
Jupyter Notebook Documentation


Release 7.0.0a5

<https://jupyter.org>

Sep 26, 2022

CONTENTS








- 1 User Documentation 3**
 - 1.1 The Jupyter Notebook 3
 - 1.2 User interface components 9
 - 1.3 Notebook Examples 12
 - 1.4 What to do when things go wrong 47
 - 1.5 Changelog 50
- 2 Configuration 89**
 - 2.1 Configuration Overview 89
 - 2.2 Extending the Notebook 90
- 3 Contributor 91**
 - 3.1 Contributing to Jupyter Notebook 91
 - 3.2 Developer FAQ 93



Running Code

Last Checkpoint: 10 months ago

File Edit View Run Kernel Settings Help


Markdown

Interface Python 3 (ipykernel)

Running Code

First and foremost, the Jupyter Notebook is an interactive environment for writing and running code. The notebook is capable of running code in a wide range of languages. However, each notebook is associated with a single kernel. This notebook is associated with the IPython kernel, therefore runs Python code.

Code cells allow you to enter and run code

Run a code cell using `Shift-Enter` or pressing the  button in the toolbar above:

```
[1]: a = 10
```


```
[2]: print(a)
```

```
10
```

There are two other keyboard shortcuts for running code:

- `Alt-Enter` runs the current cell and inserts a new one below.
- `Ctrl-Enter` run the current cell and enters command mode.

Managing the Kernel

Code is run in a separate process called the Kernel. The Kernel can be interrupted or restarted. Try running the following cell and then hit the  button in the toolbar above.

```
[3]: import time
time.sleep(10)
```

If the Kernel dies you will be prompted to restart it. Here we call the low-level system `libc.time` routine with the wrong argument via `ctypes` to segfault the Python interpreter:

- [Installation](#)
- [Starting the Notebook](#)

USER DOCUMENTATION

1.1 The Jupyter Notebook

1.1.1 Introduction

The notebook extends the console-based approach to interactive computing in a qualitatively new direction, providing a web-based application suitable for capturing the whole computation process: developing, documenting, and executing code, as well as communicating the results. The Jupyter notebook combines two components:

A web application: a browser-based tool for interactive authoring of documents which combine explanatory text, mathematics, computations and their rich media output.

Notebook documents: a representation of all content visible in the web application, including inputs and outputs of the computations, explanatory text, mathematics, images, and rich media representations of objects.

See also:

See the [installation guide](#) on how to install the notebook and its dependencies.

Main features of the web application

- In-browser editing for code, with automatic syntax highlighting, indentation, and tab completion/introspection.
- The ability to execute code from the browser, with the results of computations attached to the code which generated them.
- Displaying the result of computation using rich media representations, such as HTML, LaTeX, PNG, SVG, etc. For example, publication-quality figures rendered by the [matplotlib](#) library, can be included inline.
- In-browser editing for rich text using the [Markdown](#) markup language, which can provide commentary for the code, is not limited to plain text.
- The ability to easily include mathematical notation within markdown cells using LaTeX, and rendered natively by [MathJax](#).

Notebook documents

Notebook documents contains the inputs and outputs of an interactive session as well as additional text that accompanies the code but is not meant for execution. In this way, notebook files can serve as a complete computational record of a session, interleaving executable code with explanatory text, mathematics, and rich representations of resulting objects. These documents are internally [JSON](#) files and are saved with the `.ipynb` extension. Since JSON is a plain text format, they can be version-controlled and shared with colleagues.

Notebooks may be exported to a range of static formats, including HTML (for example, for blog posts), reStructuredText, LaTeX, PDF, and slide shows, via the [nbconvert](#) command.

Furthermore, any `.ipynb` notebook document available from a public URL can be shared via the Jupyter Notebook Viewer `<nbviewer>`. This service loads the notebook document from the URL and renders it as a static web page. The results may thus be shared with a colleague, or as a public blog post, without other users needing to install the Jupyter notebook themselves. In effect, nbviewer is simply [nbconvert](#) as a web service, so you can do your own static conversions with nbconvert, without relying on nbviewer.

See also:

[Details on the notebook JSON file format](#)

Notebooks and privacy

Because you use Jupyter in a web browser, some people are understandably concerned about using it with sensitive data. However, if you followed the standard [install instructions](#), Jupyter is actually running on your own computer. If the URL in the address bar starts with `http://localhost:` or `http://127.0.0.1:`, it's your computer acting as the server. Jupyter doesn't send your data anywhere else—and as it's open source, other people can check that we're being honest about this.

You can also use Jupyter remotely: your company or university might run the server for you, for instance. If you want to work with sensitive data in those cases, talk to your IT or data protection staff about it.

We aim to ensure that other pages in your browser or other users on the same computer can't access your notebook server. See the [security documentation](#) for more about this.

1.1.2 Starting the notebook server

You can start running a notebook server from the command line using the following command:

```
jupyter notebook
```

This will print some information about the notebook server in your console, and open a web browser to the URL of the web application (by default, `http://127.0.0.1:8888`).

The landing page of the Jupyter notebook web application, the **dashboard**, shows the notebooks currently available in the notebook directory (by default, the directory from which the notebook server was started).

You can create new notebooks from the dashboard with the **New Notebook** button, or open existing ones by clicking on their name. You can also drag and drop `.ipynb` notebooks and standard `.py` Python source code files into the notebook list area.

When starting a notebook server from the command line, you can also open a particular notebook directly, bypassing the dashboard, with `jupyter notebook my_notebook.ipynb`. The `.ipynb` extension is assumed if no extension is given.

When you are inside an open notebook, the *File | Open...* menu option will open the dashboard in a new browser tab, to allow you to open another notebook from the notebook directory or to create a new notebook.

Note: You can start more than one notebook server at the same time, if you want to work on notebooks in different directories. By default the first notebook server starts on port 8888, and later notebook servers search for ports near that one. You can also manually specify the port with the `--port` option.

Creating a new notebook document

A new notebook may be created at any time, either from the dashboard, or using the *File* → *New* menu option from within an active notebook. The new notebook is created within the same directory and will open in a new browser tab. It will also be reflected as a new entry in the notebook list on the dashboard.

Opening notebooks

An open notebook has **exactly one** interactive session connected to a kernel, which will execute code sent by the user and communicate back results. This kernel remains active if the web browser window is closed, and reopening the same notebook from the dashboard will reconnect the web application to the same kernel. In the dashboard, notebooks with an active kernel have a *Shutdown* button next to them, whereas notebooks without an active kernel have a *Delete* button in its place.

Other clients may connect to the same kernel. When each kernel is started, the notebook server prints to the terminal a message like this:

```
[JupyterNotebookApp] Kernel started: 87f7d2c0-13e3-43df-8bb8-1bd37aaf3373
```

This long string is the kernel's ID which is sufficient for getting the information necessary to connect to the kernel. If the notebook uses the IPython kernel, you can also see this connection data by running the `%connect_info` magic, which will print the same ID information along with other details.

You can then, for example, manually start a Qt console connected to the *same* kernel from the command line, by passing a portion of the ID:

```
$ jupyter qtconsole --existing 87f7d2c0
```

Without an ID, `--existing` will connect to the most recently started kernel.

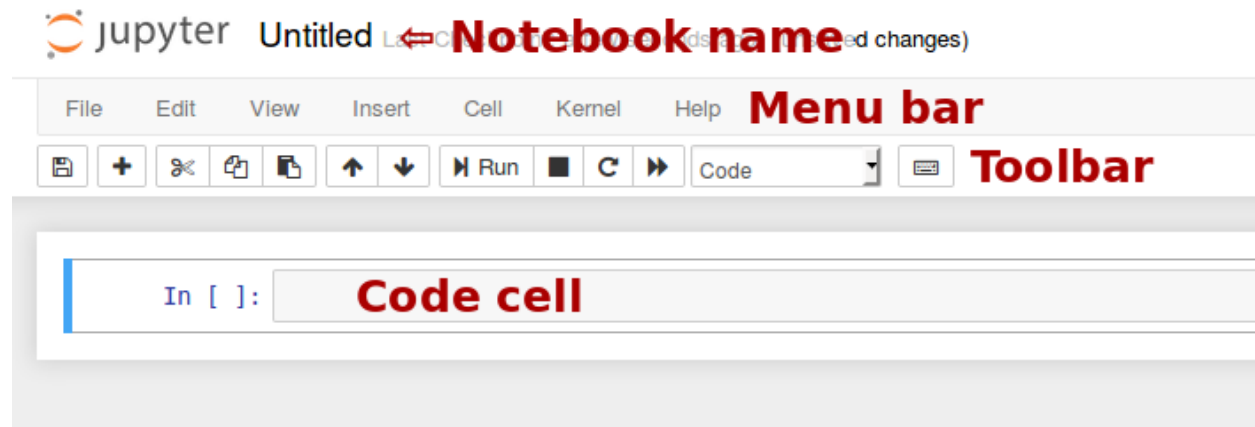
With the IPython kernel, you can also run the `%qtconsole` magic in the notebook to open a Qt console connected to the same kernel.

See also:

[Decoupled two-process model](#)

1.1.3 Notebook user interface

When you create a new notebook document, you will be presented with the **notebook name**, a **menu bar**, a **toolbar** and an empty **code cell**.



Notebook name: The name displayed at the top of the page, next to the Jupyter logo, reflects the name of the `.ipynb` file. Clicking on the notebook name brings up a dialog which allows you to rename it. Thus, renaming a notebook from “Untitled0” to “My first notebook” in the browser, renames the `Untitled0.ipynb` file to `My first notebook.ipynb`.

Menu bar: The menu bar presents different options that may be used to manipulate the way the notebook functions.

Toolbar: The tool bar gives a quick way of performing the most-used operations within the notebook, by clicking on an icon.

Code cell: the default type of cell; read on for an explanation of cells.

1.1.4 Structure of a notebook document

The notebook consists of a sequence of cells. A cell is a multiline text input field, and its contents can be executed by using `Shift-Enter`, or by clicking either the “Play” button the toolbar, or *Cell, Run* in the menu bar. The execution behavior of a cell is determined by the cell’s type. There are three types of cells: **code cells**, **markdown cells**, and **raw cells**. Every cell starts off being a **code cell**, but its type can be changed by using a drop-down on the toolbar (which will be “Code”, initially), or via *keyboard shortcuts*.

For more information on the different things you can do in a notebook, see the [collection of examples](#).

Code cells

A *code cell* allows you to edit and write new code, with full syntax highlighting and tab completion. The programming language you use depends on the *kernel*, and the default kernel (IPython) runs Python code.

When a code cell is executed, code that it contains is sent to the kernel associated with the notebook. The results that are returned from this computation are then displayed in the notebook as the cell’s *output*. The output is not limited to text, with many other possible forms of output are also possible, including `matplotlib` figures and HTML tables (as used, for example, in the `pandas` data analysis package). This is known as IPython’s *rich display* capability.

See also:

[Rich Output example notebook](#)

Markdown cells

You can document the computational process in a literate way, alternating descriptive text with code, using *rich text*. In IPython this is accomplished by marking up text with the Markdown language. The corresponding cells are called *Markdown cells*. The Markdown language provides a simple way to perform this text markup, that is, to specify which parts of the text should be emphasized (italics), bold, form lists, etc.

If you want to provide structure for your document, you can use markdown headings. Markdown headings consist of 1 to 6 hash # signs # followed by a space and the title of your section. The markdown heading will be converted to a clickable link for a section of the notebook. It is also used as a hint when exporting to other document formats, like PDF.

When a Markdown cell is executed, the Markdown code is converted into the corresponding formatted rich text. Markdown allows arbitrary HTML code for formatting.

Within Markdown cells, you can also include *mathematics* in a straightforward way, using standard LaTeX notation: $...$ for inline mathematics and
$$...$$
 for displayed mathematics. When the Markdown cell is executed, the LaTeX portions are automatically rendered in the HTML output as equations with high quality typography. This is made possible by [MathJax](#), which supports a [large subset](#) of LaTeX functionality

Standard mathematics environments defined by LaTeX and AMS-LaTeX (the `amsmath` package) also work, such as `\begin{equation}...\end{equation}`, and `\begin{align}...\end{align}`. New LaTeX macros may be defined using standard methods, such as `\newcommand`, by placing them anywhere *between math delimiters* in a Markdown cell. These definitions are then available throughout the rest of the IPython session.

