Python: Variables

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- To access the updated handouts, please click on the following link: https://yasirbhutta.github.io/python/docs/variables.html

Variables

- Storage containers for data (numbers, text, etc.).

What is a variable

- A variable is a named storage location in a computer's memory that is used to hold data or values. It allows programmers to store and manipulate data within a program.

Purpose: Variables provide a way to store and manage data that can be used and manipulated throughout a program. They make programs more flexible and allow for dynamic data storage.

Assignment statement: in Python is used to assign a value to a variable. Its primary purpose is to store and manage data within a program.

Imagine variables as labeled boxes:

- You have boxes for storing different things (numbers, words, etc.).
- Each box has a name (label) to identify what's inside.
- You can put things in, take them out, and change what's inside.

video:Python Variables and Assignment video: Meaningful Variable Names | Python Best Practices video: Asterisk (*) in Variable Assignment

Example #1: Storing a name

```
name = "Muhammad Hamza"
print(name)
```

Example #2: Tracking a score:

```
score = 0
score = score + 10 # adds 10 to the score
print(score)
```

Example #3: Remembering a favorite color

```python
favorite_color = "blue" #stores "blue"  in variable
print(favorite_color)
```

Example #4: Calculating the area of a rectangle

```python
length = 10
width = 5

# calculates the area
area = length * width
print(area)
```

Understanding Dynamic Variables in Python with Examples

Important: In Python, variables are dynamic, meaning they can change types during the execution of a program. This flexibility allows you to assign a value of any type to a variable and later reassign it to a value of a different type without any issues. This dynamic nature of variables is due to Python being a dynamically typed language.

Example #5: Dynamic Variables in Python

```python
# Initial assignment of an integer value
x = 10
print(x)  # Output: 10
print(type(x))  # Output: <class 'int'>

# Reassigning a string value to the same variable
x = "Hello, World!"
print(x)  # Output: Hello, World!
print(type(x))  # Output: <class 'str'>

# Reassigning a list to the same variable
x = [1, 2, 3]
print(x)  # Output: [1, 2, 3]
print(type(x))  # Output: <class 'list'>

# Reassigning a float value to the same variable
x = 3.14
print(x)  # Output: 3.14
print(type(x))  # Output: <class 'float'>
```

In this example:

1. `x` is initially assigned an integer value of `10`.
2. `x` is then reassigned a string value `"Hello, World!"`.
3. `x` is later reassigned a list `[1, 2, 3]`.

4. Finally, `x` is reassigned a float value `3.14`.

Each time, the type of `x` changes dynamically to match the type of the value assigned to it. This flexibility is one of the powerful features of Python, allowing for more concise and adaptable code.

Example 6: How to assign multiple values to multiple variables? **Example 7:** How to Swap Variables Without a Third Variable in Python **Example 8:** Calculate the Area of a Circle with Radius **Example 9:** Python Variable Names: Case-Sensitive? Avoid This Coding Mistake!

Key Points:

- **Choose meaningful names:** Use names that describe what the variable stores (e.g., pizza_slices instead of x).
  - video: Meaningful Variable Names | Python Best Practices
- **Assign values using =:** The equals sign is used to put a value into a variable.
- **Change values:** You can update a variable's value later in your code.
- **Use variables in calculations and operations:** Variables can be used just like regular numbers or text in expressions.
- **Think of variables as placeholders:** They hold information that can change as your program runs.

Key Terms

True/False (Mark T for True and F for False)

1. Variable names in Python are case-sensitive.
2. In Python, variables must be declared with a specific data type before they can be used.
3. The statement x = 5 both creates the variable x and assigns it the value 5.

Answer Key (True/False):

1. True
2. False
3. True

Multiple Choice (Select the best answer)

1. **What is a variable in Python?**

   - A) A reserved word in Python
   - B) A placeholder for storing data values
   - C) A function that prints data
   - D) A built-in library in Python

2. **Which statement best describes a variable in Python?**

   - A) A variable can hold multiple values at once.
   - B) A variable must be declared with a data type.
   - C) A variable is a name that refers to a value.
   - D) A variable is used only in loops.

3. **What is the output of the following code?**

```
x = 10
print(x)
```

- A) `10`
- B) `x`
- C) `Error`
- D) `None`

4. **Which of the following is not true about variables in Python?**

    - A) Variables can be reassigned to different data types.
    - B) Variables must start with a letter or an underscore.
    - C) Variables are case-sensitive.
    - D) Variables must be declared before use.

5. **What will be the output of the following code?**

    ```
    x = 5
    y = x
    x = 7
    print(y)
    ```

    - A) `7`
    - B) `5`
    - C) `0`
    - D) `None`

6. **Why is it important to use meaningful variable names?**

    - A) It is required by the Python interpreter.
    - B) It helps make the code more readable and maintainable.
    - C) It increases the execution speed of the program.
    - D) It is necessary for the code to run without errors.

