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Python in practice

Lesson 2: Variables, operators

Semester 2021/22/2

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Subject matter

1. Introduction
2. Variables, operators
3. Sequence, selection, iteration
4. Programming theses
5. Strings
6. Regular expressions
7. Files
8. Object-oriented programming
9. Multithread applications
10. GUI with tkinter
11. Communications
12. SQL basics
13. SQL queries
14. Example application

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Python in practice

Literals & expressions

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Literals

- Constant `values`
- Same for each program run
- Possibility to change only after writing to storage

- Data in memory:
  - Represented by a discrete value that is a number
    - Any type of data ↔ number
  - Complex data is made up of several elementary data
    - Complex data ↔ multiple numbers

- Data types:
  - Elementary: *Numbers, Characters*
  - Complex: *Strings*
  - `None`

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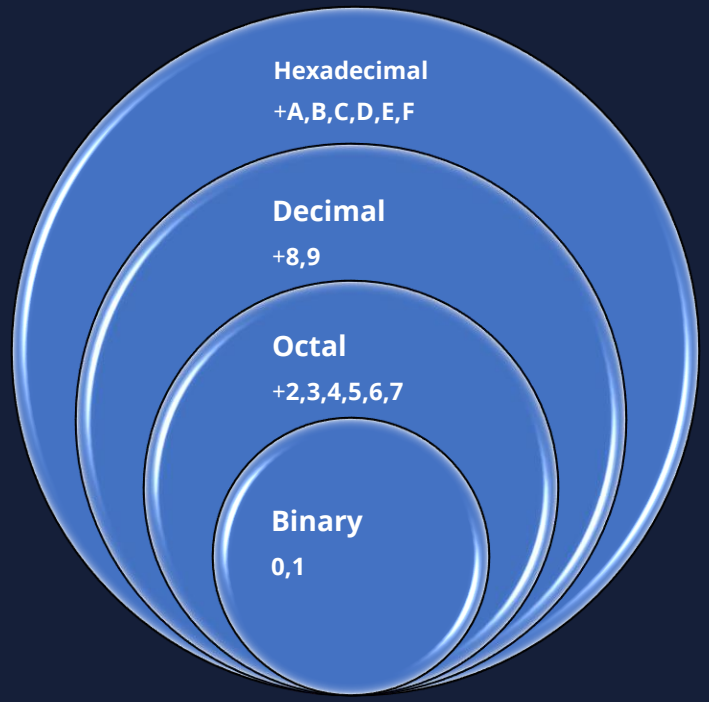
Numbers

- The easiest way to represent data in source code is to enter them as numbers.

- Integers
  - Decimal: `1, 2, 3`
  - Binary: `0b10110`
  - Octal: `0o127`
  - Hexadecimal: `0x1F`

Number system name	Radix	Allowed symbols for representation	Description
Decimal	10	0, 1, 2, 3, 4, 5, 6, 7, 8, 9	Everyday use
Binary	2	0, 1	Used by computers
Octal	8	0, 1, 2, 3, 4, 5, 6, 7	Permissions on UNIX systems
Hexadecimal	16	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F	Used during programming to display numbers > 9



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Numbers

- Floating point: 0.1
  - Suitable for displaying fractional numbers
  - Approximation ❗❗
    - The fraction is composed solely of the sum of the negative powers of the two.

$$fraction = \sum_{n=1}^{\infty} (2^{-n} \cdot digit)$$

    - So, this means you can't use it later to check if it's equal to a decimal number
  - https://www.h-schmidt.net/FloatConverter/IEEE754.html
  - https://docs.python.org/3/tutorial/floatingpoint.html
  - The `float.as_integer_ratio()` method expresses the value of a float as a fraction.

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Characters

- A character is a symbol (such as a letter or number) that represents information.
- ASCII (American Standard Code for Information Interchange)
  - 7-bit wide codes ($\log_2 8 + \log_2 16 = 7$)
  - 2 group:
    - Control characters
    - Printable characters

ASCII Code Chart

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HT	LF	VT	FF	CR	SO	SI
1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
2		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	DEL

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Characters

- Character literals: `‘a’, ‘Z’, ‘0’, ‘.’, ‘\n’, ‘\ufe0f’`
  - Escape character ‘\’ with one following letter is used to identify the control characters (ASCII 0..31 or 0x00..0x1F)
  - Escape character with letter U ‘\uNNNN’ identify a character from the Unicode table
  - ASCII represented by 1 byte (only 7 bits used); Unicode represented with 2 bytes (max value is 0x10FFFF)