See also:

[Working with Markdown Cells](#) example notebook

Raw cells

Raw cells provide a place in which you can write *output* directly. Raw cells are not evaluated by the notebook. When passed through `nbconvert`, raw cells arrive in the destination format unmodified. For example, you can type full LaTeX into a raw cell, which will only be rendered by LaTeX after conversion by `nbconvert`.

1.1.5 Basic workflow

The normal workflow in a notebook is, then, quite similar to a standard IPython session, with the difference that you can edit cells in-place multiple times until you obtain the desired results, rather than having to rerun separate scripts with the `%run` magic command.

Typically, you will work on a computational problem in pieces, organizing related ideas into cells and moving forward once previous parts work correctly. This is much more convenient for interactive exploration than breaking up a computation into scripts that must be executed together, as was previously necessary, especially if parts of them take a long time to run.

To interrupt a calculation which is taking too long, use the *Kernel, Interrupt* menu option, or the `i, i` keyboard shortcut. Similarly, to restart the whole computational process, use the *Kernel, Restart* menu option or `0, 0` shortcut.

A notebook may be downloaded as a `.ipynb` file or converted to a number of other formats using the menu option *File, Download as*.

See also:

[Running Code in the Jupyter Notebook](#) example notebook

[Notebook Basics](#) example notebook

Keyboard shortcuts

All actions in the notebook can be performed with the mouse, but keyboard shortcuts are also available for the most common ones. The essential shortcuts to remember are the following:

- **Shift-Enter: run cell**
Execute the current cell, show any output, and jump to the next cell below. If **Shift-Enter** is invoked on the last cell, it makes a new cell below. This is equivalent to clicking the *Cell, Run* menu item, or the Play button in the toolbar.
- **Esc: Command mode**
In command mode, you can navigate around the notebook using keyboard shortcuts.
- **Enter: Edit mode**
In edit mode, you can edit text in cells.

For the full list of available shortcuts, click *Help, Keyboard Shortcuts* in the notebook menus.

1.1.6 Plotting

One major feature of the Jupyter notebook is the ability to display plots that are the output of running code cells. The IPython kernel is designed to work seamlessly with the [matplotlib](#) plotting library to provide this functionality. Specific plotting library integration is a feature of the kernel.

1.1.7 Installing kernels

For information on how to install a Python kernel, refer to the [IPython install page](#).

The Jupyter wiki has a long list of [Kernels for other languages](#). They usually come with instructions on how to make the kernel available in the notebook.

1.1.8 Trusting Notebooks

To prevent untrusted code from executing on users' behalf when notebooks open, we store a signature of each trusted notebook. The notebook server verifies this signature when a notebook is opened. If no matching signature is found, Javascript and HTML output will not be displayed until they are regenerated by re-executing the cells.

Any notebook that you have fully executed yourself will be considered trusted, and its HTML and Javascript output will be displayed on load.

If you need to see HTML or Javascript output without re-executing, and you are sure the notebook is not malicious, you can tell Jupyter to trust it at the command-line with:

```
$ jupyter trust mynotebook.ipynb
```

See the [security documentation](#) for more details about the trust mechanism.

1.1.9 Browser Compatibility

The Jupyter Notebook aims to support the latest versions of these browsers:

- Chrome
- Safari
- Firefox

Up to date versions of Opera and Edge may also work, but if they don't, please use one of the supported browsers.

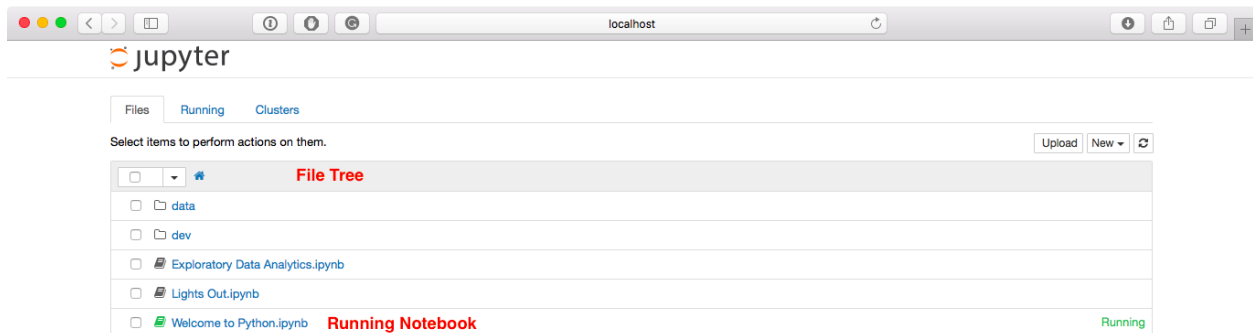
Using Safari with HTTPS and an untrusted certificate is known to not work (websockets will fail).

1.2 User interface components

When opening bug reports or sending emails to the Jupyter mailing list, it is useful to know the names of different UI components so that other developers and users have an easier time helping you diagnose your problems. This section will familiarize you with the names of UI elements within the Notebook and the different Notebook modes.

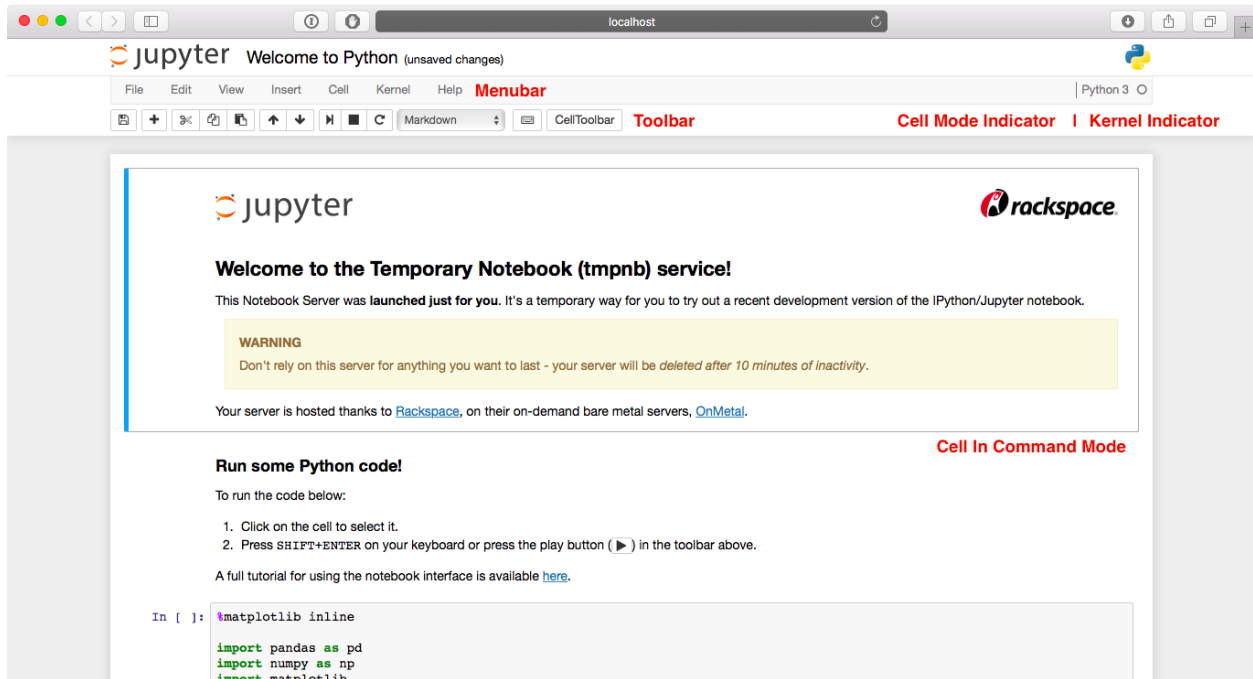
1.2.1 Notebook Dashboard

When you launch `jupyter notebook` the first page that you encounter is the Notebook Dashboard.



1.2.2 Notebook Editor

Once you've selected a Notebook to edit, the Notebook will open in the Notebook Editor.

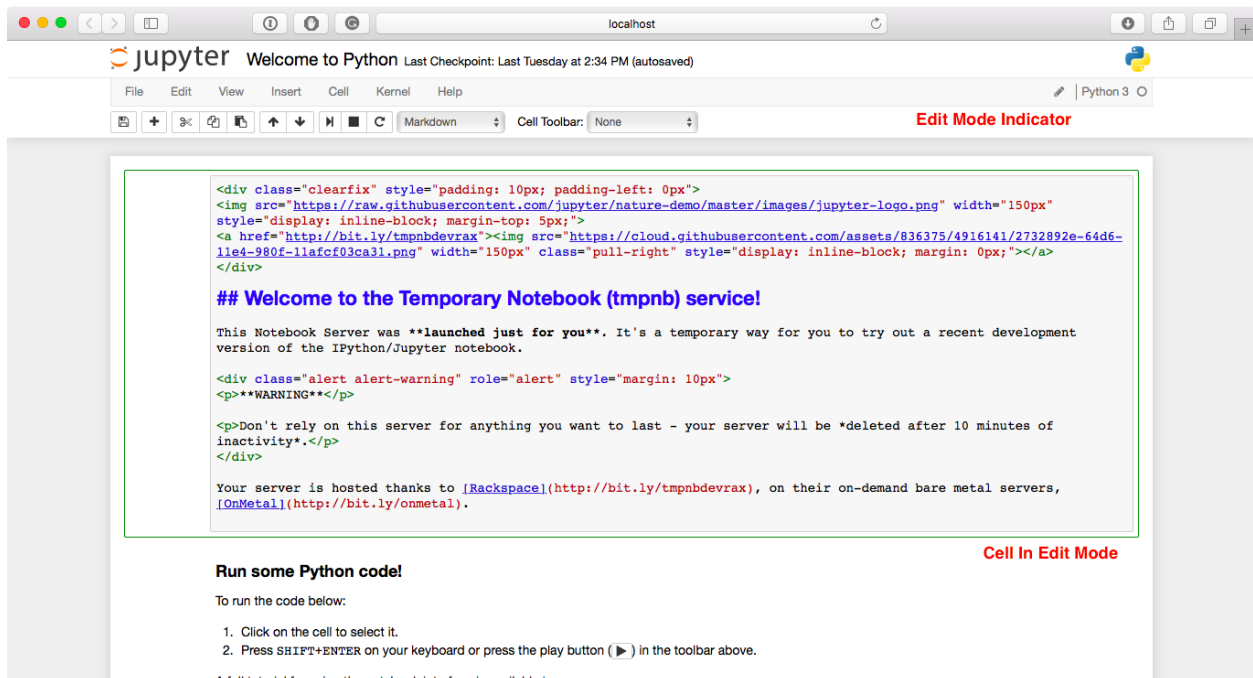


1.2.3 Interactive User Interface Tour of the Notebook

If you would like to learn more about the specific elements within the Notebook Editor, you can go through the user interface tour by selecting *Help* in the menubar then selecting *User Interface Tour*.

