



## PhD Course on “Introduction to SageMath”

**Péter Burcsi,**

Associate Professor, Eötvös Loránd University Budapest, Hungary,  
bupe@inf.elte.hu

Do you ever need to multiply matrices, calculate a complicated integral, plot functions, calculate the chromatic number of a graph or solve an optimization problem? Do you know how to find the first ten-digit prime number in the digits of  $\pi$ ? Can you assign digits to the letters to make the equation  $AREA = PI * R * R$  true? Are you familiar with Python? Learn these and more in an introductory course to the SageMath mathematical software.

*Prerequisites:* basic knowledge of analysis, linear algebra, algebra and number theory (typically covered in first or second year courses at universities) is sufficient for most of the course. Some advanced concepts such as differential equations, abstract algebra, algebraic number theory are mentioned but not necessary for following the course.

*Short description:*

We give an overview and a brief introduction to the SAGE computer algebra system. SageMath (previously Sage or SAGE, System for Algebra and Geometry Experimentation) is a mathematical software with features covering many aspects of math, including algebra, combinatorics, numerical mathematics, number theory, calculus.

*Learning outcome:*

familiarity with the SAGE computer algebra system, skills to prepare your own sage notebooks for various purposes, some advanced concepts.

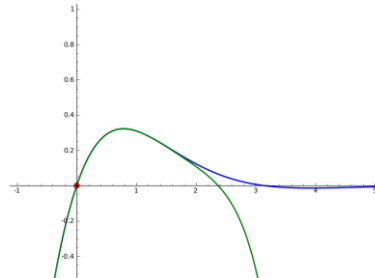
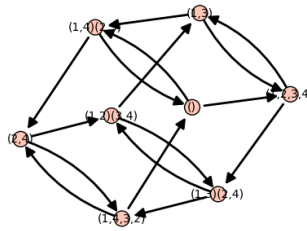
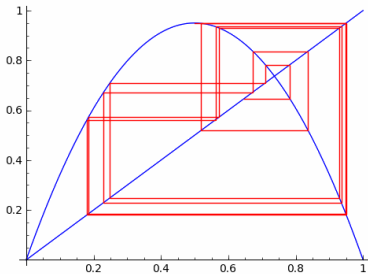
*Syllabus:*

We plan to cover the following topics (details depend on background of students):

- Start using SAGE: the command line and the notebook interfaces. The SAGE cloud. The help system. Start using the system for simple calculations.
- Simple data types: numbers, strings and booleans. Composite data types: lists, tuples, dictionaries, sets, vectors, matrices. Basic linear algebra.
- Basic programming constructs in SAGE/python: conditionals, loops and functions. Indentation.
- Put it all together: some simple programs in various topics: graphs, algebra, analysis and elementary number theory.
- Plotting functions, curves and geometric figures. Interactive plots.
- Some advanced mathematical topics: differential equations, abstract algebra, algebraic number theory.



- Some advanced programming concepts: object-oriented programming and functional elements in SAGE/python.
- Put it together: build a more sophisticated program solving a non-trivial task in your area of expertise.



Class Meetings

- Jan 20, 2020 – 16.10/17.50 – LAB ~~GAMMA~~ *alfa*
- Jan 21, 2020 – 17.00/18.40 – LAB ~~GAMMA~~ *delta*
- Jan 22, 2020 – 16.10/17.50 – LAB ~~GAMMA~~ *alfa*
- Jan 23, 2020 – 12.50/14.30 – LAB ~~DELTA~~ *alfa*

Local organization and contact:

Prof,ssa Zsuzsanna Liptak

[zsuzsanna.liptak@univr.it](mailto:zsuzsanna.liptak@univr.it)