Programming with Python

Vedran Šego <vsego@vsego.org>

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MANCHESTER 1824
The University of Manchester

M\crNA
Manchester Numerical Analysis

Outline

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Who? What? Where?

- Name: Vedran Šego
- Office: 1.218
- E-mail: vsego@vsego.org
  Please use:
  - only plain text (no HTML nor non-standard characters),
  - clear, informative subjects.
- Office hours: Friday, 12:00–13:00
- The course website:
  http://vsego.org/math20622 or http://vsego.org/python

Outline

Where can I use any of this?

While we shall cover none of these topic, you should become able to "dig out" on your own how to tackle the problems in:

1. Matrix Analysis (MATH36001) – SciPy and NumPy modules;
2. Combinatorics and Graph Theory (MATH39001) – modules `math`, `itertools`, `combinatorics`, `pyncomb`, `qombinatorics`, `networkx`, built-in lists and dictionaries (see here);
3. Mathematical Biology (MATH35032) – `SciPy` module for ODEs, `PyMOOSE` module, built-in lists and dictionaries;
4. Problem Solving by Computer (MATH36032) – Python and MATLAB are quite similar (and somewhat a competition);
5. Mathematical Programming (MATH39012) – modules `PyLPSolve`, `CVXOpt`, `PyGLPK`, `PyMathProg`.

And these are just some of the 3rd year undergraduate courses.

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Our language of choice: Python 3 (with some effort, fairly simple!)

However,...

...we do **not** aim to:

- make you into World class programmers (this would take at least a whole programme and does not fit in a single course),
- address all the features and the libraries of Python (this would take even longer),
- learn "dark" tricks that almost all languages have.

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Don't worry, this is not as easy as it sounds. ☺

Father and son

Python currently has two branches:

- Python 2: old(-ish), well established, widely used;
- Python 3 (our choice): newer, better designed, also widely used, gaining acceptance, some modules are not converted (yet), but almost all widely used either are converted or will soon be.

The two are very similar, but there are some significant differences!
$\Rightarrow$ Some of these will be addressed as necessary.

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Our focus is on algorithms, not on the programming language!
$\Rightarrow$ Python specifics will be avoided as much as possible.
(but they will be shown for those interested in Python itself)

Lectures and lab classes

- Week 1:
  - This lecture: about the course.
  - Lab class (tomorrow): the first lecture.
- From the second week on:
  - Lectures: covering the new material.
  - Lab class: students solve problems on computers.

Marking

- Six one-hour tests during the lab classes (30%):
  - The best five will be taken into account.
  - The first one is in week 3.
  - Two problems on each; 3 points per problem.
  - Small(-ish) programs done on computers.
  - Covering the material up to the previous week.
- Coursework at the end of semester (70%):
  - A project to program at home.

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- Trial-and-error on a computer is the only way to learn!
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Why?

- Remember the "fundamentally different algorithmic way of thinking" from a few slides before?
- Too many details to consider – **experience is crucial!** (and you're here to get some of it)

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  For example, these four are different types of data, mostly with very different properties:

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f = ( "x", 17, "y", 19, "z", 23 )
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  How about the difference between these two?

```
f = h
g = h(x)
```

How to actually do this? (2)

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  Run the program and test it (give it some input and check that the output is correct).

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- **Do NOT learn chunks of code by heart!**
  These cannot be just "reused"; they must be **understood**!
  Otherwise, you get a wrong impression of "understanding", which backfires in exams and practical situations.

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- Test the boundary cases!
  Does your expansion to prime factors work if the input itself is a prime number? What if it's a negative number?
  Does your algorithm work properly with the first/last member of the list, or only with the ones in the middle? How about an empty list?
  ...

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2. Then return to it later and try to solve the problem without using the solution (reading Python documentation is always fine).
3. If that fails, go back to step 1.
4. If you have to do this for (almost) all problems, seek help with the staff. Do not wait for the exams to address the issue! This process takes time and effort!