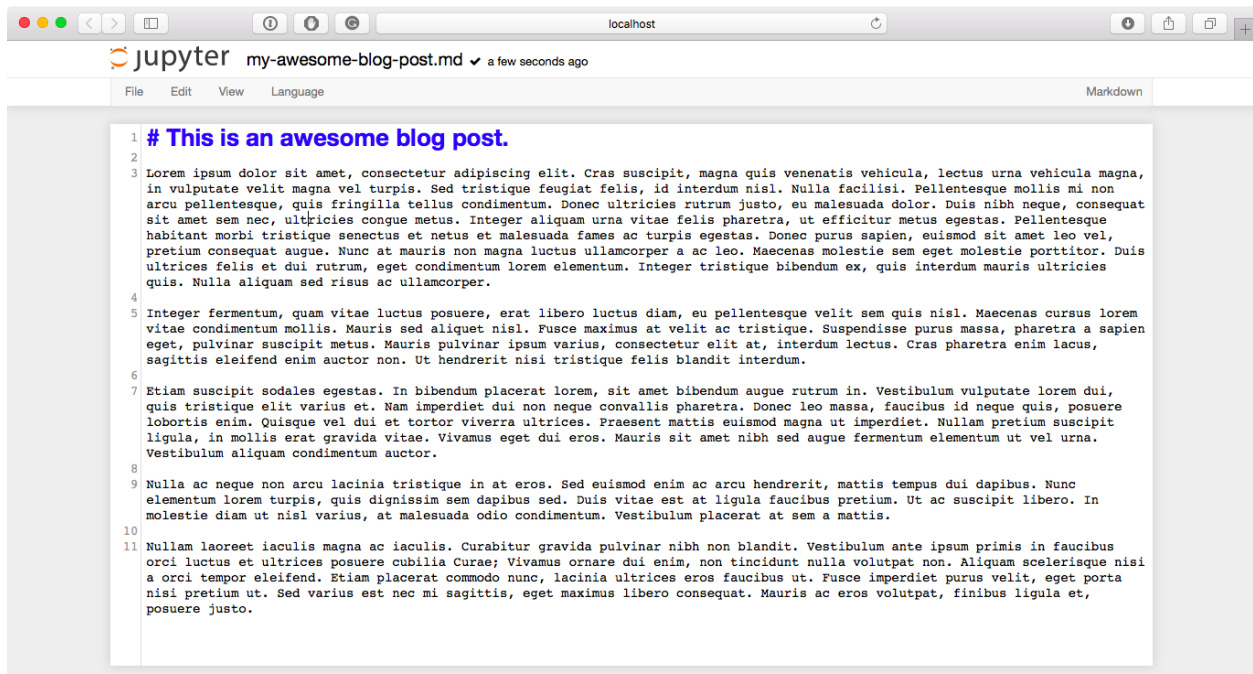
Edit Mode and Notebook Editor

When a cell is in edit mode, the Cell Mode Indicator will change to reflect the cell's state. This state is indicated by a small pencil icon on the top right of the interface. When the cell is in command mode, there is no icon in that location.



1.2.4 File Editor

Now let's say that you've chosen to open a Markdown file instead of a Notebook file whilst in the Notebook Dashboard. If so, the file will be opened in the File Editor.



1.3 Notebook Examples

The pages in this section are all converted notebook files. You can also [view these notebooks on nbviewer](#).

1.3.1 What is the Jupyter Notebook?

Introduction

The Jupyter Notebook is an **interactive computing environment** that enables users to author notebook documents that include: - Live code - Interactive widgets - Plots - Narrative text - Equations - Images - Video

These documents provide a **complete and self-contained record of a computation** that can be converted to various formats and shared with others using email, [Dropbox](#), version control systems (like [git/GitHub](#)) or [nbviewer.jupyter.org](#).

Components

The Jupyter Notebook combines three components:

- **The notebook web application:** An interactive web application for writing and running code interactively and authoring notebook documents.
- **Kernels:** Separate processes started by the notebook web application that runs users' code in a given language and returns output back to the notebook web application. The kernel also handles things like computations for interactive widgets, tab completion and introspection.
- **Notebook documents:** Self-contained documents that contain a representation of all content visible in the notebook web application, including inputs and outputs of the computations, narrative text, equations, images, and rich media representations of objects. Each notebook document has its own kernel.

Notebook web application

The notebook web application enables users to:

- **Edit code in the browser**, with automatic syntax highlighting, indentation, and tab completion/introspection.
- **Run code from the browser**, with the results of computations attached to the code which generated them.
- See the results of computations with **rich media representations**, such as HTML, LaTeX, PNG, SVG, PDF, etc.
- Create and use **interactive JavaScript widgets**, which bind interactive user interface controls and visualizations to reactive kernel side computations.
- Author **narrative text** using the [Markdown](#) markup language.
- Include mathematical equations using **LaTeX syntax in Markdown**, which are rendered in-browser by [MathJax](#).

Kernels

Through Jupyter’s kernel and messaging architecture, the Notebook allows code to be run in a range of different programming languages. For each notebook document that a user opens, the web application starts a kernel that runs the code for that notebook. Each kernel is capable of running code in a single programming language and there are kernels available in the following languages:

- Python(<https://github.com/ipython/ipython>)
- Julia (<https://github.com/JuliaLang/IJulia.jl>)
- R (<https://github.com/IRkernel/IRkernel>)
- Ruby (<https://github.com/minrk/iruby>)
- Haskell (<https://github.com/gibiansky/IHaskell>)
- Scala (<https://github.com/Bridgewater/scala-notebook>)
- node.js (<https://gist.github.com/Carreau/4279371>)
- Go (<https://github.com/takluyver/igo>)

The default kernel runs Python code. The notebook provides a simple way for users to pick which of these kernels is used for a given notebook.

Each of these kernels communicate with the notebook web application and web browser using a JSON over ZeroMQ/WebSockets message protocol that is described [here](#). Most users don’t need to know about these details, but it helps to understand that “kernels run code.”

Notebook documents

Notebook documents contain the **inputs and outputs** of an interactive session as well as **narrative text** that accompanies the code but is not meant for execution. **Rich output** generated by running code, including HTML, images, video, and plots, is embedded in the notebook, which makes it a complete and self-contained record of a computation.

When you run the notebook web application on your computer, notebook documents are just **files on your local filesystem with a .ipynb extension**. This allows you to use familiar workflows for organizing your notebooks into folders and sharing them with others.

Notebooks consist of a **linear sequence of cells**. There are three basic cell types:

- **Code cells:** Input and output of live code that is run in the kernel
- **Markdown cells:** Narrative text with embedded LaTeX equations
- **Raw cells:** Unformatted text that is included, without modification, when notebooks are converted to different formats using nbconvert

Internally, notebook documents are **JSON data** with **binary values** [base64](#) encoded. This allows them to be **read and manipulated programmatically** by any programming language. Because JSON is a text format, notebook documents are version control friendly.

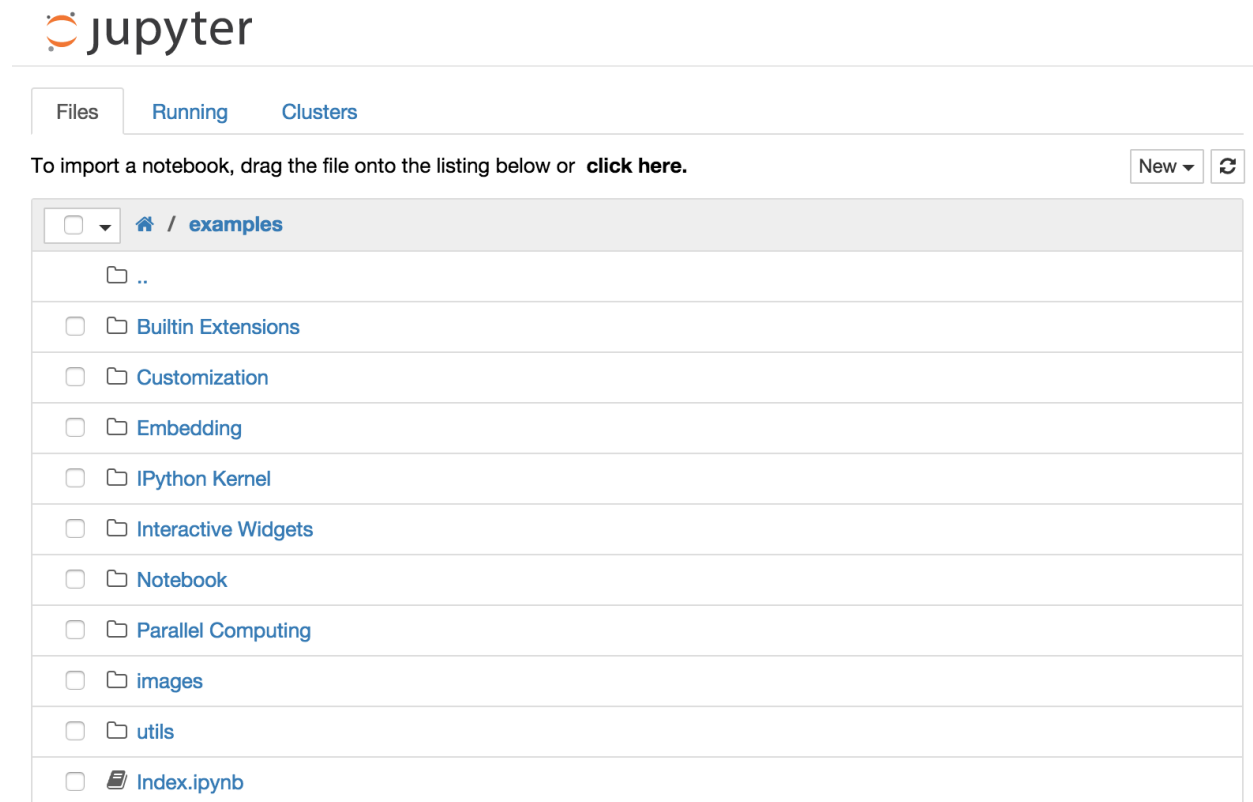
Notebooks can be exported to different static formats including HTML, reStructuredText, LaTeX, PDF, and slide shows ([reveal.js](#)) using Jupyter’s nbconvert utility.

Furthermore, any notebook document available from a **public URL or on GitHub can be shared** via [nbviewer](#). This service loads the notebook document from the URL and renders it as a static web page. The resulting web page may thus be shared with others **without their needing to install the Jupyter Notebook**.

1.3.2 Notebook Basics

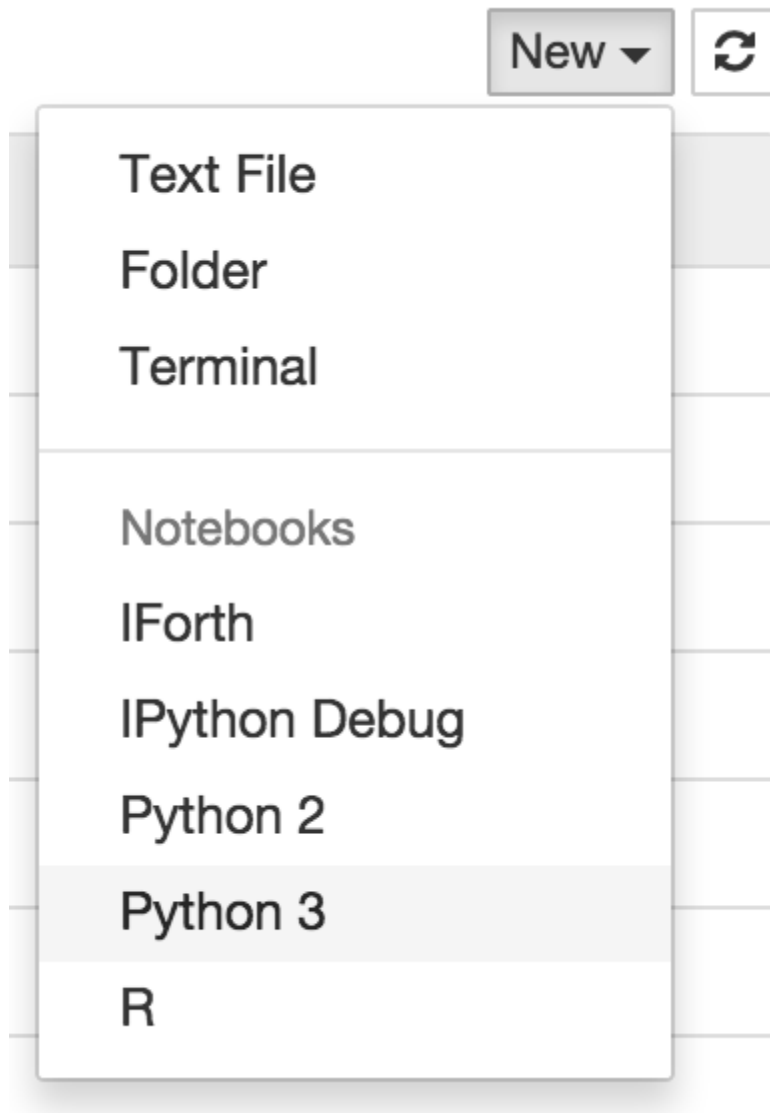
The Notebook dashboard

When you first start the notebook server, your browser will open to the notebook dashboard. The dashboard serves as a home page for the notebook. Its main purpose is to display the notebooks and files in the current directory. For example, here is a screenshot of the dashboard page for the `examples` directory in the Jupyter repository:



The top of the notebook list displays clickable breadcrumbs of the current directory. By clicking on these breadcrumbs or on sub-directories in the notebook list, you can navigate your file system.

