Variables, Assignments and If-statements

Julia Wippermann Robin Horn Kamran Vatankhah-Barazandeh Leonard Frommelt

Apr 19, 2021

Variables, Assignments and If-statements

Julia Wippermann Robin Horn Kamran Vatankhah-Barazandeh Leonard Frommelt

Apr 19, 2021

UNIVERSITÄT OSNABRÜCK

1 Basic Programming in Python
2 What are variables?
3 What is a data type?
4 How to write if-statements?
5 How to deal with errors?

Feedback sessions and Practice sessions

Feedback sessions

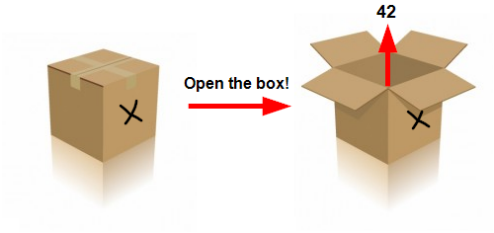
- are great for getting individual feedback
- e.g. discuss new concepts
- sign up on StudIP

Practice sessions

- you are welcome to come to the practice session any time
- you can collaborate with your fellow students
- we are there to give you guidance on the current homework

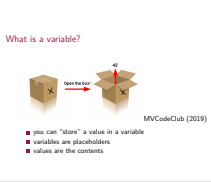
Feedback sessions and Practice sessions
Feedback sessions
are great for getting individual feedback
e.g. discuss new concepts
sign up on StudIP
Practice sessions
you are welcome to come to the practice session any time
you can collaborate with your fellow students
we are there to give you guidance on the current homework

What is a variable?



MVCodeClub (2019)

- you can "store" a value in a variable
- variables are placeholders
- values are the contents



A variable is a placeholder for a concept. The value that you can assign to it, is its realization.

You can think of a variable as a box. The value (that is assigned to it) is its content.

Assigning a value to a variable

- we use the = operator to assign a value to a variable

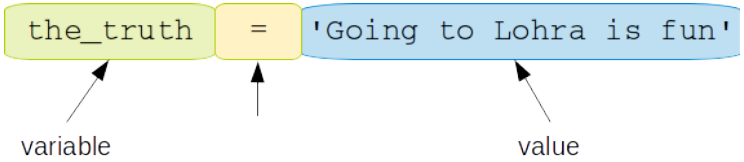
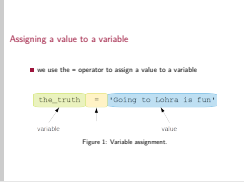


Figure 1: Variable assignment.



the_truth = 'Going to Lohra is fun'
variable
value

Figure 2: Variable assignment.

On the left side of the assignment operator (=) is the **variable name** (`the_truth`).
On the right side is the **value** of the variable (`'Going to Lohra is fun!'`)

Assigning a value to a variable

Caution

= in code (denoting assignment)
is **not** the same as
= in math (denoting equality)

Assigning a value to a variable
Caution
= in code (denoting assignment)
is **not** the same as
= in math (denoting equality)

In code, the right side of the equal sign is assigned to the variable left to the equal sign.

In math, the left and the right side of the equal sign must be equal.

Variables in Python

- variables are created when they are first assigned
- variables must be assigned before you use them

Variables in Python
- variables are created when they are first assigned
- variables must be assigned before you use them

Let's print the variable

```
the_truth = 'Going to Lohra is fun!'

print(the_truth)
```

Output:

```
Going to Lohra is fun!
```


Let's print the variable

the_truth = 'Going to Lohra is fun!'

print(the_truth)

Output:

Going to Lohra is fun!

- First we assign the string `'Going to Lohra is fun!'` to the variable `the_truth`.
- To print the content of the variable to the command line, we use the print function that you got to know in the last lecture.

Variable assignment

```
the_truth = 'Going to Lohra is fun!'
```

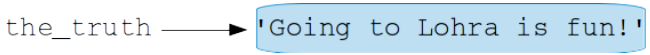


Figure 3: Variable assignment.

Variable assignment
the_truth = 'Going to Lohra is fun!'
Figure 3: Variable assignment.

Assigning a variable to another variable

```
the_truth = 'Going to Lohra is fun!'
fun_fact = the_truth
```

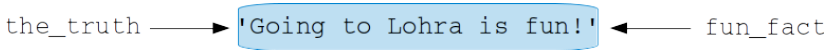
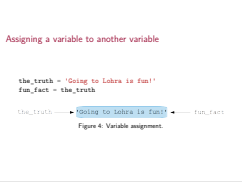


Figure 4: Variable assignment.



