

Proseminar on computer-assisted mathematics

Session 2 - Matrices in Sage

Matrices in Sage

When we define a matrix in Sage, we can specify the ring or field in which we take the entries.

Let us for instance consider the matrix

$$\begin{pmatrix} 2 & 4 & 6 \\ 4 & 5 & 6 \\ 3 & 1 & 2 \end{pmatrix}$$

and declare it first as a matrix A with entries in \mathbb{Q} , then as a matrix B with entries the field with seven elements \mathbb{F}_7 .

```
A = matrix( QQ, [[2,4,6],[4,5,6],[3,1,2]] )  
show(A)
```

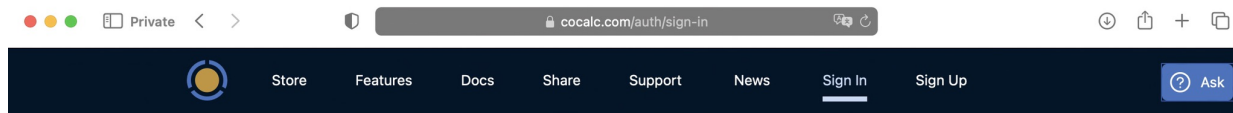
Florent Schaffhauser
Heidelberg University, Summer semester 2023

We have just seen a brief introduction to Sage.

You can now download the notebook from the Zulip channel or the seminar webpage.

Two options for you to practice:

- ① Install Sage and JupyterLab or team up with someone who has, then launch it and upload the notebook there.
- ② Sign in on cocalc.com using your GitHub account and upload the notebook there.



[Sign In](#) Password Reset



Sign In to CoCalc

Sign in using your email address or a single sign-on provider. [Use your GitHub account.](#)



[Institutional Single Sign-On:](#)



Sign in using your
GitHub account.



Sign in to GitHub
to continue to CoCalc

Username or email address

Password

[Forgot password?](#)