To create a new notebook, click on the “New” button at the top of the list and select a kernel from the dropdown (as seen below). Which kernels are listed depend on what’s installed on the server. Some of the kernels in the screenshot below may not exist as an option to you.



Notebooks and files can be uploaded to the current directory by dragging a notebook file onto the notebook list or by the “click here” text above the list.

The notebook list shows green “Running” text and a green notebook icon next to running notebooks (as seen below). Notebooks remain running until you explicitly shut them down; closing the notebook’s page is not sufficient.

| | |
|---|--|
|  ▾ |  / examples |
|  | .. |
| <input type="checkbox"/> |  Builtin Extensions |
| <input type="checkbox"/> |  Customization |
| <input type="checkbox"/> |  Embedding |
| <input type="checkbox"/> |  IPython Kernel |
| <input type="checkbox"/> |  Interactive Widgets |
| <input type="checkbox"/> |  Notebook |
| <input type="checkbox"/> |  Parallel Computing |
| <input type="checkbox"/> |  images |
| <input type="checkbox"/> |  utils |
| <input checked="" type="checkbox"/> |  Index.ipynb Running |

To shutdown, delete, duplicate, or rename a notebook check the checkbox next to it and an array of controls will appear at the top of the notebook list (as seen below). You can also use the same operations on directories and files when applicable.



To see all of your running notebooks along with their directories, click on the “Running” tab:



Files Running Clusters

Currently running Jupyter processes



Terminals ▾

There are no terminals running.

Notebooks ▾

| | |
|--|----------|
| examples/Notebook/Index.ipynb | Shutdown |
| examples/Notebook/What is the IPython Notebook.ipynb | Shutdown |
| examples/Notebook/Running the Notebook Server.ipynb | Shutdown |
| examples/Notebook/Notebook Basics.ipynb | Shutdown |
| examples/Notebook/Running Code.ipynb | Shutdown |
| examples/Notebook/Working With Markdown Cells.ipynb | Shutdown |
| examples/Notebook/Custom Keyboard Shortcuts.ipynb | Shutdown |
| examples/Notebook/JavaScript Notebook Extensions.ipynb | Shutdown |
| examples/Notebook/Notebook Security.ipynb | Shutdown |

This view provides a convenient way to track notebooks that you start as you navigate the file system in a long running notebook server.

Overview of the Notebook UI

If you create a new notebook or open an existing one, you will be taken to the notebook user interface (UI). This UI allows you to run code and author notebook documents interactively. The notebook UI has the following main areas:

- Menu
- Toolbar
- Notebook area and cells

The notebook has an interactive tour of these elements that can be started in the “Help:User Interface Tour” menu item.

Modal editor

Starting with IPython 2.0, the Jupyter Notebook has a modal user interface. This means that the keyboard does different things depending on which mode the Notebook is in. There are two modes: edit mode and command mode.

Edit mode

Edit mode is indicated by a green cell border and a prompt showing in the editor area:

```
In [1]: a = 10
```

When a cell is in edit mode, you can type into the cell, like a normal text editor.

Enter edit mode by pressing **Enter** or using the mouse to click on a cell's editor area.

Command mode

Command mode is indicated by a grey cell border with a blue left margin:

```
In [1]: a = 10
```

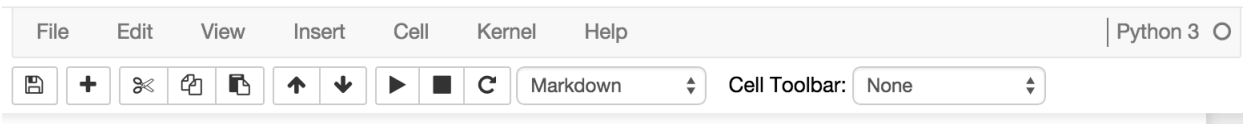
When you are in command mode, you are able to edit the notebook as a whole, but not type into individual cells. Most importantly, in command mode, the keyboard is mapped to a set of shortcuts that let you perform notebook and cell actions efficiently. For example, if you are in command mode and you press **c**, you will copy the current cell - no modifier is needed.

Don't try to type into a cell in command mode; unexpected things will happen!

Enter command mode by pressing **Esc** or using the mouse to click *outside* a cell's editor area.

Mouse navigation

All navigation and actions in the Notebook are available using the mouse through the menubar and toolbar, which are both above the main Notebook area:



The first idea of mouse based navigation is that **cells can be selected by clicking on them**. The currently selected cell gets a grey or green border depending on whether the notebook is in edit or command mode. If you click inside a cell's editor area, you will enter edit mode. If you click on the prompt or output area of a cell you will enter command mode.

If you are running this notebook in a live session (not on <http://nbviewer.jupyter.org>) try selecting different cells and going between edit and command mode. Try typing into a cell.

The second idea of mouse based navigation is that **cell actions usually apply to the currently selected cell**. Thus if you want to run the code in a cell, you would select it and click the

button in the toolbar or the “Cell:Run” menu item. Similarly, to copy a cell you would select it and click the

button in the toolbar or the “Edit:Copy” menu item. With this simple pattern, you should be able to do most everything you need with the mouse.

Markdown cells have one other state that can be modified with the mouse. These cells can either be rendered or unrendered. When they are rendered, you will see a nice formatted representation of the cell's contents. When they are unrendered, you will see the raw text source of the cell. To render the selected cell with the mouse, click the

button in the toolbar or the “Cell:Run” menu item. To unrender the selected cell, double click on the cell.

Keyboard Navigation

The modal user interface of the Jupyter Notebook has been optimized for efficient keyboard usage. This is made possible by having two different sets of keyboard shortcuts: one set that is active in edit mode and another in command mode.

The most important keyboard shortcuts are **Enter**, which enters edit mode, and **Esc**, which enters command mode.

In edit mode, most of the keyboard is dedicated to typing into the cell's editor. Thus, in edit mode there are relatively few shortcuts. In command mode, the entire keyboard is available for shortcuts, so there are many more. The `Help->Keyboard Shortcuts` dialog lists the available shortcuts.

We recommend learning the command mode shortcuts in the following rough order:

1. Basic navigation: `enter`, `shift-enter`, `up/k`, `down/j`
2. Saving the notebook: `s`
3. Change Cell types: `y`, `m`, `1-6`, `t`
4. Cell creation: `a`, `b`
5. Cell editing: `x`, `c`, `v`, `d`, `z`
6. Kernel operations: `i`, `0` (press twice)

1.3.3 Running Code

First and foremost, the Jupyter Notebook is an interactive environment for writing and running code. The notebook is capable of running code in a wide range of languages. However, each notebook is associated with a single kernel. This notebook is associated with the IPython kernel, therefore runs Python code.

Code cells allow you to enter and run code

Run a code cell using **Shift-Enter** or pressing the button in the toolbar above:

```
[1]: a = 10
```

```
[2]: print(a)
```

```
10
```

There are two other keyboard shortcuts for running code:

- **Alt-Enter** runs the current cell and inserts a new one below.
- **Ctrl-Enter** run the current cell and enters command mode.

Managing the Kernel

Code is run in a separate process called the Kernel. The Kernel can be interrupted or restarted. Try running the following cell and then hit the

button in the toolbar above.

```
[3]: import time
     time.sleep(10)
```

If the Kernel dies you will be prompted to restart it. Here we call the low-level system `libc.time` routine with the wrong argument via `ctypes` to segfault the Python interpreter:

```
[5]: import sys
     from ctypes import CDLL
     # This will crash a Linux or Mac system
     # equivalent calls can be made on Windows

     # Uncomment these lines if you would like to see the segfault

     # dll = 'dylib' if sys.platform == 'darwin' else 'so.6'
     # libc = CDLL("libc.%s" % dll)
     # libc.time(-1) # BOOM!!
```

Cell menu

The “Cell” menu has a number of menu items for running code in different ways. These includes:

- Run and Select Below
- Run and Insert Below
- Run All
- Run All Above
- Run All Below

Restarting the kernels

The kernel maintains the state of a notebook’s computations. You can reset this state by restarting the kernel. This is done by clicking on the

in the toolbar above.

sys.stdout and sys.stderr

The stdout and stderr streams are displayed as text in the output area.

```
[6]: print("hi, stdout")
     hi, stdout
```

```
[7]: from __future__ import print_function
     print('hi, stderr', file=sys.stderr)
```



```
hi, stderr
```

Output is asynchronous

All output is displayed asynchronously as it is generated in the Kernel. If you execute the next cell, you will see the output one piece at a time, not all at the end.

```
[8]: import time, sys
      for i in range(8):
          print(i)
          time.sleep(0.5)
```

```
0
1
2
3
4
5
6
7
```

Large outputs

To better handle large outputs, the output area can be collapsed. Run the following cell and then single- or double-click on the active area to the left of the output:

```
[9]: for i in range(50):
      print(i)
```

```
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
```

(continues on next page)

(continued from previous page)

```
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
```

Beyond a certain point, output will scroll automatically:

```
[10]: for i in range(500):
      print(2**i - 1)
```

```
0
1
3
7
15
31
63
127
255
511
1023
2047
4095
8191
16383
32767
65535
131071
262143
524287
```

(continues on next page)

(continued from previous page)

```
1048575
2097151
4194303
8388607
16777215
33554431
67108863
134217727
268435455
536870911
1073741823
2147483647
4294967295
8589934591
17179869183
34359738367
68719476735
137438953471
274877906943
549755813887
1099511627775
2199023255551
4398046511103
8796093022207
17592186044415
35184372088831
70368744177663
140737488355327
281474976710655
562949953421311
1125899906842623
2251799813685247
4503599627370495
9007199254740991
18014398509481983
36028797018963967
72057594037927935
144115188075855871
288230376151711743
576460752303423487
1152921504606846975
2305843009213693951
4611686018427387903
9223372036854775807
18446744073709551615
36893488147419103231
73786976294838206463
147573952589676412927
295147905179352825855
590295810358705651711
1180591620717411303423
2361183241434822606847
```

(continues on next page)

(continued from previous page)

```
4722366482869645213695
9444732965739290427391
18889465931478580854783
37778931862957161709567
75557863725914323419135
151115727451828646838271
302231454903657293676543
604462909807314587353087
1208925819614629174706175
2417851639229258349412351
4835703278458516698824703
9671406556917033397649407
19342813113834066795298815
38685626227668133590597631
77371252455336267181195263
154742504910672534362390527
309485009821345068724781055
618970019642690137449562111
1237940039285380274899124223
2475880078570760549798248447
4951760157141521099596496895
9903520314283042199192993791
19807040628566084398385987583
39614081257132168796771975167
79228162514264337593543950335
158456325028528675187087900671
316912650057057350374175801343
633825300114114700748351602687
1267650600228229401496703205375
2535301200456458802993406410751
5070602400912917605986812821503
10141204801825835211973625643007
20282409603651670423947251286015
40564819207303340847894502572031
81129638414606681695789005144063
162259276829213363391578010288127
324518553658426726783156020576255
649037107316853453566312041152511
1298074214633706907132624082305023
2596148429267413814265248164610047
5192296858534827628530496329220095
10384593717069655257060992658440191
20769187434139310514121985316880383
41538374868278621028243970633760767
83076749736557242056487941267521535
166153499473114484112975882535043071
332306998946228968225951765070086143
664613997892457936451903530140172287
1329227995784915872903807060280344575
2658455991569831745807614120560689151
5316911983139663491615228241121378303
10633823966279326983230456482242756607
```

