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From notebooks to standalone web applications and dashboards.

Voilà allows you to convert a Jupyter Notebook into an interactive dashboard that allows you to share your work with others. It is secure and customizable, giving you control over what your readers experience.

For example, here’s a dashboard created with Voilà. (You can try it interactively at the following Binder link)

For more information about Voilà, see the sections below.
Voilà can be installed with the `mamba` or `conda` package manager

```
mamba install -c conda-forge voila
```

or from PyPI:

```
pip install voila
```

Once Voilà is installed, it can be used either as a Command-Line Interface, or as a Jupyter Server extension. See *Using Voilà* for information on how to use Voilà.
Voilà can be used as a standalone application, or as a Jupyter server extension. This page describes how to do each. Before you begin, make sure that you follow the steps in Installing Voilà.

The following sections cover how to use Voilà.

### 2.1 As a standalone application

Voilà can be used to run, convert, and serve a Jupyter notebook as a standalone app. This can be done via the command-line, with the following pattern:

```
voila <path-to-notebook> <options>
```

For example, to render the `bqplot` example notebook as a standalone app, run

```
git clone https://github.com/voila-dashboards/voila
cd voila
voila notebooks/bqplot.ipynb
```

Voilà displays a message when your notebook-based application is live. By default, Voilà runs at `localhost:8866`.

To serve a directory of Jupyter Notebooks, navigate to the directory you’d like to serve, then simply run `voila`:

```
cd notebooks/
voila
```

The page served by Voilà will now contain a list of any notebooks in the directory. By clicking on one, you will trigger Voilà’s conversion process. A new Jupyter kernel will be created for each notebook you click.

### 2.2 As a Jupyter server extension

You can also use Voilà from within a Jupyter server (e.g., after running `jupyter lab` or `jupyter notebook`).

**Note:** Voilà can also be used as a notebook server extension, both with the notebook server or with the `jupyter_server`.

To use Voilà within a pre-existing Jupyter server, first start the server, then go to the following URL:

```
<url-of-my-server>/voila
```
For example, if you typed `jupyter lab` and it was running at `http://localhost:8888/lab`, then Voilà would be accessed at `http://localhost:8888/voila`.

In this case, Voilà will serve the directory in which the Jupyter server was started.

### 2.3 How does Voilà work?

When Voilà is run on a notebook, the following steps occur:

1. Voilà runs the code in the notebook and collects the outputs
2. The notebook and its outputs are converted to HTML. By default, the notebook code cells are hidden.
3. This page is served either as a Tornado application, or via the Jupyter server.
4. When users access the page, the widgets on the page have access to the underlying Jupyter kernel.

### 2.4 The example notebooks

The notebooks directory contains a collection of Jupyter notebooks that can be rendered using Voilà:

- **basics.ipynb** - a notebook with interactions requiring a roundtrip to the kernel.
- **bqplot.ipynb** - uses custom Jupyter widgets such as `bqplot`.
- **dashboard.ipynb** - uses gridstack.js for the layout of each output.
- **gridspecLayout.ipynb** - uses GridspecLayout for the layout of different widgets.
- **interactive.ipynb** - makes use of ipywidget's `@interact`.
- **ipyml.ipynb** - contains custom interactive matplotlib figures using the `ipyml` widget.
- **ipyvolume.ipynb** - uses custom Jupyter widgets such as `ipyvolume`.
- **query-strings.ipynb** - uses HTTP query parameters to parametrize a notebook
- **xleaflet.ipynb** - a notebook that uses C++ kernel and interactive widgets

These examples demonstrate different interactive HTML widgets and can be used as inspiration for getting started with Voilà.

To run the example notebooks, a few additional libraries can be installed using:

```bash
conda install -c conda-forge ipywidgets ipyvolume bqplot scipy
```

Or alternatively:

```bash
conda env create
```

The examples can then be served with:

```bash
cd notebooks/
voila
```
2.5 Using third-party Widgets with Voilà

By default, Voilà doesn’t serve Jupyter Widgets installed as a classic notebook extension (nbextension).
Instead, it fallbacks to fetching the files from a CDN. This might result in an error (404) in case the custom widget has not been published to npm, or when Voilà runs in an environment without an Internet connection.
To let the Voilà standalone app serve the nbextensions, use the enable_nbextensions flag as follows:

```
voila --enable_nbextensions=True
```

When using Voilà as a server extension:

```
jupyter notebook --VoilaConfiguration.enable_nbextensions=True
```
There are many ways you can customize Voilà to control the look and feel of the dashboards you create.

