Welcome to MCS 320

1. About the Course and Evaluation
   - catalog, prerequisites, the computational track
   - goals and expectations
2. Symbolic Computation and Computer Algebra
   - two definitions
   - SageMath and CoCalc
   - organization of the content
3. Interactive Computing
   - the Jupyter notebook

MCS 320 Lecture 1
Introduction to Symbolic Computation
Jan Verschelde, 10 June 2024

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Catalog Description and the Computational Track

MCS 320. Introduction to Symbolic Computation. 3 hours.

Introduction to computer algebra systems, symbolic computation, and the mathematical algorithms employed in such computation, with examples and applications to topics in undergraduate mathematics.

Prerequisites: MATH 210 (calculus III) and computer literacy:
MCS 260 (introduction to computer science)
or CS 107 (introduction to computing and programming);
or CS 109 (programming for engineers with MATLAB);
or CS 111 (program design I); or consent of the instructor.

MCS 320 is on the computational track in the MCS curriculum, followed by

- MCS 471, Numerical Analysis; and
- MCS 472, Introduction to Industrial Math & Computation.

This is a ***computational*** course, not a programming class.

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Goals and Expectations

Three goals:

1. understand concepts of symbolic computation,
2. gain *hands on* experience with computer algebra,
3. learn mathematics through computations (computational thinking).

Your grade will be determined on a total of 700 points:

- five quizzes, each 20 points, for a total of 100 points;
- three projects, for a total of 200 points;
- two midterm exams, each for 100 points, for a total of 200 points;
- one final exam, worth 200 points.

Homework is essential for practice and to makeup for points lost.

By default, unless explicitly stated that collaborations are allowed,

all submitted solutions must be your own work.

Course URL: `http://homepages.math.uic.edu/~jan/mcs320`.

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Symbolic Computation and Computer Algebra

Definition (Computer Algebra)

Computer Algebra is the discipline that studies the *algorithms* for Symbolic Computation.

Definition (Symbolic Computation)

Symbolic Computation is the computation with *symbols*, rather than with numbers.

In this course we are mostly concerned with practical aspects, in particular its implementation and its application to solve problems.

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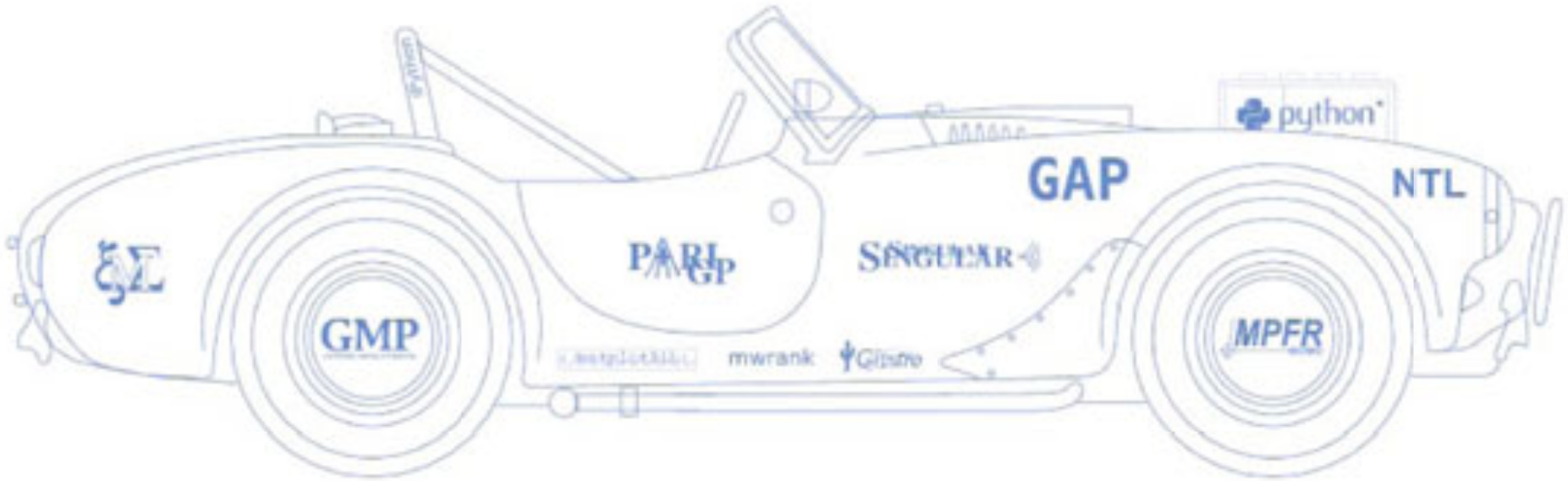
SageMath and CoCalc

SageMath bundles many open source software packages.



From: B. Eröcal and W. Stein. *The Sage project: Unifying free mathematical software to create a viable alternative to Magma, Maple, Mathematica, and MATLAB.* In *Mathematical Software - ICMS 2010*, Springer-Verlag, 2010.

- `https://www.sagemath.org` for source, docs, installation, etc.
- `https://cocalc.com` for online execution.

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Organization of the Content

There are five parts in the course:

1. first steps,
2. polynomials and expressions,
3. calculus,
4. plotting and solving equations,
5. advanced topics.

The last two lectures introduce Julia,
a new programming language for scientific computing.

Lecture notes are posted at the course web site.

A good reference is '*Sage for Undergraduates*' by Gregory V. Bard,
AMS 2015 (ISBN 978-1-4704-1111-4); and
available at `www.gregory-bard.com/Sage.html`.

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the Jupyter notebook

The Jupyter notebook is a web based interface for computations.

Jupyter stands for Julia, Python, R, and many others.

- Input cells can contain code or text (markdown, LaTeX).
- Output cells hold numerical data, symbolic expressions, or plots.
- We use Jupyter to document our computations.

Jupyter is the default interface for SageMath.

A well structured notebook runs as a computer program.