(continues on next page)

(continued from previous page)

```

21267647932558653966460912964485513215
42535295865117307932921825928971026431
85070591730234615865843651857942052863
170141183460469231731687303715884105727
340282366920938463463374607431768211455
680564733841876926926749214863536422911
1361129467683753853853498429727072845823
2722258935367507707706996859454145691647
5444517870735015415413993718908291383295
10889035741470030830827987437816582766591
21778071482940061661655974875633165533183
43556142965880123323311949751266331066367
87112285931760246646623899502532662132735
174224571863520493293247799005065324265471
348449143727040986586495598010130648530943
696898287454081973172991196020261297061887
1393796574908163946345982392040522594123775
2787593149816327892691964784081045188247551
5575186299632655785383929568162090376495103
11150372599265311570767859136324180752990207
22300745198530623141535718272648361505980415
44601490397061246283071436545296723011960831
89202980794122492566142873090593446023921663
178405961588244985132285746181186892047843327
356811923176489970264571492362373784095686655
713623846352979940529142984724747568191373311
1427247692705959881058285969449495136382746623
2854495385411919762116571938898990272765493247
570899077082383952423314387797980545530986495
11417981541647679048466287755595961091061972991
22835963083295358096932575511191922182123945983
45671926166590716193865151022383844364247891967
91343852333181432387730302044767688728495783935
182687704666362864775460604089535377456991567871
365375409332725729550921208179070754913983135743
730750818665451459101842416358141509827966271487
1461501637330902918203684832716283019655932542975
2923003274661805836407369665432566039311865085951
5846006549323611672814739330865132078623730171903
11692013098647223345629478661730264157247460343807
23384026197294446691258957323460528314494920687615
46768052394588893382517914646921056628989841375231
93536104789177786765035829293842113257979682750463
187072209578355573530071658587684226515959365500927
374144419156711147060143317175368453031918731001855
748288838313422294120286634350736906063837462003711
1496577676626844588240573268701473812127674924007423
2993155353253689176481146537402947624255349848014847
5986310706507378352962293074805895248510699696029695
11972621413014756705924586149611790497021399392059391
23945242826029513411849172299223580994042798784118783
47890485652059026823698344598447161988085597568237567

```

(continues on next page)

(continued from previous page)

```
95780971304118053647396689196894323976171195136475135
191561942608236107294793378393788647952342390272950271
383123885216472214589586756787577295904684780545900543
766247770432944429179173513575154591809369561091801087
153249554086588858358347027150309183618739122183602175
3064991081731777716716694054300618367237478244367204351
612998216346355543343388108601236734474956488734408703
12259964326927110866866776217202473468949912977468817407
24519928653854221733733552434404946937899825954937634815
49039857307708443467467104868809893875799651909875269631
98079714615416886934934209737619787751599303819750539263
196159429230833773869868419475239575503198607639501078527
392318858461667547739736838950479151006397215279002157055
784637716923335095479473677900958302012794430558004314111
1569275433846670190958947355801916604025588861116008628223
3138550867693340381917894711603833208051177722232017256447
6277101735386680763835789423207666416102355444464034512895
12554203470773361527671578846415332832204710888928069025791
25108406941546723055343157692830665664409421777856138051583
50216813883093446110686315385661331328818843555712276103167
100433627766186892221372630771322662657637687111424552206335
200867255532373784442745261542645325315275374222849104412671
401734511064747568885490523085290650630550748445698208825343
803469022129495137770981046170581301261101496891396417650687
1606938044258990275541962092341162602522202993782792835301375
3213876088517980551083924184682325205044405987565585670602751
6427752177035961102167848369364650410088811975131171341205503
12855504354071922204335696738729300820177623950262342682411007
25711008708143844408671393477458601640355247900524685364822015
51422017416287688817342786954917203280710495801049370729644031
102844034832575377634685573909834406561420991602098741459288063
205688069665150755269371147819668813122841983204197482918576127
411376139330301510538742295639337626245683966408394965837152255
822752278660603021077484591278675252491367932816789931674304511
1645504557321206042154969182557350504982735865633579863348609023
3291009114642412084309938365114701009965471731267159726697218047
6582018229284824168619876730229402019930943462534319453394436095
13164036458569648337239753460458804039861886925068638906788872191
26328072917139296674479506920917608079723773850137277813577744383
52656145834278593348959013841835216159447547700274555627155488767
105312291668557186697918027683670432318895095400549111254310977535
210624583337114373395836055367340864637790190801098222508621955071
421249166674228746791672110734681729275580381602196445017243910143
842498333348457493583344221469363458551160763204392890034487820287
1684996666696914987166688442938726917102321526408785780068975640575
3369993333393829974333376885877453834204643052817571560137951281151
6739986666787659948666753771754907668409286105635143120275902562303
13479973333575319897333507543509815336818572211270286240551805124607
26959946667150639794667015087019630673637144422540572481103610249215
5391989333401279589334030174039261347274288845081144962207220498431
107839786668602559178668060348078522694548577690162289924414440996863
215679573337205118357336120696157045389097155380324579848828881993727
```

(continues on next page)

(continued from previous page)

```
431359146674410236714672241392314090778194310760649159697657763987455
862718293348820473429344482784628181556388621521298319395315527974911
1725436586697640946858688965569256363112777243042596638790631055949823
3450873173395281893717377931138512726225554486085193277581262111899647
6901746346790563787434755862277025452451108972170386555162524223799295
13803492693581127574869511724554050904902217944340773110325048447598591
27606985387162255149739023449108101809804435888681546220650096895197183
55213970774324510299478046898216203619608871777363092441300193790394367
110427941548649020598956093796432407239217743554726184882600387580788735
220855883097298041197912187592864814478435487109452369765200775161577471
441711766194596082395824375185729628956870974218904739530401550323154943
883423532389192164791648750371459257913741948437809479060803100646309887
1766847064778384329583297500742918515827483896875618958121606201292619775
3533694129556768659166595001485837031654967793751237916243212402585239551
7067388259113537318333190002971674063309935587502475832486424805170479103
14134776518227074636666380005943348126619871175004951664972849610340958207
28269553036454149273332760011886696253239742350009903329945699220681916415
56539106072908298546665520023773392506479484700019806659891398441363832831
113078212145816597093331040047546785012958969400039613319782796882727665663
226156424291633194186662080095093570025917938800079226639565593765455331327
452312848583266388373324160190187140051835877600158453279131187530910662655
904625697166532776746648320380374280103671755200316906558262375061821325311
1809251394333065553493296640760748560207343510400633813116524750123642650623
3618502788666131106986593281521497120414687020801267626233049500247285301247
7237005577332262213973186563042994240829374041602535252466099000494570602495
14474011154664524427946373126085988481658748083205070504932198000989141204991
28948022309329048855892746252171976963317496166410141009864396001978282409983
57896044618658097711785492504343953926634992332820282019728792003956564819967
115792089237316195423570985008687907853269984665640564039457584007913129639935
231584178474632390847141970017375815706539969331281128078915168015826259279871
463168356949264781694283940034751631413079938662562256157830336031652518559743
926336713898529563388567880069503262826159877325124512315660672063305037119487
1852673427797059126777135760139006525652319754650249024631321344126610074238975
3705346855594118253554271520278013051304639509300498049262642688253220148477951
7410693711188236507108543040556026102609279018600996098525285376506440296955903
14821387422376473014217086081112052205218558037201992197050570753012880593911807
29642774844752946028434172162224104410437116074403984394101141506025761187823615
59285549689505892056868344324448208820874232148807968788202283012051522375647231
118571099379011784113736688648896417641748464297615937576404566024103044751294463
23714219875802356822747337297792835283496928595231875152809132048206089502588927
474284397516047136454946754595585670566993857190463750305618264096412179005177855
948568795032094272909893509191171341133987714380927500611236528192824358010355711
1897137590064188545819787018382342682267975428761855001222473056385648716020711423
3794275180128377091639574036764685364535950857523710002444946112771297432041422847
7588550360256754183279148073529370729071901715047420004889892225542594864082845695
15177100720513508366558296147058741458143803430094840009779784451085189728165691391
30354201441027016733116592294117482916287606860189680019559568902170379456331382783
60708402882054033466233184588234965832575213720379360039119137804340758912662765567
121416805764108066932466369176469931665150427440758720078238275608681517825325531135
242833611528216133864932738352939863330300854881517440156476551217363035650651062271
485667223056432267729865476705879726660601709763034880312953102434726071301302124543
971334446112864535459730953411759453321203419526069760625906204869452142602604249087
```

(continues on next page)

(continued from previous page)

```
1942668892225729070919461906823518906642406839052139521251812409738904285205208498175
3885337784451458141838923813647037813284813678104279042503624819477808570410416996351
7770675568902916283677847627294075626569627356208558085007249638955617140820833992703
15541351137805832567355695254588151253139254712417116170014499277911234281641667985407
31082702275611665134711390509176302506278509424834232340028998555822468563283335970815
62165404551223330269422781018352605012557018849668464680057997111644937126566671941631
124330809102446660538845562036705210025114037699336929360115994223289874253133343883263
248661618204893321077691124073410420050228075398673858720231988446579748506266687766527
497323236409786642155382248146820840100456150797347717440463976893159497012533375533055
994646472819573284310764496293641680200912301594695434880927953786318994025066751066111
1989292945639146568621528992587283360401824603189390869761855907572637988050133502132223
3978585891278293137243057985174566720803649206378781739523711815145275976100267004264447
7957171782556586274486115970349133441607298412757563479047423630290551952200534008528895
15914343565113172548972231940698266883214596825515126958094847260581103904401068017057791
31828687130226345097944463881396533766429193651030253916189694521162207808802136034115583
63657374260452690195888927762793067532858387302060507832379389042324415617604272068231167
127314748520905380391777855525586135065716774604121015664758778084648831235208544136462335
254629497041810760783555711051172270131433549208242031329517556169297662470417088272924671
509258994083621521567111422102344540262867098416484062659035112338595324940834176545849343
1018517988167243043134222844204689080525734196832968125318070224677190649881668353091698687
2037035976334486086268445688409378161051468393665936250636140449354381299763336706183397375
4074071952668972172536891376818756322102936787331872501272280898708762599526673412366794751
8148143905337944345073782753637512644205873574663745002544561797417525199053346824733589503
16296287810675888690147565507275025288411747149327490005089123594835050398106693649467179007
32592575621351777380295131014550050576823494298654980010178247189670100796213387298934358015
65185151242703554760590262029100101153646988597309960020356494379340201592426774597868716031
130370302485407109521180524058200202307293977194619920040712988758680403184853549195737432063
260740604970814219042361048116400404614587954389239840081425977517360806369707098391474864127
521481209941628438084722096232800809229175908778479680162851955034721612739414196782949728255
1042962419883256876169444192465601618458351817556959360325703910069443225478828393565899456511
2085924839766513752338888384931203236916703635113918720651407820138886450957656787131798913023
4171849679533027504677776769862406473833407270227837441302815640277772901915313574263597826047
8343699359066055009355553539724812947666814540455674882605631280555545803830627148527195652095
16687398718132110018711107079449625895333629080911349765211262561111091607661254297054391304191
3337479743626422003742221415889925179066725816182269953042252512222183215322508594108782608383
66749594872528440074844428317798503581334516323645399060845050244444366430645017188217565216767
133499189745056880149688856635597007162669032647290798121690100488888732861290034376435130433535
266998379490113760299377713271194014325338065294581596243380200977777465722580068752870260867071
533996758980227520598755426542388028650676130589163192486760401955554931445160137505740521734143
1067993517960455041197510853084776057301352261178326384973520803911109862890320275011481043468287
2135987035920910082395021706169552114602704522356652769947041607822219725780640550022962086936575
4271974071841820164790043412339104229205409044713305539894083215644439451561281100045924173873151
8543948143683640329580086824678208458410818089426611079788166431288878903122562200091848347746303
17087896287367280659160173649356416916821636178853222159576332862577757806245124400183696695492607
34175792574734561318320347298712833833643272357706444319152665725155515612490248800367393390985215
68351585149469122636640694597425667667286544715412888638305331450311031224980497600734786781970431
136703170298938245273281389194851335334573089430825777276610662900622062449960995201469573563940863
273406340597876490546562778389702670669146178861651554553221325801244124899921990402939147127881727
546812681195752981093125556779405341338292357723303109106442651602488249799843980805878294255763455
1093625362391505962186251113558810682676584715446606218212885303204976499599687961611756588511526911
2187250724783011924372502227117621365353169430893212436425770606409952999199375923223513177023053823
4374501449566023848745004454235242730706338861786424872851541212819905998398751846447026354046107647
```