### 3.1 Changing the theme

By default, Voilà uses the light theme, but you can set the theme to dark by passing the following option:

```bash
voila <path-to-notebook> --theme=dark
```

Or by passing in the query parameter `voila-theme`, e.g. a URL like `http://localhost:8867/voila/render/query-strings.ipynb?voila-theme=dark`.

The theme can also be set in the notebook metadata, under `metadata/voila/theme` by editing the notebook file manually, or using the metadata editor in for instance the classical notebook.
Voilà, Release 0.3.5

System administrators who want to disable changing the theme, can pass --VoilaConfiguration.
allow_theme_override=NO or --VoilaConfiguration.allow_theme_override=NOTEBOOK to disable
changing the theme completely, or only allow it from the notebook metadata.

Like nbconvert, Voilà supports the light and dark themes by default, but you can also use custom JupyterLab themes:

```bash
pip install jupyterlab_miami_nights
voila <path-to-notebook> --theme=jupyterlab_miami_nights
```

**Warning:** Theme are specific to the “lab” template, they will not work for the “classic” template

**Note:** Changing the theme from the notebook metadata may change in the future if this features moves to nbconvert.
3.2 Controlling the nbconvert template

Voilà uses nbconvert to convert your Jupyter Notebook into an HTML dashboard. nbconvert has a rich templating system that allows you to customize the way in which your Jupyter Notebook is converted into HTML.

By default, Voilà will render the HTML from your notebook in the same linear fashion that the notebook follows. If you’d like to use a different layout, this can be controlled by creating a new nbconvert template, registering it with Voilà, and calling it from the command-line like so:

```
voila <path-to-notebook> --template=<name-of-template>
```

For example, Voilà includes one other template that uses a Javascript library and an alternate `<div>` layout in order to let the user drag and drop cells.

For example, to use the gridstack template, use the command:

```
voila <path-to-notebook> --template=gridstack
```

Or by passing in the query parameter voila-template, e.g. a URL like http://localhost:8867/voila/render/query-strings.ipynb?voila-template=material (Note that this requires installing voila-material).

The template can also set in the notebook metadata, under metadata/voila/template by editing the notebook file manually, or using the metadata editor in for instance the classical notebook.
3.3 Creating your own template

You can create your own nbconvert template for use with Voilà. This allows you to control the look and feel of your dashboard.

In order to create your own template, first familiarize yourself with Jinja, HTML, and CSS. Each of these is used in creating custom templates. For more information, see the nbconvert templates documentation. For one example, check out the nbconvert basic HTML template.

A few example voila/nbconvert template projects are:

- https://github.com/voila-dashboards/voila-gridstack

Note: Changing the template from the notebook metadata may change in the future if this features moves to nbconvert.
• https://github.com/voila-dashboards/voila-material
• https://github.com/voila-dashboards/voila-vuetify

3.3.1 Where are Voilà templates located?

All Voilà templates are stored as folders with particular configuration/template files inside. These folders can exist in the standard Jupyter configuration locations, in a folder called `voila/templates`. For example:

```
~/.local/share/jupyter/voila/templates
~/.local/share/jupyter/voila/templates
~/.local/share/jupyter/voila/templates
```

Voilà will search these locations for a folder, one per template, where the folder name defines the template name.

3.3.2 The Voilà template structure

Within each template folder, you can provide your own nbconvert templates, static files, and HTML templates (for pages such as a 404 error). For example, here is the folder structure of the base Voilà template (called “default”):

```
tree path/to/env/share/jupyter/voila/templates/default/
  nbconvert_templates
    base.tpl
    voila.tpl
  templates
    404.html
    error.html
    page.html
    tree.html
```

To customize the nbconvert template, store it in a folder called `templatename/nbconvert_templates/voila.tpl`. In the case of the default template, we also provide a `base.tpl` that our custom template uses as a base. The name `voila.tpl` is special - you cannot name your custom nbconvert something else.