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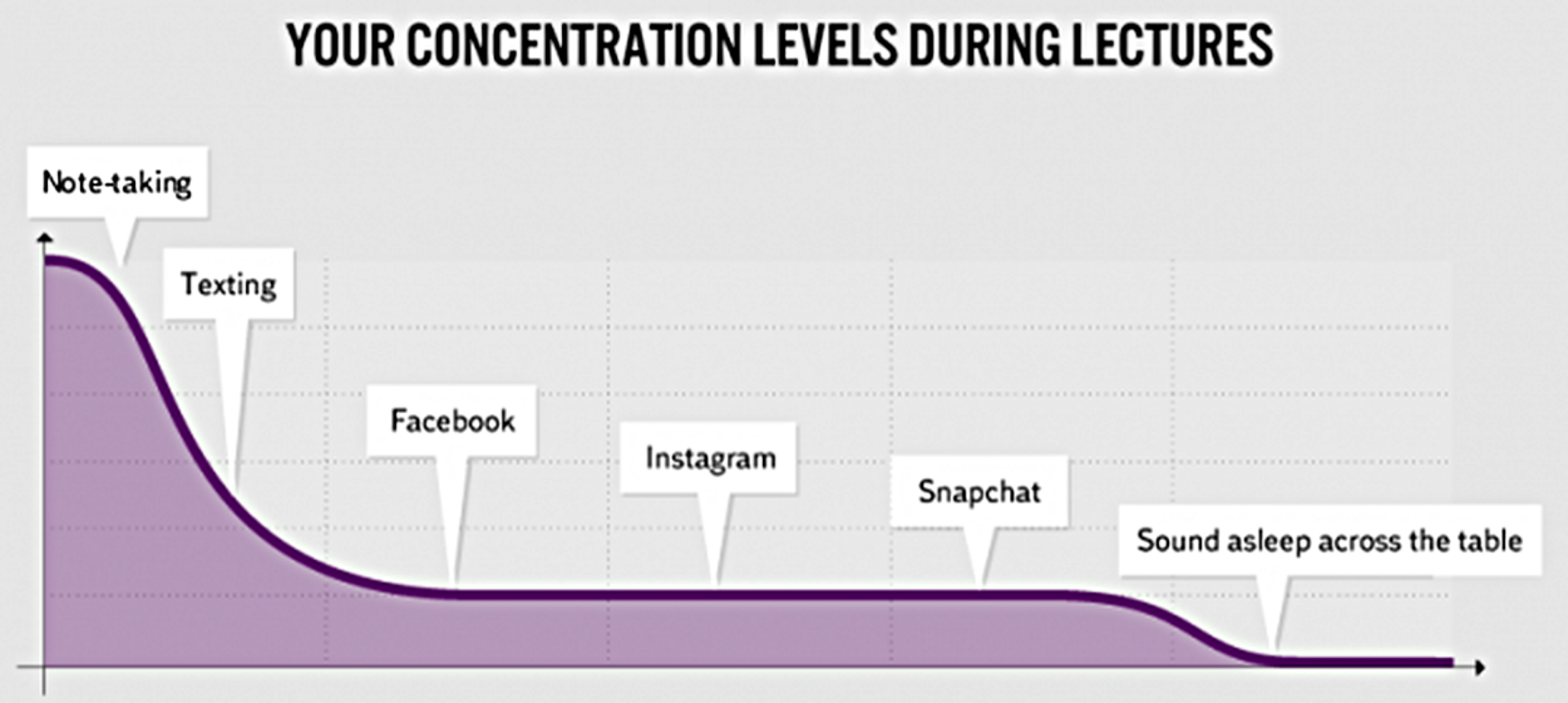
By the way, the above is an example of an algorithm. ☺

How to actually do this? (9 3/4)

How you approach these classes might also have a wee bit of an impact on the whole "crafting your programming skills" process... ☺



[Image source]

Outline

Asking for help (1)

If you encounter a problem, address it immediately – most of the lectures rely on the understanding of the previous ones!

You can ask:

- teaching assistants,
- me,
- your colleagues (be careful, though),
- on-line.
  I suggest Stack Overflow. Before asking a question there, read their instructions! The community is very helpful, but they require effort and will not just solve your problems for you.

Asking for help (2)

At a more advanced level:

- Code Review Stack Exchange – get expert opinion and advice on your properly working code;
- Programmers Stack Exchange – for conceptual questions about software development.

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Hint: There is also Mathematics Stack Exchange...

References (1)

Some useful references:

- For most of the questions, it is enough to Google `python3 whatever you want to know`
- The official Python 3 documentation (there is also a Python 2 documentation, if you ever need it),
- Built-in help, invoked from Python itself:

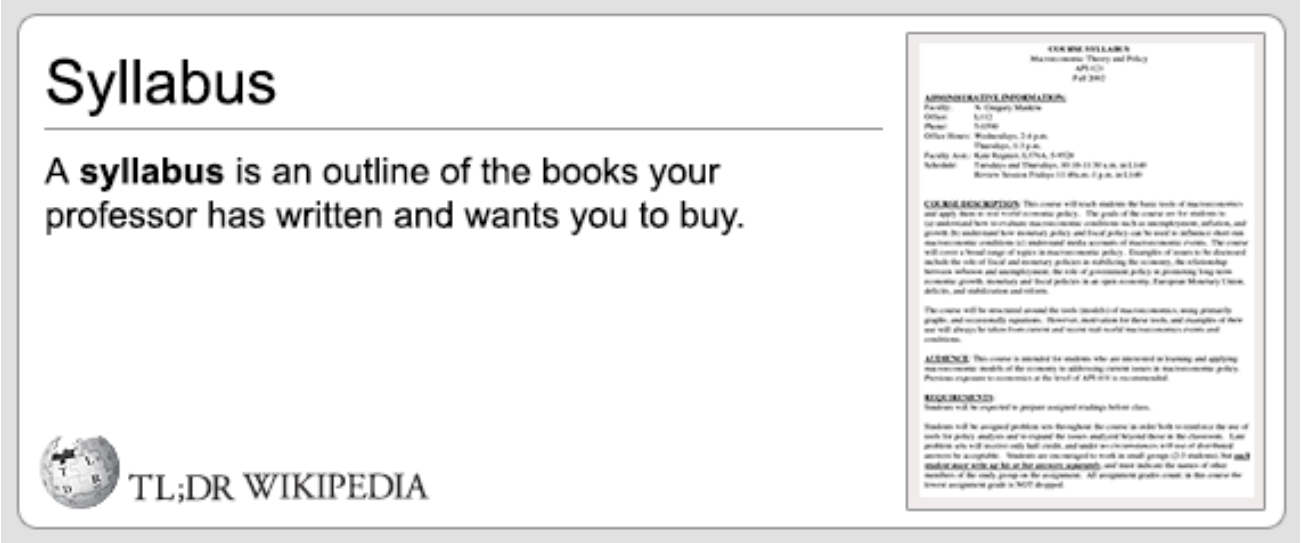
```
help(print)
```

  or

```
import numpy
help(numpy)
```

- Aforementioned Stack Exchange sites.

References (2)



For those preferring dead wood books,

- Mark Lutz, "Learning Python". (no, I am not Mark Lutz ☺)

For those already familiar with programming, just not in Python:

- Mark Pilgrim, "Dive into Python 3" (freely downloadable HTML and PDF); you can also buy a dead wood version, or install it for free on Android devices.
  There is a Python 2 version as well.

Homework

- Install Python 3 (the instructions are on the course web site) on your home computer.
- Try running this program to verify that your Python installation works properly:

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import this
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  Yes, there is only one line and there are no interpunctions.
  It should print a poem "The Zen of Python", by Tim Peters.

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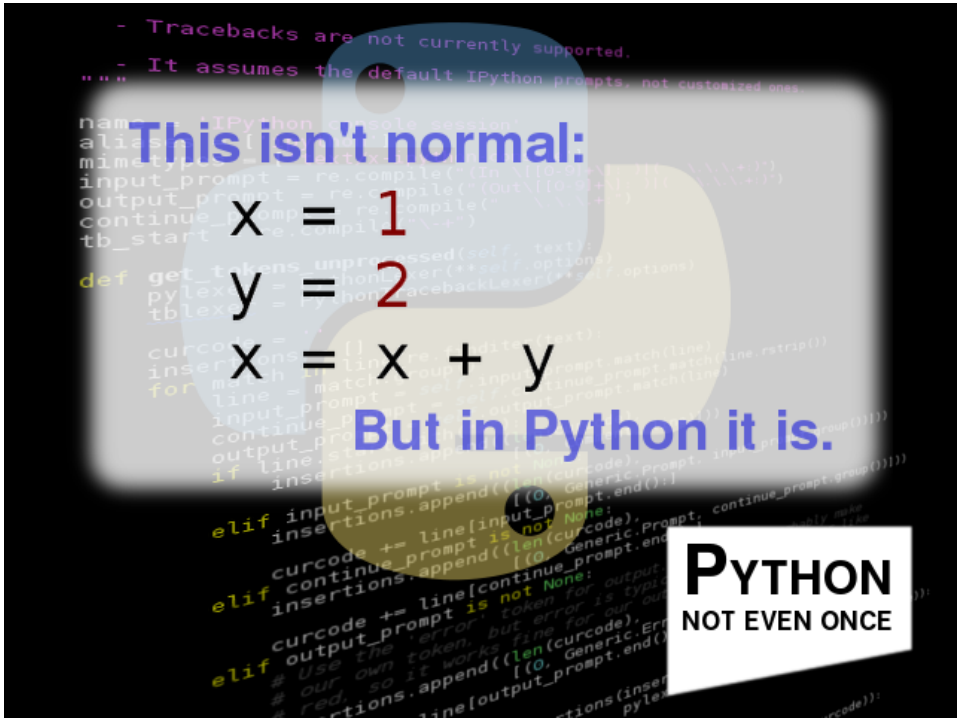
But don't worry, none of it affects "real" programming...

That's all for today (unless, of course, there are questions)



Thank you for your attention!