(continues on next page)

(continued from previous page)

```
8749002899132047697490008908470485461412677723572849745703082425639811996797503692894052708092215295
17498005798264095394980017816940970922825355447145699491406164851279623993595007385788105416184430591
34996011596528190789960035633881941845650710894291398982812329702559247987190014771576210832368861183
69992023193056381579920071267763883691301421788582797965624659405118495974380029543152421664737722367
139984046386112763159840142535527767382602843577165595931249318810236991948760059086304843329475444735
279968092772225526319680285071055534765205687154331191862498637620473983897520118172609686658950889471
559936185544451052639360570142111069530411374308662383724997275240947967795040236345219373317901778943
1119872371088902105278721140284222139060822748617324767449994550481895935590080472690438746635803557887
2239744742177804210557442280568444278121645497234649534899989100963791871180160945380877493271607115775
4479489484355608421114884561136888556243290994469299069799978201927583742360321890761754986543214231551
8958978968711216842229769122273777112486581988938598139599956403855167484720643781523509973086428463103
1791795793742243368445953824454755422497316397787719627919991280771033496944128756304701994617285692620
3583591587484486736891907648909510844994632795575439255839982561542066993888257512609403989234571385241
7167183174968973473783815297819021689989265591150878511679965123084133987776515025218807978469142770483
143343663499379469475676305956380433799785311823017570233599302461682679755303005043761595693828554096
2866873269987589389513526119127608675995706236460351404671986049233653595110606010087523191387657108193
5733746539975178779027052238255217351991412472920702809343972098467307190221212020175046382775314216386
1146749307995035755805410447651043470398282494584140561868794419693461438044242404035009276555062843277
2293498615990071511610820895302086940796564989168281123737588839386922876088484808070018553110125686554
4586997231980143023221641790604173881593129978336562247475177678773845752176969616140037106220251373109
9173994463960286046443283581208347763186259956673124494950355357547691504353939232280074212440502746218
1834798892792057209288656716241669552637251991334624898990071071509538300870787846456014842488100549243
3669597785584114418577313432483339105274503982669249797980142143019076601741575692912029684976201098487
7339195571168228837154626864966678210549007965338499595960284286038153203483151385824059369952402196974
1467839114233645767430925372993335642109801593067699919192056857207630640696630277164811873990480439394
2935678228467291534861850745986671284219603186135399838384113714415261281393260554329623747980960878789
5871356456934583069723701491973342568439206372270799676768227428830522562786521108659247495961921757579
1174271291386916613944740298394668513687841274454159935353645485766104512557304221731849499192384351515
2348542582773833227889480596789337027375682548908319870707290971532209025114608443463698998384768703031
4697085165547666455778961193578674054751365097816639741414581943064418050229216886927397996769537406063
9394170331095332911557922387157348109502730195633279482829163886128836100458433773854795993539074812127
1878834066219066582311584477431469621900546039126655896565832777225767220091686754770959198707814962425
3757668132438133164623168954862939243801092078253311793131665554451534440183373509541918397415629924851
7515336264876266329246337909725878487602184156506623586263331108903068880366747019083836794831259849702
1503067252975253265849267581945175697520436831301324717252666221780613776073349403816767358966251969940
3006134505950506531698535163890351395040873662602649434505332443561227552146698807633534717932503939880
6012269011901013063397070327780702790081747325205298869010664887122455104293397615267069435865007879761
1202453802380202612679414065556140558016349465041059773802132977424491020858679523053413887173001575952
2404907604760405225358828131112281116032698930082119547604265954848982041717359046106827774346003151904
480981520952081045071765626224562232065397860164239095208531909697964083434718092213655548692006303809
9619630419041620901435312524449124464130795720328478190417063819395928166869436184427311097384012607618
1923926083808324180287062504889824892826159144065695638083412763879185633373887236885462219476802521523
3847852167616648360574125009779649785652318288131391276166825527758371266747774473770924438953605043047
7695704335233296721148250019559299571304636576262782552333651055516742533495548947541848877907210086095
1539140867046659344229650003911859914260927315252556510466730211103348506699109789508369775581442017219
3078281734093318688459300007823719828521854630505113020933460422206697013398219579016739551162884034438
6156563468186637376918600015647439657043709261010226041866920844413394026796439158033479102325768068876
1231312693637327475383720003129487931408741852202045208373384168882678805359287831606695820465153613775
2462625387274654950767440006258975862817483704404090416746768337765357610718575663213391640930307227550
4925250774549309901534880012517951725634967408808180833493536675530715221437151326426783281860614455100
9850501549098619803069760025035903451269934817616361666987073351061430442874302652853566563721228910201
1970100309819723960613952005007180690253986963523272333397414670212286088574860530570713312744245782040
```

(continues on next page)

(continued from previous page)

39402006196394479212279040100143613805079739270465446667948293404245721771497210611414266254884915640800
7880401239278895842455808020028722761015947854093089333589658680849144354299442122282853250976983128161
1576080247855779168491161604005744552203189570818617866717931736169828870859888424456570650195396625632
3152160495711558336982323208011489104406379141637235733435863472339657741719776848913141300390793251264
6304320991423116673964646416022978208812758283274471466871726944679315483439553697826282600781586502529
1260864198284623334792929283204595641762551656654894293374345388935863096687910739565256520156317300505
2521728396569246669585858566409191283525103313309788586748690777871726193375821479130513040312634601011
5043456793138493339171717132818382567050206626619577173497381555743452386751642958261026080625269202023
1008691358627698667834343426563676513410041325323915434699476311148690477350328591652205216125053840404
2017382717255397335668686853127353026820082650647830869398952622297380954700657183304410432250107680809
4034765434510794671337373706254706053640165301295661738797905244594761909401314366608820864500215361618
8069530869021589342674747412509412107280330602591323477595810489189523818802628733217641729000430723237
1613906173804317868534949482501882421456066120518264695519162097837904763760525746643528345800086144647
3227812347608635737069898965003764842912132241036529391038324195675809527521051493287056691600172289294
6455624695217271474139797930007529685824264482073058782076648391351619055042102986574113383200344578589
1291124939043454294827959586001505937164852896414611756415329678270323811008420597314822676640068915717
2582249878086908589655919172003011874329705792829223512830659356540647622016841194629645353280137831435
5164499756173817179311838344006023748659411585658447025661318713081295244033682389259290706560275662871
1032899951234763435862367668801204749731882317131689405132263742616259048806736477851858141312055132574
2065799902469526871724735337602409499463764634263378810264527485232518097613472955703716282624110265148
4131599804939053743449470675204818998927529268526757620529054970465036195226945911407432565248220530297
8263199609878107486898941350409637997855058537053515241058109940930072390453891822814865130496441060594
1652639921975621497379788270081927599571011707410703048211621988186014478090778364562973026099288212118
3305279843951242994759576540163855199142023414821406096423243976372028956181556729125946052198576424237
6610559687902485989519153080327710398284046829642812192846487952744057912363113458251892104397152848475
1322111937580497197903830616065542079656809365928562438569297590548811582472622691650378420879430569695
2644223875160994395807661232131084159313618731857124877138595181097623164945245383300756841758861139390
5288447750321988791615322464262168318627237463714249754277190362195246329890490766601513683517722278780
1057689550064397758323064492852433663725447492742849950855438072439049265978098153320302736703544455756
2115379100128795516646128985704867327450894985485699901710876144878098531956196306640605473407088911512
4230758200257591033292257971409734654901789970971399803421752289756197063912392613281210946814177823024
8461516400515182066584515942819469309803579941942799606843504579512394127824785226562421893628355646049
1692303280103036413316903188563893861960715988388559921368700915902478825564957045312484378725671129209
3384606560206072826633806377127787723921431976777119842737401831804957651129914090624968757451342258419
6769213120412145653267612754255575447842863953554239685474803663609915302259828181249937514902684516839
1353842624082429130653522550851115089568572790710847937094960732721983060451965636249987502980536903367
2707685248164858261307045101702230179137145581421695874189921465443966120903931272499975005961073806735
5415370496329716522614090203404460358274291162843391748379842930887932241807862544999950011922147613471
1083074099265943304522818040680892071654858232568678349675968586177586448361572508999990002384429522694
2166148198531886609045636081361784143309716465137356699351937172355172896723145017999980004768859045388
4332296397063773218091272162723568286619432930274713398703874344710345793446290035999960009537718090777
8664592794127546436182544325447136573238865860549426797407748689420691586892580071999920019075436181554
1732918558825509287236508865089427314647773172109885359481549737884138317378516014399984003815087236310
3465837117651018574473017730178854629295546344219770718963099475768276634757032028799968007630174472621
6931674235302037148946035460357709258591092688439541437926198951536553269514064057599936015260348945243
1386334847060407429789207092071541851718218537687908287585239790307310653902812811519987203052069789048
2772669694120814859578414184143083703436437075375816575170479580614621307805625623039974406104139578097
5545339388241629719156828368286167406872874150751633150340959161229242615611251246079948812208279156194
1109067877648325943831365673657233481374574830150326630068191832245848523122250249215989762441655831238
2218135755296651887662731347314466962749149660300653260136383664491697046244500498431979524883311662477
4436271510593303775325462694628933925498299320601306520272767328983394092489000996863959049766623324955
8872543021186607550650925389257867850996598641202613040545534657966788184978001993727918099533246649911

(continues on next page)

