Variables

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Learning Objectives

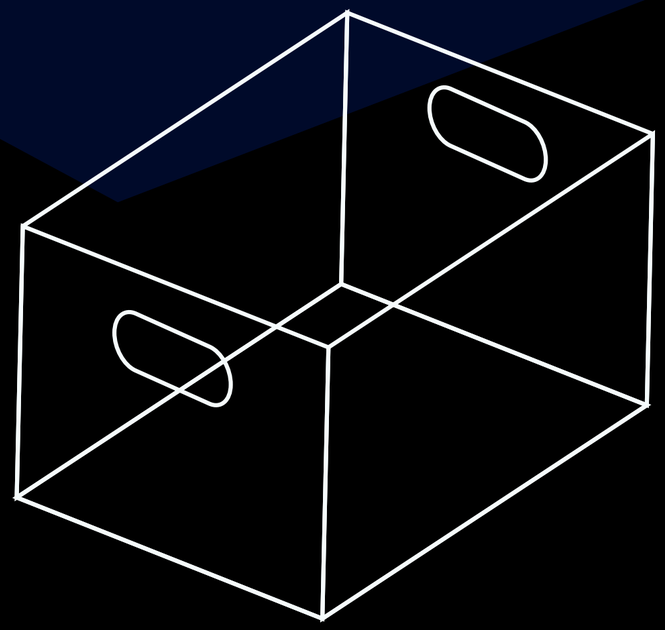
1. Declaring variables
2. Using good variable naming conventions
3. Printing using variables
4. Reassigning values to variables after they have been declared

Declaring Variables

What is a Variable?

A **variable** is a named portion of computer memory used to store a data value.

- Like a box with a name
- Can store any kind of data, but only stores one piece at a time
- Contents can *vary* throughout a program



Declaring Variables

Variable Declaration is the process of creating a variable by giving it:

1. a name
2. an initial value.

Generally:

```
new_variable_name = <expression>
```

Examples: Declaring Variables

Variable Declaration is the process of creating a variable by giving it:

1. a name
2. an initial value.

```
year = 2024
first_name = "Harry"
pi = 3.141592653
```

The Assignment Operator

- The `=` operator is the assignment operator in Python
  - Creates the variable the first time it's used
  - Assigns a new value to the variable
- Assigning a value to a variable is a *proclamation*, not a mere *question*.
  - Different way of thinking about `=` compared to, say, algebra

Naming Conventions

- Use `snake_case`: lowercase letters, separate words with underscores (`_`)
  - `first_name` is good, `firstName` or `first-name` are not.
- Variable names should be descriptive
  - Prefer `average_height` to `avg_ht` or `ah` or `x`
- Variable names can include digits but cannot start with digits
  - `color_2` is OK, but `2_color` is not.

Expressions & Using Variables

Expressions

- **Expressions** are portions of a program that have a value.
- Basic expressions are composed of **literals**, **variables**, and **operators**

Term	Definition	Example
Literal	A part of an expression that has a value which can be interpreted *literally*	`4.0` or `"python"`
Variable	A named portion of memory that stores some value	`year` or `x` or `last_name`
Operator	A symbol defining an operation or transformation	`+` or `*`

Expressions

The definitions are very formal, but expressions are usually pretty friendly.

```
5 * 3                    # has a value of 15
(9 - 3 + 10.5) * 2 / 4   # 8.25
4 == 7 - 3               # True
"yes" == "no"            # False
```

Evaluation Order of Expressions

Evaluation order in Python is generally similar to mathematics

- Use "PEMDAS" to do parentheses, then multiplication/division, then addition/subtraction.
- Hard to remember the specifics, easy to just use parentheses

Example of evaluation order:

```
(9 - 3 + 10.5) * 2 / 4 # original expression
(6 + 10.5) * 2 / 4     # equivalent expressions...
16.5 * 2 / 4
33 / 4
8.25
```

Expressions with Variables

Valid expressions may include variables!

- The value of the expression will depend on the values of the variables inside it
- You can always print the value of an expression

```
three = 3
print(three + 4) # 🖨️➡️`7`
```

Check: What does this print?

```
three = 5
print(three + 4)
```

Expressions with Variables

A variable's value can be examined by printing it out.

```
mystery = 4
print(mystery) # 🖨️ ➡️ 4
```

Expressions might consist only of variables and operators.

```
x = 17
y = 4
print(x - y) # 🖨️ ➡️ 13
```

Expressions with Variables

Variables store values.

➡️ Expressions have values.

➡️ Expressions can be written in terms of variables.

➡️ Variables can be defined in terms of other variables!

```
a = 10
b = 20
c = a + b
print(c) # 🖨️ ➡️ 30
a = 5
print(c) # 🖨️ ➡️ 30
```

The value stored is the result of evaluating the right-hand side expression at the moment the assignment is done.

Updating Variables

Updating Variables: Assigning Again

Variables can *vary*, and we make this happen by assigning a new value to them.

- Old value is totally forgotten
- Assignment works the same way: `my_var = <expression>`

```
coin = "heads"
print(coin) # 🖨️ ➡️ heads
coin = "tails"
print(coin) # 🖨️ ➡️ tails
```

Counting & Adding

Keeping score in board games and card games often relies on adding up points earned in different rounds.

- e.g. each time you play a word in Scrabble/Words with Friends
- We can use a `score` variable to represent a running total that we update with new values as they come in

```
score = 0            # starting score is 0
score = score + 8    # points for round 1
score = score + 15   # points for round 2
score = score + 22   # points for round 3
print(score)         # 🖨️ ➡️ 45
```

Keep Your Types Consistent!

Try to preserve the type of a variable over time! This code is very confusing.

```
my_name = "Harry Smith"
print("My name is:")
print(my_name)
my_name = 27
print("In three years, I will be:")
print(my_name + 3)
```

More Powerful Printing

Always Be Printing 🖨️

If you need to know the value of a variable or expression, don't guess! **Just** `print()`.

```
mystery = "hooooo egassem terces"[::-1]
print(mystery)
```

🖨️👇

```
secret message oooooh
```

Printing Multiple Things

If you want to print out multiple pieces of information on a single line, each separated with a space, you can do so by interleaving commas between the things you want to print.

```
num_bottles = 99
print(num_bottles, "bottles of beer on the wall,", num_bottles, "bottles of beer...")
```

🖨️👇

```
99 bottles of beer on the wall, 99 bottles of beer...
```

Printing Multiple Things

Each time we write `print()`, the information inside of that print statement all goes on its own line.

```
num_bottles = 99
print(num_bottles, "bottles of beer on the wall,", num_bottles, "bottles of beer...")
print("Take one down, pass it around!")
num_bottles = num_bottles - 1 # decrease the value stored in num_bottles by one
print(num_bottles, "bottles of beer on the wall.")
```

🖨️👇

```
99 bottles of beer on the wall, 99 bottles of beer...
Take one down, pass it around!
98 bottles of beer on the wall.
```

f-strings; or, Enough with the Commas!

An f-string is a slight variation of a typical string that is denoted by placing an `f` right before the start of the string:

```
msg = f"this is a simple f-string. You can tell by the f."
print(msg)
```

🖨️👇

```
this is a simple f-string. You can tell by the f.
```

f-strings; or, Enough with the Commas!

We can leave slots inside of the f-string to be filled with the result of an expression.

- Slots are denoted with curly braces (`{}`)
- Slots can be filled with any expression that you want to write.

```
age = 27
birthday = "August 29"
print(f"I'm {age}, and after {birthday}, I'll turn {age + 1}.")
```

🖨️👇

```
I'm 27, and after August 29, I'll turn 28.
```