7. **What will be the output of the following code?**

    ```
    a = 1
    b = a
    a = a + 1
    print(a, b)
    ```

    - A) `1 1`
    - B) `2 1`
    - C) `1 2`
    - D) `2 2`

8. **Which of the following is a valid variable name in Python?**

    - A) `2ndValue`
    - B) `value#2`
    - C) `_value2`
    - D) `value-2`

9. **Which of the following is a correct way to declare a variable in Python?**

- A) `int x = 5`
- B) `x = 5`
- C) `declare x = 5`
- D) `var x = 5`

10. **What is the output of the following code?**

```
x = 5
y = "Hello"
print(x + y)
```

- A) `5Hello`
- B) `Hello5`
- C) `TypeError`
- D) `Hello 5`

11. **Which of the following is not a valid variable name in Python?**

- A) `my_var`
- B) `_var`
- C) `2var`
- D) `var2`

12. **Which of the following statements is true about variable assignment in Python?**

- A) Variables must be declared before they are assigned a value.
- B) Variables are created when they are first assigned a value.
- C) Variable names must begin with a number.
- D) Python variables must be declared with a type.

13. **What will be the output of the following code?**

```
x = 5
y = x
x = 10
print(y)
```

- A) `5`
- B) `10`

- C) `0`
- D) `5 10`

Answer key (Mutiple Choice):

1. B) A placeholder for storing data values
2. C) A variable is a name that refers to a value.
3. A) `10`
4. D) Variables must be declared before use.
5. B) `5`
6. B) It helps make the code more readable and maintainable.
7. B) `2 1`
8. C) `_value2`
9. B) `x = 5`
10. C) `TypeError`
    - **Explanation:** In Python, the + operator is used for both arithmetic addition and string concatenation. However, it cannot be used to add an integer and a string directly. The code provided attempts to add an integer (x = 5) to a string (y = "Hello"), which is not a valid operation and will result in a TypeError.
11. C) `2var`
    - **Explanation:** In Python, variable names must start with a letter or an underscore and cannot start with a number. Thus, my_var, _var, and var2 are valid, but 2var is not.
12. B) Variables are created when they are first assigned a value.
13. A) `5`

Fill in the Blanks

1. Variable names in Python must start with a letter or an _________.
2. Variables in Python are _________, meaning they can change type when assigned a new value.
3. The assignment operator in Python is the _________ symbol.

Answer Key (Fill in the Blanks):

1. underscore (_)
2. dynamic
3. equals (=)

Exercises

Exercise 1: Basic Variable Assignment

1. Create a variable called `name` and assign your name to it.
2. Create a variable called `age` and assign your age to it.
3. Create a variable called `city` and assign the city you live in to it.
4. Print all three variables.

Exercise 2: Variable Reassignment

1. Create a variable called `favorite_color` and assign your favorite color to it.

2. Print the value of `favorite_color`.
3. Reassign a new color to `favorite_color`.
4. Print the new value of `favorite_color`.

Exercise 3: Variable Operations

1. Create two variables called `a` and `b` and assign them the values 5 and 10, respectively.
2. Create a new variable called `sum` and assign it the value of `a` plus `b`.
3. Create a new variable called `difference` and assign it the value of `a` minus `b`.
4. Create a new variable called `product` and assign it the value of `a` times `b`.
5. Print the values of `sum`, `difference`, and `product`.

Exercise 4: String Concatenation

1. Create a variable called `first_name` and assign your first name to it.
2. Create a variable called `last_name` and assign your last name to it.
3. Create a new variable called `full_name` and assign it the value of `first_name` concatenated with `last_name` (with a space in between).
4. Print the value of `full_name`.

Example Solution:

```
first_name = "Alice"
last_name = "Johnson"

full_name = first_name + " " + last_name
print(full_name)
```

Exercise 5: Input and Variables

1. Use the `input()` function to get the user's name and store it in a variable called `user_name`.
2. Use the `input()` function to get the user's age and store it in a variable called `user_age`.
3. Print a message saying "Hello [user_name], you are [user_age] years old."

Example Solution:

```
user_name = input("Enter your name: ")
user_age = input("Enter your age: ")

print("Hello", user_name + ", you are", user_age, "years old.")
```

6. Calculate the Area of a Circle with Radius Example Solution
7. How to Swap Variables Without a Third Variable in Python. Example Solution
8. How to assign multiple values to multiple variables. Example Solution

Review Questions

1. What is a variable in computer programming? Answer: A variable is a named storage location in a computer's memory that is used to hold data or values. It allows programmers to store and manipulate data within a program.

2. What is the purpose of using variables in programming? Answer: Variables provide a way to store and manage data that can be used and manipulated throughout a program. They make programs more flexible and allow for dynamic data storage.

3. What is the difference between declaring and initializing a variable? Answer: Declaring a variable involves specifying its name and data type, while initializing a variable means giving it an initial value. Initialization usually follows declaration but is not always required.

References and Bibliography