Python Fundamentals

Agenda

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8. Andmestruktuurid (Data Structures)
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11. Sissejuhatus funktsioonidesse (Intruduction to functions)
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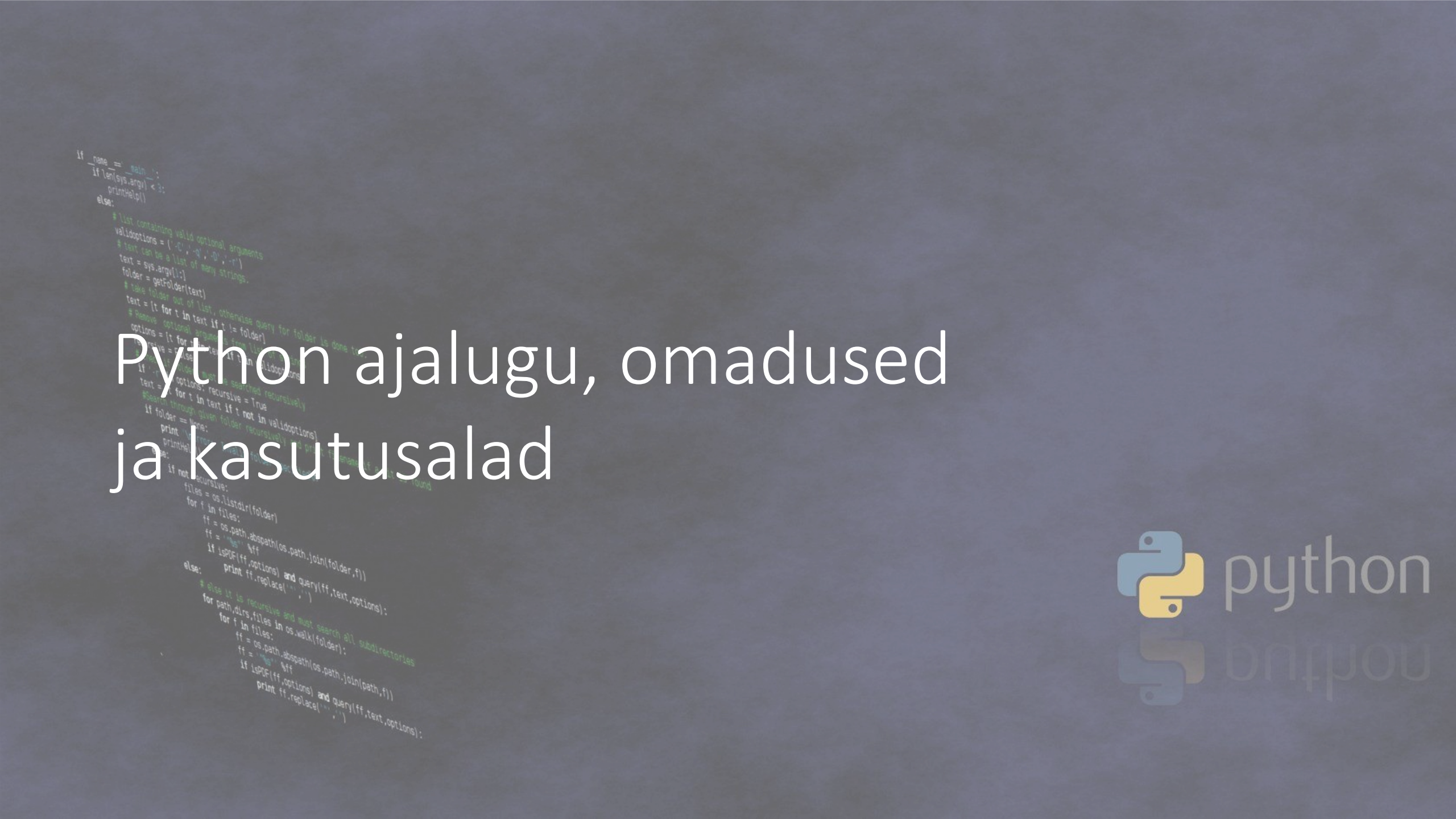
Python ajalugu, omadused ja kasutusalad



Python’ ajalugu

- Python’ töötas välja 1990ndate alguses Guido van Rossum.
- Python on üldotstarbeline interpreeritav programmeerimiskeel, mida algselt arendati skriptimiskeeleks.
- Esimest korda ametlikult avaldati 1991 veebruaris, esimene peamine väljalase (1.0.0) 26.jaanuar 1994.
- Python 3.0 lasti välja 8.detsember 2008.
- Python 3.0 on ainus ametlikult toetatud versioon.

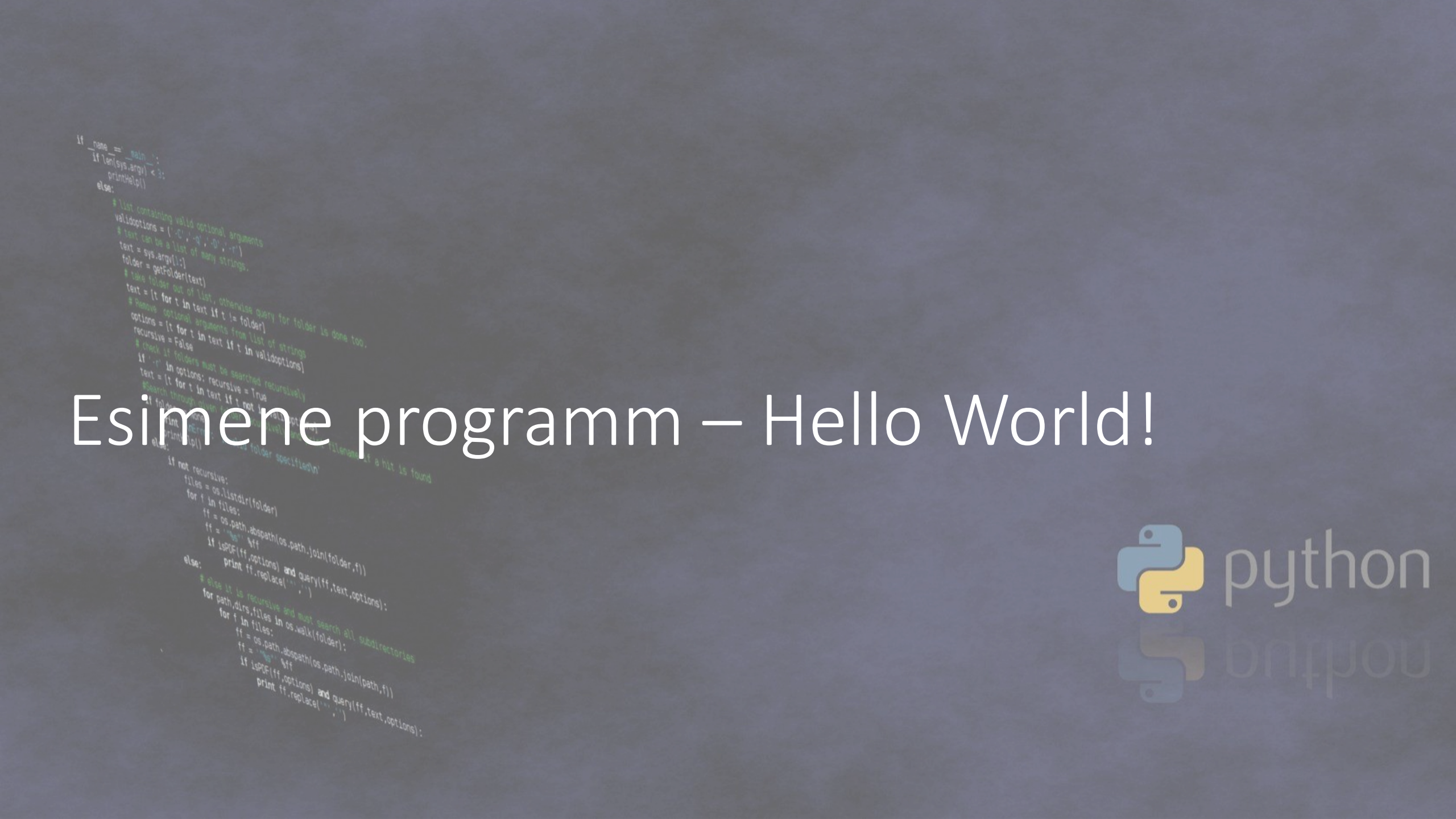
Omadused/Tehniline info

- Dünaamiliste andmetüüpidega keel, kus ei ole tarvis määrata muutujate tüüpe
- Interpreteeritud (Interpreted) - interpretaator loeb sisemällu programmifaili ja asub seda rida-realt täitma
- Aeglasem kui kompileeritud keeled
- Objekt-orienteeritud (Object-oriented)
- Kergesti loetav
- *Whitespace sensitive*
- Laialdane standard *library*
- Tasuta ja *open-source*

Kasutusalad

- Tehisintellekt ja Masinõpe (Artificial Intelligence and Machine Learning) - SciKit, pyTorch, Tensor Flow.
- Veebi *backend* - Django, Pyramid, Flask, Bottle, paramiko.
- Testimine - pytest, robot framework.
- Automatiseerimine (Task automatization) - Selenium, pyautogui, requests.
- DevOps - Ansible, Salt, OpenStack.
- Andmeteadus (Data Science) - Pandas, IPython, Jupyter Notebook

Esimene programm – Hello World!



