Using and Creating a New Python 3.13 Virtual Environment to Run Marimo

As mentioned in class Marimo (https://marimo.io/) is a new *reactive* Python notebook that has many nice features over the IPython/Jupyter notebook, Jupyter Lab legacy. For the curious A marimo is a moss ball of densely packed algal filaments, free-floating filaments, or growth on rocks. If you would like to check out Marimo it is easy to create a new *virtual environment* using miniconda. Standford University is where `marimo` got its start. I have watched a few videos and find many people pronouce `marimo` as "mar ee mo" or "mar i mo"

Create a new virtual environment

The new virtual environment will be created using the base environment of the previously installed `Miniconda` and its `base` environment.

> **Note**: Virtual environments are where you do your work with Python. Creating multiple virtual environments is a safe way of trying new Python packages, such as `marimo`, without the risk of messing up a known good virtual environment. If you do mess up a new virtual environment you can always delete and start over. Leaving the minimalistic base environment of `Miniconda` intact gives you an environment you can always *activate* to safely mange one or more virtual environments.

The command line below will create a Python 3.13 virtual environment named `marimo-dsp-comm313`. This new environment, unlike the previous environment names `dsp-comm313` will not contain `jupyterlab`

```
(base) PS C:\Users\mwickert> conda create --name marimo-dsp-comm313 python=3.13
```

Activate the new environment:

```
(base) PS C:\Users\mwickert> conda activate marimo-dsp-comm313
```

Now install the Marimo package:

```
(marimo-dsp-comm313) PS C:\Users\mwickert> conda install -c conda-forge marimo
```

Now install the scipy stack:

```
(marimo-dsp-comm313) PS C:\Users\mwickert> conda install numpy matplotlib scipy
```

Now install scikit-dsp-comm:

```
(marimo-dsp-comm313) PS C:\Users\mwickert>conda install -c conda-forge scikit-dsp-comm
```

> **Note**: For now I do not recommend installing `pyaudio`, as I have not tested it in `marimo`. You have your Jupyter-besed virtual environment to fall back on for `pyaudio_helper` related work, which does use `ipwidgets`

> **Note**: The above shows the use of Windows `Powershell` but your install of `miniconda` may equivalently end with you having to use the Windows `cmd` shell. On `macOS` you most likely will use the `zsh` shell and on Linux (including Windows Subsystem for Linux (WSL)) the `bash` shell.

Verify the `Marimo` Installation

```
(marimo-dsp-comm313) PS C:\Users\mwickert>marimo tutorial intro
```