To customize the HTML page templates, store them in a folder called `templatename/templates/<name>.html`. These are files that Voilà can serve as standalone HTML (for example, the `tree.html` template defines how folders/files are displayed in localhost:8866/voila/tree). You can override the defaults by providing your own HTML files of the same name.

To configure your Voilà template, you should add a `config.json` file to the root of your template folder.

3.3.3 An example custom template

To show how to create your own custom template, let’s create our own nbconvert template. We’ll have two goals:

1. Add an `<h1>` header displaying “Our awesome template” to the Voilà dashboard.
2. Add a custom 404.html page that displays an image.

First, we’ll create a folder in `~/.local/share/jupyter/voila/templates` called `mytemplate`:

```
mkdir ~/.local/share/jupyter/voila/templates/mytemplate
```

```
cd ~/.local/share/jupyter/voila/templates/mytemplate
```
Next, we’ll copy over the base template files for Voilà, which we’ll modify:

```
cp -r path/to/env/share/jupyter/voila/templates/default/nbconvert_templates ./
cp -r path/to/env/share/jupyter/voila/templates/default/templates ./
```

We should now have a folder structure like this:

```
tree .
  nbconvert_templates
    base.tpl
    voila.tpl
  templates
    404.html
    error.html
    page.html
    tree.html
```

Now, we’ll edit `nbconvert_templates/voila.tpl` to include a custom H1 header.

As well as `templates/tree.html` to include an image.

Finally, we can tell Voilà to use this custom template the next time we use it on a Jupyter notebook by using the name of the folder in the --template parameter:

```
voila mynotebook.ipynb --template=mytemplate
```

The result should be a Voilà dashboard with your custom modifications made!

### 3.3.4 Voilà template cookiecutter

There is a Voilà template cookiecutter available to give you a running start. This cookiecutter contains some docker configuration for live reloading of your template changes to make development easier. Please refer to the [cookiecutter repo](#) for more information on how to use the Voilà template cookiecutter.

### 3.4 Adding your own static files

If you create your own theme, you may also want to define and use your own static files, such as CSS and Javascript. To use your own static files, follow these steps:

1. Create a folder along with your template (e.g., mytemplate/static/).
2. Put your static files in this template.
3. In your template file (e.g. voila.tpl), link these static files with the following path:

   ```
   {{resources.base_url}}voila/static/<path-to-static-files>
   ```

4. When you call `voila`, configure the static folder by using the --static kwarg, or by configuring --VoilaConfiguration.static_root.

Any folders / files that are inside the folder given with this configuration will be copied to {{resources.base_url}}voila/static/.

For example, if you had a CSS file called custom.css in static/css, you would link it in your template like so:
3.5 Configure Voilà for the Jupyter Server

Several pieces of voila’s functionality can be controlled when it is run. This can be done either as a part of the standalone CLI, or with the Jupyter Server. To configure voila when run by the Jupyter Server, use the following pattern when invoking the command that runs Jupyter (e.g., Jupyter Lab or Jupyter Notebook):

```bash
<jupyter-command> --VoilaConfiguration.<config-key>=<config-value>
```

For example, to control the template used by voila from within a Jupyter Lab session, use the following command when starting the server:

```bash
jupyter lab --VoilaConfiguration.template=distill
```

When users run voila by hitting the voila/ endpoint, this configuration will be used.

3.6 Serving static files

Unlike JupyterLab or the classic notebook server, voila does not serve all files that are present in the directory of the notebook. Only files that match one of the whitelists and none of the blacklist regular expression are served by Voilà:

```bash
voila mydir --VoilaConfiguration.file_whitelist="[\.*\]" \
   --VoilaConfiguration.file_blacklist="[\'private.*\', \.'\.*\.(ipynb)']"
```

Which will serve all files, except anything starting with private, or notebook files:

```bash
voila mydir --VoilaConfiguration.file_whitelist="[\.*\.(png|jpg|gif|svg|mp4|avi|ogg)]"
```

Will serve many media files, and also never serve notebook files (which is the default blacklist).

