

Python Basics Jupyter Notebook

A Comprehensive Beginner's Guide

This notebook covers fundamental Python concepts with practical examples and patterns.

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1. Variables and Data Types

```
In [5]: # Integer
age = 23
print(f"Integer variable: age = {age}")
print(f"Type: {type(age)}")
print()

# Float
temperature = 98.6
print(f"Float variable: temperature = {temperature}")
print(f"Type: {type(temperature)}")
print()

# String
name = "John Doe"
print(f"String variable: name = '{name}'")
print(f"Type: {type(name)}")
print()

# Boolean
is_student = True
print(f"Boolean variable: is_student = {is_student}")
print(f"Type: {type(is_student)}")
print()

# List
colors = ["red", "green", "blue"]
print(f"List: colors = {colors}")
print(f"Type: {type(colors)}")
print()
```

```

# Tuple
coordinates = (10, 20)
print(f"Tuple: coordinates = {coordinates}")
print(f"Type: {type(coordinates)}")
print()

# Dictionary
person = {"name": "Alice", "age": 30, "city": "New York"}
print(f"Dictionary: person = {person}")
print(f"Type: {type(person)}")
print()

# Set
unique_numbers = {1, 2, 3, 3, 2, 1}
print(f"Set: unique_numbers = {unique_numbers}")
print(f"Type: {type(unique_numbers)}")

```

Integer variable: age = 23
Type: <class 'int'>

Float variable: temperature = 98.6
Type: <class 'float'>

String variable: name = 'John Doe'
Type: <class 'str'>

Boolean variable: is_student = True
Type: <class 'bool'>

List: colors = ['red', 'green', 'blue']
Type: <class 'list'>

Tuple: coordinates = (10, 20)
Type: <class 'tuple'>

Dictionary: person = {'name': 'Alice', 'age': 30, 'city': 'New York'}
Type: <class 'dict'>

Set: unique_numbers = {1, 2, 3}
Type: <class 'set'>

2. Basic Operations

```

In [6]: # Arithmetic Operations
print("=== Arithmetic Operations ===")
a, b = 10, 3
print(f"Addition: {a} + {b} = {a + b}")
print(f"Subtraction: {a} - {b} = {a - b}")
print(f"Multiplication: {a} × {b} = {a * b}")
print(f"Division: {a} ÷ {b} = {a / b:.2f}")
print(f"Floor Division: {a} // {b} = {a // b}")
print(f"Modulus: {a} % {b} = {a % b}")
print(f"Exponent: {a} ** {b} = {a ** b}")
print()

# Comparison Operations
print("=== Comparison Operations ===")
print(f"{a} > {b}: {a > b}")

```

```

print(f"{a} < {b}: {a < b}")
print(f"{a} == {b}: {a == b}")
print(f"{a} != {b}: {a != b}")
print(f"{a} >= {b}: {a >= b}")
print(f"{a} <= {b}: {a <= b}")
print()

# String Operations
print("=== String Operations ===")
str1 = "Hello"
str2 = "World"
print(f"Concatenation: '{str1}' + ' ' + '{str2}' = '{str1 + ' ' + str2}'")
print(f"Repetition: '{str1}' * 3 = '{str1 * 3}'")
print(f"Uppercase: '{str1}'.upper() = '{str1.upper()}'")
print(f"Lowercase: '{str2}'.lower() = '{str2.lower()}'")
print(f"Length of '{str1}': {len(str1)}")

```

=== Arithmetic Operations ===

Addition: $10 + 3 = 13$

Subtraction: $10 - 3 = 7$

Multiplication: $10 \times 3 = 30$

Division: $10 \div 3 = 3.33$

Floor Division: $10 // 3 = 3$

Modulus: $10 \% 3 = 1$

Exponent: $10 ** 3 = 1000$

=== Comparison Operations ===

$10 > 3$: True

$10 < 3$: False

$10 == 3$: False

$10 != 3$: True

$10 >= 3$: True

$10 <= 3$: False

=== String Operations ===

Concatenation: 'Hello' + ' ' + 'World' = 'Hello World'

Repetition: 'Hello' * 3 = 'HelloHelloHello'

Uppercase: 'Hello'.upper() = 'HELLO'