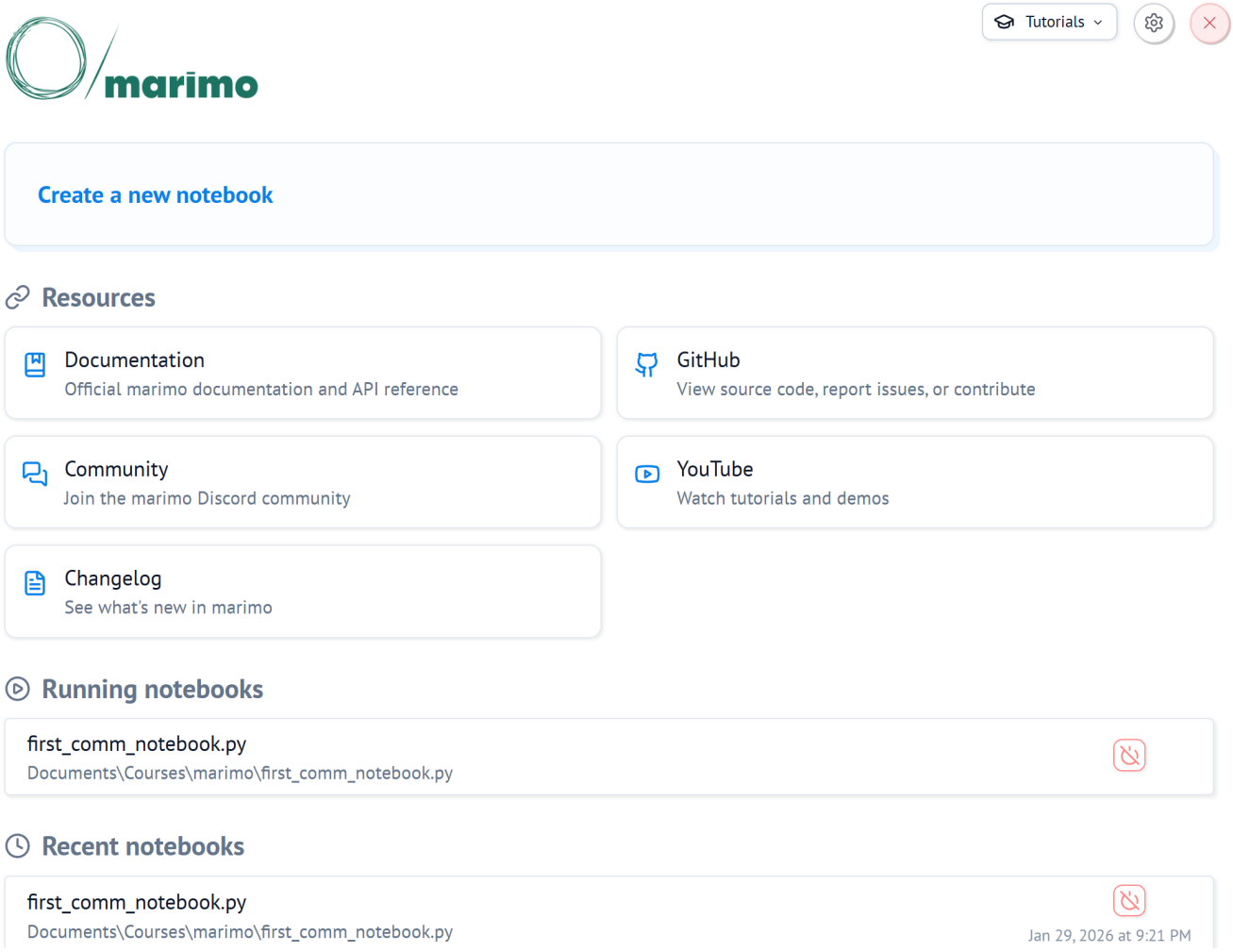
This will open a sample tutorial notebook of `marimo:

Run an `edit` Session to Create and Open Existing Notebooks

To start working with your own `marimo` notebooks run:

```
(marimo-dsp-comm313) PS C:\Users\mwickert>marimo edit
```

You will see a "front page" for doing a wide variety of `marimo` notebook related tasks:



- Create a new notebook (very near the top)
- Tutorials pulldown (very top right)
- Five *Resources* tabs (below the new notebook cell)
- Next down, *Running Notebooks* (you can stop a notebook too)
- Next down, *Recent Notebooks* (those running can be stopped too)
- Finally, *Workspace Listing* of notebooks found on your system or in cloud drives