Prerequisites

- Python 3.10 installed
- PyCharm Community installed

Hello World!

1. Loo uus kaust (nt. **Python_Fundamentals**) mis hakkab sisaldama faile selle kursuse kohta.
2. Ava see kaust PyCharm’is klikkides **Open** ja valides see listist.
3. PyCharm’is, selle kausta sees, loo uus kaust **1-hello-world**.
4. Sinna kausta, loo fail **hello-world.py**.
5. Sinna faili, kirjuta: `print("Hello, World!")`
6. Jookusta programm parem-klikkides faili peale *project files* aknas ja kliki **Run** ‘hello-world’.

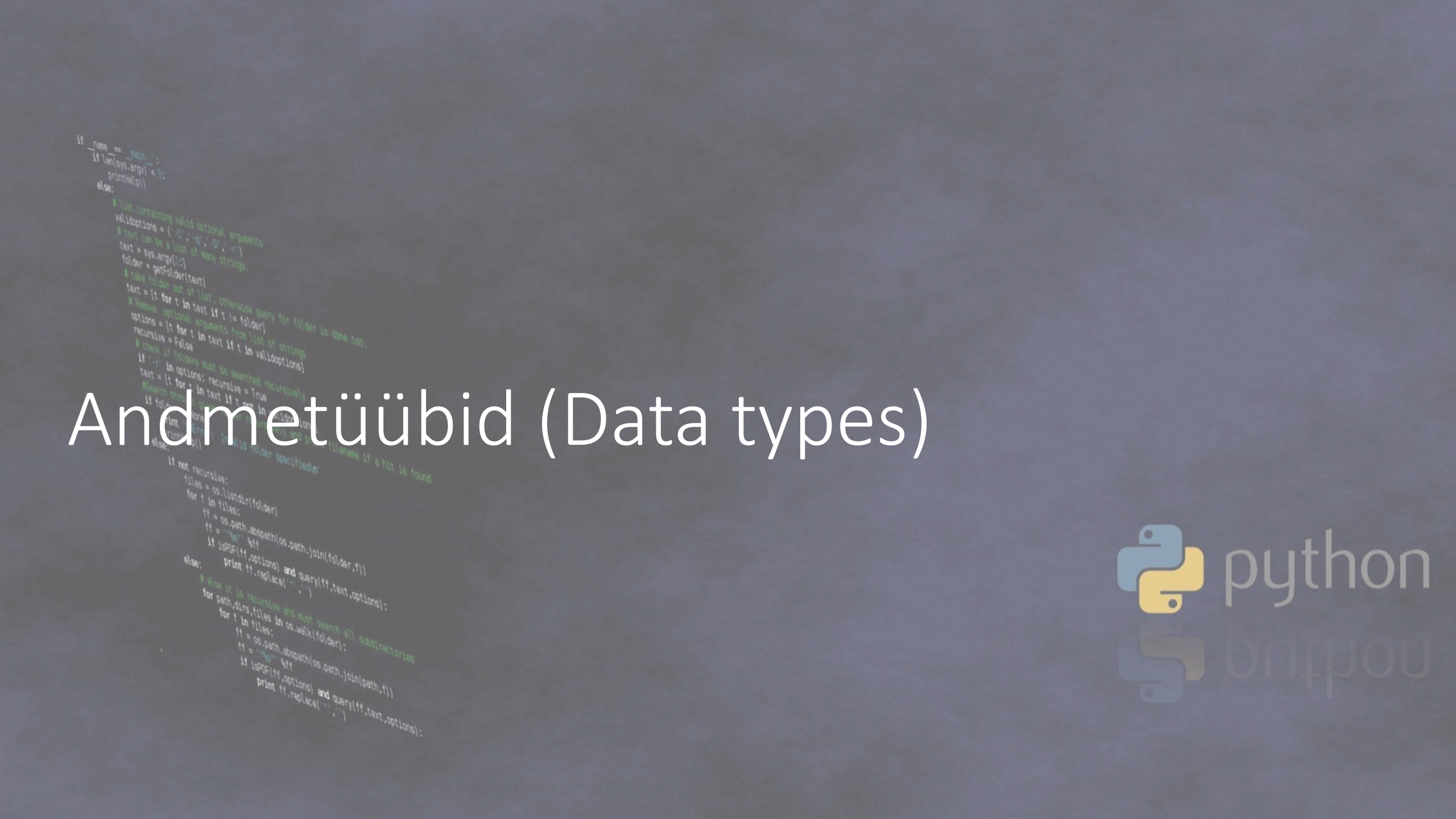
Selgitus

Meie hello-world programmis, me printisime välja lihtsa sõnumi. Me saavutasime selle kutsudes built-in print() **funktsiooni**.

See funktsioon aktsepteerib sulgdude sisse **String parameetri** ja printib selle konsoolile.

We will learn about functions later, for now think of them as **behaviours** - something gets done based on some **input** (**parameter**).

Andmetüübid (Data types)



Andmetüübid

- int - kasutatakse täisarvudeks (integers)
- float - kasutatakse ratsionaalarvudeks (floating point numbers)
- complex - kasutatakse kompleksarvude jaoks
- str and bytes - kasutatakse tekstideks
- bool - kasutatakse true/false väärtuste jaoks
- NoneType - spetsiaalne, “not defined” tüüp

Näited

int	0, 1, -3, 6, 128, 267, 561234
float	3.14, 456.123, 4.0
complex	(1-2j), (30+15j)
str	"house", "", "This is a sentence", 'single quotes'
bytes	b"This is a byte sequence", b'simple'
bool	True, False
Nonetype	None

Printing erinevaid andmetüüpe

Me võime printida samamoodi erinevad andmetüübid nagu me tegime seda ‘Hello World!’ programmis.

```
# Printing different data types
print("A message.")
print(-17)
print(123.4)
print(False)
print(None)
```

Ülesanne

1. Loo Pycharmis kaust **2-data-types**.
2. Sinna kausta, loo fail **ülesanne-1.py**.
3. Print’ välja kõik andmetüübid.

Andmetüübi kontrollimine

Kõik Python'is on **objekt**. Me õpime hiljem, mis on Object Oriented Programming (OOP).
Me saame iga objekti tüüpi kontrollida built-in funktsiooniga type().

type() tagastab (returns) tekst väärtuse (string), mis kirjeldab parameetri andmetüüpi.

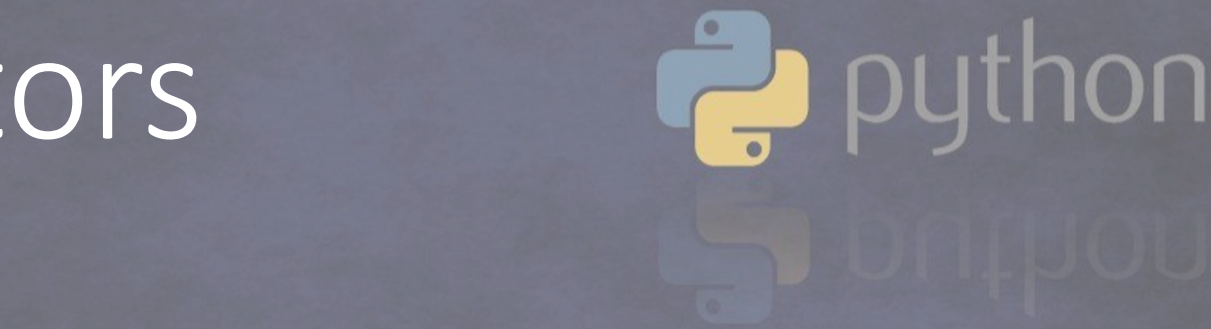
Et näha konsoolis tulemust, on vaja see sisestada print() funktsiooni parameetriks.

```
print(type("Mis on mu tüüp?"))  # Output: <class 'str'>
print(type(10.2))               # Output: <class 'float'>
print(type(False))              # Output: <class bool'>
```

Ülesanne

- 1. Kausta **2-data-types**, loo fail **ülesanne-2.py**.
- 2. Print’ välja iga andmetüübi type.

Muutujad & Operaatorid
Variables & Operators



Variables

Sageli kasutame samu andmeid (näiteks nimi, valuutakurss vms) koodis korduvalt, sellisel juhul pole otstarbekas infot dubleerida: mitmes kohas muutuste tegemine on ajamahukas ja keeruline, suureneb vigade oht. Seetõttu kasutatakse **muutujaid**.

