

Geometric Tools for Computer Graphics

Instructions for the lab work (and problems)

We will use *SageMath* for the lab exercises. If you wish, you can also use it for solving the problems.

SageMath was previously called SAGE (System for Algebra and Geometry Experimentation). It is a free and open-source mathematics software system licensed under the GPL (General Public License). It is convenient for this course because it allows you to go straight from the mathematical formulation of the solution of a problem to its visualization, without having to deal with graphical representation issues. It is convenient in general because it is a powerful tool. It builds on top of many existing open-source packages: [NumPy](#), [SciPy](#), [matplotlib](#), [SymPy](#), [Maxima](#), [GAP](#), [FLINT](#), [R](#) and many more, and it is written mostly in Python and Cython. The goal of [William A. Stein](#) with this project is to create a “viable free open source alternative to [Magma](#), [Maple](#), [Mathematica](#) and [Matlab](#)”.

Option 1: *SageMath* cloud

1. Start any session.
2. Launch any web browser and go to CoCalc (Collaborative Calculation in the Cloud): <https://cocalc.com/>
3. Sign in or create an account.
4. Once sage cloud is running, you can start working: either you upload a file or you create a brand new one.

Option 2: *SageMath* in your own computer

1. You can also download and install *SageMath* locally in your computer from the following adress: <http://www.sagemath.org/>

Help

You will find everything you may need at <http://www.sagemath.org/>

In addition, we provide you with the following files:

1. **Dealing with vectors and matrices in *SageMath***
This short file shows how to declare vector and matrix types and how to operate with them.
2. **Plotting linear objects with *SageMath***
Our main reason for choosing SageMath for your lab exercise is that you will not have to take care of visualization issues, and that you will be able concentrate in solving the geometrical problems. For this to be possible, you need to know how to instruct SageMath to show your geometric objects in the screen of your computer. We start with polygons and polygonal lines.
3. **Plotting curves and surfaces with *SageMath***
And we continue with curves and surfaces.
4. **Using quaternions in *SageMath***
This file shows how to declare and use quaternions.