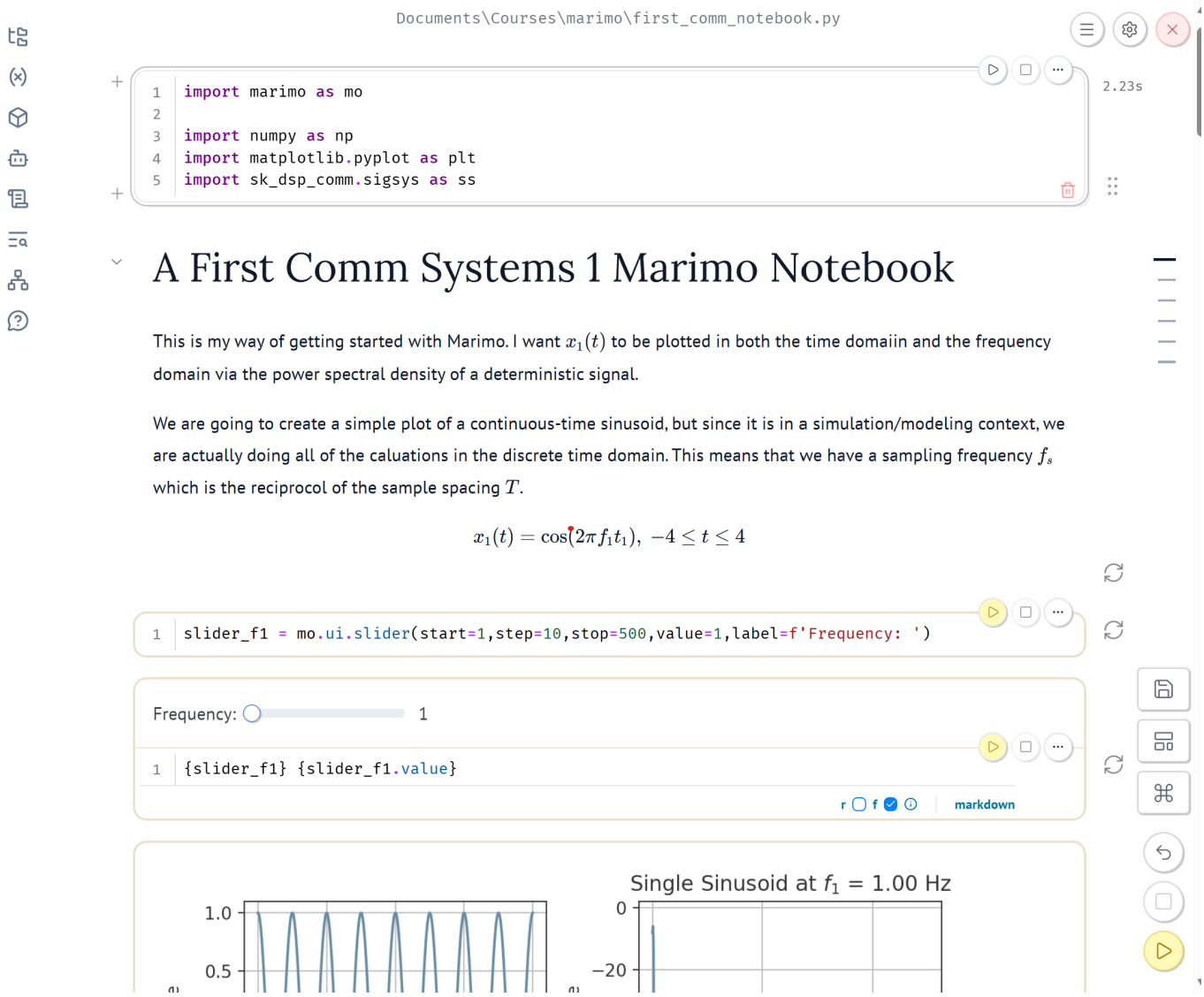
A Sample Start Cell for DSP/Comm Work

To get your notebook up and usable `import marimo as mo`, but also packages for DSP and Comm should be included. A good starting point is the following:

```
import marimo as mo

import numpy as np
import matplotlib.pyplot as plt
import scipy.signal as signal
import sk_dsp_comm.sigsys as ss
```

- Add more packages as needed
- Note that `marimo` wants you to follow the good Python practice of not importing entire packages into the global environment
- This means that all `numpy` functions, such as `arange`, `pi`, `sin`, etc. all need to be prefixed with the traditional alias name `np`
- To create plots using `matplotlib.pyplot` you prefix all plotting functions such as `plot`, `xlabel`, `grid`, etc with the alias `plt`
- Additionally after all the plotting related commands are given you need to show the plot using `plt.show()`, but when animation is present this will result in graphics jumping, so instead use `plt.gca()` (this is a `marimo` trick)



> **Note** In `marimo` you the option to have code above or below the cell output. In the screenshots here I have the output above the code, which is the way Julia ractive `pluto` notebooks work by default. Of course `jupyter` notebooks have outputs below the code.