Muutujat võime ette kujutada kui karpi, mis sisaldab mingit teavet: nimi, vanus jne. Muutujale antud väärtus on see, mis defineerib muutuja andmetüübi.

Python on **dünaamiline** keel, nii et me ei pea määrama **muutuja** andmetüüpi.

Kui me loome muutuja, siis me peame ka talle andma väärtuse.

Muutuja deklareerimine number = 10 väärtuse andmine

Variables - reeglid

- Variable väärtust saab muuta - määrates talle uue väärtuse.
- Variable nimi võib koosneda ainult a-z, A-Z, 0-9 ja _ sümbolitest.
- Variable nimi ei või alata numbriga.

Variables

Kuna muutujale on antud väärtus, siis see väärtus justkui esindab seda. Tänu sellele saame me kasutada muutujaid funktsiooni parameetritena.

```
# Declare and assign a variable.
number = 10
print(number)  # See printib 10 konsoolile
```

character annab Pythonile teada, et ignoreeri seda rida ja seda kasutatakse, et lisada koodi kommentaare.

Ülesanne

1. Loo Pycharmis kaust **3-variables-and-operators**.
2. Lisa sinna kausta fail **variables-ülesanne.py**.
3. Loo muutujad igale andmetüübile.
4. Print’ need välja.
5. Määra uued väärtused teiste andmetüüpidega olemasolevaletele muutujatele.
6. Print’ need uuesti konsoolile.

Keywords

Keywords are names reserved by the language itself.

Neid on keelatud kasutada variable, funktsiooni või class'i nimedene koodis. Tehes seda on result'iks **SyntaxError**.

and	as	assert	async	await	break
class	continue	def	del	elif	else
except	False	finally	for	from	global
if	import	in	is	lambda	None
nonlocal	not	or	pass	raise	return
True	try	while	with	yield	

Operators

Arithmetic operators	+ - * ** / // %
Comparison operators	== != < > <= >=
Assignment operators	= += -= *= **= /= //= %= &= ^= |= <<= >>= |=
Identity operators	is, is not
Logical operators	and, or, not
Membership operators	in, not in
Bitwise operators	& AND, | OR, ^ XOR, ~ NOT, << left shift, >> right shift

Arithmetic operators

Andmete töötlemisel kasutatakse erinevaid **aritmeetilisi operaatoreid**:

- \+ liitmine, saab kasutada ka stringidega
- \- lahutamine
- * korrutamine, saab kasutada ka stringidega
- / jagamine (5 / 2 = 2.5)
- // täisarvuline jagamine (alles jääb tulemuse täisarvuline osa, näiteks 5 // 2 = 2)
- % jäägi leidmine (5 % 2 = 1) (**modulo operator)**
- ** astendamine

```
# Arithmetic operators
print(1 + 2 + 5 - (2 * 2))
print(501.0 - 99.9999)
print(2 ** 3)
print(10.0 / 4.0)
print(10.0 // 4.0)
print(5 % 2)
```

```
# Strings concatenation
name = "John"
greeting = "Hello, " + name
# Prints 'Hello, John'
print(greeting)
```

```
# String repeat
message = "Hello"
# Prints 'HelloHello'
print(message * 2)
```

Assingment operators

Muutujate määramiseks kasutatakse erinevaid **assingment operaatoreid**:

- = määrab variable’ väärtuse
- += lisab väärtuse olemasoleva variable’ väärtusele
- -= lahutab väärtuse olemasoleva variable’ väärtusest
- *= korrutab väärtuse olemasoleva variable’ väärtusega
- /= jagab väärtuse olemasoleva variable’ väärtusega
- **= astendab väärtuse olemasoleva variable’ väärtusega (raise to the power)
- //= määrab variable’ väärtuseks tulemuse täisarvulise osa

```
# Assignment operators
num = 3
num += 2
print(num)
num -= 1
print(num)
num *= 3
print(num)
num /= 2
print(num)
num **= 3
print(num)
num //= 2
print(num)
```

Comparison operators

Võrdlemiseks kasutatakse erinevaid võrdlusoperaatoreid:

- == returns **True** kui mõlemad elemendid on võrdsed
- != returns **True** kui mõlemad elemendid on erinevad
- < returns **True** kui element on väiksem kui teine element
- > returns **True** kui element on suurem kui teine element
- <= returns **True** kui element on väiksem või võrdne kui teine element
- >= returns **True** kui element on suurem või võrdne kui teine element

```
# Comparison
john_1 = "John"
john_2 = "John"
print(john_1 == john_2)
print(1 != 1)
print(99 < 1.1)
print(99 > 1.1)
print(-32 <= -33)
print(123 >= 123)
```

Logical operators

- **and** returns **True** kui mõlemad statemendid on tõesed
- **or** returns **True** kui üks statementidest on tõene
- **not** returns **True** kui statement on väärt, returns **True** teisti.

```
# Logical operators
print(True or False)
print(False and False and True)
print(not False)
is_greater = 40 > 30
print(not is_greater)
```

Membership operators

- **in** returns **True** when a value is present in a sequence (list, range, string, etc.),
- **not in** returns **True** when a value is not present in a sequence (list, range, string, etc.).

```
# Membership operators
print("fox" not in "cow, sheep, dog")
print(”apple" in [”apple”, “banana”, “orange”])
```

Ülesanne

1. Proovi määrata mis on iga printi output.

```
num = 10
print(num)
num += 1
print(num)
num -= 3
print(num)
num *= -0.5
print(num)
num **= 2
print(num)
num /= 3
print(num)
num  //= 2
print(num)
num %= 2
print(num)
```

```
print(True == True)
print(1 != 3)
print(2 < 3)
print(2 > 500)
print(2 >= 2)
print(2 <= 2)
```

```
print(5 + 5)
print(30.1 - 0.71)
print(2 * 2)
print(2 =* 3)
print(2.5 / 5.0)
print(10 % 3)
```

```
print(False or False or False)
print(False or True)
print(True and True)
print(True and False)
print(not False)
print(not True)
print(True and not False)
```

UTF-8

UTF-8

- In 1963 the standard for information encoding ASCII was created. ASCII consisted originally of 128 characters, including lowercase and uppercase letters, numbers and punctuation, each one encoded using 7 bits.
- Then came “extended ASCII” which used all 8 bits to accomodate for more characters like á, é, ü and so on. It became apparent that neither 128 (7 bit) or 256 (8 bit) slots were enough to represent a very big number of characters consistently.

UTF-8

- **Unicode** was created as a standard to represent characters from nearly all writing systems. It currently consists of more than 1,000,000 code points (they have the prefix “U+”).

- **UTF-8** is a method for encoding these code points and is the default encoding system for almost everything now.

UTF-8

- Python 3.X is UTF-8 encoded by default.
- This means you can utilize diacritical marks in the string sequences.
- It is also possible to use them in variable, class and function names, but it is strongly discouraged.

UTF-8 näide

```
# This is fine
pangram_en = "How veÿinglĀ quick daft zebras jump!"
pangram_fr = "Voiÿ ambiguë d'un cœur qui, au zéphĀr, préfère les jattes de kiwis."
pangram_de = '"Fiÿ, SchwĀz!", quäkt Jürgen blöd vom Paß.'
hello_cn = "你好， 世界。"
print(pangram_en)
print(pangram_fr)
print(pangram_de)
print(hello_cn)

# This is STRONGLY discouraged
整数 = 7
print(整数)
```

Ülesanne

1. In PyCharm, create folder 04-utf-8-compliance.
2. Inside that folder, create file utf-8-exercise.py.
3. Print out all characters of the Greek alphabet.

String formatting and printing

String printing

Andmete printimiseks on neli põhilist viisi:

1. unformatted output
2. printf-style formatting (old style)
3. str.format() formatting (new style)
4. string interpolation (formatted string literals or f-strings)

print() function

Me juba vaatasime algelist print() funktsiooni kasutust, kuid seda saab ka kasutada, et:

- et kuvada mitut väärtust korraga
- defineerida **a separator**, mis sisestada väärtuste vahele
- lisada **ending** string viimasele väärtusele

print() – mitu väärtust

We can provide from one to unlimited number of strings to be printed out. By default they will be separated by a space.

```
# Printing out multiple strings
print("What", "a", "lovely", "day", ".")
print("1", "2", 3,  4,  5)
fruit = "orange"
print("apple", "banana", fruit)
```

print() - separator

Me saame defineerida **separator**’ mis sisestatakse väärtuste vahele *overwrite’des* funktsiooni **sep** parameetri default väärtuse (space).

```
# Printing out multiple strings with a separator
print("What", "a", "lovely", "day", ".", sep="-")
print("1", "2", 3, 4, 5, sep=” < ")
fruit = "orange"
print("apple", "banana", fruit, sep=" + ")
```

print() - ending

Me saame defineerida ka ending string' mis lisatakse viimasele väärtusele *overwrite*'des funktsiooni **end** parameetri default väärtuse ("\n" - new line).

```
# Printing out multiple strings with a separator and ending
print("What", "a", "lovely", "day", ".", sep="-", end="!\n")
print("1", "2",  3,  4,  5,  sep=" < ", end=" < ...\n")
fruit = "orange"
print("apple", "banana", fruit, sep=" + ", end=" = Yummy")
```