(continued from previous page)

```
1774508604237321510130185077851573570199319728240522608109106931593357636995600398745583619906649329982
3549017208474643020260370155703147140398639456481045216218213863186715273991200797491167239813298659964
7098034416949286040520740311406294280797278912962090432436427726373430547982401594982334479626597319929
1419606883389857208104148062281258856159455782592418086487285545274686109596480318996466895925319463985
2839213766779714416208296124562517712318911565184836172974571090549372219192960637992933791850638927971
5678427533559428832416592249125035424637823130369672345949142181098744438385921275985867583701277855943
1135685506711885766483318449825007084927564626073934469189828436219748887677184255197173516740255571188
2271371013423771532966636899650014169855129252147868938379656872439497775354368510394347033480511142377
4542742026847543065933273799300028339710258504295737876759313744878995550708737020788694066961022284754
9085484053695086131866547598600056679420517008591475753518627489757991101417474041577388133922044569509
1817096810739017226373309519720011335884103401718295150703725497951598220283494808315477626784408913901
3634193621478034452746619039440022671768206803436590301407450995903196440566989616630955253568817827803
7268387242956068905493238078880045343536413606873180602814901991806392881133979233261910507137635655607
1453677448591213781098647615776009068707282721374636120562980398361278576226795846652382101427527131121
2907354897182427562197295231552018137414565442749272241125960796722557152453591693304764202855054262243
5814709794364855124394590463104036274829130885498544482251921593445114304907183386609528405710108524486
1162941958872971024878918092620807254965826177099708896450384318689022860981436677321905681142021704897
2325883917745942049757836185241614509931652354199417792900768637378045721962873354643811362284043409794
4651767835491884099515672370483229019863304708398835585801537274756091443925746709287622724568086819588
9303535670983768199031344740966458039726609416797671171603074549512182887851493418575245449136173639177
186070713419675363980626894819329160794532188335934234320614909902436577570298683715049089827234727835
3721414268393507279612537896386583215890643766719068468641229819804873155140597367430098179654469455671
7442828536787014559225075792773166431781287533438136937282459639609746310281194734860196359308938911342
1488565707357402911845015158554633286356257506687627387456491927921949262056238946972039271861787782268
2977131414714805823690030317109266572712515013375254774912983855843898524112477893944078543723575564536
5954262829429611647380060634218533145425030026750509549825967711687797048224955787888157087447151129073
1190852565885922329476012126843706629085006005350101909965193542337559409644991157577631417489430225814
2381705131771844658952024253687413258170012010700203819930387084675118819289982315155262834978860451629
4763410263543689317904048507374826516340024021400407639860774169350237638579964630310525669957720903259
9526820527087378635808097014749653032680048042800815279721548338700475277159929260621051339915441806518
1905364105417475727161619402949930606536009608560163055944309667740095055431985852124210267983088361303
3810728210834951454323238805899861213072019217120326111888619335480190110863971704248420535966176722607
7621456421669902908646477611799722426144038434240652223777238670960380221727943408496841071932353445214
1524291284333980581729295522359944485228807686848130444755447734192076044345588681699368214386470689042
3048582568667961163458591044719888970457615373696260889510895468384152088691177363398736428772941378085
6097165137335922326917182089439777940915230747392521779021790936768304177382354726797472857545882756171
1219433027467184465383436417887955588183046149478504355804358187353660835476470945359494571509176551234
2438866054934368930766872835775911176366092298957008711608716374707321670952941890718989143018353102468
4877732109868737861533745671551822352732184597914017423217432749414643341905883781437978286036706204937
9755464219737475723067491343103644705464369195828034846434865498829286683811767562875956572073412409874
1951092843947495144613498268620728941092873839165606969286973099765857336762353512575191314414682481974
3902185687894990289226996537241457882185747678331213938573946199531714673524707025150382628829364963949
7804371375789980578453993074482915764371495356662427877147892399063429347049414050300765257658729927899
1560874275157996115690798614896583152874299071332485575429578479812685869409882810060153051531745985579
3121748550315992231381597229793166305748598142664971150859156959625371738819765620120306103063491971159
6243497100631984462763194459586332611497196285329942301718313919250743477639531240240612206126983942319
1248699420126396892552638891917266522299439257065988460343662783850148695527906248048122441225396788463
2497398840252793785105277783834533044598878514131976920687325567700297391055812496096244882450793576927
4994797680505587570210555567669066089197757028263953841374651135400594782111624992192489764901587153855
998959536101117514042111135338132178395514056527907682749302270801189564223249984384979529803174307711
199791907220223502808422227067626435679102811305581536549860454160237912844649996876995905960634861542
3995838144404470056168444454135252871358205622611163073099720908320475825689299993753991811921269723084
```

(continues on next page)

(continued from previous page)

```
7991676288808940112336888908270505742716411245222326146199441816640951651378599987507983623842539446169
1598335257761788022467377781654101148543282249044465229239888363328190330275719997501596724768507889233
3196670515523576044934755563308202297086564498088930458479776726656380660551439995003193449537015778467
6393341031047152089869511126616404594173128996177860916959553453312761321102879990006386899074031556935
1278668206209430417973902225323280918834625799235572183391910690662552264220575998001277379814806311387
2557336412418860835947804450646561837669251598471144366783821381325104528441151996002554759629612622774
5114672824837721671895608901293123675338503196942288733567642762650209056882303992005109519259225245548
1022934564967544334379121780258624735067700639388457746713528552530041811376460798401021903851845049109
2045869129935088668758243560517249470135401278776915493427057105060083622752921596802043807703690098219
4091738259870177337516487121034498940270802557553830986854114210120167245505843193604087615407380196438
8183476519740354675032974242068997880541605115107661973708228420240334491011686387208175230814760392877
1636695303948070935006594848413799576108321023021532394741645684048066898202337277441635046162952078575
```

1.3.4 Markdown Cells

Text can be added to Jupyter Notebooks using Markdown cells. You can change the cell type to Markdown by using the Cell menu, the toolbar, or the key shortcut `m`. Markdown is a popular markup language that is a superset of HTML. Its specification can be found here:

<https://daringfireball.net/projects/markdown/>

Markdown basics

You can make text *italic* or **bold** by surrounding a block of text with a single or double `*` respectively

You can build nested itemized or enumerated lists:

- One
 - Sublist
 - * This
- Sublist - That - The other thing
- Two
- Sublist
- Three
- Sublist

Now another list:

1. Here we go
 1. Sublist
 2. Sublist
2. There we go
3. Now this

You can add horizontal rules:

Here is a blockquote:

Beautiful is better than ugly. Explicit is better than implicit. Simple is better than complex. Complex is better than complicated. Flat is better than nested. Sparse is better than dense. Readability counts. Special cases aren't special enough to break the rules. Although practicality beats purity. Errors should never pass silently. Unless explicitly silenced. In the face of ambiguity, refuse the temptation to guess. There should be one— and preferably only one —obvious way to do it. Although that way may not be obvious at first unless you're Dutch. Now is better than never. Although never is often better than *right* now. If the implementation is hard to explain, it's a bad idea. If the implementation is easy to explain, it may be a good idea. Namespaces are one honking great idea – let's do more of those!

And shorthand for links:

[Jupyter's website](#)

You can use backslash to generate literal characters which would otherwise have special meaning in the Markdown syntax.

```
\*literal asterisks\*
*literal asterisks*
```

Use double backslash to generate the literal \$ symbol.

Headings

You can add headings by starting a line with one (or multiple) # followed by a space, as in the following example:

```
# Heading 1
# Heading 2
## Heading 2.1
## Heading 2.2
```

Embedded code

You can embed code meant for illustration instead of execution in Python:

```
def f(x):
    """a docstring"""
    return x**2
```

or other languages:

```
for (i=0; i<n; i++) {
    printf("hello %d\n", i);
    x += 4;
}
```

LaTeX equations

Courtesy of MathJax, you can include mathematical expressions both inline: $e^{i\pi} + 1 = 0$ and displayed:

$$e^x = \sum_{i=0}^{\infty} \frac{1}{i!} x^i \quad (1.1)$$

Inline expressions can be added by surrounding the latex code with \$:

```
$e^{i\pi} + 1 = 0$
```

Expressions on their own line are surrounded by `\begin{equation}` and `\end{equation}`:

```
\begin{equation}
e^x = \sum_{i=0}^{\infty} \frac{1}{i!} x^i
\end{equation}
```

GitHub flavored markdown

The Notebook webapp supports Github flavored markdown meaning that you can use triple backticks for code blocks:

```
```python
print "Hello World"
```

```javascript
console.log("Hello World")
```
```

Gives:

```
print "Hello World"
```

```
console.log("Hello World")
```

And a table like this:

```
| This | is |
|-----|-----|
| a | table|
```

A nice HTML Table:

| | |
|------|-------|
| This | is |
| a | table |

General HTML

Because Markdown is a superset of HTML you can even add things like HTML tables:

Header 1

Header 2

row 1, cell 1

row 1, cell 2

row 2, cell 1

row 2, cell 2

Local files

If you have local files in your Notebook directory, you can refer to these files in Markdown cells directly:

```
[subdirectory/]<filename>
```

For example, in the images folder, we have the Python logo:

```

```

and a video with the HTML5 video tag:

```
<video controls src="../../../images/animation.m4v">animation</video>
```

animation

These do not embed the data into the notebook file, and require that the files exist when you are viewing the notebook.

Security of local files

Note that this means that the Jupyter notebook server also acts as a generic file server for files inside the same tree as your notebooks. Access is not granted outside the notebook folder so you have strict control over what files are visible, but for this reason it is highly recommended that you do not run the notebook server with a notebook directory at a high level in your filesystem (e.g. your home directory).

When you run the notebook in a password-protected manner, local file access is restricted to authenticated users unless read-only views are active.

Markdown attachments

Since Jupyter notebook version 5.0, in addition to referencing external file you can attach a file to a markdown cell. To do so drag the file from in a markdown cell while editing it:



Files are stored in cell metadata and will be automatically scrubbed at save-time if not referenced. You can recognize attached images from other files by their url that starts with `attachment:`. For the image above:

```
![pycon-logo.jpg](attachment:pycon-logo.jpg)
```

Keep in mind that attached files will increase the size of your notebook.

You can manually edit the attachment by using the `View > Cell Toolbar > Attachment` menu, but you should not need to.

1.3.5 Keyboard Shortcut Customization

You can customize the `command` mode shortcuts from within the Notebook Application itself.

Head to the **Settings** menu and select the **Settings Editor** item. A dialog will guide you through the process of adding custom keyboard shortcuts.

Keyboard shortcut set from within the Notebook Application will be persisted to your configuration file. A single action may have several shortcuts attached to it.

1.3.6 Importing Jupyter Notebooks as Modules

It is a common problem that people want to import code from Jupyter Notebooks. This is made difficult by the fact that Notebooks are not plain Python files, and thus cannot be imported by the regular Python machinery.

Fortunately, Python provides some fairly sophisticated [hooks](#) into the import machinery, so we can actually make Jupyter notebooks importable without much difficulty, and only using public APIs.

```
[ ]: import io, os, sys, types
```

```
[ ]: from IPython import get_ipython
     from nbformat import read
     from IPython.core.interactiveshell import InteractiveShell
```

Import hooks typically take the form of two objects:

1. a Module **Loader**, which takes a module name (e.g. 'IPython.display'), and returns a Module
2. a Module **Finder**, which figures out whether a module might exist, and tells Python what **Loader** to use

```
[ ]: def find_notebook(fullname, path=None):
    """find a notebook, given its fully qualified name and an optional path

    This turns "foo.bar" into "foo/bar.ipynb"
    and tries turning "Foo_Bar" into "Foo Bar" if Foo_Bar
    does not exist.
    """
    name = fullname.rsplit('.', 1)[-1]
    if not path:
        path = ['']
    for d in path:
        nb_path = os.path.join(d, name + ".ipynb")
        if os.path.isfile(nb_path):
            return nb_path
        # let import Notebook_Name find "Notebook Name.ipynb"
        nb_path = nb_path.replace("-", " ")
        if os.path.isfile(nb_path):
            return nb_path
```

Notebook Loader

Here we have our Notebook Loader. It's actually quite simple - once we figure out the filename of the module, all it does is:

1. load the notebook document into memory
2. create an empty Module
3. execute every cell in the Module namespace

Since IPython cells can have extended syntax, the IPython transform is applied to turn each of these cells into their pure-Python counterparts before executing them. If all of your notebook cells are pure-Python, this step is unnecessary.

```
[ ]: class NotebookLoader(object):
    """Module Loader for Jupyter Notebooks"""
    def __init__(self, path=None):
```

(continues on next page)

(continued from previous page)

```
self.shell = InteractiveShell.instance()
self.path = path

def load_module(self, fullname):
    """import a notebook as a module"""
    path = find_notebook(fullname, self.path)

    print ("importing Jupyter notebook from %s" % path)

    # load the notebook object
    with io.open(path, 'r', encoding='utf-8') as f:
        nb = read(f, 4)

    # create the module and add it to sys.modules
    # if name in sys.modules:
    #     return sys.modules[name]
    mod = types.ModuleType(fullname)
    mod.__file__ = path
    mod.__loader__ = self
    mod.__dict__['get_ipython'] = get_ipython
    sys.modules[fullname] = mod

    # extra work to ensure that magics that would affect the user_ns
    # actually affect the notebook module's ns
    save_user_ns = self.shell.user_ns
    self.shell.user_ns = mod.__dict__

    try:
        for cell in nb.cells:
            if cell.cell_type == 'code':
                # transform the input to executable Python
                code = self.shell.input_transformer_manager.transform_cell(cell.source)
                # run the code in the module
                exec(code, mod.__dict__)
    finally:
        self.shell.user_ns = save_user_ns
    return mod
```

The Module Finder

The finder is a simple object that tells you whether a name can be imported, and returns the appropriate loader. All this one does is check, when you do:

```
import mynotebook
```

it checks whether `mynotebook.ipynb` exists. If a notebook is found, then it returns a `NotebookLoader`.