A Simple Slider Layout using `mo.vstack()`

Here we use a layout container to vertically stack four sliders using `mo.md(f'')` f-strings that include the interactive value of each of the sliders: part1 creating and stacking the sliders, part 2 creating an interactive

plot:

```
# Define the some sliders
slider_tau1 = mo.ui.slider(start=0.5,step=0.1,stop=5,value=0.5,label=r'$\tau_1$: ')
slider_T1 = mo.ui.slider(start=-5,step=0.1,stop=5,value=0,label=f'$T_1$: ')
slider_tau2 = mo.ui.slider(start=0.5,step=0.1,stop=5,value=0.5,label=r'$\tau_2$: ')
slider_T2 = mo.ui.slider(start=-5,step=0.1,stop=5,value=0,label=r'$T_2$: ')
# mo.vstack([mo.hstack([slider_tau1,slider_tau1.value]),slider_T1,slider_tau2,slider_T2])
```

1.5

τ_1: 1.5

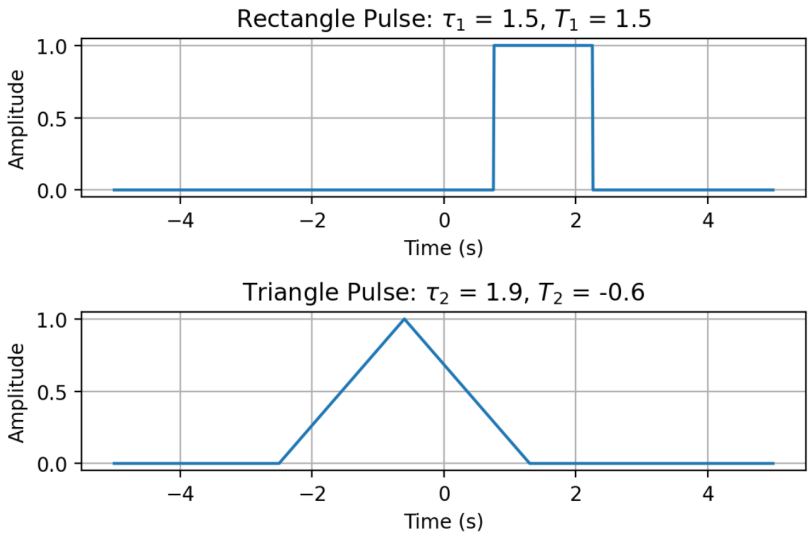
T_1: 1.5

τ_2: 1.9

T_2: -0.6

```
# Display the sliders
mo.vstack([mo.md(f"{slider_tau1} {slider_tau1.value}"),
mo.md(f"{slider_T1} {slider_T1.value}"),
mo.md(f"{slider_tau2} {slider_tau2.value}"),
mo.md(f"{slider_T2} {slider_T2.value}")])
```