3.7 Run scripts

Voilà can run text (or script) files, by configuring how a file extension maps to a kernel language:

```bash
voila mydir --VoilaConfiguration.extension_language_mapping='{".py": "python", ".jl": "julia"}'
```

Voilà will find a kernel that matches the language specified, but can also be configured to use a specific kernel for each language:

```bash
voila mydir --VoilaConfiguration.extension_language_mapping='{".py": "python", ".jl": "julia"}"
   --VoilaConfiguration.language_kernel_mapping='{"python": "xeus-python"}'
```

In this case it will use the xeus-python kernel to run .py files.
Note that the script will be executed as notebook with a single cell, meaning that only the last expression will be printed as output. Use the Jupyter display mechanism to output any text or rich output such as Jupyter widgets. For Python this would be a call to IPython.display.display.

Using Jupyter text is another way to support script files. After installing jupyter text, Voilà will see script files as if they are notebooks, and requires no extra configuration.

### 3.8 Cull idle kernels

Voilà starts a new Jupyter kernel every time a notebook is rendered to the user. In some situations, this can lead to a higher memory consumption.

The Jupyter Server exposes several options that can be used to terminate kernels that are not active anymore. They can be configured using the Voilà standalone app:

```bash
voila --MappingKernelManager.cull_interval=60 --MappingKernelManager.cull_idle_timeout=120
```

The server will periodically check for idle kernels, in this example every 60 seconds, and cull them if they have been idle for more than 120 seconds.

The same parameters apply when using Voilà as a server extension:

```bash
jupyter notebook --MappingKernelManager.cull_interval=60 --MappingKernelManager.cull_idle_timeout=120
```

There is also the `MappingKernelManager.cull_busy` and `MappingKernelManager.cull_connected` options to cull busy kernels and kernels with an active connection.

For more information about these options, check out the Jupyter Server documentation.

### 3.9 Preheated kernels

Since Voilà needs to start a new jupyter kernel and execute the requested notebook in this kernel for every connection, this would lead to a long waiting time before the widgets can be displayed in the browser. To reduce this waiting time, especially for the heavy notebooks, users can activate the preheating kernel option of Voilà, this option will enable two features:

- A pool of kernels is started for each notebook and kept in standby, then the notebook is executed in every kernel of its pool. When a new client requests a kernel, the preheated kernel in this pool is used and another kernel is started asynchronously to refill the pool.

- The HTML version of the notebook is rendered in each preheated kernel and stored, when a client connects to Voilà, under some conditions, the cached HTML is served instead of re-rendering the notebook.

The preheating kernel option works with any kernel manager, it is deactivated by default, re-activate it by setting `preheat_kernel = True`. For example, with this command, for each notebook Voilà started with, a pool of 5 kernels is created and will be used for new connections.

```bash
voila --preheat_kernel=True --pool_size=5
```

If the pool size does not match the user’s requirements, or some notebooks need to use environment variables…, additional settings are needed. The easiest way to change these settings is to provide a file named `voila.json` in the same folder containing the notebooks. Settings for preheating kernel ( list of notebooks does not need preheated
kernels, number of kernels in pool, refilling delay, environment variables for starting kernel...) can be set under the VoilaKernelManager class name.

Here is an example of settings with explanations for preheating kernel option.

```json
# voila.json
{
    "VoilaConfiguration": {
        # Activate or deactivate preheat kernel option.
        "preheat_kernel": true
    },
    "VoilaKernelManager": {
        # A list of notebook name or regex patterns to exclude notebooks from using preheat kernel.
        "preheat_blacklist": [
            "notebook-does-not-need-preheat.ipynb",
            "^.*foo.*$",
            ...
        ],
        # Configuration for kernel pools
        "kernel_pools_config": {
            # Setting for `voila.ipynb` notebook
            "voila.ipynb": {
                "pool_size": 3,
                # Size of pool
                "kernel_env_variables": {
                    # The environment variables used to start kernel
                    "foo2": "bar2"
                }
            },
            # Setting for `test/sub-voila.ipynb` notebook
            "test/sub-voila.ipynb": {
                "pool_size": 1
            },
            ...
            # If a notebook does not have setting, it will use default setting
            "default": {
                "pool_size": 2,
                "kernel_env_variables": {
                    "foo": "bar"
                }
            },
            # Delay time in second before filling the kernel pool.
            "fill_delay": 0
        }
    }
}
```

Notebook HTML will be pre-rendered with template and theme defined in VoilaConfiguration or notebook metadata. The preheated kernel and cached HTML are used if these conditions are matched:

- There is an available preheated kernel in the kernel pool.
- If user overrides the template/theme with query string, it must match the template/theme used to pre-render the notebook.