Variable assignment

```
the_truth = 'Going to Lohra is fun!'
fun_fact = the_truth
fun_fact = 'Going to Trash is fun!'
```

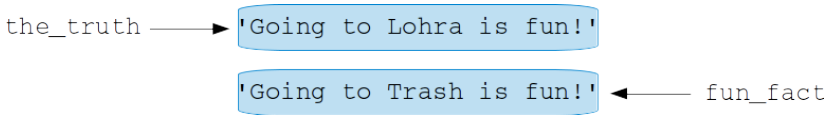
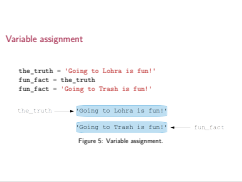


Figure 5: Variable assignment.



Variable assignment

```
the_truth = 'Going to Lohra is fun!'
fun_fact = the_truth
fun_fact = 'Going to Trash is fun!'
the_truth = 'Learn Python for fun!'
```

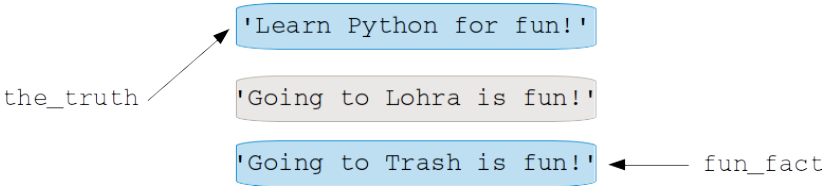
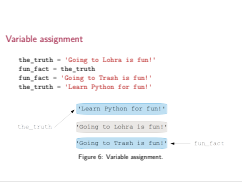


Figure 6: Variable assignment.



Recap: string concatenation

```
who = 'Most Coxis think: '
the_truth = 'Going to Lohra is fun!'

# intended output on the command line:
# Most Coxis think: 'Going to Lohra is fun!'

# your code goes here
```


Recap: string concatenation

who = 'Most Coxis think: '
the_truth = 'Going to Lohra is fun!'

intended output on the command line:
Most Coxis think: 'Going to Lohra is fun!'

your code goes here

- a line in your script that begins with #, is a comment
- the comment is not executed when you run your script
- strings can be enclosed by single quotes or double quotes

Recap: string concatenation

```
who = 'Most Coxis think: '
the_truth = 'Going to Lohra is fun!'

print(who + "'" + the_truth + "'")
```

Output:

```
Most Coxis think: 'Going to Lohra is fun!'
```


Recap: string concatenation

who = 'Most Coxis think: '
the_truth = 'Going to Lohra is fun!'

print(who + "'" + the_truth + "'")

Output:

Most Coxis think: 'Going to Lohra is fun!'

- we can use the + operator to concatenate two strings
- the comment is not executed when you run your script

print()

```
answer = 'We are learning'
language = 'Python.'

print(answer + " " + language)
print()
print(answer, language)
```

Output:

```
We are learning Python.

We are learning Python.
```


print()

answer = 'We are learning'
language = 'Python.'

print(answer + " " + language)
print()
print(answer, language)

Output:

We are learning Python.

We are learning Python.

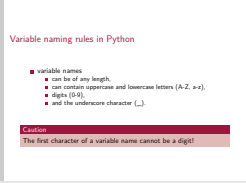
To print the string `We are learning Python.`, you can either use string concatenation (+) inside the print function
or
you can separate the variables that you want to print with a comma. Note that in this case there are spaces between the variables in the output.

Variable naming rules in Python

- variable names
  - can be of any length,
  - can contain uppercase and lowercase letters (A-Z, a-z),
  - digits (0-9),
  - and the underscore character (_).

Caution

The first character of a variable name cannot be a digit!



How to use PINGO?

