

COCALC as a teaching tool

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This work is dedicated to *Jesus Hernando Pérez "Pelusa"*.

- 1 CAS and SAGE/COCALC
- 2 CAS and Mathematics T/L
- 3 Mathematics and Inquiry
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Definition

A computer algebra system (CAS from now on) can be understood as “a math computer program capable of working symbolically as well as numerically.” (Botana, Abánades, Escribano, 2014).

Example

$$(2/3 x^2 + 1/5 y^3 z)^{1000}$$

SAGE

- System for Arithmetic Geometry Experimentation (2005)
- William Stein
- Open Source
- SageMathCloud (2012)
- CoCalc (2017)

Tools

- Projects (Private - Cooperative)
- \LaTeX , R , Jupyter , GNU/Linux , ...
- CAS
- Course Management Features
- <https://github.com/sagemathinc/cocalc/wiki/Teaching>

How do we use technology? (Assuming we do it)

- To see objects (GDC, Winplot, Desmos, ...)
- To manipulate objects (Cabri, Geogebra, ...)
- To deal with a lot of numbers (R, MatLab, SPSS, Excel, ...)
- To submit assignments (\LaTeX , Word, ...)
- To deal with symbolic elements (Maple, Mathematica, ...)
- To code (C++, Python, ...)
- To manage a class (Moodle, Classroom, ...)

Why do we use technology?

- Because we have to (Policies)
- Because everybody does it
- Because it is a "non-optional social convention"
- Because it helps to improve teaching
- Because students need it

Geometry

- The Geometric Suppose (Yerushalmy, Houde, 1986)
- Geometry Sketchpad, Cabri, CarMetal, and GeoGebra among others

- CAS approach may be less intuitive, but it allows both teachers and students to manipulate mathematical object out of the reach of interactive geometry. Besides, it can be used in high school (Domes, 2014) (Kramarski Hirsch, 2003), upper school (Botana, Abánades, Escribano, 2014).
- CAS systems may be conceived in education as a Toolbox for Algebra, Calculus and related issues (Botana, Abánades, Escribano, 2014).

How do we teach math?

- Lectures (Always)
- Student's Work (The bigger the better)
- Use of Technology (Sometimes)

Inquiry

- A mathematician model and solve problems while working effectively with others.
- The problems used in this approach should be more than routine textbook problems (Santos-Trigo, Camacho-Machín, 2009).
- The use of CoCalc should promote students collaborative support (Popel, Shokalyuk, Shyshkina, 2018), their engagement with the learning process and the develop of academic social skills.

EGA 2017

A new perspective:

- Technology is a way, but a purpose
- We still need pencil and paper
- Skills instead of topics
- Problems according to the tool
- A significant "piece" of assessment

Universidad Sergio Arboleda

- Degree in Mathematics (20 years)
- Master in Applied Mathematics
- Research in Applied and Pure Mathematics
 - Machine Learning, Big Data
 - Combinatorics
 - Dynamical Systems and PDE
 - Applied Mathematics: Risk, Stock markets, ...

Study Cases

Subjects

- Integral Calculus and Infinite Sequences
- Discrete Dynamical Systems
- Number Theory

Structure

- Shared project
- Assignments (Formative)
- Projects (Summative)

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