Lowercase: 'World'.lower() = 'world'

Length of 'Hello': 5

3. Control Structures

```

In [7]: # If-Elif-Else Statement
print("=== If-Elif-Else Example ===")
score = 85
print(f"Score: {score}")

if score >= 90:
    grade = "A"
elif score >= 80:
    grade = "B"
elif score >= 70:
    grade = "C"
elif score >= 60:
    grade = "D"
else:
    grade = "F"

```

```
print(f"Grade: {grade}")
print()

# For Loop
print("=== For Loop Example ===")
print("Counting from 1 to 5:")
for i in range(1, 6):
    print(f"  Iteration {i}")
print()

# While Loop
print("=== While Loop Example ===")
print("Countdown from 5 to 1:")
counter = 5
while counter > 0:
    print(f"  {counter}")
    counter -= 1
print("Blast off!")
print()

# Break and Continue
print("=== Break and Continue Example ===")
print("Numbers 1-10, skip 5, stop at 8:")
for num in range(1, 11):
    if num == 5:
        continue # Skip 5
    if num == 9:
        break # Stop before 9
    print(f"  {num}")
print("Loop ended.")
```

```
=== If-Elif-Else Example ===
```

```
Score: 85
```

```
Grade: B
```

```
=== For Loop Example ===
```

```
Counting from 1 to 5:
```

```
Iteration 1
```

```
Iteration 2
```

```
Iteration 3
```

```
Iteration 4
```

```
Iteration 5
```

```
=== While Loop Example ===
```

```
Countdown from 5 to 1:
```

```
5
```

```
4
```

```
3
```

```
2
```

```
1
```

```
Blast off!
```

```
=== Break and Continue Example ===
```

```
Numbers 1-10, skip 5, stop at 8:
```

```
1
```

```
2
```

```
3
```

```
4
```

```
6
```

```
7
```

```
8
```

```
Loop ended.
```

4. Functions

```
In [9]: # Basic Function
def greet(name):
    """Function to greet a person"""
    return f"Hello, {name}!"

print("=== Basic Function ===")
print(greet("Asif"))
print(greet("Danish"))
print()

# Function with default parameters
def calculate_area(length, width=1):
    """Calculate area of rectangle, default width makes it a square"""
    return length * width

print("=== Function with Default Parameters ===")
print(f"Rectangle area (5, 3): {calculate_area(5, 3)}")
print(f"Square area (4): {calculate_area(4)}")
print()

# Lambda Function (Anonymous function)
print("=== Lambda Function ===")
square = lambda x: x ** 2
print(f"Square of 5: {square(5)}")
```

```

print(f"Square of 7: {square(7)}")
print()

# Function with *args (variable arguments)
def sum_all(*numbers):
    """Sum any number of arguments"""
    return sum(numbers)

print("=== Function with Variable Arguments ===")
print(f"Sum of 1, 2, 3: {sum_all(1, 2, 3)}")
print(f"Sum of 10, 20, 30, 40: {sum_all(10, 20, 30, 40)}")

```

=== Basic Function ===

Hello, Asif!

Hello, Danish!

=== Function with Default Parameters ===

Rectangle area (5, 3): 15

Square area (4): 4

=== Lambda Function ===

Square of 5: 25

Square of 7: 49

=== Function with Variable Arguments ===

Sum of 1, 2, 3: 6

Sum of 10, 20, 30, 40: 100

5. Pattern Examples

```

In [10]: # Pattern 1: Right Triangle
print("=== Pattern 1: Right Triangle ===")
rows = 5
for i in range(1, rows + 1):
    print('*' * i)
print()

# Pattern 2: Pyramid
print("=== Pattern 2: Pyramid ===")
n = 5
for i in range(1, n + 1):
    spaces = ' ' * (n - i)
    stars = '*' * (2 * i - 1)
    print(spaces + stars)
print()

# Pattern 3: Diamond
print("=== Pattern 3: Diamond ===")
size = 5
# Upper half
for i in range(size):
    print(' ' * (size - i - 1) + '*' * (2 * i + 1))
# Lower half
for i in range(size - 2, -1, -1):
    print(' ' * (size - i - 1) + '*' * (2 * i + 1))
print()

# Pattern 4: Number Triangle