- Code cells above and below in this notebook can be closed

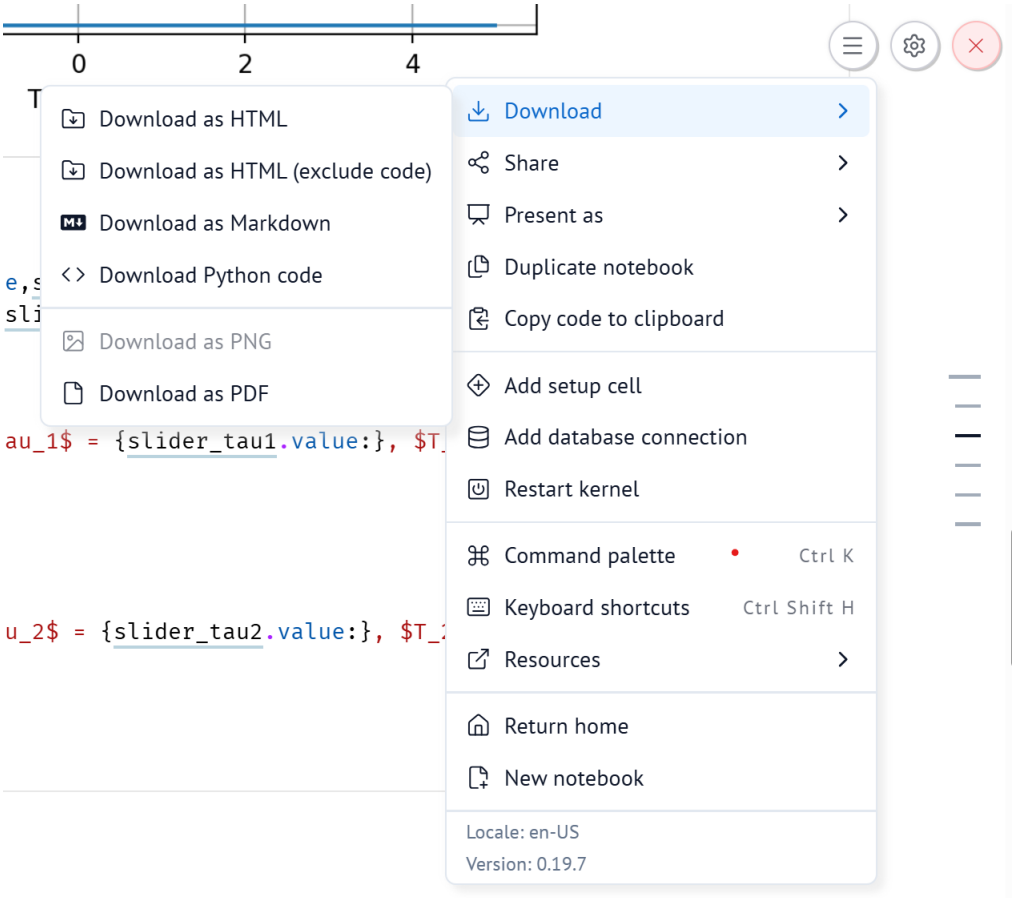



```
# Make plots
plt.figure(figsize=(6,4.0))
t = np.arange(-5,5,.01)
x_rect = ss.rect(t-slider_T1.value,slider_tau1.value)
x_tri = ss.tri(t-slider_T2.value,slider_tau2.value)
plt.subplot(211)
plt.plot(t,x_rect)
plt.grid()
plt.title(f'Rectangle Pulse: $\\tau_1$ = {slider_tau1.value:}, $T_1$ = {slider_T1.value:}')
plt.xlabel(r'Time (s)')
plt.ylabel(r'Amplitude');
plt.subplot(212)
plt.plot(t,x_tri)
plt.grid()
plt.title(f'Triangle Pulse: $\\tau_2$ = {slider_tau2.value:}, $T_2$ = {slider_T2.value:}')
plt.xlabel(r'Time (s)')
plt.ylabel(r'Amplitude');
plt.tight_layout()
plt.gca()
```

Note The use of `plt.gca()` to avoid jumping when the sliders are adjusted works as advertised. To me the intertactivity with `marimo` is not as snappy as using Pluto reactive notebooks with Julia.