If the kernel pool is empty or the request does not match these conditions, Voila will fail back to start a normal kernel.
and render the notebook as usual.

### 3.9.1 Partially pre-render notebook

To benefit the acceleration of preheating kernel mode, the notebooks need to be pre-rendered before users actually connect to Voilà. But in many real-world cases, the notebook requires some user-specific data to render correctly the widgets, which makes pre-rendering impossible. To overcome this limit, Voilà offers a feature to treat the most used method for providing user data: the URL query string.

In normal mode, Voilà users can get the *query string* at runtime through the `QUERY_STRING` environment variable:

```python
import os
query_string = os.getenv('QUERY_STRING')
```

In preheating kernel mode, users can prepend with `wait_for_request` from `voila.utils`:

```python
import os
from voila.utils import wait_for_request
wait_for_request()
query_string = os.getenv('QUERY_STRING')
```

`wait_for_request` will pause the execution of the notebook in the preheated kernel at this cell and wait for an actual user to connect to Voilà, set the request info environment variables and then continue the execution of the remaining cells.

If the Voilà websocket handler is not started with the default protocol (ws), the default IP address (127.0.0.1) the default port (8866) or with url suffix, users need to provide these values through the environment variables `VOILA_WS_PROTOCOL`, `VOILA_APP_IP`, `VOILA_APP_PORT` and `VOILA_WS_BASE_URL`. The easiest way is to set these variables in the `voila.json` configuration file, for example:

```json
# voila.json
{
  ...
  "VoilaKernelManager": {
    "kernel_pools_config": {
      "foo.ipynb": {
        "kernel_env_variables": {
          "VOILA_APP_IP": "192.168.1.1",
          "VOILA_APP_PORT": "6789",
          "VOILA_WS_PROTOCOL": "wss"
        }
      },
    },
  },
  ...
}
```
3.10 Hiding output and code cells based on cell tags

Voilà uses nbconvert under the hood to render the notebooks so we can benefit from some of its advanced functionalities to hide code and output cells based on cell tags.

To hide the cell output for every cell in your notebook that has been tagged (how to tag) with “hide” in Voilà:

```
voila --TagRemovePreprocessor.remove_all_outputs_tags='{"hide"}' your_notebook.ipynb
```

To hide both the code cell and the output cell (if any) for every cell that has been tagged with “hide”:

```
voila --TagRemovePreprocessor.remove_cell_tags='{"hide"}' your_notebook.ipynb
```

You can use any tag you want but be sure to use the same tag name in the Voilà command. And please note that this functionality will only hide the cells in Voilà but will not prevent them from being executed.

3.11 Cell execution timeouts

By default, Voilà does not have an execution timeout, meaning there is no limit for how long it takes for Voilà to execute and render your notebook. If you have potentially long-running cells, you may wish to set a cell execution timeout so that users of your dashboard will get an error if it takes longer than expected to execute the notebook. For example:

```
voila --VoilaExecutor.timeout=30 your_notebook.ipynb
```

With this setting, if any cell takes longer than 30 seconds to run, a TimeoutError will be raised. You can further customize this behavior using the VoilaExecutor.timeout_func and VoilaExecutor.interrupt_on_timeout options.
The deployment docs are split up in two parts. First there is the general section, which should always be followed. Then there is a cloud service provider specific section of which one provider should be chosen.

If you are not sure where to deploy your app, we suggest Binder or Heroku. You can test deploying and serving your app without having to enter any credit card details, and with very little prior experience of deployments.

### 4.1 Setup an example project

1. Create a project directory of notebooks you wish to display. For this tutorial we will clone Voilà and treat the notebooks folder as our project root.