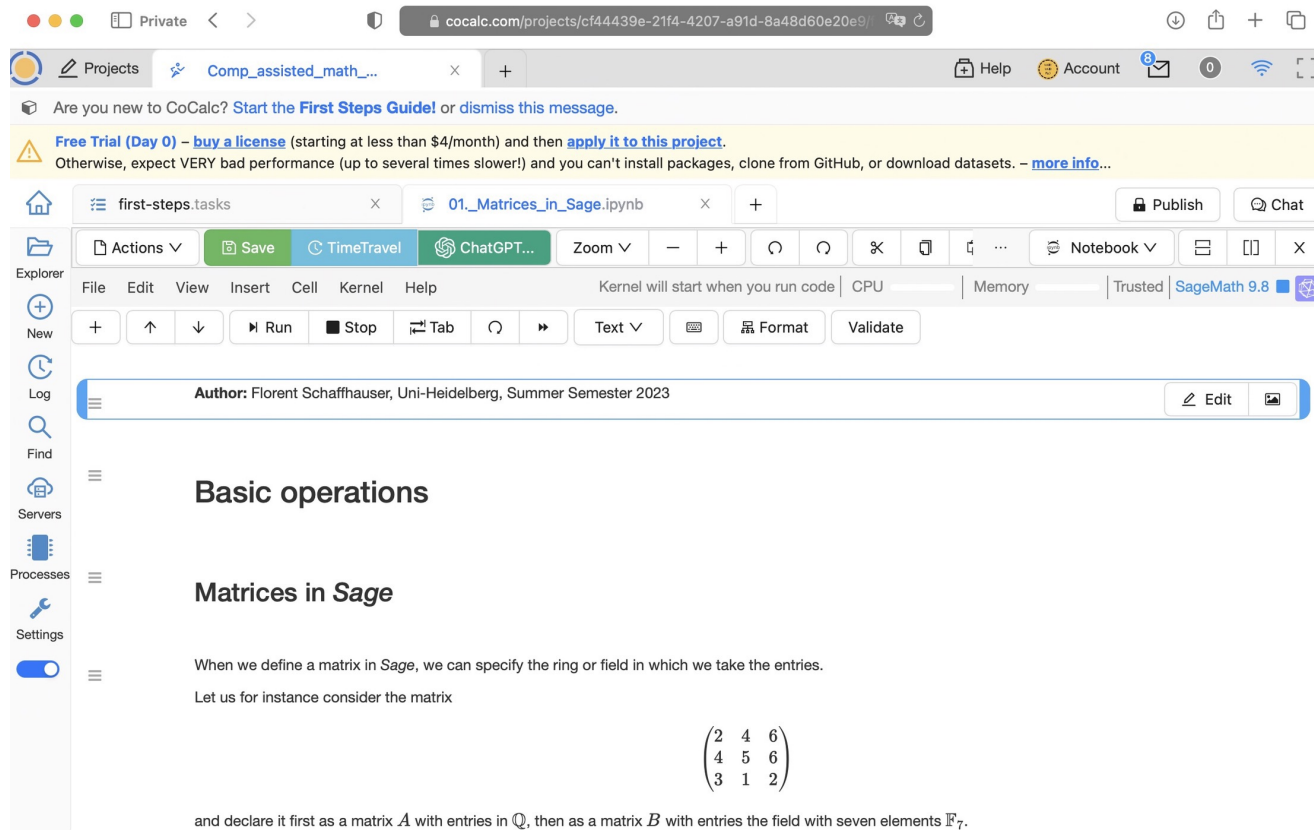
Sign in

[New to GitHub? Create an account.](#)

You can also
create one on the
spot.

Once logged in, create a new project and start the first steps guide (recommended).

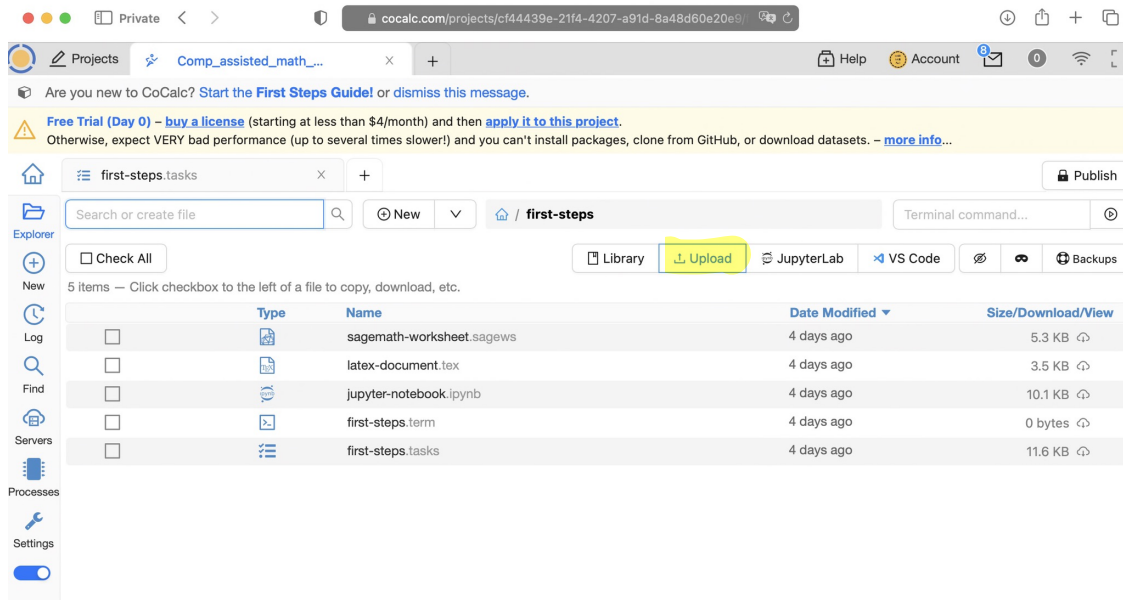
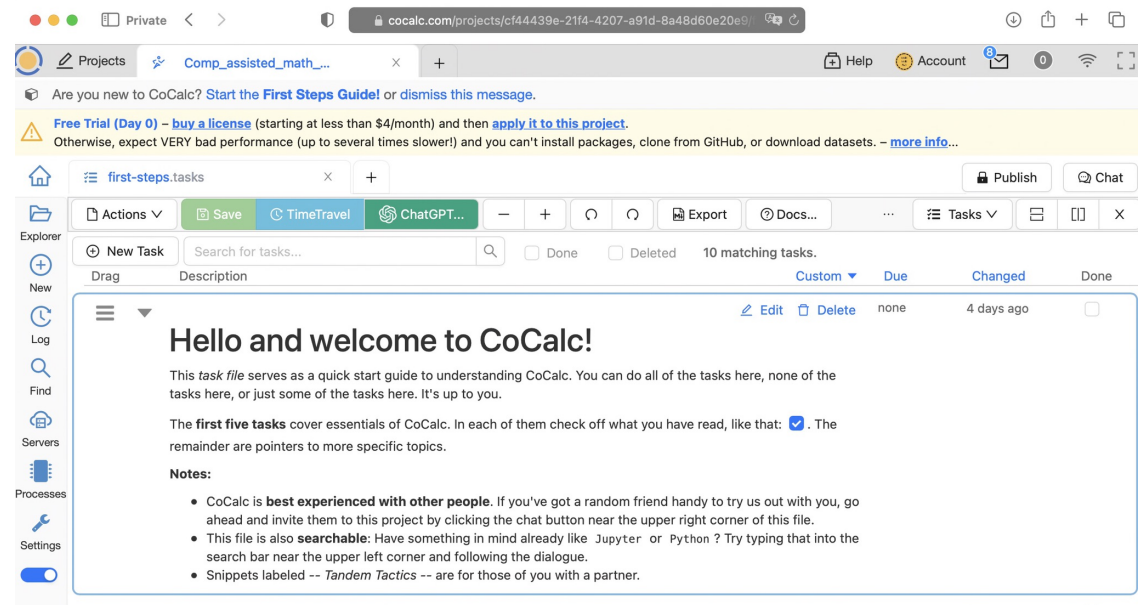
Then upload the notebook about matrices in Sage and start practicing!