Ülesanne

1. Loo PyCharmis kaust 05-string-formatting-and-printing.
2. Sinna kausta, loo fail printing-exercise.py.
3. Print välja numbrid 0-5, igaüks eraldi reale, alustades “|START|” string’ga ja lõpetades “|END|” string’ga kasutades maksimaalselt 2 print() funkstsiooni. Tulemus peaks välja nägema selline:

```
|START|0|END|
|START|1|END|
|START|2|END|
|START|3|END|
|START|4|END|
|START|5|END|
```

Printf-style formatting

String'idel Pythonis on unikaalne built-in operation, mida saab kasutada **% operator**'ga. Seda kutsutakse "old-style" formatting. See teeb positsioonilise vormindamise väga lihtsaks.

```
# Formatting and printing (old style)
name = "General"
last_name = "Kenobi"
print("Hello there, %s %s" % (name, last_name))
```

Printf-style formatting

It is also possible to refer to **variable substitutions by name** in the format string, if we pass a mapping to the % operator.

```
# Formatting and printing (old style)
name = "General"
last_name = "Kenobi"
print("Hello there, %(name)s %(last_name)s" % {"name": name, "last_name": last_name})
```

Printf-style formatting

Variable substitutions by name make format strings easier to maintain and easier to modify in the future.

You do not have to worry about making sure the order you are passing the values in matches up with the order in which the values are referenced in the format string.

Of course, the downside is that this technique requires a little more typing.

str.format() formatting

Python 3 introduced a new way to do string formatting that was also later back-ported to **Python 2.7**.

This “new style” string formatting gets rid of the **% operator** special syntax and makes the syntax for string formatting more regular and intuitive to use.

str.format() formatting

Formatting is performed by calling format() function on a string object. We can use format() to do simple positional formatting, just like we could with “old style” formatting.

```
# Formatting and printing (new style)
name = "General"
last_name = "Kenobi"
print("Hello there, {} {}".format(name, last_name))
```

str.format() formatting

We can also refer to **variable substitutions by name** and use them in any order we want. This is quite a powerful feature as it allows for re-arranging the order of display without changing the arguments passed to the format() function.

```
# Formatting and printing (new style)
name = "General"
last_name = "Kenobi"
print("Hello there, {name} {last_name}".format(name=name,last_name=last_name))
```

String interpolation

Python 3.6 added a new string formatting approach called **formatted string literals** or **f-strings**. This new way of formatting strings allows us to use embedded **Python expressions** inside string constants.

```
# Formatting and printing (string interpolation)
name = "General"
last_name = "Kenobi"
print(f"Hello there, {name} {last_name}")
```

String interpolation

String interpolation prefixes the string constant with the letter **“f”** - hence the name **“f-strings”**. This new formatting syntax is powerful, because we can embed arbitrary **Python expressions** like for example inline arithmetics.

```
# Formatting and printing (string interpolation)
a = 2
b = 7
print(f"{a} times {b} raised to power of 2 is { (a * b) ** 2 }.")
```

String interpolation

On võimalik ka defineerida kuidas variable kuvada. Näiteks, me võime defineerida, et variable peaks olema pikendatud tühikutega täpselt X korda, kui see on väiksem.

```
header1 = "Name"
header2 = "Age"
name = "John"
age = 22
print(f"| { header1:10 } | { header2:10 } |")
print("-" * 27)
print(f"| { name:10 } | { age:10 } |")
```

```
|Name      |Age       |
---------------------------
| John      |        22|
```

String interpolation

Ja on ka võimalik defineerida, mitu komakohta peaks olema kuvatud või kuvada see protsendina.

```
# Changing how variable is displayed
n = 109.432188881111
print(f"{ n: .3f }")  # prints out 109.432

voters_percentage = 0.71
print(f"{ voters_percentage: .1% }")  # prints out 71.0%
```

Ülesanne

1. Loo kausta **5-string-formatting-and-printing** fail **formatting-ülesanne-2.py**.
2. Print välja tabel koos header reaga, mis sisaldab name, age and salary ja igaüks neist on pikendatud vastavalt 15, 5 ja 12 character'ni.
3. Print välja line, et eraldada header'it andmetest, mis on täpselt sama pikk kui kogu tabel.
4. Print välja 3 rida andmeid sellesse tabelisse, kus kõik veerud(columns) on sama pikad kui header veerud ja salary on 2 komakohaga.

```
| Name          | Age    | Salary              |
-------------------------------------------------
|John Doe       |     27 |          123456.00|
|John Wick      |     40 |           50000.00|
|Jeff Bezos     |     45 |    999999999.95|
```

Basic string operations

What strings are really?

A string is basically **a group of characters in a specified order**, called **a sequence of characters**.
Sequences are **zero-indexed** which means that we count elements in the sequence starting with 0.

H	e	l	l	o	,		W	o	r	l	d	!
0	1	2	3	4	5	6	7	8	9	10	11	12

And that is exactly how each string is stored in most programming languages, including Python.

len() function

The .len() function returns a number that is equal to the number of characters in the string.

```
# Print out amount of characters in the sentence
sentence = "Lorem ipsum dolor sit amet..."
print(len(sentence))  # prints out 29
```

.index() function

The .index() function returns a number that is equal to the position of first occurrence of a particular character in the string.

```
# Print out index of first 'o' character in the sentence
sentence = "Lorem ipsum dolor sit amet..."
print(sentence.index("o"))  # prints out 1
```

L	o	r	e	m		i	p	s	u	m		...
0	1	2	3	4	5	6	7	8	9	10	11	...

.count() function

The .count() function returns a number that is equal to the number of times a particular character occurs in the string.

```
# Print out amount of 'o' characters in the sentence
sentence = "Lorem ipsum dolor sit amet..."
print(sentence.count("o"))  # prints out 3
```

Single character retrieval

The [] operator is used to retrieve a particular character of the string based on provided index.

```
# Print out 4th character of the sentence
sentence = "Lorem ipsum dolor sit amet..."
print(sentence[ 3 ]) # prints out e
```

L	o	r	e	m		i	p	s	u	m		...
0	1	2	3	4	5	6	7	8	9	10	11	...

String slicing

The [] operator can be also used to retrieve a substring of of the string based on provided range containing of inclusive start index, colon and exclusive end index.

```
# Print out 'm ips' substring of the sentence
sentence = "Lorem ipsum dolor sit amet..."
print(sentence[ 4:9 ])  # prints out 'm ips'
```

L	o	r	e	m		i	p	s	u	m		...
0	1	2	3	4	5	6	7	8	9	10	11	...

String slicing

If we only specify the start index of the [] operator, retrieved substring will start at that index and continue to the original string ending.

```
# Print out 'um dolor sit amet==.' substring of the sentence
sentence = "Lorem ipsum dolor sit amet..."
print(sentence[ 9: ])  # prints out 'um dolor sit amet...'
```

L	o	r	e	m		i	p	s	u	m		...
0	1	2	3	4	5	6	7	8	9	10	11	...

String slicing

If we only specify the end index of the [] operator, retrieved substring will start at the original string beginning and end at that index.

```
# Print out 'Lorem ip' substring of the sentence
sentence = "Lorem ipsum dolor sit amet..."
print(sentence[ :8 ])  # prints out 'Lorem ip'
```

L	o	r	e	m		i	p	s	u	m		...
0	1	2	3	4	5	6	7	8	9	10	11	...

String slicing with skipping

The [] operator can be extended even further, to retrieve a substring skipping every nth character.

```
# Print out 'mis' substring of the sentence
sentence = "Lorem ipsum dolor sit amet..."
print(sentence[ 4:9:2 ])  # prints out 'mis'
```

L	o	r	e	m		i	p	s	u	m		...
0	1	2	3	4	5	6	7	8	9	10	11	...

String reversing

The special syntax of the [] operator is used to reverse the string.

```
# Print out the sentence in reverse order
sentence = "Lorem ipsum dolor sit amet..."
print(sentence[ ::-1 ])  # prints out '...tema tis rolod muspi meroL'
```

.upper() function

The .upper() function returns a string that is equal to the original string with characters raised to uppercase.

```
# Print out the sentence in uppercase
sentence = "Lorem ipsum dolor sit amet..."
print(sentence.upper())  # prints out the sentence in uppercase
```

.lower() function

The .lower() function returns a string that is equal to the original string with characters lowered to lowercase.

```
# Print out the sentence in uppercase
sentence = "Lorem ipsum dolor sit amet..."
print(sentence.lower())  # prints out the sentence in lowercase
```

Ülesanne

1. Loo Pycharmis kaust **6-basic-string-operations**.
2. Sinna kausta loo fail **strings-ülesanne.py**.
3. Kirjuta programm, mis input_stringi põhjal, mille pikkus on alati vähemalt 10 tähemärki tagastab:

   a. Substring' mis on 4 tähemärki pikk ja on täpselt originaalse stringi keskel, kui string pikkus on paarisarv.

   b. Substring' mis on 5 tähemärki pikk ja on täpselt originaalse stringi keskel, kui string pikkus on paaritu.

