Python

CS*101* `lec01`

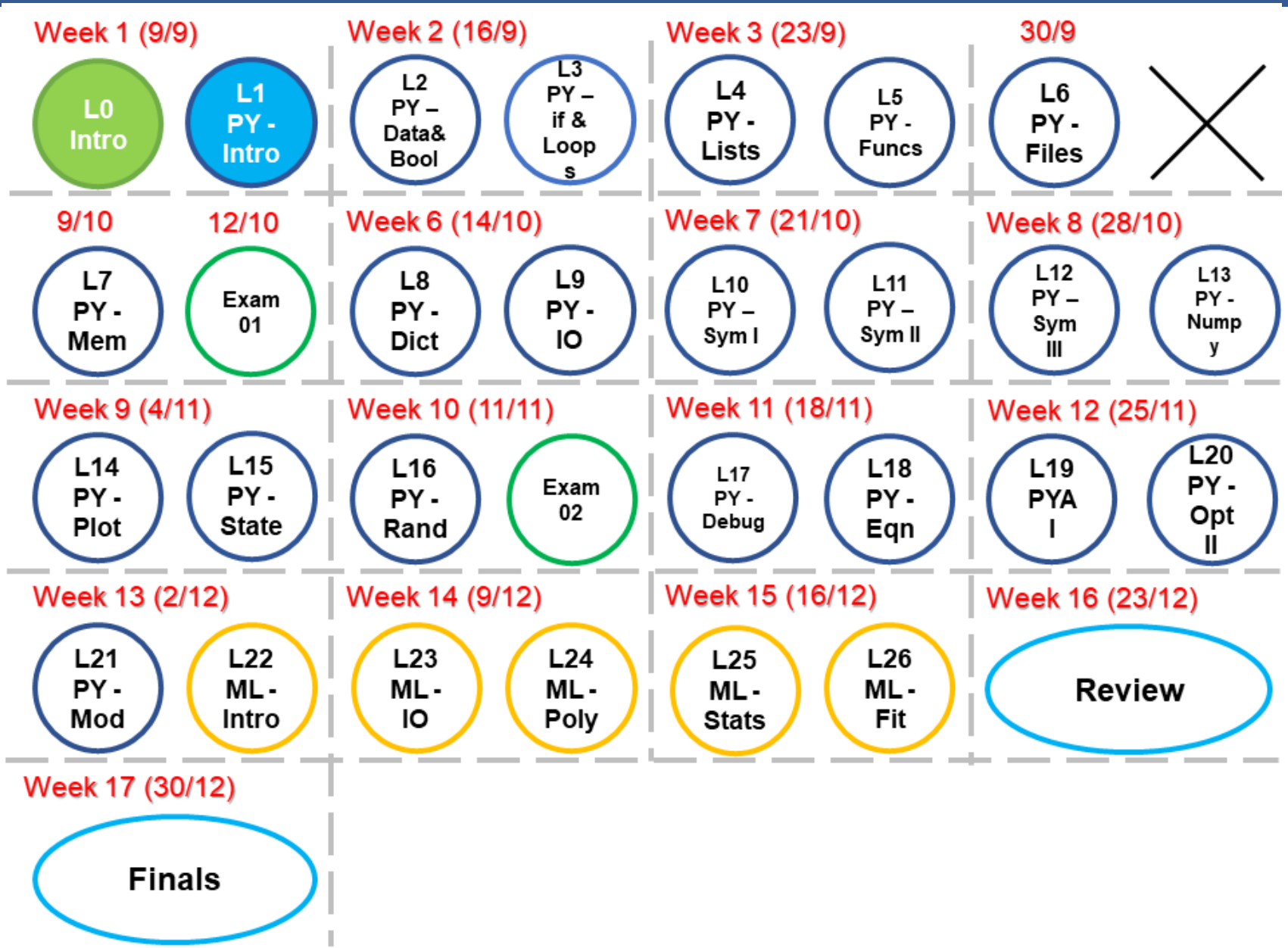
Introduction to Python

2019-09-11

Announcements

- Have you signed up in RELATE yet?
  https://relate.intl.zju.edu.cn/course/2019Fall-CS101/
- `quiz00` *due today and* `quiz01` *due tomrrow*

Roadmap


Week 1 (9/9)
L0 Intro
L1 PY - Intro
Week 2 (16/9)
L2 PY – Data& Bool
L3 PY – if & Loop s
Week 3 (23/9)
L4 PY - Lists
L5 PY - Funcs
30/9
L6 PY - Files
9/10
L7 PY - Mem
12/10
Exam 01
Week 6 (14/10)
L8 PY - Dict
L9 PY - IO
Week 7 (21/10)
L10 PY – Sym I
L11 PY – Sym II
Week 8 (28/10)
L12 PY – Sym III
L13 PY - Numpy
Week 9 (4/11)
L14 PY - Plot
L15 PY - State
Week 10 (11/11)
L16 PY - Rand
Exam 02
Week 11 (18/11)
L17 PY - Debug
L18 PY - Eqn
Week 12 (25/11)
L19 PYA I
L20 PY - Opt II
Week 13 (2/12)
L21 PY - Mod
L22 ML - Intro
Week 14 (9/12)
L23 ML - IO
L24 ML - Poly
Week 15 (16/12)
L25 ML - Stats
L26 ML - Fit
Week 16 (23/12)
Review
Week 17 (30/12)
Finals

Review

Question

Nothing to review! Yeh!

Objectives

1. Compose expressions and statements using Python syntax.
2. Identify and correct simple errors in mathematical expressions.
3. Annotate short programs in Python with comments. container.
4. Use Python or IPython (e.g., Jupyter)

Program

What is a program?