(More details below)

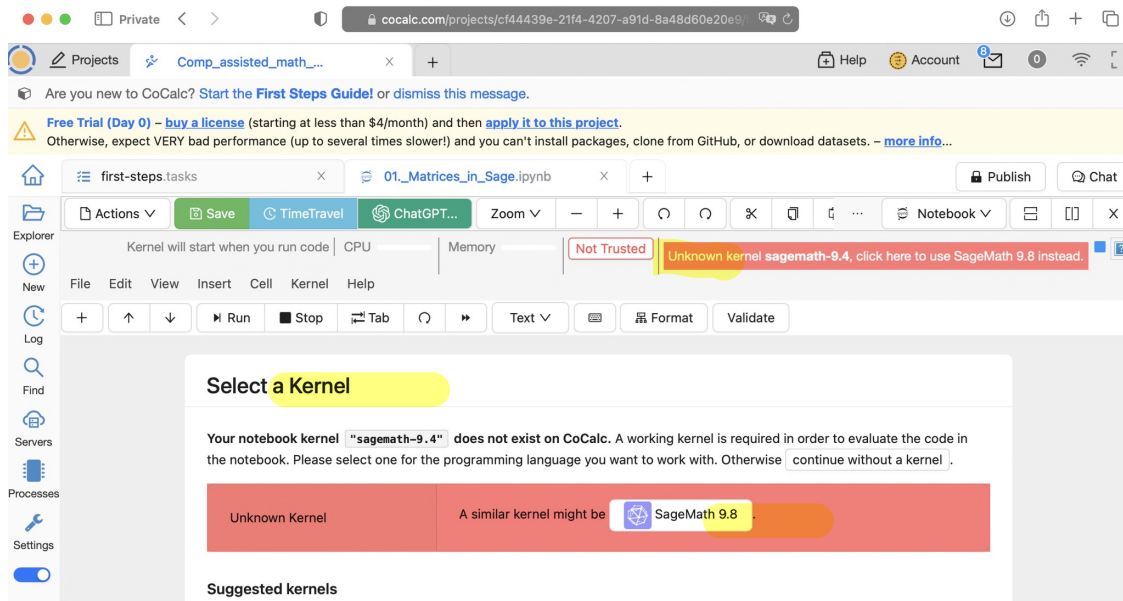
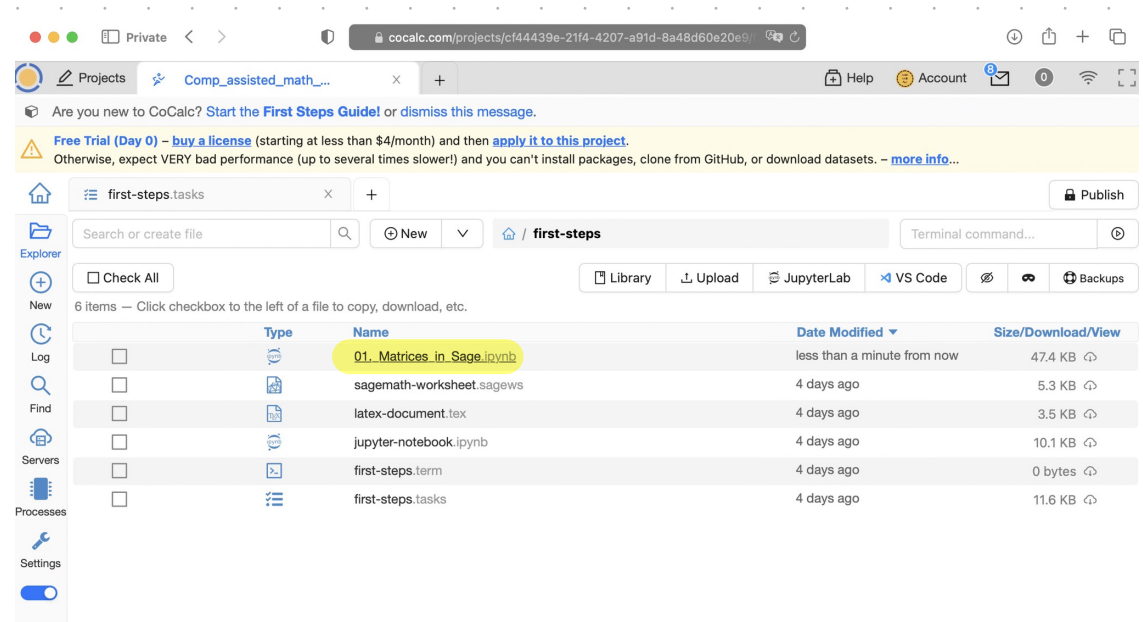
Step-by-step