Tips: Kasuta len() ja int() funktsioone ja ka % ja [] operaatoreid. Näide int() funktsioonist:

```
a = int(3 / 2)  # rounds down 1.5 to 1 and assigns it to a
```

Collections

Mis on collection?

Senini me oleme töötanud üksikute väärtustega. Me oleme ka õppinud, et string on **a sequence of characters**. **Collection** on container object, mis võib hoida null või mitu erineva andmetüübiga objekti. Kõige olulisemad collectionid Python'is on :

- List
- Dictionary
- Tuple
- Set

List

Lists võib sisaldada igat tüüpi objekte ja neid nii palju kui me ise tahame.
Et initsialiseerida(initialize) tühi list, kasutame me **[]** operaatorit ja len() funktsiooni et kontrollida, kui mitu elementi on listis.

```
# Declare and initialize a list variable
alphabet = []  # this is an empty list
print(f"Current length of 'alphabet': { len(alphabet) }")  # prints out 0
```

List.append()

Et lisada listi element, kasutatakse .append() funktsiooni.

```
# Add some letters
alphabet.append("a")
alphabet.append("b")
alphabet.append("c")
print(f"Alphabet: { alphabet } (length: { len(alphabet)} )")
```

List indexing

List indexing on **zero-based**, samamoodi nagu string puhul.

```
# Indexing
print(f"The first letter of alphabet is '{ alphabet[0] }' ")
```

List.extend()

Et lisada mitu elementi korraga, kasutatakse .extend() funktsiooni.

```
# Add some more letters
alphabet.extend( ["f", "d", "g", "e"] )
print(f"Alphabet (mixed): {alphabet} (length: {len(alphabet)} )")
```

List.sort()

.sort() funktsioon sorteerib kõik elemendid listis. Stringid tähestikuliselt ja arvud väiksemast suuremani.

```
# Sort the list
alphabet.sort()
print(f"Alphabet (sorted): {alphabet} (length: {len(alphabet)} )")
```

Other list functions

Et näha kõiki list funktsioone, on olemas help(list) command, mõned neist on:

- count(value) - returns number of occurrences of value.
- index(value) - returns first index of the value.
- insert(index, object) - inserts the object before the index.
- pop(index) - removes and returns object at the index.
- pop() - removes and returns object at the last position.
- remove(val) - removes first occurence of the value.
- clear() - removes all items from the list.
- reverse() - reverses list order.

Ülesanne

1. Loo Pycharmis kaust **7-collections**.
2. Sinna kausta loo fail **list-exercise.py**.
3. Listi [1, 2, 3, 4, 5] põhjal:
    a. Kasuta len() et printida selle pikkus.
    b. Kasuta append() et lisada kuues element: 2.
    c. Kasuta count() et leida, mitu number 2 on listis.
    d. Kasuta sama fuktsiooni et leida, mitu 7 on listis, kuigi seda seal ei ole. Mis on tulemus?
    e. Kasuta extend() et lisada: [6, 7, 8].
    f. Kasuta index() kontrollida 7 indexit.
    g. Kasuta insert() et lisada väärtus 10 kohale, mille index on 0. Printi list välja, et näha, mis muutus.
    h. Kasuta [-1] indexing et kontrollida, mis on listi viimane väärtus.
    i. Kasuta pop() et eemaldada viimane element listist.
    j. Kasuta remove() et eemaldada väärtus 4 listist.
    k. Kasuta reverse() ja print list.
    l. Kasuta sort() ja print list uuesti.
    m. Kasuta clear() et list tühjaks teha.

List slicing

1. Lists can be sliced.
2. Slicing operator is exactly the same as for string slicing:

   [start_index : stop_index]

3. The result of slicing is a list.
4. Stop_index ei ole kaasatud (nagu ka stringide puhul).

List slicing

```
users = ["Alice", "Bob", "Chris", "Deborah"]
print(users)
print(users[0:3]) # prints out ['Alice', 'Bob', 'Chris']
print(users[1:2])  # prints out ['Bob']
print(users[:2])  # prints out ['Alice', 'Bob']
print(users[1:]) # prints out ['Bob', 'Chris', 'Deborah']
```

Ülesanne

1. Loo kausta **7-collections** fail **list-slicing-ülesanne.py**.
2. Listi users = [**"User1"**, **"UserChris"**, **"User2"**, **"Admin"**] põhjal:
   a. Print välja slice, mis sisaldab ainult ”User2”.
   b. Print välja slice kõikidest kasutajatest, välja arvatud esimene.
   c. Print välja slice kõikidest kasutajatest, välja arvatud ’’Admin’’.
   d. Print välja slice kuni kolmanda kasutajani.

Dictionary

A dictionary is a data type similar to list, but works with keys and values instead of indexes.

Each value stored in a dictionary can be accessed using a key, which is any type of object (a string, a number, a list, etc.) instead of using its index to address it.

We must use the {} operator to initialize an empty dictionary.

Dictionary

```
# Declare and initialize an empty dictionary
phonebook = {}
# Add elements
phonebook["John"] = 111111111
phonebook["Jack"] = 222222222
print(phonebook)  # prints out {'John': 111111111, 'Jack': 222222222}
print(phonebook["Jack"])  # prints out 222222222
```

Dictionary

```
# Declare and initialize a dictionary
phonebook = {
        "John" : 111111111,
        "Jack" : 222222222
        }
print(phonebook)  # prints out {'John': 111111111, 'Jack': 222222222}
print(phonebook["Jack"])  # prints out 222222222
```

Dictionary element removal

The .pop() function and the **del** keyword deletes elements from the list.

```
phonebook = {"John": 111111111, "Jack": 222222222}

# Delete elements
del phonebook["John"]
phonebook.pop("Jack")
```

Dictionary.get()

The .get() function returns an object mapped to a key. We can also specify a default value when the key does not exist in the dictionary.

```
phonebook = {"John": 111111111, "Jack": 222222222}

# Find element by key that does not exist
print(phonebook.get("Dory"))  # prints out None
print(phonebook.get("Dory", 555555555))  # prints out 555555555
```

To see all dictionary functions we can use help(dict) command.

Ülesanne

1. In folder 07-collections create file dictionary-exercise.py.
2. Given dictionary {1: "one", 2: "two", 3: "three"}:

a. Use len() to print out its length.

b. Using set-item operator [], add a new key-pair: 4:"four".

c. Using get-item operator [], print out the value assigned to key 2.

d. Using get-item operator [], print out value for unassigned key, like 10. What happens?

e. Using dictionary function get(key), replace the previous get-item operator [] and print out the value for key 10. What happens?

f. Using dictionary function get(key, default), print out the value for key 10, this time setting default value to "unknown".

g. Using dictionary function get(key, default), print out the value for key 3. Set default value to "unknown".

h. Use pop() to print out value assigned to 2. Print out the dictionary after using pop().

i. Create a new dictionary {0: "zero"}. Using update(), update main dictionary with values from the new dictionary. Print out the main dictionary.

j. Using clear(), clear the dictionary.

Tuple

A tuple is a sequence of **immutable Python objects**. Tuples are sequences, just like lists. The differences between tuples and lists are, **the tuples cannot be changed** unlike lists and **tuples use parentheses**, whereas lists use square brackets.

Creating a tuple is as simple as putting different comma-separated values.

Optionally we can put these comma-separated values between parentheses also.

Tuple

A tuple can be initialized in many ways.

```
# Declare and initialize a tuple
my_things = ("Dog", "Cat", 1997, 32.0, True)
my_things = "a", "b", "c", "d"
```

Tuple

We can access tuple elements and slice them just like lists.

```
# Access tuple element and slice the tuple
my_things = ("Dog", "Cat", 1997, 32.0, True)
print(my_things[0])
print(my_things[1:3])
```

We already know most of the tuple functions from lists and dictionaries. To see all tuple functions we can use help(tuple) command.

Ülesanne

1. In folder 07-collections create file tuple-exercise.py.
2. Given tuple recipe = ("boil water", "insert egg", "wait 5min", "eat"):

a. Use len() to print out its length.

b. Use get-item operator [], to get 3rd step of the recipe.

c. Print out a slice of the last two steps of the recipe.

d. Count occurrences of “wait 5min” using count() function.

e. Check whether “boil water” is the first step using index() function.

Set

A set is a collection which is **unordered** and **unindexed**. In Python sets are written with curly brackets.

We cannot access items in a set by referring to an index, since sets are unordered the items have no index.

We already know most of the set functions from lists and dictionaries. To see all set functions we can use help(set) command.