```

```

print("=== Pattern 4: Number Triangle ===")
for i in range(1, 6):
    for j in range(1, i + 1):
        print(j, end=' ')
    print()
print()

# Pattern 5: Chessboard Pattern
print("=== Pattern 5: Chessboard ===")
for i in range(8):
    for j in range(8):
        if (i + j) % 2 == 0:
            print('■', end='')
        else:
            print(' ', end='')
    print()

```

```

=== Pattern 1: Right Triangle ===
*
**
***
****
*****

```

```

=== Pattern 2: Pyramid ===
      *
     ***
    *****
   ********
  **********

```

```

=== Pattern 3: Diamond ===
      *
     ***
    *****
   ********
  **********
   ********
    *****
     ***
      *

```

```

=== Pattern 4: Number Triangle ===
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5

```

```

=== Pattern 5: Chessboard ===
■ ■ ■ ■ ■
 ■ ■ ■ ■ ■
■ ■ ■ ■ ■
 ■ ■ ■ ■ ■
■ ■ ■ ■ ■
 ■ ■ ■ ■ ■
■ ■ ■ ■ ■
 ■ ■ ■ ■ ■
■ ■ ■ ■ ■

```

6. Data Structures

```
In [12]: # List Operations
print("=== List Operations ===")
fruits = ["apple", "banana", "cherry"]
print(f"Original list: {fruits}")

# Add items
fruits.append("orange")
print(f"After append: {fruits}")

# Insert at specific position
fruits.insert(1, "blueberry")
print(f"After insert: {fruits}")

# Remove item
fruits.remove("banana")
print(f"After remove: {fruits}")

# Sort
fruits.sort()
print(f"Sorted list: {fruits}")
print()

# Dictionary Operations
print("=== Dictionary Operations ===")
student = {
    "name": "Asif",
    "age": 21,
    "major": "Mathametics",
    "grades": {"math": 90, "science": 85, "english": 88}
}
print(f"Student dictionary: {student}")
print(f"Name: {student['name']}")
print(f"Age: {student['age']}")
print(f"Math grade: {student['grades']['math']}")

# Add new key
student["graduation_year"] = 2024
print(f"After adding graduation year: {student}")

# Get all keys
print(f"Keys: {list(student.keys())}")
print(f"Values: {list(student.values())}")
print()

# Set Operations
print("=== Set Operations ===")
A = {1, 2, 3, 4, 5}
B = {4, 5, 6, 7, 8}
print(f"Set A: {A}")
print(f"Set B: {B}")
print(f"Union: {A.union(B)}")
print(f"Intersection: {A.intersection(B)}")
print(f"Difference (A - B): {A.difference(B)}")
print(f"Symmetric Difference: {A.symmetric_difference(B)}")
```


=== List Operations ===

Original list: ['apple', 'banana', 'cherry']

After append: ['apple', 'banana', 'cherry', 'orange']

After insert: ['apple', 'blueberry', 'banana', 'cherry', 'orange']

After remove: ['apple', 'blueberry', 'cherry', 'orange']

Sorted list: ['apple', 'blueberry', 'cherry', 'orange']

=== Dictionary Operations ===

Student dictionary: {'name': 'Asif', 'age': 21, 'major': 'Mathametics', 'grades': {'math': 90, 'science': 85, 'english': 88}}

Name: Asif

Age: 21

Math grade: 90

After adding graduation year: {'name': 'Asif', 'age': 21, 'major': 'Mathametics', 'grades': {'math': 90, 'science': 85, 'english': 88}, 'graduation_year': 2024}

Keys: ['name', 'age', 'major', 'grades', 'graduation_year']

Values: ['Asif', 21, 'Mathametics', {'math': 90, 'science': 85, 'english': 88}, 2024]

=== Set Operations ===

Set A: {1, 2, 3, 4, 5}

Set B: {4, 5, 6, 7, 8}

Union: {1, 2, 3, 4, 5, 6, 7, 8}

Intersection: {4, 5}

Difference (A - B): {1, 2, 3}

Symmetric Difference: {1, 2, 3, 6, 7, 8}