</td> </tr> {% endfor %} </tbody>
</table> {% endblock %}
```

## 27. URL Routing

### Main URLs

```
# vidly/urls.py from django.contrib import admin from django.urls import path, include urlpatterns = [
path('admin/', admin.site.urls), path('movies/', include('movies.urls')), ]
```

### App URLs

```
# movies/urls.py from django.urls import path from . import views app_name = 'movies' urlpatterns = [
path('', views.index, name='index'), path('<int:movie_id>', views.detail, name='detail'), ]
```

### URL Parameters

```
# URL patterns path('<int:id>', views.detail) # Integer path('<str:slug>', views.by_slug) # String
path('<int:year>/<int:month>', views.archive) # Multiple
```

## 28. REST APIs

### Installing TastyPie

```
pip install django-tastypie
```

### Creating API Resource

```
# api/models.py from tastypie.resources import ModelResource from movies.models import Movie class
MovieResource(ModelResource): class Meta: queryset = Movie.objects.all() resource_name = 'movies' excludes
= ['date_created']
```

### Registering API

```
# vidly/urls.py from api.models import MovieResource movie_resource = MovieResource() urlpatterns = [
path('admin/', admin.site.urls), path('api/', include(movie_resource.urls)), ]
```

### API Endpoints

```
GET /api/movies/ # List all GET /api/movies/1/ # Get one POST /api/movies/ # Create PUT /api/movies/1/ #
Update DELETE /api/movies/1/ # Delete
```

## 29. Deployment

## Heroku Deployment

```
# Install Heroku CLI brew install heroku # Install dependencies pip install gunicorn whitenoise # Create Procfile echo "web: gunicorn vidly.wsgi" > Procfile # Configure static files STATIC_ROOT = os.path.join(BASE_DIR, 'static') python manage.py collectstatic # Git setup git init  
git add . git commit -m "Initial commit" # Deploy to Heroku heroku login heroku create git push heroku master heroku run python manage.py migrate
```

---

## Part 3: Machine Learning

### 30. Machine Learning Basics

#### What is Machine Learning?

ML enables computers to learn patterns from data without explicit programming.

#### Use Cases:

- Image recognition
- Speech recognition
- Recommendation systems
- Fraud detection
- Stock prediction

#### ML Workflow

```
1. Import Data (CSV, Database) 2. Clean Data (Remove nulls, duplicates) 3. Split Data (80% train, 20% test) 4. Create Model (Select algorithm) 5. Train Model 6. Make Predictions 7. Evaluate Accuracy 8. Fine-tune
```

#### Installing Libraries

```
# Install Anaconda (includes all libraries) # Or install individually: pip install numpy pandas matplotlib scikit-learn jupyter
```

---

### 31. Pandas & Data Analysis

#### Loading Data

```
import pandas as pd # Read CSV df = pd.read_csv('music.csv') # View data df.head() # First 5 rows df.tail() # Last 5 rows df.shape # (rows, columns) df.describe() # Statistics
```

#### Data Selection

```
# Select column ages = df['age'] # Select multiple columns subset = df[['age', 'gender']] # Filter rows
young = df[df['age'] < 25]
```

## Data Cleaning

```
# Check nulls df.isnull().sum() # Remove nulls df = df.dropna() # Fill nulls
df['age'].fillna(df['age'].mean(), inplace=True) # Remove duplicates df = df.drop_duplicates()
```

---

## 32. Model Training

### Preparing Data

```
import pandas as pd from sklearn.model_selection import train_test_split from sklearn.tree import
DecisionTreeClassifier from sklearn.metrics import accuracy_score # Load data df =
pd.read_csv('music.csv') # Input/Output sets X = df.drop(columns=['genre']) # Features y = df['genre'] # Target # Split data X_train, X_test, y_train, y_test = train_test_split( X, y, test_size=0.2
)
)
```

### Training Model

```
# Create model model = DecisionTreeClassifier() # Train model model.fit(X_train, y_train) # Make
predictions predictions = model.predict(X_test) # Evaluate accuracy = accuracy_score(y_test, predictions)
print(f"Accuracy: {accuracy * 100}%)")
```

### Model Persistence

```
from sklearn.externals import joblib # Save model joblib.dump(model, 'music-model.joblib') # Load model
model = joblib.load('music-model.joblib') # Predict predictions = model.predict([[21, 1]])
print(predictions) # ['HipHop']
```

---

## 33. Decision Trees

### How Decision Trees Work

```
[age <= 30.5] / \ [gender <= 0.5] [Classical] / \ [Dance] [HipHop]
```

### Visualizing Decision Trees

```
from sklearn import tree # Export tree tree.export_graphviz( model, out_file='tree.dot',
feature_names=['age', 'gender'], class_names=sorted(y.unique()), label='all', rounded=True, filled=True )
```

### Key Concepts

#### Accuracy Factors:

1. **More data** = Better accuracy
2. **Clean data** = Better patterns

3. **Feature selection** = Relevant features only

4. **Algorithm choice** = Right tool for job

---

## Summary & Best Practices

### Python Fundamentals

- Use meaningful variable names
- Follow PEP 8 style guide
- Write functions for reusability
- Handle exceptions properly
- Use list comprehensions
- Document your code

### Django Development

- Use migrations for DB changes
- Never delete migrations
- Name URLs and use {% url %} tag
- Use get\_object\_or\_404()
- Organize templates with base templates
- Use environment variables for secrets

### Machine Learning

- Always split train/test data
- Clean data thoroughly
- Save trained models
- Measure accuracy
- Use more data for better results
- Try different algorithms

---

## Quick Reference

### Python Syntax Cheat Sheet

```
# Variables x = 10 # Functions def greet(name): return f"Hello {name}" # Lists numbers = [1, 2, 3] #
Dictionaries person = {"name": "John", "age": 25} # Loops for i in range(5):
```

```
print(i) # Conditions if x > 10: print("Large") else: print("Small") # Classes class Person: def  
__init__(self, name): self.name = name
```

## Django Commands

```
# Create project django-admin startproject myproject # Create app python manage.py startapp myapp #  
Migrations python manage.py makemigrations python manage.py migrate # Admin python manage.py  
createsuperuser # Run server python manage.py runserver
```

## ML Quick Start

```
import pandas as pd from sklearn.model_selection import train_test_split from sklearn.tree import  
DecisionTreeClassifier # Load & prepare df = pd.read_csv('data.csv') X = df.drop(columns=['target']) y =  
df['target'] # Train X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2) model =  
DecisionTreeClassifier() model.fit(X_train, y_train) # Predict  
  
predictions = model.predict(X_test)
```

---

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