Set

```
# Declare and initialize a set
animals = {"Dog", "Cat", "Elephant"}
# Add an element
animals.add("Mouse")
# Add multiple elements
animals.update(["Bird", "Horse"])
```

Set

```
# Declare and initialize a set
animals = {"Dog", "Cat", "Elephant"}
# Remove an element, throw an error if not present
animals.remove(”Cat")
# Remove an element, DO NOT throw an error if not present
animals.discard(”Cat")
```

User Input

User Input

All applications operate on data. One of the sources of data is user input.

Common ways of obtaining user input are:

- an interactive prompt
- command line parameters

Interactive prompt

The input() function is used to prompt user for data input. The program will halt the execution until an input is provided. The function's parameter is the message that should be displayed in the console when asking user for the input.

```
# Ask user for input and read it
print("Welcome to the interactive greeting system.")
user_name = input("Enter your name: ")
print(f"Hello, {user_name} !")
```

Ülesanne

1. In PyCharm, create folder 08-user-input.
2. Inside that folder, create file input-exercise-01.py.
3. Write an application that prints a dictionary containing 3 country - capital pairs:
   a. Use input function to query user for a country and its capital three times for each pair (6 inputs total).
   b. Print out the resulting dictionary.
4. In folder 08-user-input create file input-exercise-02.py.
5. Write the same application this time using input() only 3 times.
   a. User should input country and its capital in one input, separated by a comma “Japan,Tokyo”.
   b. Use string split(“,”) function to split the string into a list of 2 substrings - the country and the city. The split(“,”) function splits a string by a programmer defined delimiter into a list of substrings, for example: 'Japan,Tokyo' => ['Japan', ‘Tokyo’]
   c. Print out the resulting dictionary.

Command line parameters

Another way of providing input to our programs is to use **command line parameters**. Those parameters are provided when launching a program from the terminal / command after the program file name.

```
python3 my-program.py hello world!
```

Command line parameters

Before we are able to read those parameters in our program, we must import a module that will help us achieve that by adding simple line **import sys** at the top of our program file.

Once it is imported, we can use it to retrieve the command line parameters as a list of strings, where the first item in the list is always full path to the application being executed and its name and the next elements are the parameters we provided.

?!?! :TODO

python3 my-program.py hello world!

```
# Import sys module and read command line parameters
import sys
# prints out full path to the application and its name
print(f"Application name: {sys.argv[0]} ")
print(f"First argument: {sys.argv[1]} ")  # prints out hello
print(f"Second argument: {sys.argv[2]}")  # prints out world!
```

Command line parameters

We can also provide command line parameters using PyCharm.

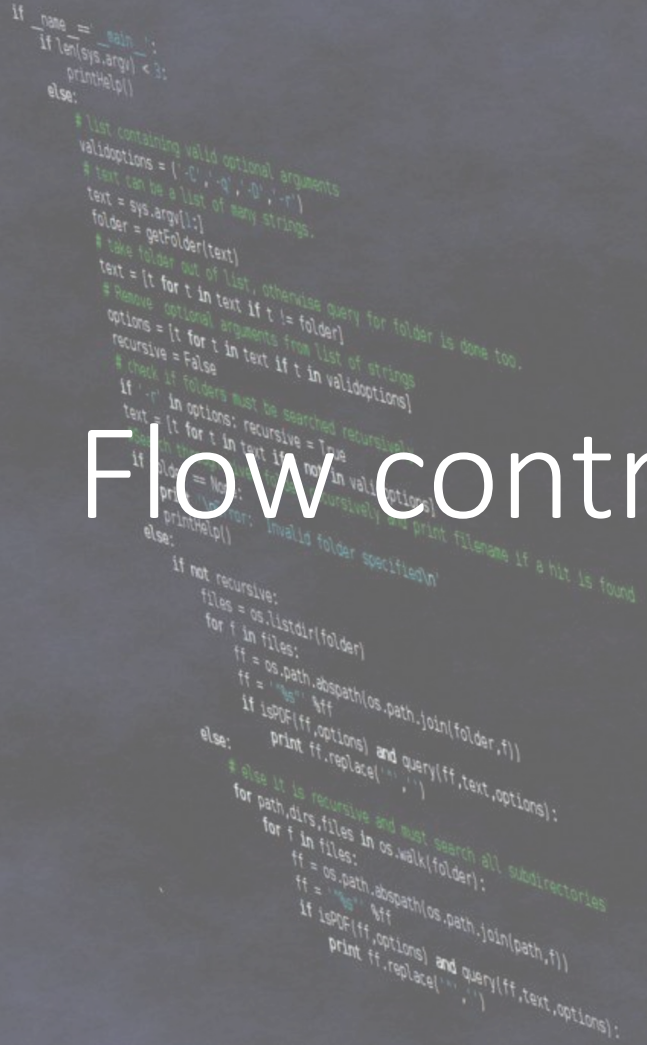
To do so we must:

1. click ‘Edit Configurations…’ button in the upper right side of PyCharm,
2. provide the parameters in appropriate input field,
3. click ‘Apply’,
4. run the program.

Ülesanne

1. In folder 08-user-input create file command-line-parameters-exercise-01.py.
2. Write the same application as in the previous exercise (input-exercise-01.py), this time using command line parameters instead of input() function.
3. In folder 08-user-input create file command-line-parameters-exercise-02.py.
4. Write the same application as in the previous exercise (input-exercise-02.py), this time using command line parameters instead of input() function.

Flow control



Flow control

Python supports statements that alter the top to bottom execution of the script.

They are grouped into two groups: **conditional statements** (if, elif, else) and **loops** (while loop, for loop, break and continue statements).

Conditional statements

In the real world, we commonly must evaluate information around us and then choose one course of action or another based on what we observe.

If the weather is nice, then I'll mow the lawn.

In a Python program, the **if statement** is how you perform this sort of decision-making. **It allows for conditional execution of a statement or group of statements based on the value of an expression**.

The if statement

The most basic form of the if statement in its simplest form.

```
if <expr>:
    <statement>
```

<expr> is an expression evaluated in **Boolean** context, <statement> is a valid Python statement, which must be indented. If <expr> is **true** (evaluates to a value that is **True**), then <statement> is executed. If <expr> is **false**, then <statement> is skipped over and not executed.

The if statement

```
x = 0
y = 3

if x > y:  # evaluates to false, message is not displayed
    print(f"{x} is greater than {y}")
if x < y:  # evaluates to true, message is displayed
    print(f"{x} is lesser than {y}")
```

Indentation

Python is all about the indentation. To execute more than one statement in an if block, all statements must be indented accordingly.

Indentation is used to define compound statements or blocks. In a Python program, contiguous statements that are indented to the same level are considered to be part of the same block.

```
if <expr>:
        <statement>
        <statement>
        …
        <statement>
<following_statement>
```

The else clause

We already know how to use an if statement to conditionally execute a single statement or a block of several statements. But what if we want to evaluate a condition and **take one path if it is true** but specify **an alternative path if it is false**.

This is accomplished with an **else** clause.

```
if <expr>:
    <statement(s)>
else:
    <statement(s)>
```

The else clause

```
x = 0
y = 3

if x > y:  # evaluates to false, message is not displayed
    print(f"{x} is greater than {y}")
else:  # is executed when if statement evaluates to false, message is displayed
    print(f"{x} is lesser than {y}")
```

The elif clause

There is also syntax for branching execution based on several alternatives. For this, use **one or more elif** (short for else if) clauses.

Python evaluates each <expr> in turn and **executes the suite corresponding to the first that is true**. If none of the expressions are true, and an else clause is specified, then its suite is executed.

```
if <expr>:
    <statement(s)>
elif <expr>:
    <statement(s)>
elif <expr>:
    <statement(s)>
    ...
else:
<statement(s)>
```

The elif clause

An arbitrary number of elif clauses can be specified. The **else clause is optional**. If it is present, there can be only one, and it must be specified last.

At most, one of the code blocks specified will be executed. If an else clause isn't included, and all the conditions are false, then none of the blocks will be executed.

```
if <expr>:
    <statement(s)>
elif <expr>:
    <statement(s)>
elif <expr>:
    <statement(s)>
    ...
else:
<statement(s)>
```

The else clause

```
x = 0
y = 3

if x > y:  # evaluates to false, message is not displayed
    print(f"{x} is greater than {y}")
elif x == 3: # evaluates to false, message is not displayed
    print(f"{x} is equal to {y}")
else: # is executed when none of the if/elif statement evaluates to true, message is displayed
    print(f"{x} is lesser than {y}")
```

Ülesanne

1. In PyCharm, create folder 09-flow-control.
2. Inside that folder, create file if-statement-exercise.py.
3. Write an application that:

a. Asks user for a number from 1 to 7.

b. If the number provided by user is smaller than 1, prints out “There are no negative number days!”.

c. For input number 1, prints out “You chose Monday”.

d. If the number provided by user is greater than 7, prints out “There are only 7 days in a week!”.

Loops

To iterate means to execute the same block of code over and over. A programming structure that implements iteration is called a **loop**.

