

# PROGRAMMING WITH PYTHON

Vedran Šego <[vsego@vsego.org](mailto:vsego@vsego.org)>

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MANCHESTER  
1824

The University of Manchester

M\crNA  
Manchester Numerical Analysis

# OUTLINE

- 1 BASICS
- 2 AIMS OF THE COURSE
- 3 HOW TO TACKLE THIS COURSE
- 4 SOME FINAL REMARKS

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- 1 BASICS
  - The course and the lecturer
- 2 AIMS OF THE COURSE
- 3 HOW TO TACKLE THIS COURSE
- 4 SOME FINAL REMARKS

# WHO? WHAT? WHERE?

- Name: Vedran Šego
- Office: 1.218
- E-mail: [vsego@vsego.org](mailto: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

## 1 BASICS

## 2 AIMS OF THE COURSE

- Where does this course stand
- A note on the language
- Lectures and lab classes
- Marking

## 3 HOW TO TACKLE THIS COURSE

## 4 SOME FINAL REMARKS

# 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:

- ➊ Matrix Analysis (MATH36001) – SciPy and NumPy modules;
- ➋ Combinatorics and Graph Theory (MATH39001) – modules `math`, `itertools`, `combinatorics`, `pyncomb`, `qcombinatorics`, `networkx`, built-in lists and dictionaries (see [here](#));
- ➌ Mathematical Biology (MATH35032) – SciPy module for ODEs, PyMOOSE module, built-in lists and dictionaries;
- ➍ Problem Solving by Computer (MATH36032) – Python and MATLAB are quite similar (and somewhat a competition);
- ➎ Mathematical Programming (MATH39012) – modules `PyLPSolve`, `CVXOpt`, `PyGLPK`, `PyMathProg`.

And these are just some of the 3<sup>rd</sup> 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),
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Don't worry, this is **not as easy as it sounds**. 😊

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!

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Our focus is on **algorithms**, not on the programming language!

⇒ Python specifics will be avoided as much as possible.

(but they will be shown for those interested in Python itself)

- 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.



- 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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This means:

- Traditional “learning by reading” is of **little use**.
- 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)

# HOW TO ACTUALLY DO THIS? (1)

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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 )  
b = [ "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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Take a break from it and, some hours later, **try to write your own solution** to the same problem, without looking at or trying to recall the “official” solution.
- **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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If they are wrong, read your code and try to figure which part(s) produce a result different from what you expected.
- 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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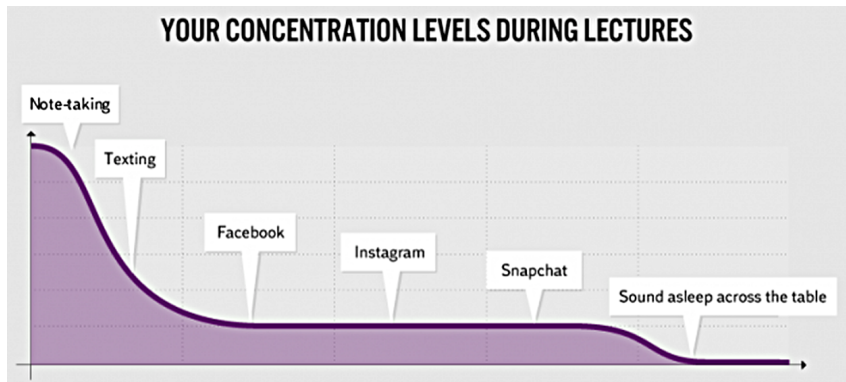
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By the way, the above is an example of an algorithm. 😊

# HOW TO ACTUALLY DO THIS? (9<sup>3/4</sup>)

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



[Image source]

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- 4 SOME FINAL REMARKS
  - Asking for help
  - Useful references

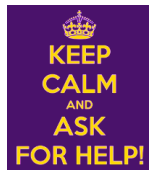
# ASKING FOR HELP (1)

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.

As before, **read their instructions before asking a question!**

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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)

## Syllabus

A **syllabus** is an outline of the books your professor has written and wants you to buy.

TL;DR WIKIPEDIA

**COURSE SYLLABUS**  
Macroeconomics Theory and Policy  
Fall 2002

**APPROPRIATE COURSE INFORMATION:**  
Faculty: Dr. George Yorgos  
Section: 10101  
Prereq: 10100  
Office Hours: Wednesdays 1:45 p.m.  
Thursdays 1:15 p.m.  
Faculty E-mail: [George.Yorgos@utoronto.ca](mailto:George.Yorgos@utoronto.ca)  
Syllabus: [www.econ.utoronto.ca/~yorgos](http://www.econ.utoronto.ca/~yorgos)  
Textbook: [www.econ.utoronto.ca/~yorgos](http://www.econ.utoronto.ca/~yorgos)

**COURSE DESCRIPTION:** This course will teach students the basic tools of macroeconomics and apply them to real-world economic policy. The goals of the course are for students to understand how to construct macroeconomic models and to be able to apply them to real-world economic policy. The course will cover the following topics: the role of fiscal and monetary policy in stabilizing the economy, the relationship between inflation and unemployment, the role of government policy in promoting long-term economic growth, and the role of international trade in economic growth. The course will be assessed through a series of assignments, a mid-term exam, and a final exam.

**AUDIENCE:** This course is intended for students who are interested in learning and applying macroeconomic theory to real-world economic policy. Previous exposure to economics at the level of APB 101 is recommended.

**REQUIREMENTS:** Students will be required to prepare assigned readings before class. Students will be assigned problems sets throughout the course in order to reinforce the use of the tools for policy analysis and to prepare for the exam and final exam. Some problems sets will require only half credit and others will require full credit. Students will be required to write a research paper at the end of the course. Students are encouraged to work in small groups to complete the assignments. Students are encouraged to work in small groups to complete the assignments. All assignments must be submitted by the deadline. All assignments must be submitted by the deadline. All assignments must be submitted by the deadline.

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.

- 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:

```
import this
```

Yes, there is only one line and there are no interpunctuations. It should print a poem “The Zen of Python”, by Tim Peters.

# HOMEWORK

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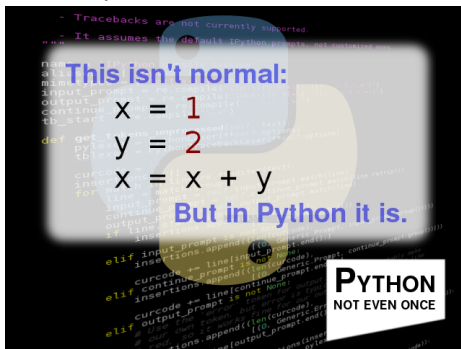
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That's all for today (unless, of course, there are questions)



Thank you for your attention!