Building notebook interfaces and web apps with iPyWidgets & Voilà

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Why widgets?

- Allow students to quickly change variables and see the results
- Partially or completely hide code
- Create a interactive web app
  - E.g., a PhET-like simulation

Objectives

- Know some of the various options for creating web apps with Python
- Explain the difference between iPyWidgets and Voilà
- Use widgets to update a plot in a notebook

Outline

- Alternatives
- Fundamental concepts
- A simple example
- Your turn
  - Titration simulator
  - Particle-in-a-box
- The solutions
- Hosting

Python in a web browser

Alternatives to Jupyter

- Runs on the client's machine, not the server.
- **Brython**
  - Alternative to JavaScript for web programming.
  - Reimplementation of Python interpreter in JavaScript
- **Skulpt**
  - Interactive coding interface
  - Foundation of runestone.academy ActiveCode and Codelens.
- **PyScript**
  - Port of CPython to JavaScript.
  - Run any pure python package available on PyPi.
  - Uses micropip.
- **JupyterLite**
  - Jupyter Lab in the browser.
- **VPython**
  - Library for 3D physics simulations
  - Both client-side and notebook support
- **Dashboard frameworks**
  - Bokeh, Panel, Plotly/Dash, Streamlit, …
  - Python libraries for dashboards
  - Some have both client-side and notebook support

iPyWidgets and Voilà

Widgets and code hiding

`iPyWidgets`

- Adds interactive widgets, like buttons and sliders to you notebook.
- Documentation at ipywidgets.readthedocs.io.
- No need to install on myBinder.org or chemcompute.org.
- Can use arbitrary plotting library.
  - Explicit support for Matplotlib
- Integrated into Jupiter Notebooks.

`Voilà`

- Hides all code.
- Creates a dashboard-style display.
- Documentation at voila.readthedocs.io.
- No need to install on myBinder.org or chemcompute.org.
- No code to write or import. Just displays the contents of widgets.
- Can use other widget libraries, like Bokeh.
- Integrated into Jupiter Notebooks.

iPyWidgets Essentials

- **Input widgets**
  - Slider
  - Dropdown
  - Textbox
  - Radio Buttons
  - File upload
  - Etc.
- **Output widgets**
  - Output (misc)
  - YouTubeVideo
  - Progress
  - HTML
  - Image
  - Etc.
- **Layouts**
  - HBox
  - VBox
  - Grid
  - Tab
  - Etc.
- **Events**
  - Observer
  - Callbacks
  - Linking widgets
  - Etc.

A simple example

Sine with variable amplitude

- Plot a single sine function.
- Adjust the amplitude with a slider.

Time to try it out

- Two examples
  - Particle-in-a-box
  - Titration simulator

Installing and running notebooks with Voilà

Anaconda

Install

```
conda create --name voila
conda activate voila
conda install -c conda-forge voila jupyterlab
conda install -c conda-forge ipywidgets
conda install -c conda-forge matplotlib ipympl
```

Run

```
> voila
```

```
> jupyter-lab
```