With indefinite iteration, the number of times the loop is executed isn't specified explicitly in advance. Rather, the designated block is executed repeatedly as long as some condition is met.

With **definite iteration**, the number of times the designated block will be executed is specified explicitly at the time the loop starts.

The while loop

When a **while loop** is encountered, <expr> is first evaluated in Boolean context. If it is true, the loop body is executed. Then <expr> is checked again, and if still true, the body is executed again.

This continues until <expr> becomes false, at which point program execution proceeds to the first statement beyond the loop body.

while <expr>:

    <statement(s)>

The while loop

This program prints out 1, 2, 3, 4, 5 each in new line.

```
# Execute while body block as long as n < 5
n = 0
while n < 5:
  n += 1  # increment n with each loop execution
print(n)
```

Loop termination

Python provides two keywords that terminate a loop iteration prematurely.

The **break** statement immediately **terminates a loop entirely**. Program execution proceeds to the first statement following the loop body.

The **continue** statement immediately **terminates the current loop iteration**. Execution jumps to the top of the loop, and the controlling expression is re-evaluated to determine whether the loop will execute again or terminate.

The while loop

This program will print out 2 and 3 each in new line.

```
# Execute while body block as long as n < 5
n = 0
while n < 5:
    n += 1  # increment n with each loop execution
    if n == 4:  # if n is 4 then exit the loop
        break
    if n == 1:  # if n is 1 then start next iteration
        continue
    print(n)
```

The else statement in while loop

Python allows an optional **else** clause at the end of a **while** loop. When <additional_statement(s)> are placed in an **else** clause, they will be executed only if the loop terminates “by exhaustion”. That is, if the loop iterates until the controlling condition becomes false. If the loop is exited by a **break** statement, the **else** clause won’t be executed.

```
while <expr>:
    <statement(s)>
else:
    <additional_statement(s)>
```

The else statement in while loop

```
# Execute while body block as long as n < 5


n = 0
while n < 5:
    n += 1  # increment n with each loop execution
    print(n)
else:
    print("Done.")  # print out Done. only when while loop condition is exhausted
```

Ülesanne

1. In folder 09-flow-control create file while-loop-exercise.py.
2. Write an application that:
    a. Asks user for an input in a loop and prints it out.
    b. If the input is equal to “exit”, program terminates printing out provided input and “Done.”.
    c. If the input is equal to “exit-no-print”, program terminates without printing out anything.
    d. If the input is equal to “no-print”, program moves to next loop iteration without printing anything.
    e. If the input is different than “exit”, “exit-no-print” and “no-print”, program repeats.

The for loop

<iterable> is a collection of objects - a list for instance. The <statement(s)> in the loop body are denoted by indentation, as are all Python control structures.

The loop body is **executed once for each item** in <iterable>. The loop variable <var> takes on the value of the next element in <iterable>.

```
for <var> in <iterable>:
    <statement(s)>
```

The for loop

Printing out all elements of a collection is really that simple.

```
animals = ["Dog", "Cat", "Fish"]
# Print out all animals in the list
for animal in animals:
    print(animal)  # prints out a single animal
```

The for loop

The **break** and **continue** statements as well as **else** statement are fully supported in the **for** loop just like they are in the **while** loop.

The range() function

Very often, we would like to execute a loop given amount of times. We could create a simple list of numbers and iterate over it.

```
for i in (1, 2, 3).
```

But what if we wanted to do it way more times?

That is where the range() function comes in handy.

The range() function

The range() function returns an iterable that contains integers starting with **start**, up to but not including **end**.

If specified, **step** indicates an amount to skip between values - just like the step value used for string and list slicing.

range(start, stop, step)

The range() function

```
# Print 0, 1, 2
for i in range(3):
    print(i)
```

```
# Print 0, 3, 5, 7, 9
for i in range(3, 11, 2):
    print(i)
```

```
# Print -3, -2, -1, 0
for i in range(-3, 1):
    print(i)
```

```
# Print -1, -2, -3
for i in range(-1, -4, -1):
    print(i)
```

Ülesanne

1. In folder 09-flow-control create file for-loop-exercise.py.
2. Write an application that prints a sum of all even numbers between 2020 and 3030.

Introduction to functions

What are functions?

Functions are a convenient way to divide our code into useful blocks, allowing us to order our code, make it more readable, reuse it and save some time.

Functions are used to extract pieces of code that should be reused, potentially with different arguments thus generating different outcome.

Functions must be declared before piece of code that is calling them.

Functions

Functions in python are defined using the **def** keyword, followed with the function's name and zero or more parameters in parentheses.

```
# Define function print_hello_world()
def print_hello_world():
    print("Hello world from function!")

# Call function print_hello_world()
print_hello_world()
```

Functions

Function parameters should be placed inside parentheses, so that the function can operate on them.

```
# Define function greet_by_name(name)
def greet_by_name(name):
    print(f"Hello, {name}")

# Call function greet_by_name(name) passing "John" as name
greet_by_name("John")
```

Function parameters

Function parameters can be:

- mandatory,
- optional (keyword parameters).

Arguments to mandatory parameters are usually passed without naming them.
Arguments to optional parameters are usually named in function call.

Optional parameters must always be defined after mandatory parameters.

Function parameters

Parameters in functions can be assigned default values, which can be overwritten by passing values in function call statement.

```
# Define function greet_by_name(name) with default argument value
def greet_by_name(name="World!"):
    print(f"Hello, {name}")

# Call function greet_by_name(name) using default value of the argument
greet_by_name()  # prints 'Hello, World!’
# Call function greet_by_name(name) passing "John" as name
greet_by_name("John")  # prints 'Hello, John'
greet_by_name(name="John")  # prints 'Hello, John'
```

Functions

Functions in python can return a value using the **return** keyword. Functions that don't explicitly use the return keyword also **return** value equal to **None**.

```
# Define function calculating volume of the cube
def calculate_volume_of_the_cube(wall_length):
    return wall_length ** 3

volume = calculate_volume_of_the_cube(6)
print(volume)  # prints 216
```

Ülesanne

1. In PyCharm, create folder 10-functions.
2. Inside that folder, create file functions-exercise-01.py.
3. Write a function maÿ_of_three(a, b, c) which returns the biggest of the three numbers.

Ülesanne

1. In folder 10-functions, create file functions-exercise-02.py.
2. Write a function print_rectangle which prints out a rectangle made of character and wall size defined by user.
3. Make the character parameter optional with default value ‘#’.
4. Make the wall size parameter mandatory.
5. For wall_size = 3 the output should be:

```
###
###
###
```

Object-oriented programming

Object-oriented paradigm

Object-oriented paradigm is based on the concept of objects. Those objects contain fields representing their **state** (**variables**) and **methods** (**object-specific functions**) that are able to read and modify the state.

Object-oriented programming is based on the idea of defining such objects and their interactions to simplify complex problems, separate responsibilities, parallelize code execution and more.

Class and object

Class is essentially a template defining the object by specifying fields (variables), methods (functions) and default state. Think of the class as of a definition or a blueprint for creating an object.

Object is a result of creating an instance of a class. There can be infinite number of objects of a particular class. Objects get their variables and functions from classes.

Class

Class is defined using the **class** keyword followed by desired class name. Then with appropriate indentation, class variables can be defined. The __init__(self) function is called when an object of a class is being instantiated (created) and then initialized. The self parameter is required in every **class** function so that it can refer to itself.

```
class Animal:
    name = ""  # class variable
    age = 0       # class variable

    def __init__(self):  # special method used for instantiation - that is object creation
        self.name = "Jenna"  # setting default name when creating the object
        self.age = 2  # setting default age when creating the object

    def print_details(self):  # class method printing state of the instance
        print(f"Name: {self.name}, age: {self.age}")
```

Object

Once the class is defined, its instances (objects) can be instantiated (created), initialized and assigned to a variable. This is done by calling the __init__(self) function (**my_dog = Animal()**). Once the object of the class is created, we can use it just like we used other objects (for example string) before.