Exporting to PDF

The instructions here apply to version 0.19.7. Click the *hambuger* button in the upper right:



- The download as PDF works the best on a system with a full LaTeX setup, but code cells are usually closed
- Printing a notebook to HTML first is easier but has caveats
- Good: Exporting to HTML the widgets are preserved in the HTML document and render when printed to pdf
- Good & Bad: In the current version code cells always seem to *close* when printing to pdf in say Chrome, Safari, and Edge browsers
- To resolve this you can always place a markdown cell immediately below with Python colorization set, e.g.

```
# Plot the time and frequency domains of a rect pulse
tau_ft1 = 1.5
t_ft1 = np.arange(-4,4,.001)
x_ft1 = ss.rect(t_ft1,tau=tau_ft1)
f_ft1 = np.arange(-5,5,.001)
X_ft1 =tau_ft1*np.sinc(tau_ft1*f_ft1)
# Time domain
plt.figure(figsize=(6,3))
plt.subplot(121)
plt.plot(t_ft1,x_ft1)
plt.xlabel(r'Time (s)')
plt.ylabel(r'Amplitude')
plt.title(f'Time Domain $\\tau =$ {tau_ft1:1.1f}')
```

```
# Frequency domain
plt.subplot(122)
plt.plot(f_ft1,np.abs(X_ft1))
plt.xlabel(r'Time (s)')
plt.ylabel(r'Magnitude')
plt.title(f'Frequency Domain $\\tau =$ {tau_ft1:1.1f}')
plt.tight_layout()
plt.gca()
# plt.savefig('ft_example.svg')
```

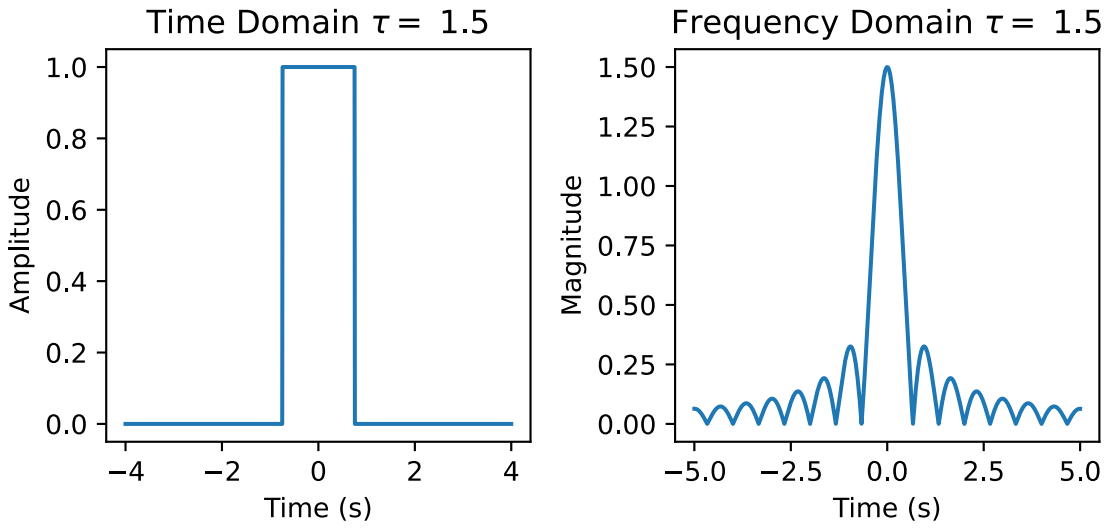
- Now in the printing of the HTML output to PDF the code cells will close and the Markdown cells containing code you want visible will indeed **be visible**, e.g., homework turn in, etc.

Typst and *Download as Markdown*

- With Download as Markdown you get a nice Markdown file that be imported into Typst
- The figures/graphics have to be dealt with separately, but you can add a single line at the bottom of each computation cell producing `matplotlib` graphics of the form:

```
plt.savefig('ft_example.svg')
```

- The above FT example will return an SVG graphics which is easily managed in Typst
- Here I shown it rendered to PDF from this Markdown file (converted to PDF) I am writing in *vs code* using the `Markdown PDF` extension:



A figure caption can be added in Typst or in Markdown