    ```bash
    git clone git@github.com:voila-dashboards/voila.git
    cd voila/notebooks/
    ``

2. Add a requirements.txt file to the project directory. This file should contain all the Python dependencies your Voilà app needs to run. For this tutorial we will copy the contents of the environment.yml of Voilà. We omit xleaflet and xeus-cling because these require extra work that is beyond the scope of this guide.

    ```
bqplot
ipyml
ipyvolume
scipy
voila
    ```

### 4.2 Cloud Service Providers

#### 4.2.1 Deployment on Binder

Binder is one of the most accessible ways to deploy Voilà applications. The service is available at [mybinder.org](https://mybinder.org) and is increasingly being used for reproducible research, making it an excellent fit for deploying Voilà applications.

1. Make sure the repository is publicly available (on GitHub, Gitlab or as a gist).

2. Follow [this guide](#) to prepare the repository. For simple deployments, steps listed in *Setup an example project* will be sufficient.

**Note:** Binder also supports `environment.yml` files and conda environments.
3. Go to mybinder.org and enter the URL of the repository.

4. In Path to a notebook file, select URL and use the Voilà endpoint: voila/render/path/to/notebook.ipynb

5. Click Launch.

6. Binder will trigger a new build if this is the first launch (or if there has been new changes since the last build). This might take a few minutes to complete. If an image is already available, the server will be able to start within a few seconds.

Customizing Voilà on Binder

To specify different options (such as the theme and template), create a jupyter_config.json file at the root of the repository with the following content:

```json
{
   "VoilaConfiguration": {
      "theme": "dark",
      "template": "gridstack"
   }
}
```

An example can be found in the voila-demo repository.

### 4.2.2 Deployment on Heroku

Heroku.com is an attractive option if you want to try out deployment for free. You have limited computing hours, however the app will also automatically shutdown if it is idle.

The general steps for deployment at Heroku can be found here. High level instructions, specific to Voilà can be found below:

1. Follow the steps of the official documentation to install the heroku cli and login on your machine.

2. Add a file named runtime.txt to the project directory with a valid Python runtime:

   ```
   python-3.9.9
   ```

3. Add a file named Procfile to the project directory with the following content if you want to show all notebooks:

   ```
   web: voila --port=$PORT --no-browser
   ```

   Or the following if you only want to show one notebook:

   ```
   web: voila --port=$PORT --no-browser your_notebook.ipynb
   ```

4. Initialize your git repo and commit your code. At minimum you need to commit your notebooks, requirements.txt, runtime.txt, and the Procfile.

   ```
   git init
   git add <your-files>
   git commit -m "my message"
   ```

5. Create an Heroku instance and push the code.
6. Open your web app

```
heroku open
```

To resolve issues, it is useful to see the logs of your application. You can do this by running:

```
heroku logs --tail
```

### 4.2.3 Deployment on Google App Engine

You can deploy on Google App Engine in a “flexible” environment. This means that the underlying machine will always run. This is more expensive than a “standard” environment, which is similar to Heroku’s free option. However, Google App Engine’s “standard” environment does not support websockets, which is a requirement for voila.

The general steps for deployment at Google App Engine can be found here. High level instructions specific to Voilà can be found below:

1. Follow the “Before you begin steps” from the official documentation to create your account, project and App Engine app.
2. Add an app.yaml file to the project directory with the following content:

   ```yaml
   runtime: python
   env: flex
   runtime_config:
     python_version: 3
   entrypoint: voila --port=$PORT --no-browser
   ```

3. Edit the last line if you want to show only one notebook

   ```
   entrypoint: voila --port=$PORT --no-browser your_notebook.ipynb
   ```

4. Deploy your app

   ```
gcloud app deploy
```

5. Open your app

   ```
gcloud app browse
```

### 4.3 Running Voilà on a private server

#### 4.3.1 Prerequisites

- A server running Ubuntu 18.04 (or later) with root access.
- Ability to SSH into the server and run commands from the prompt.
- The public IP address of the server.
- A domain name pointing to the IP address of the server.