To access object's variables or call functions, we must refer to their names my_dog.age = 3 or my_dog.print_details()

```
class Animal:
    …
my_dog = Animal()
my_dog.print_details()  # call function on particular object (my_dog)
print(my_dog.name)  # access particular object's field variable (my_dog)
my_dog.age = 3  # change particular object's field value (my_dog)
```

Object

Each of the instances (objects) of a class has its own state. Changing the state in one object does not change it in other.

```
class Animal:
    ...
my_puppy = Animal()  # create my_puppy instance of Animal
my_older_dog = Animal()  # create my_older_dog instance of Animal
my_puppy.age = 1
my_puppy.name = "Rex Junior"
my_older_dog.age = 10
my_older_dog.name = "Rex Senior"
# prints out ‘My puppy: Rex Junior, 1 and my older dog: Rex Senior, 10'
print(f"My puppy: {my_puppy.name}, {my_puppy.age} and my older dog: {my_older_dog.name},
{my_older_dog.age}")
```

The __init__() function

Setting a default object's state is not always desired. When we were creating our animals, we had to create the object and set the name and age. However, we can extend the __init__(self) function with optional parameters. This way we have default values that can be overwritten!

```
def __init__(self, name="Jenna", age=2):
    self.name = name  # setting name when creating the object
    self.age = age  # setting age when creating the object
```

Ülesanne

1. In PyCharm, create folder 11-oop.
2. Inside that folder, create file oop-exercise-01.py.
3. Create Vehicle class with fields: name, type, color and value and methods: description() that returns a string describing the vehicle.
4. The Vehicle class initialization method should require name and price parameters and have default values for type and color.
5. Create vehicles list.
6. Write a loop that asks user 3 times for input regarding vehicle creation. With each loop iteration user should provide name and price and should be asked if he wants to provide type and color. If the user responds yes, he should be asked for the type and color. Once the input is collected, create new vehicle based on the input and add it to the vehicles list.
7. In a loop, print details of each car in the cars list.

Public vs. private

In our Animal class, we were able to access the age field and set any value we wanted.

Imagine, that other people will use our Animal class, and some of them will try to put in negative number in that property. This should not be possible.

Private variable

In Python world, attributes prefixed with a single underscore character are treated as internal class variables that should not be touched by people using particular class. However, this is only a convention and the field is still accessible.

```
class Animal:
    _name = ""  # private class variable, still accessible
    _age = 0  # private class variable, still accessible
    …

my_dog = Animal()
print(my_dog._name)  # prints out the variable without issues
print(my_dog._age)  # prints out the variable without issues
```

Mangled variable

To introduce a real private field that is not directly accessible, we must use double underscore.

Such variable is called a mangled variable.

```
class Animal:
    __name = ""  # mangled class variable, inaccessible
    __age = 0  # mangled class variable, inaccessible
    …

my_dog = Animal()
print(my_dog.__name)  # throws and error
print(my_dog.__age)  # throws an error
```

Mangled variable

Once the mangled variable is introduced, we are certain that nobody will change the animal's age to a negative number, simply because they can't change anything now.

This is quite troubling, because we want to allow users to change the age of their animals to correct values.

To remedy the problem we can create methods in Animal class that will access the mangled variables and return them for printing purposes.

Mangled variable

```
class Animal:
    __name = ""  # mangled class variable, inaccessible
    __age = 0  # mangled class variable, inaccessible
    ...
    def set_age(self, age):
        if age > 0:
            self.__age = age
        else:
            print("Age must be greater than 0.")
    def get_age(self):
        return self.__age


my_dog = Animal()
my_dog.set_age(3)  # sets the age
print(my_dog.get_age())  # gets the age
```

Properties

Calling functions to set or get a variable value is not really the Pythonic way of dealing with things. That is where the **properties** come with the rescue.

Properties are class' special attributes and are used to truly encapsulate class' fields.

A **property** can have a **getter**, **setter** and **deleter** method. Property's methods share its name and are distinguished by the operator.

Properties

```
class Animal:
    ...
    @property  # getter
    def age(self):
        return self.__age
    @age.setter  # setter
    def age(self, age):
        if age > 0:
            self.__age = age
        else:
            print("Age must be greater than 0.")
    @age.deleter  # deleter
    def age(self):
        del self.__age
```

```
my_dog = Animal()
my_dog.age = 3  # sets the age
print(my_dog.age)  # gets the age
```

Property method names must be the same for all three actions (get, set and delete) and the **method name becomes the property name** when accessing the property.

Ülesanne

1. In folder 11-oop, create file oop-exercise-02.py.
2. Create User class with name and password fields.
3. The name field should be accessible and the password field should be mangled and accessed through a property.
4. The initialization method should accept only the name field.
5. The password's setter should check if the password is at least 6 characters long, if it is less then it should extend the provided value to 6 characters by adding appropriate number of "#" characters ('ab' -> 'ab####'). If the password is 6 or more characters long then it should not modify it.
6. The getter should return the password in an encrypted format, that is replacing all letters except first and last with the "*" character ('password' -> 'p******d').
7. The deleter should delete the password.

Value and reference

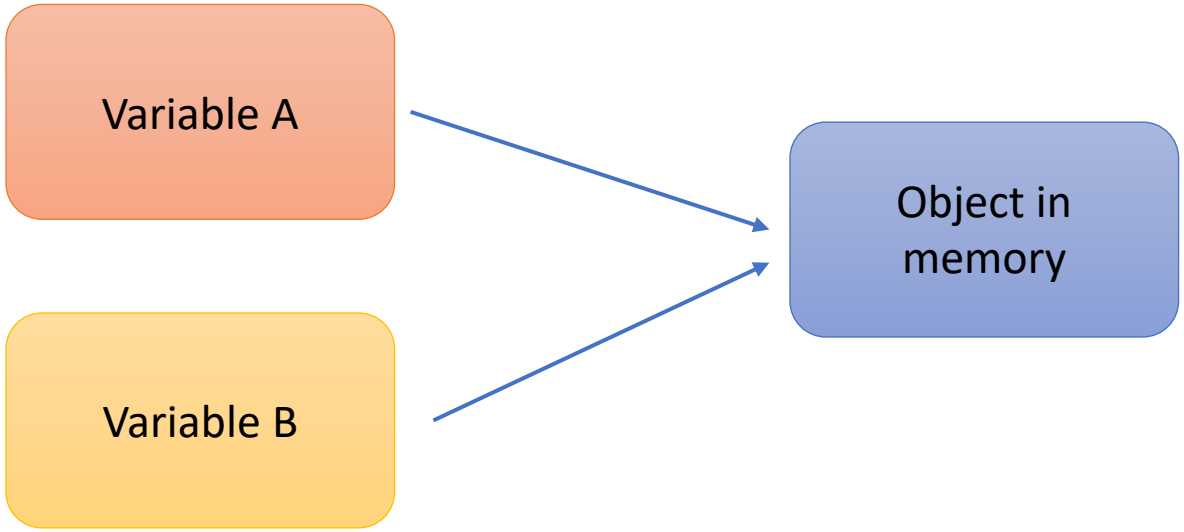
When we assign an object to a variable name, we create a **binding between them called reference**.

When we assign a new object to an existing name, the existing binding disappears and a new binding is created.

Multiple names can be bound to one object. We can call and modify the object using any of the bindings.

Value and reference

We can change state of the object using one variable and the change is reflected in all other variables, because it is the object itself that was changed and variables are just references to that object.



Value and reference

By changing object state using one reference (dog_a), the changes are present in the other reference (dog_b).

```
class Animal:
    ...

dog_a = Animal()
dog_b = dog_a
print(dog_a.name) # prints out 'Jenna'
print(dog_b.name) # prints out 'Jenna'
dog_a.name = "Changed value!"
print(dog_a.name) # prints out 'Changed value!'
print(dog_b.name) # prints out 'Changed value!'
```

File operations

File operations

To open a file in Python we must use the open() function, it returns a **file object**. File objects contain methods and attributes that can be used to collect information about the file and manipulate it.

The name attribute tells us the name of the file that the file object has opened.

We must understand that a **file** and **file object** are two wholly separate, yet related things.

File modes

Files have special modes that describe how a file will be used:

- ”r” - read mode (default),
- “w” - write mode,
- “x” - exclusive creation, fails if the file already exists,
- “a” - open for writing, appending to the end of file (if file exists),
- “b” - binary mode,
- “t” - text mode (default),
- “+” - open file for updating (reading/writing).

Reading a file

To read a file we must use the open() function passing path to the file we want to open as parameter. We can then iterate every line of the file using the enumerate() function passing file object as parameter. It is advised to remove end of line character in every line with .rstrip() function before printing it out.

```
with open("data/example.txt") as f:  # f is a file object
    for i, line in enumerate(f):  # iterate every line of the file
        if i == 0:  # skip first line
            continue
        clean_line = line.rstrip()  # remove "\n" - end of line character at the end of each line
        if clean_line == "":  # skip empty lines
            continue
        print(clean_line)
# f.close() is called automatically when code exits "with open()" block
```

Writing to a file

To write to a file we must use the open() function passing path to the file we want to open as parameter. We can then write lines to the file using the write() function passing desired text to be written. We must explicitly specify end of line character if we want to write new lines with each loop iteration.

```
with open("data/sample.txt", "w+") as f:  # open file in write mode
    for i in range(10):
        f.write(f"This is line number {i}\n")  # write to file, adding new line with each iteration
```

Ülesanne

1. In PyCharm, create folder 12-file-operations.
2. Inside that folder, create file file-operations-exercise.py.
3. Write an application that will count how many times a word has occurred in the file and will calculate total words in the file and save the results to a new file.
4. Be careful not to count a word and a non word character such as a comma as one word (e.g. “Hello, World!” should count 2 words total, one “Hello” and one “World”).
5. Be careful not to be case sensitive (e.g. “Hello hello” should count 2 words total, two “Hello”).

The end