1. use your smartphone or laptop
2. type in the session number
3. answer the question

Type in the session number: 203586

Conventions

- choose meaningful variable names
- do not begin variable names with a capital letter
  - capital letters are reserved for other things (convention)
  - more about this in the next weeks

Conventions
- choose meaningful variable names
- do not begin variable names with a capital letter
  - capital letters are reserved for other things (convention)
  - more about this in the next weeks

Conventions

```
# do not do this
var_1 = '12.04.2019'
x = '14.04.2019'

print('Lohra is from ' + var_1 + ' to ' + x)
```

Output:

```
Lohra is from 12.04.2019 to 14.04.2019
```


Conventions

# do not do this
var_1 = '12.04.2019'
x = '14.04.2019'

print('Lohra is from ' + var_1 + ' to ' + x)

Output:

Lohra is from 12.04.2019 to 14.04.2019

Conventions

```
# do this
# give your variables descriptive names
start_date = '12.04.2019'
end_date = '14.04.2019'

print('Lohra is from ' +  start_date
      + ' to ' + end_date)
```

Output:

```
Lohra is from 12.04.2019 to 14.04.2019
```


Conventions

```
# do this
# give your variables descriptive names
start_date = '12.04.2019'
end_date = '14.04.2019'

print('Lohra is from ' +  start_date
      + ' to ' + end_date)
```

Output:

```
Lohra is from 12.04.2019 to 14.04.2019
```

- make long variables readable by using snake_case
- snake_case means that each word is separated by an underscore

```
total_number_of_participants_lohra = 958
```


- make long variables readable by using snake_case
- snake_case means that each word is separated by an underscore

total_number_of_participants_lohra = 958

What is a data type?

- defines how the value of the variable is stored
- defines which operations are valid for the variable

└What is a data type?

What is a data type?
- defines how the value of the variable is stored
- defines which operations are valid for the variable

In Python, every value has a data type. There are several data types in Python. In this lecture, we will learn about strings, integers, floats and booleans.

Data types in Python

- the data type of a variable is interpreted based on the value that is assigned to the variable
- there is no explicit declaration of a data type for a variable
- use the `type()` function to check the type of a variable

Data types in Python
- the data type of a variable is interpreted based on the value that is assigned to the variable
- there is no explicit declaration of a data type for a variable
- use the type() function to check the type of a variable

In Python, you do not have to declare the data type of a variable explicitly. The data type of a variable will be interpreted based on the value that is assigned to it when you run your code. That means that the data type of a variable can change while running a script.

```python
# the variable is a string.
ultimate_answer = 'forty-two'
print('The answer is', ultimate_answer)
print('The type is', type(ultimate_answer))
```

Output:

```
The answer is forty-two
The type is <class 'str'>
```

# the variable is a string.
ultimate_answer = 'forty-two'
print('The answer is', ultimate_answer)
print('The type is', type(ultimate_answer))
Output:
The answer is forty-two
The type is <class 'str'>

```python
# the variable is an integer
ultimate_answer = 42
print('The answer is', ultimate_answer)
print('The type is', type(ultimate_answer))
```

Output:

```
The answer is 42
The type is <class 'int'>
```


```python
# the variable is an integer
ultimate_answer = 42
print('The answer is', ultimate_answer)
print('The type is', type(ultimate_answer))
```

Output:

```
The answer is 42
The type is <class 'int'>
```

```
# the varibale is a float
ultimate_answer = 42 + 0.0
print('The answer is', ultimate_answer)
print('The type is', type(ultimate_answer))
```

Output:

```
The answer is 42.0
The type is <class 'float'>
```


# the varibale is a float
ultimate_answer = 42 + 0.0
print('The answer is', ultimate_answer)
print('The type is', type(ultimate_answer))
Output:
The answer is 42.0
The type is <class 'float'>

Note that Python does implicit conversion if possible.

Data types in this lecture

	Type	Description	Example
Integer	int	integer of arbitrary magnitude	x = 1
Float	float	floating-point number	x = 1.0
String	str	character string	x = 'one'
Boolean	bool	boolean value	x = True

Data types in this lecture

	Type	Description	Example
Integer	int	integer of arbitrary magnitude	x = 1
Float	float	floating-point number	x = 1.0
String	str	character string	x = 'one'
Boolean	bool	boolean value	x = True

In the following weeks, you will get to know more data types like Lists or Dictionaries.

Operations on data types

Subtraction is a valid operation on two integers.

```
to_be_paid = 12
given_cash = 15

money = given_cash - to_be_paid
print('The cashier will give you', money, 'Euros.')
```

Output:

```
The cashier will give you 3 Euros.
```


Operations on data types

Subtraction is a valid operation on two integers.

```
to_be_paid = 12
given_cash = 15

money = given_cash - to_be_paid
print('The cashier will give you', money, 'Euros.')
```

Output:

```
The cashier will give you 3 Euros.
```

Operations on data types

Subtraction is an invalid operation between an integer and a string.

```
to_be_paid = '12'
given_cash = 15

money = given_cash - to_be_paid
```