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4.3.2 Steps

1. SSH into the server:

   ```bash
   ssh ubuntu@<ip-address>
   ```

2. Install nginx:

   ```bash
   sudo apt install nginx
   ```

3. To check that nginx is correctly installed:

   ```bash
   sudo systemctl status nginx
   ```

4. Create the file `/etc/nginx/sites-enabled/yourdomain.com` with the following content:

   ```bash
   server {
       listen 80;
       server_name yourdomain.com;
       proxy_buffering off;
       location / {
           proxy_pass http://localhost:8866;
           proxy_set_header Host $host;
           proxy_set_header X-Real-IP $remote_addr;
           proxy_set_header X-Forwarded-For $proxy_add_x_forwarded_for;
           proxy_http_version 1.1;
           proxy_set_header Upgrade $http_upgrade;
           proxy_set_header Connection "upgrade";
           proxy_read_timeout 86400;
       }

       client_max_body_size 100M;
       error_log /var/log/nginx/error.log;
   }
   ```

5. Enable and start the nginx service:

   ```bash
   sudo systemctl enable nginx.service
   sudo systemctl start nginx.service
   ```

6. Install pip:

   ```bash
   sudo apt update && sudo apt install python3-pip
   ```

7. Follow the instructions in Setup an example project, and install the dependencies:

   ```bash
   sudo python3 -m pip install -r requirements.txt
   ```

8. Create a new systemd service for running Voilà in `/usr/lib/systemd/system/voila.service`. The service will ensure Voilà is automatically restarted on startup:

   ```ini
   [Unit]
   Description=Voila
   ```
In this example Voilà is started with `voila --no-browser voila/notebooks/basics.ipynb` to serve a single notebook. You can edit the command to change this behavior and the notebooks Voilà is serving.

9. Enable and start the `voila` service:

```
sudo systemctl enable voila.service
sudo systemctl start voila.service
```

**Note:** To check the logs for Voilà:

```
journalctl -u voila.service
```

10. Now go to `yourdomain.com` to access the Voilà application.

### 4.3.3 Enable HTTPS with Let's Encrypt

1. Install `certbot`:

```
sudo add-apt-repository ppa:certbot/certbot
sudo apt update
sudo apt install python-certbot-nginx
```

2. Obtain the certificates from Let's Encrypt. The `--nginx` flag will edit the nginx configuration automatically:

```
sudo certbot --nginx -d yourdomain.com
```

3. `/etc/nginx/sites-enabled/yourdomain.com` should now contain a few more entries:

```
$ cat /etc/nginx/sites-enabled/yourdomain.com

...  
listen 443 ssl; # managed by Certbot
ssl_certificate /etc/letsencrypt/live/yourdomain.com/fullchain.pem; #
    managed by Certbot
ssl_certificate_key /etc/letsencrypt/live/yourdomain.com/privkey.pem; #
    managed by Certbot
include /etc/letsencrypt/options-ssl-nginx.conf; # managed by Certbot
ssl_dhparam /etc/letsencrypt/ssl-dhparams.pem; # managed by Certbot
...
```
4. Visit yourdomain.com to access the Voilà applications over HTTPS.

5. To automatically renew the certificates (they expire after 90 days), open the crontab file:

```
crontab -e
```

And add the following line:

```
0 12 * * * /usr/bin/certbot renew --quiet
```

For more information, you can also follow the guide on the nginx blog.

## 4.4 Sharing Voilà applications with ngrok

ngrok is a useful tool to expose local servers to the public internet over secure tunnels. It can be used to share Voilà applications served by a local instance of Voilà.

The main use case for using Voilà with ngrok is to quickly share a notebook as an interactive application without having to deploy to external hosting.

**Warning:** Don’t forget to exercise caution before exposing local apps and data to the public over the internet. While Voilà does not permit arbitrary code execution, be aware that sensitive information could be exposed, depending on the content and the logic of the notebook.

It’s good practice to keep the ngrok tunnel connection short-lived, and limit its use to quick sharing purposes.

### 4.4.1 Setup ngrok

To setup ngrok, follow the Download and setup ngrok guide.