After starting the first steps guide:

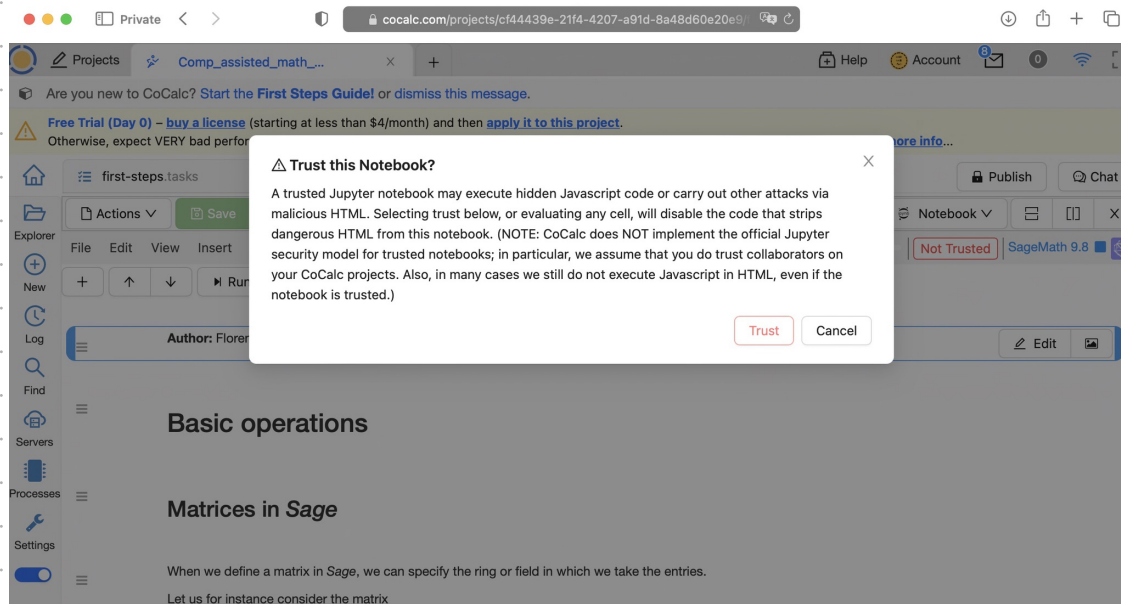


Click on upload.

Open the
uploaded file.