ASCII Code Chart

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HT	LF	VT	FF	CR	SO	SI
1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
2		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	DEL

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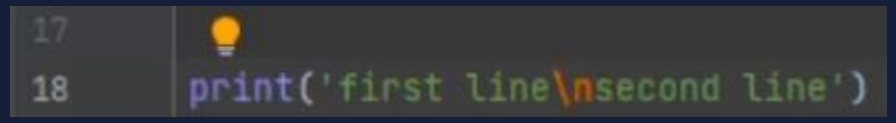
Other literals

- „Texts” → `Strings`
  - Complex data, which is made up of a sequence of characters
  - Multiple data stored in memory in the correct order



- `None`
  - Represent the emptiness or nothing
  - Existing object at the start of the program
  - NULL has the same purpose but works slightly differently in other languages
    - Not to be confused with the number 0 and the character ‘0’ ‼️

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Expressions

- Expressions are built from operands and operators
  - `Operand`: is a value
  - `Operator`: is a symbol, used to identify a mathematical operation what should be performed with the operand(s)
  - example: `5 + 6`, where 5 and 6 are operands, + is the operator
- Replacement value:
  - calculated while the program is running
  - `5 + 6` will be replaced with the literal `11`.
- Use of constants:
  - e; π
- Mathematical functions:
  - $y = \sin(x)$

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Expressions

- Characters ↔ numbers
  - ASCII or Unicode identifier
  - Mathematical expressions with characters
    - It can be used to
      a) Counting with letters
      b) Case change without resource-intensive correspondence tables
      c) To filter user input

- https://docs.python.org/3/reference/expressions.html

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Operator precedence

Operator	Description
(expressions...), [expressions...], {key: value...}, {expressions...}	Binding or parenthesized expression, list display, dictionary display, set display
x[index], x[index:index], x(arguments...), x.attribute	Subscription, slicing, call, attribute reference
await x	Await expression
**	Exponentiation
+x, -x, ~x	Positive, negative, bitwise NOT
*, @, /, //, %	Multiplication, matrix multiplication, division, floor division, remainder
+, -	Addition and subtraction
<<, >>	Shifts
&	Bitwise AND
^	Bitwise XOR
|	Bitwise OR
in, not in, is, is not, <, <=, >, >=, !=, ==	Comparisons, including membership tests and identity tests
not x	Boolean NOT
and	Boolean AND
or	Boolean OR
if – else	Conditional expression
lambda	Lambda expression
:=	Assignment expression

First

Last

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Python in practice

Variables & arrays

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Variables

- Store expression result
- Variables are storage for values
- Content of the storage can be used later
- Can be read at several different times, will not be deleted after use
- Can be used in other expressions

```
29  a = 5               # Let the variable a value become 5.
30  b = 6               # Let the variable b value become 6.
31  c = a + b           # Let the variable c value is the addition of a and b variables result.
32
33  x = 0.5             # Let the variable x value become 0.5 (half).
34  y = math.sin(x)     # Let the variable y value become the result of
35                      # the substitution value of the sine function for x.
```

- To store a value the = operator is used.

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Arrays

- Multiple instances of the same datatype
- As a literal: `[1, 4, 5, 4, 5, 2, 2, 5]`
- Assigned to a variable:

```
assignment_results = [1, 4, 5, 4, 5, 2, 2, 5]
```

- Index: identifies the position of an element in an array
- Counted from `0` ‼️
- Pick one element from an array:

```
x = assignment_results[2]
assignment_results[2] = 6
```

- A variable can also be used for indexing:

```
student_id = 2
assignment_results[student_id]
```

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Arrays

- Strings are arrays too.
- "Hello world" is an array of 11 chars.
  - Is not equal to ['H', 'e', 'l', 'l', 'o', ' ', 'W', 'o', 'r', 'l', 'd'], because the interpreter immediately converts it to a list

```
37  string_1 = ['H', 'e', 'l', 'l', 'o', ' ', 'W', 'o', 'r', 'l', 'd']
38  print(string_1)
39
40  string_2 = 'Hello world'
41  print(string_2)
42
43  print(string_1[3])
44  print(string_2[3])
45
46  # sys.stdout.write(string_1)
47  sys.stdout.write(string_2)
```