### 4.4.2 Sharing Voilà applications

1. Start Voilà locally: `voila --no-browser my_notebook.ipynb`
2. In a new terminal window, start ngrok: `ngrok http 8866`
3. Copy the link from the ngrok terminal window. The links looks like the following: `8bb6fded.ngrok.io`
4. Send the link
5. When using the ngrok link, the requests will be forwarded to your local instance of Voilà.
Voilà is a subproject of Project Jupyter and subject to the Jupyter governance and Code of conduct.

5.1 General Guidelines

For general documentation about contributing to Jupyter projects, see the Project Jupyter Contributor Documentation.

5.2 Community

The Voilà team organizes public video meetings. The schedule for future meetings and minutes of past meetings can be found on our team compass

5.3 Setting up a development environment

First, you need to fork the project. Then setup your environment:

```
# create a new conda environment
conda create -n voila -c conda-forge notebook jupyterlab nodejs yarn pip
conda activate voila

# download voila from your GitHub fork
git clone https://github.com/<your-github-username>/voila.git

# install JS dependencies and build js assets
cd voila
yarn install

# install Voilà in editable mode
python -m pip install -e .
```
5.4 Run Voilà

To start Voilà, run:

```
voila
```

or

```
python -m voila
```

This will open a new browser tab at [http://localhost:8866/](http://localhost:8866/).

When making changes to the frontend side of Voilà, open a new terminal window and run:

```
cd packages/voila/
npm run watch
```

Then reload the browser tab.

**Note**: the notebooks directory contains some examples that can be run with Voilà. Checkout the instructions in the user guide for details on how to run them.

5.5 Extensions

5.5.1 Server extension

To manually enable the classic notebook server extension:

```
jupyter serverextension enable voila --sys-prefix
```

For Jupyter Server:

```
jupyter server extension enable voila.server_extension --sys-prefix
```

This makes Voilà available as a server extension: [http://localhost:8888/voila/tree](http://localhost:8888/voila/tree).

5.5.2 Notebook extension

To install the notebook extension:

```
jupyter nbextension install voila --sys-prefix --py
jupyter nbextension enable voila --sys-prefix --py
```
5.5.3 JupyterLab extension

Node.js is required and can be installed with conda:

```bash
conda install -c conda-forge nodejs
```

The JupyterLab extension requires the server extension to be enabled. This can be done by running:

```bash
jupyter serverextension enable voila --sys-prefix
```

You can verify if the server extension is enabled by running:

```bash
jupyter serverextension list
```

If you use Jupyter Server:

```bash
jupyter server extension enable voila --sys-prefix
```

You can verify if the server extension is enabled by running:

```bash
jupyter server extension list
```

The JupyterLab extension is developed as a prebuilt extension using the new distribution system added in JupyterLab 3.0. To setup the development environment:

```bash
# install the package in development mode
python -m pip install -e .

# link your development version of the extension with JupyterLab
jupyter labextension develop . --overwrite

# build the lab extension
jlpm run build --scope @voila-dashboards/jupyterlab-preview

# it is also possible to start in watch mode to pick up changes automatically
jlpm run watch
```

5.5.4 Frontend Packages

The Voilà repository consists of several packages such as the Voilà frontend and the JupyterLab extension.

It follows a monorepo structure and uses lerna to streamline the workflow.

To build all the frontend packages at once, run the following commands:

```bash
# install dependencies
jlpm

# build the packages
jlpm run build
```

This will run the build script in each of the packages.

Using this structure, packages can easily be linted and follow the same code style and conventions used in other Jupyter projects. To lint the packages:
# install dependencies
jlpm

# run ESLint
jlpm run eslint

# run prettier
jlpm run prettier

## 5.6 Tests

Install the test dependencies

```
python -m pip install -e ".[test]"
```

Enable the Jupyter server extension:

```
jupyter server extension enable voila.server_extension --sys-prefix
```

Running the tests locally also requires the `test_template` and `skip_template` to be installed:

```
python -m pip install ./tests/test_template ./tests/skip_template
```

Finally, to run the tests:

```
python -m pytest
```

## 5.7 Editing templates

The default template files are located in the folder `share/jupyter/voila/templates/default`. They are automatically picked up when running Voilà in development mode.

After editing the templates, reload the browser tab to see the changes.