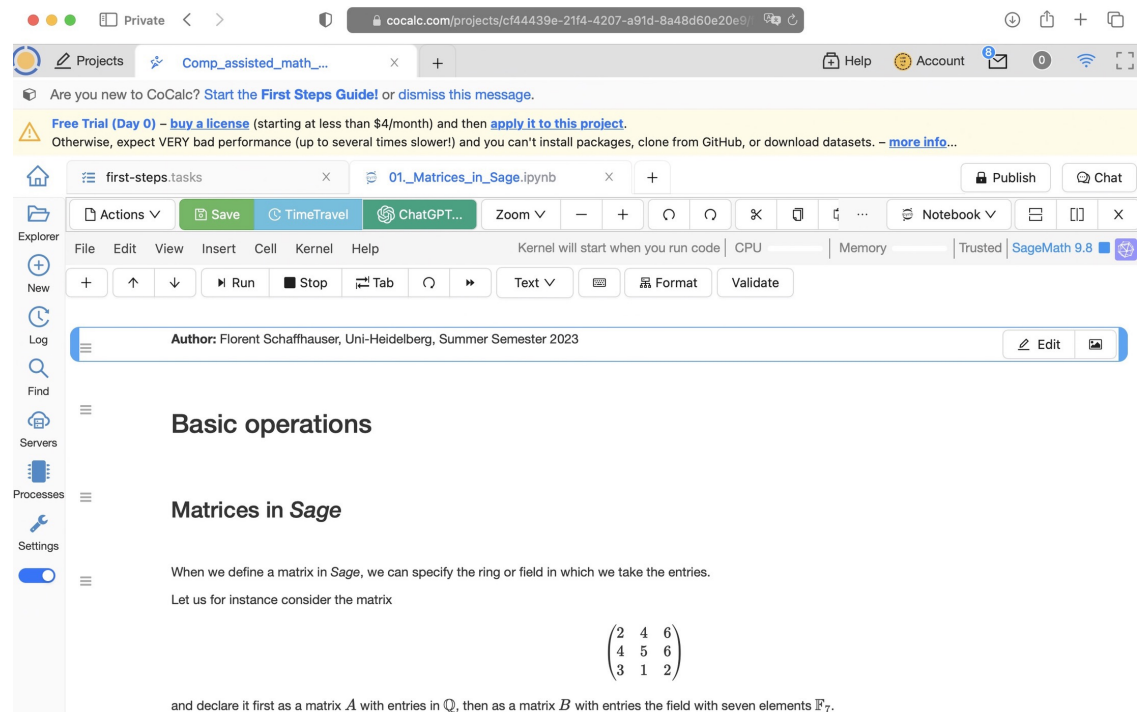


You will need to select the
Sagemath 9.8 kernel, then
click on 'Not trusted'.



Yes, you can trust this notebook (I promise!).

We are finally there:



Alternately, you can open the notebook in a JupyterLab server hosted directly on CoCalc (no local installation):

Recommended!