Output:

```
Traceback (most recent call last):
  File "<string>", line 4, in <module>
TypeError: unsupported operand type(s) for -: 'int'
and 'str'
```


Operations on data types
Subtraction is an invalid operation between an integer and a string.
to_be_paid = '12'
given_cash = 15
money = given_cash - to_be_paid
Output:
Traceback (most recent call last):
File "<string>", line 4, in <module>
TypeError: unsupported operand type(s) for -: 'int'
and 'str'

Casting

```
to_be_paid = '12'
given_cash = 15

money = given_cash - int(to_be_paid)
print('The cashier will give you', money, 'Euros.')
```

Output:

```
The cashier will give you 3 Euros.
```


Casting

to_be_paid = '12'
given_cash = 15

money = given_cash - int(to_be_paid)
print('The cashier will give you', money, 'Euros.')

Output:

The cashier will give you 3 Euros.

You can change the type of a variable with a so-called cast operation.
That only works if Python knows how to convert the previous type into the other type!
You can cast with functions like:

- int()
- str()
- float()

The Boolean data type - True or False

With a Boolean you express truth values:

something is `True`
(which corresponds to `1`)

or

something is `False`
(which corresponds to `0`)

```
light_on = True
light_of = False
```


The Boolean data type - True or False
With a Boolean you express truth values:
something is True
(which corresponds to 1)
or
something is False
(which corresponds to 0)
light_on = True
light_of = False

Caution

Pay attention to the correct spelling of `True` and `False`. Both keywords begin with a capital letter followed by lower case letters.

Checking if a statement is True or False

```
>>> 10 == 10
True

>>> 1 > 2
False

>>> 2 != 2
False

age = 14
>>>  12 < age < 20
True
```


Checking if a statement is True or False

```
>>> 10 == 10
True
>>> 1 > 2
False
>>> 2 != 2
False
age = 14
>>>  12 < age < 20
True
```

Operators for comparisons

Operator	Comparison	True	False
==	equal	`1 == 1`	`5 == 3`
!=	not equal	`2.3 != 2.313`	`5 != 5`
<	less than	`2.5 < 9`	`4 < 3`
>	greater than	`2.4 > 2.399`	`0.1 > 5`
<=	less than or equal	`3 <= 3`	`4 <= 3`
>=	greater than or equal	`2.4 >= 2.399`	`0 >= 5`

How to make conditional statements?

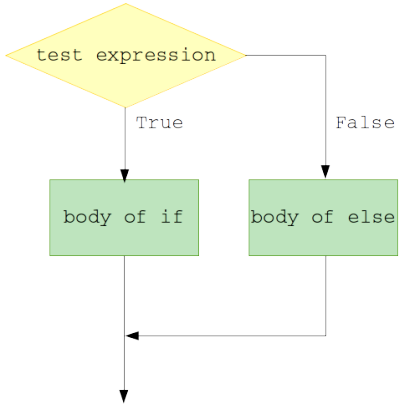
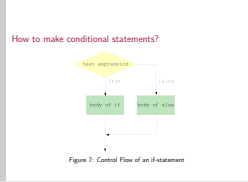


Figure 7: Control Flow of an if-statement



Sometimes you want to execute code depending on whether a condition is met or not. For this, we can use so called if-statements.

- if the condition after the keyword `if` evaluates to `True`, the body of the if-statement is executed
- otherwise (`else`), the body of the else-statement is executed

If - statements

```
age = 14

if age == 14:
    print('You are 14 years old!')

if 13 <= age <= 19 :
    print('You are a teenager.')
else:
    print('You are not a teenager.')
```


If - statements

```
age = 14

if age == 14:
    print('You are 14 years old!')

if 13 <= age <= 19 :
    print('You are a teenager.')
else:
    print('You are not a teenager.')
```

- to create an if-statement, we use the keyword `if`
- same indentation –> block of code
- we indent by using 4 spaces

```
age = 14

if age == 14:
    print('You are 14 years old!')

if 13 <= age <= 19 :
    print('You are a teenager.')
else:
    print('You are not a teenager.')
```

Output:

```
You are 14 years old!
You are a teenager.
```


age = 14

if age == 14:
print('You are 14 years old!')

if 13 <= age <= 19 :
print('You are a teenager.')
else:
print('You are not a teenager.')

Output:

You are 14 years old!
You are a teenager.