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- A set of instructions a computer executes to achieve a goal.

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- For us, “programming” = “computing” = “coding”.

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  - 00011101 (or simply 11101) = ?
    - 29

$$29_{10} = 11101_2 = 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

1×2^4 1×2^3 1×2^2 0×2^1 1×2^0

What is data?

- Information stored in a computer.
- Bit, Byte, Word

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- Bit, Byte, Word
- All data is stored in binary.

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```
-------- --- --- -------- ---------
00000001 00101010 01000000 00100000
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- So to a computer, a program is just data!
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         add $t0, $t1, $t2
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add $t0, $t1, $t2
=B5+B6
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```

- High-level languages express things more like humans.
- Low-level languages are “closer to the metal (CTM)”.

Elements of Programs

A simple program

DEG F	11
DEG C	(DEG F -32)*5/9
TEST: 100 C =	212 F

Syntax

```
F = 212                 # deg F
C = (F-32) * 5/9        # deg C
print( F,' deg F is ',C,' deg C.' )
assert C == 100
```

212 deg F is 100 deg c

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  - Define own functions
  - Loops
  - Logics
  - Input
  - ...

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A simple program

Initialize variables

Function block: Using operators

```
F = 212                # deg F
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assert C == 100
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Output

A simple program

```
F = 212                # deg F
C = (F-32) * 5/9       # deg C
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```

1. Note the structure here.
2. Structure—syntax—is fixed!
3. Syntax is how to write a program, like spelling and grammar.

A simple program

```
Writing a simple Python program is like
writing an English essay. There are very
precise rules for grammar and spelling. The
hardest part is learning how to translate
one's thoughts into this precise mode of
expression.
```

Syntax

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Several elements of Python syntax in this program:

Syntax

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F = 212                 # deg F
C = (F-32) * 5/9        # deg C
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```

Several elements of Python syntax in this program:

1. `literals` - Numbers and the text strings (blue and red)
2. `keywords` - Commands or structural indicators
3. `names` - variables or functions like *print* and *C*
4. `operators` - like + and = calculate values
5. `comments` - # anything here is not interpreted by the machine

What is a literal?

- Fixed value (noun)
- Represents data that doesn't change (`3` or `'firefly'`)

What is an operator?

- Manipulates data (verb)
- + - * **

What is an expression?

- Combines literals and operators (phrase)

What is an expression?

- Combines literals and operators (phrase)
- Produce a new value
  - `3 * 5`
  - `100 - 23`

What is an expression?

- Can be arbitrarily complicated
  - `3 + 8*5 + 4 - 7/100`

Question

$\texttt{1} + \texttt{1} * \texttt{2} \stackrel{?}{=}$

a) 4

b) 3

c) Something else

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$\texttt{1} + \texttt{1} * \texttt{2} \stackrel{?}{=}$

a) 4

b) 3 $\star\star$`Order of operations`

c) Something else

Question

$23 + 6/2 - 4 \stackrel{?}{=}$

a) 22

b) 18

c) -9

d) None of these are correct.

Question

$\texttt{23} + \texttt{6}/\texttt{2} - \texttt{4} \stackrel{?}{=}$

a) 22 ⋆⋆`Again, ooooo....`

b) 18

c) -9

d) None of these are correct.

Use parentheses!

$23 + (6/2) - 4$ is always clearer.

What are some other operators?

- exponentiation, `**`

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- exponentiation, `**`
- modulus, `%` (gives the remainder)
- floor division, `//`

More operators? (Optional)

- bitwise `OR`, `|`
- bitwise `XOR`, `^`
- bitwise `AND`, `&`
- bitwise left shift, `<<`
- bitwise right shift, `>>`

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- bitwise `OR`, `|`
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- bitwise left shift, `<<`
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- You don't need to know these, but—

Example (Optional)

`1 ^ 2` $\stackrel{?}{=}$

a) 0

b) 1

c) 2

d) 3

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`1 ^ 2` $\stackrel{?}{=}$

a) 0

b) 1

c) 2

d) 3 $\star$! `XOR`, NOT exponentiation!

Expression... so what?

$23 + (6/2) - 4$

- An expression does not change the machine state.

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$23 + (6/2) - 4$

- An expression does not change the machine state.
- Programs are complex, and we need to remember results for later use.

How do we reuse values?

- Low-level languages refer directly to memory address:

```
ADD DATA AT        10101101 11010100
TO DATA AT         11010100 01001001
STORE RESULT AT    00001101 01001110
```

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- This value can change over time — it is a placeholder.

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- To store a value, we need...

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- To store a value, we need...
- assignment, = (single equals sign)

Example

What value is stored in the variable `x`?

```
x = 17 + 7*9
```

a) 3
b) 31
c) 80
d) 216

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x = 3
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a) 0
b) 1
c) 2
d) 3 ⋆

What is a statement?

- A statement changes the state of the computer (sentence)

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- A statement changes the state of the computer (sentence)
- Example: an assignment
- `x = 17 + 7*9`

A first program

```
x = 10
y = x ** 2
y = y + y
```

What is a comment?

- A comment is ignored by the interpreter

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- Example: `# anything after a hash`
- So why do we need a comment ???

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- Shown with bold or coloured type.
- Example: `for`, `in`, `assert`

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  - Py2 vs Py3. `print` needs parentheses!
  - Use Py3 !!!

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- Write code in one of three ways:
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  - Jupyter (IPython) notebook (as in labs)

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- Each statement is executed normally in order from top to bottom.
- A `statement` contains `Literal, operators, expressions`, and `keywords`.
- Remember to include your `comments`