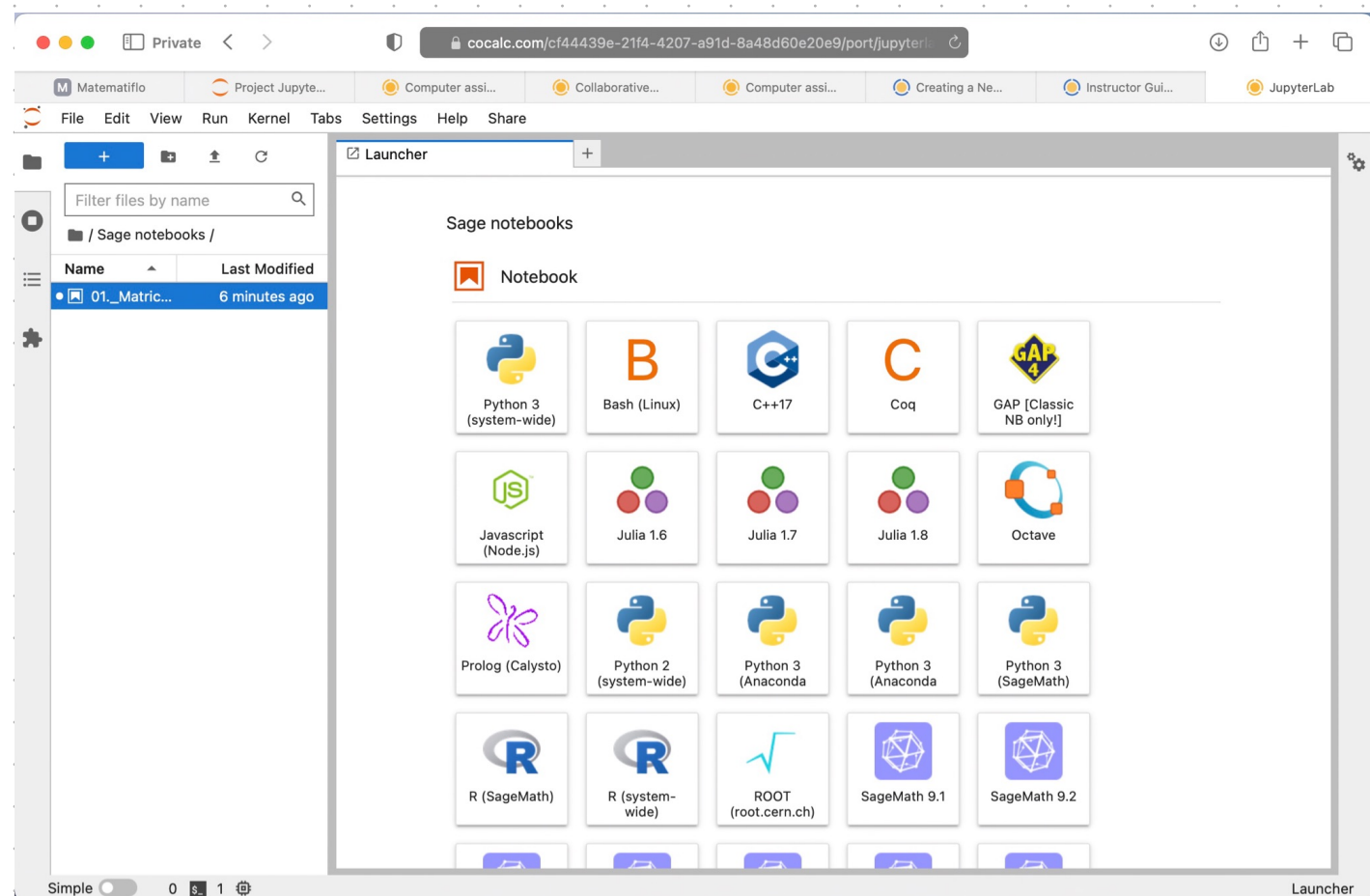
The screenshot shows the CoCalc web interface. The browser address bar displays `cocalc.com/projects/cf44439e-21f4-4207-a91d-8a48d60e20e9/`. The page title is "Comp_assisted_math_...". The interface includes a sidebar with navigation options: Explorer, Log, Find, Servers, and Processes. The main area displays a file explorer with a table of files. The "JupyterLab" button is highlighted in the top navigation bar.

Type	Name	Date Modified	Size/Download/View
File	01. Matrices in Sage.ipynb	less than a minute from now	47.4 KB
File	sagemath-worksheet.sagews	4 days ago	5.3 KB
File	latex-document.tex	4 days ago	3.5 KB
File	jupyter-notebook.ipynb	4 days ago	10.1 KB
File	first-steps.term	4 days ago	0 bytes
File	first-steps.tasks	4 days ago	11.6 KB

Click on JupyterLab (should open in a pop-up window)

There, you can either create a notebook
(many possible types!) or open the one
you have uploaded:

Our
notebook *mp*



You can now start working on the notebook!

Author: Florent Schaffhauser, Uni-Heidelberg, Summer Semester 2023

Basic operations

Matrices in Sage

When we define a matrix in *Sage*, we can specify the ring or field in which we take the entries.

Let us for instance consider the matrix

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and declare it first as a matrix *A* with entries in \mathbb{Q} , then as a matrix *B* with entries the field with seven elements \mathbb{F}_7 .

```
[1]: A = matrix( QQ, [[2,4,6],[4,5,6],[3,1,2]] )
show(A)

[1]:
```

$$\begin{pmatrix} 2 & 4 & 6 \\ 4 & 5 & 6 \\ 3 & 1 & 2 \end{pmatrix}$$

```
[2]: # The command 'type()' shows what kind of object the argument is
type(A)

[2]: <class 'sage.matrix.matrix_rational_dense.Matrix_rational_dense'>

[3]: B = matrix( GF(7), [[2,4,6],[4,5,6],[3,1,2]])
```

Simple 0 1 SageMath 9.8 | Idle Mode: Command Ln 1, Col 1 01_Matrices_in_Sage.ipynb

Just close the tab when you are done :-)