Errors

- everyone makes mistakes when writing code

Errors
everyone makes mistakes when writing code

Even the most experienced programmers make errors in their code. When running code, you will also receive error messages and need to debug your code. Error messages are great as they can often help us to spot the mistakes more easily and give hints where to start debugging.

- logical mistakes
  - your program does not do what it is supposed to do
  - you might notice because you see an unexpected result
  - worse: you trust your output but it was wrongly derived –> testing your code can help (more on this in the next weeks)
- syntax mistakes
  - similar to making an 'orthographic mistake'

–> understanding error messages is very helpful to spot and fix the mistakes

Example error

```
# this is a valid Python statement
goodn8 = 'sleep well'

# this is an invalid Python statement
4u ='for you'
```


Example error

What is wrong with this piece of code?

Example traceback

```
# this is a valid Python statement
goodn8 = 'sleep well'

# this is an invalid Python statement
4u ='for you'
```

Output:

```
  File "<string>", line 5
    4u ='for you'
     ^
SyntaxError: invalid syntax
```


Example traceback

# this is a valid Python statement
goodn8 = 'sleep well'

# this is an invalid Python statement
4u ='for you'

Output:

File "<string>", line 5
4u ='for you'
^
SyntaxError: invalid syntax

Let's have a look at the traceback:

- what type of error is it?
- what is the problem?

Traceback: The sequence of function calls that led to an error.

Reading the traceback

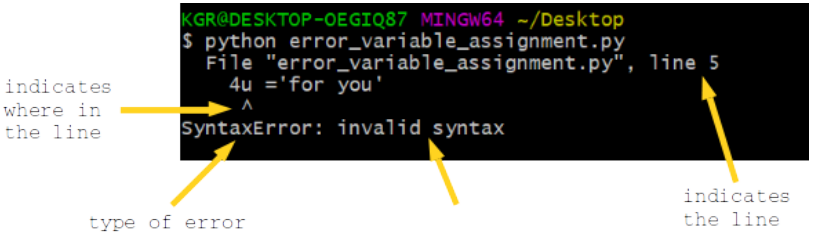
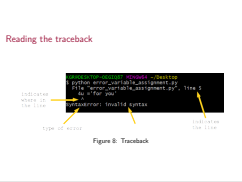


Figure 8: Traceback



- a variable name must not start with a number

SyntaxError

- your code cannot be interpreted
- similar to making an 'orthographic mistake'

–> did you only use valid Python statements?

SyntaxError
- your code cannot be interpreted
- similar to making an 'orthographic mistake'

–> did you only use valid Python statements?

Different types of errors

- SyntaxError
- NameError
- ValueError
- TypeError

You will learn about these type of errors on the exercise sheet

Different types of errors
- SyntaxError
- NameError
- ValueError
- TypeError

You will learn about these type of errors on the exercise sheet

NameError

- occurs when you use a variable that did not exist before

ValueError

- occurs when a function (more about this in the next lecture) is given an inappropriate value

TypeError

- occurs when a operation is used with inappropriate variable types

Tips for the homework

- to understand what code does
  - try to run it –> what is the output/error?
  - try to change some variable –> how does the output change?
- using a search engine is **no** cheating!
- collaborate with your peers!

Tips for the homework
- to understand what code does
  - try to run it –> what is the output/error?
  - try to change some variable –> how does the output change?
- using a search engine is **no** cheating!
- collaborate with your peers!

Recap PINGO

- start session 203586

Homework

- looks much to do at first, but if you go step by step I am sure, you will do great
- biggest hint for almost all the exercises: run the code!!
- play around with code!

Exercise 2.2

- copy the code to a python script
- add your lines of code below
- you could define a variable called total_price_apples
- assign it a value using the previously defined varibles
- do not forget to print your result to the command line

Exercise 3.3

- make a plan: what should be the output of your program?
- is there a condition that you have to check?
- look up the notes on the comparison operator slide
- define a variable at the top of your script that is the number that you want to check
- by determining, it is meant that you print to the command line whether the number defined above is positive or negative

See you tommorow!

I hope to see you in the practice session tomorrow!

See you tommorow!
I hope to see you in the practice session tomorrow!

References

MVCodeClub. 2019. “Intro to Scratch Stories 6: Rock-Paper-Scissors.” https://www.mvcode.com/lessons/intro-to-scratch-stories-6-rock-paper-scissors.

References
MVCodeClub. 2019. “Intro to Scratch Stories 6: Rock-Paper-Scissors.” https://www.mvcode.com/lessons/intro-to-scratch-stories-6-rock-paper-scissors.