

A few words on SageMath

Combinatorics 1M020

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NOTE: SageMath will only be used in class to demonstrate some computations that can be done with computer. It is **not** going to be appear in the exam or assignment.

This tutorial is only mean for students who are **curious** about using computers in combinatorics and mathematics in general.

What is SageMath



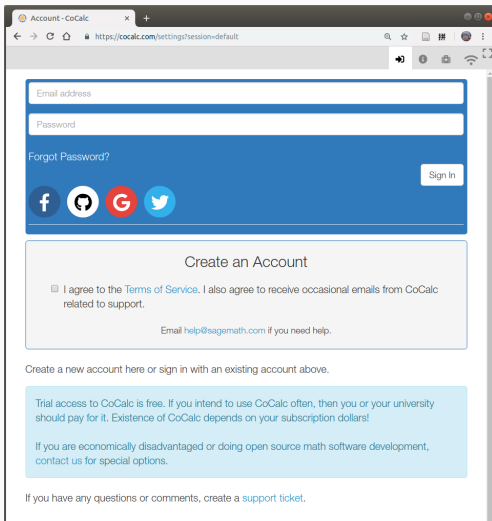
SageMath is a **free open-source** mathematics software system.

It includes many existing open-source packages: NumPy, SciPy, etc.

It meant to be a free open source alternative to Magma, Maple, Mathematica and Matlab.

Cocalc – 1. Register

The best way to start is to try the online version at <https://cocalc.com>. You can register a free account.

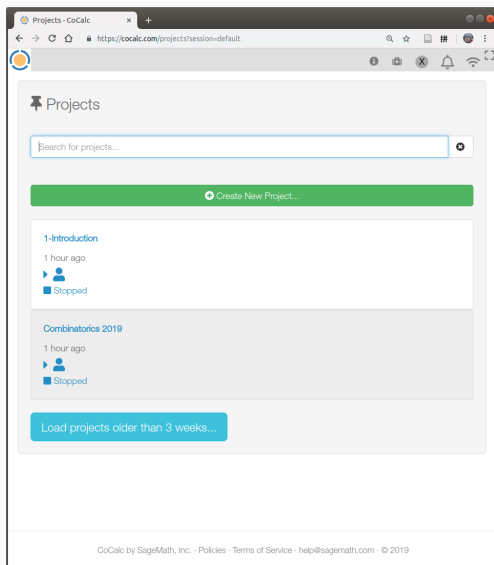


The screenshot shows a web browser window with the URL <https://cocalc.com/settings?session=default>. The page features a registration form with the following elements:

- Input fields for "Email address" and "Password".
- A "Forgot Password?" link.
- A "Sign In" button.
- Social media icons for Facebook, GitHub, Google, and Twitter.
- A "Create an Account" section containing a checkbox for agreeing to the Terms of Service and receiving emails, with a link to the Terms of Service and an email address help@sagemath.com.
- A light blue box with text: "Trial access to CoCalc is free. If you intend to use CoCalc often, then you or your university should pay for it. Existence of CoCalc depends on your subscription dollars! If you are economically disadvantaged or doing open source math software development, contact us for special options."
- A footer note: "If you have any questions or comments, create a [support ticket](#)."

Cocalc – 2. Create a project

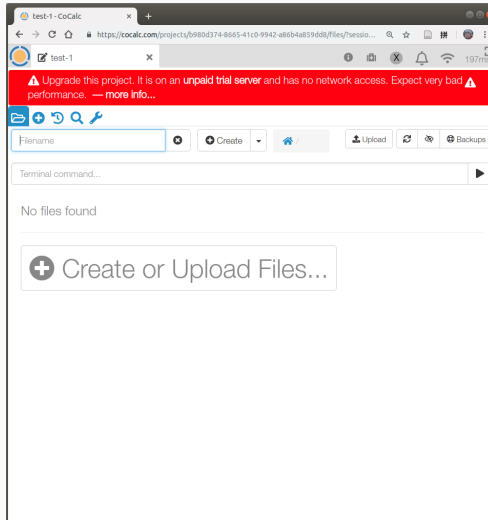
Once login, click “Create New project”.



The screenshot shows a web browser window with the URL `https://cocalc.com/projects/session=default`. The page title is "Projects - CoCalc". The main content area is titled "Projects" and features a search bar with the placeholder text "Search for projects...". Below the search bar is a prominent green button labeled "Create New Project...". Underneath this button, there is a list of projects. The first project is titled "1-Introduction", created "1 hour ago", and has a status of "Stopped". The second project is titled "Combinatorics 2019", also created "1 hour ago", and has a status of "Stopped". At the bottom of the list, there is a blue button labeled "Load projects older than 3 weeks...". The footer of the page contains the text "CoCalc by SageMath, Inc. - Policies - Terms of Service - help@sagemath.com - © 2019".

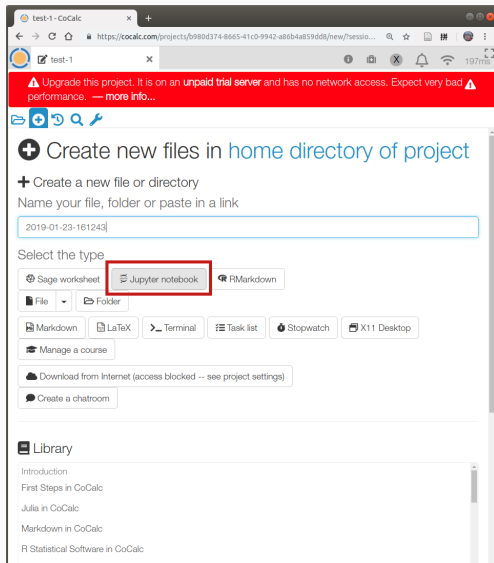
Cocalc – 3. Create or Upload Files

Once you have a project, click “Create or Upload Files”. Ignore the red warning.



Cocalc – 4.a Create a Jupyter notebook

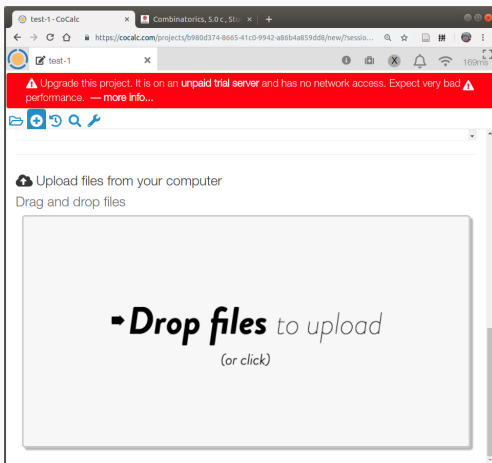
Next click “Jupyter notebook”.



The screenshot shows the CoCalc web interface in a browser window. The address bar displays the URL: `https://cocalc.com/projects/b980d374-8665-41c0-9942-a86b4a859dd8/new/?sessio...`. A red warning banner at the top states: "Upgrade this project. It is on an unpaid trial server and has no network access. Expect very bad performance. — more info...". Below the banner, there are navigation icons and a heading: "Create new files in home directory of project". Underneath, it says "Create a new file or directory" and "Name your file, folder or paste in a link". A text input field contains the text "2019-01-23-161243". The "Select the type" section has several buttons: "Sage worksheet", "Jupyter notebook" (highlighted with a red box), and "RMarkdown". Other buttons include "File", "Folder", "Markdown", "LaTeX", "Terminal", "Task list", "Stopwatch", "X11 Desktop", "Manage a course", "Download from Internet (access blocked -- see project settings)", and "Create a chatroom". At the bottom, there is a "Library" section with a list of items: "Introduction", "First Steps in CoCalc", "Julia in CoCalc", "Markdown in CoCalc", and "R Statistical Software in CoCalc".

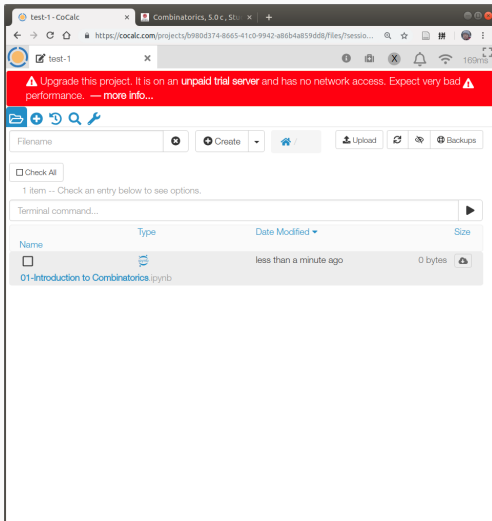
Cocalc – 4.b.1 Upload a Jupyter notebook

Alternatively, you can upload the notebooks, named *.ipynb, provided on studentportalen. For example **this one**. Scroll down on the page shown in step 3, and click “Drop files to upload” to do so.



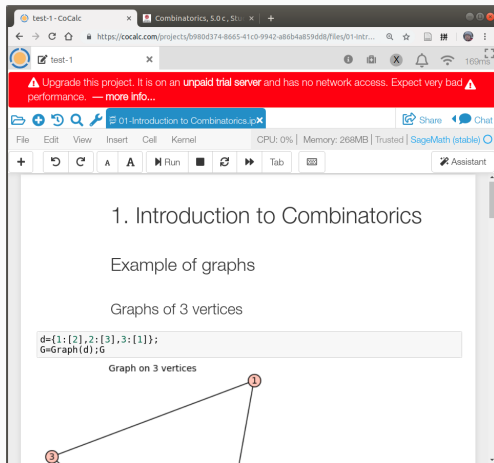
Cocalc – 4.b.2 Upload a Jupyter notebook

Once file is uploaded, click the file button, and you will see the uploaded file. Click it to open.



Cocalc – 5. A Jupyter notebook

Either way, now you have a Jupyter notebook that you can play with



The screenshot shows a web browser window with the Cocalc interface. At the top, there is a red warning banner: "Upgrade this project. It is on an unpaid trial server and has no network access. Expect very bad performance. — more info...". Below the banner is a navigation bar with a search bar containing "01-Introduction to Combinatorics.p", a "Share" button, and a "Chat" button. The main interface has a menu bar (File, Edit, View, Insert, Cell, Kernel) and a status bar (CPU: 0% | Memory: 268MB | Trusted | SageMath (stable)). The notebook content includes:

- Section 1: Introduction to Combinatorics
- Section 2: Example of graphs
- Section 3: Graphs of 3 vertices

A code cell contains the following Python code:

```
d={1:[2],2:[3],3:[1]};  
G=Graph(d);G
```

Below the code cell, a graph visualization is shown with three vertices labeled 1, 2, and 3. Vertex 1 is at the top right, vertex 2 is at the bottom left, and vertex 3 is at the bottom right. Edges connect vertex 1 to vertex 2, and vertex 1 to vertex 3.

[Quick tutorial](#) of using SageMath in a Jupyter notebook.

Free textbook – [Computational Mathematics with SageMath](#). Part IV of the book is on combinatorics.

[Cocalc tutorial](#)