Any extra logic is just for resolving paths within packages.

```
[ ]: class NotebookFinder(object):
    """Module finder that locates Jupyter Notebooks"""
    def __init__(self):
        self.loaders = {}

    def find_module(self, fullname, path=None):
        nb_path = find_notebook(fullname, path)
        if not nb_path:
            return

        key = path
        if path:
            # lists aren't hashable
            key = os.path.sep.join(path)

        if key not in self.loaders:
            self.loaders[key] = NotebookLoader(path)
        return self.loaders[key]
```

Register the hook

Now we register the NotebookFinder with `sys.meta_path`

```
[ ]: sys.meta_path.append(NotebookFinder())
```

After this point, my notebooks should be importable.

Let's look at what we have in the CWD:

```
[ ]: ls nbpackage
```

So I should be able to import `nbpackage.mynotebook`.

```
[ ]: import nbpackage.mynotebook
```

Aside: displaying notebooks

Here is some simple code to display the contents of a notebook with syntax highlighting, etc.

```
[ ]: from pygments import highlight
    from pygments.lexers import PythonLexer
    from pygments.formatters import HtmlFormatter

    from IPython.display import display, HTML

    formatter = HtmlFormatter()
    lexer = PythonLexer()

    # publish the CSS for pygments highlighting
    display(HTML("""
```

(continues on next page)

(continued from previous page)

```
<style type='text/css'>
%s
</style>
""" % formatter.get_style_defs()
))
```

```
[ ]: def show_notebook(fname):
    """display a short summary of the cells of a notebook"""
    with io.open(fname, 'r', encoding='utf-8') as f:
        nb = read(f, 4)
        html = []
        for cell in nb.cells:
            html.append("<h4>%s cell</h4>" % cell.cell_type)
            if cell.cell_type == 'code':
                html.append(highlight(cell.source, lexer, formatter))
            else:
                html.append("<pre>%s</pre>" % cell.source)
        display(HTML('\n'.join(html)))

show_notebook(os.path.join("nbpackage", "mynotebook.ipynb"))
```

So my notebook has some code cells, one of which contains some IPython syntax.

Let's see what happens when we import it

```
[ ]: from nbpackage import mynotebook
```

Hooray, it imported! Does it work?

```
[ ]: mynotebook.foo()
```

Hooray again!

Even the function that contains IPython syntax works:

```
[ ]: mynotebook.has_ip_syntax()
```

Notebooks in packages

We also have a notebook inside the nb package, so let's make sure that works as well.

```
[ ]: ls nbpackage/nbs
```

Note that the `__init__.py` is necessary for nb to be considered a package, just like usual.

```
[ ]: show_notebook(os.path.join("nbpackage", "nbs", "other.ipynb"))
```

```
[ ]: from nbpackage.nbs import other
other.bar(5)
```

So now we have importable notebooks, from both the local directory and inside packages.

I can even put a notebook inside IPython, to further demonstrate that this is working properly:

```
[ ]: import shutil
      from IPython.paths import get_ipython_package_dir

      utils = os.path.join(get_ipython_package_dir(), 'utils')
      shutil.copy(os.path.join("nbpackage", "mynotebook.ipynb"),
                  os.path.join(utils, "inside_ipython.ipynb")
      )
```

and import the notebook from IPython.utils

```
[ ]: from IPython.utils import inside_ipython
      inside_ipython.whatsmyname()
```

This approach can even import functions and classes that are defined in a notebook using the %%cython magic.

1.3.7 Connecting to an existing IPython kernel using the Qt Console

The Frontend/Kernel Model

The traditional IPython (ipython) consists of a single process that combines a terminal based UI with the process that runs the users code.

While this traditional application still exists, the modern Jupyter consists of two processes:

- Kernel: this is the process that runs the users code.
- Frontend: this is the process that provides the user interface where the user types code and sees results.

Jupyter currently has 3 frontends:

- Terminal Console (jupyter console)
- Qt Console (jupyter qtconsole)
- Notebook (jupyter notebook)

The Kernel and Frontend communicate over a ZeroMQ/JSON based messaging protocol, which allows multiple Frontends (even of different types) to communicate with a single Kernel. This opens the door for all sorts of interesting things, such as connecting a Console or Qt Console to a Notebook's Kernel. For example, you may want to connect a Qt console to your Notebook's Kernel and use it as a help browser, calling ?? on objects in the Qt console (whose pager is more flexible than the one in the notebook).

This Notebook describes how you would connect another Frontend to an IPython Kernel that is associated with a Notebook. The commands currently given here are specific to the IPython kernel.

Manual connection

To connect another Frontend to a Kernel manually, you first need to find out the connection information for the Kernel using the %connect_info magic:

```
[ ]: %connect_info
```

You can see that this magic displays everything you need to connect to this Notebook's Kernel.

Automatic connection using a new Qt Console

You can also start a new Qt Console connected to your current Kernel by using the `%qtconsole` magic. This will detect the necessary connection information and start the Qt Console for you automatically.

```
[ ]: a = 10
```

```
[ ]: %qtconsole
```

The Markdown parser included in the Jupyter Notebook is MathJax-aware. This means that you can freely mix in mathematical expressions using the [MathJax subset of Tex and LaTeX](#). Some examples from the [MathJax demos site](#) are reproduced below, as well as the Markdown+TeX source.

1.3.8 Motivating Examples

The Lorenz Equations

Source

```
\begin{align}
\dot{x} &= \sigma(y-x) \\
\dot{y} &= \rho x - y - xz \\
\dot{z} &= -\beta z + xy
\end{align}
```

Display

The Cauchy-Schwarz Inequality

Source

```
\begin{equation*}
\left( \sum_{k=1}^n a_k b_k \right)^2 \leq \left( \sum_{k=1}^n a_k^2 \right) \left( \sum_{k=1}^n b_k^2 \right)
\end{equation*}
```

Display

$$\left(\sum_{k=1}^n a_k b_k\right)^2 \leq \left(\sum_{k=1}^n a_k^2\right) \left(\sum_{k=1}^n b_k^2\right)$$

A Cross Product Formula

Source

```
\begin{equation*}
\mathbf{V}_1 \times \mathbf{V}_2 = \begin{vmatrix}
\mathbf{i} & \mathbf{j} & \mathbf{k} \\
\frac{\partial X}{\partial u} & \frac{\partial Y}{\partial u} & 0 \\
\frac{\partial X}{\partial v} & \frac{\partial Y}{\partial v} & 0
\end{vmatrix}
\end{equation*}
```

Display

$$\mathbf{V}_1 \times \mathbf{V}_2 = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ \frac{\partial X}{\partial u} & \frac{\partial Y}{\partial u} & 0 \\ \frac{\partial X}{\partial v} & \frac{\partial Y}{\partial v} & 0 \end{vmatrix}$$

The probability of getting (k) heads when flipping (n) coins is

Source

```
\begin{equation*}
P(E) = \{n \text{ choose } k\} p^k (1-p)^{n-k}
\end{equation*}
```

Display

$$P(E) = \binom{n}{k} p^k (1-p)^{n-k}$$

An Identity of Ramanujan

Source

```
\begin{equation*}
\frac{1}{1+\frac{e^{-2\pi}}{1+\frac{e^{-4\pi}}{1+\frac{e^{-6\pi}}{1+\frac{e^{-8\pi}}{1+\ldots}}}}} =
\end{equation*}
```

Display

$$\frac{1}{\left(\sqrt{\phi\sqrt{5}-\phi}\right)e^{\frac{2}{3}\pi}} = 1 + \frac{e^{-2\pi}}{1 + \frac{e^{-4\pi}}{1 + \frac{e^{-6\pi}}{1 + \frac{e^{-8\pi}}{1 + \dots}}}}$$

A Rogers-Ramanujan Identity

Source

```
\begin{equation*}
1 + \frac{q^2}{(1-q)} + \frac{q^6}{(1-q)(1-q^2)} + \cdots =
\prod_{j=0}^{\infty} \frac{1}{(1-q^{5j+2})(1-q^{5j+3})},
\quad \text{for } |q| < 1.
\end{equation*}
```

Display

$$1 + \frac{q^2}{(1-q)} + \frac{q^6}{(1-q)(1-q^2)} + \cdots = \prod_{j=0}^{\infty} \frac{1}{(1-q^{5j+2})(1-q^{5j+3})}, \quad \text{for } |q| < 1.$$

Maxwell's Equations

Source

```
\begin{align}
\nabla \times \vec{\mathbf{B}} &= \frac{1}{c} \frac{\partial \vec{\mathbf{E}}}{\partial t} \\
\nabla \cdot \vec{\mathbf{E}} &= \frac{4\pi}{c} \rho \\
\nabla \times \vec{\mathbf{E}} &= -\frac{1}{c} \frac{\partial \vec{\mathbf{B}}}{\partial t} \\
\nabla \cdot \vec{\mathbf{B}} &= 0
\end{align}
```

Display

Equation Numbering and References

Equation numbering and referencing will be available in a future version of the Jupyter notebook.

Inline Typesetting (Mixing Markdown and TeX)

While display equations look good for a page of samples, the ability to mix math and *formatted text* in a paragraph is also important.

Source

This expression $\sqrt{3x-1}+(1+x)^2$ is an example of a TeX inline equation in a [\[Markdown-formatted\]](https://daringfireball.net/projects/markdown/) (https://daringfireball.net/projects/markdown/) sentence.

Display

This expression $\sqrt{3x-1}+(1+x)^2$ is an example of a TeX inline equation in a [Markdown-formatted](#) sentence.

Other Syntax

You will notice in other places on the web that $\$$ are needed explicitly to begin and end MathJax typesetting. This is **not** required if you will be using TeX environments, but the Jupyter notebook will accept this syntax on legacy notebooks.

Source

```
$$
\begin{array}{c}
y_1 \\\
y_2 \mathtt{t}_i \\\
z_{3,4}
\end{array}
$$
```

```
$$
\begin{array}{c}
y_1 \cr
y_2 \mathtt{t}_i \cr
y_{3}
\end{array}
$$
```

```
$$\begin{eqnarray}
x' &=& \& x \sin\phi \&+& z \cos\phi \\\
z' &=& - \& x \cos\phi \&+& z \sin\phi \\\
\end{eqnarray}$$
```

```
$$
x=4
$$
```

Display

$$\begin{aligned} & y_1 \\ & y_2 \mathfrak{t}_i \\ & z_{3,4} \end{aligned}$$

$$\begin{aligned} & y_1 \\ & y_2 \mathfrak{t}_i \\ & y_3 \end{aligned}$$

$$to$$

$$\begin{aligned} x' &= \\ & x \sin \phi \\ & + z \cos \phi \\ z' &= \\ & -x \cos \phi \\ & + z \sin \phi \end{aligned}$$

$$(1.2)$$

$$\begin{aligned} &= \\ &+ \\ - &= \\ &+x \cos \phi \\ &z \sin \phi \end{aligned}$$

$$x = 4$$

1.4 What to do when things go wrong

First, have a look at the common problems listed below. If you can figure it out from these notes, it will be quicker than asking for help.

Check that you have the latest version of any packages that look relevant. Unfortunately it's not always easy to figure out what packages are relevant, but if there was a bug that's already been fixed, it's easy to upgrade and get on with what you wanted to do.

1.4.1 Jupyter fails to start

- Have you `installed it`? ;-)
- If you're using a menu shortcut or Anaconda launcher to start it, try opening a terminal or command prompt and running the command `jupyter notebook`.
- If it can't find `jupyter`, you may need to configure your `PATH` environment variable. If you don't know what that means, and don't want to find out, just (re)install Anaconda with the default settings, and it should set up `PATH` correctly.
- If Jupyter gives an error that it can't find `notebook`, check with `pip` or `conda` that the `notebook` package is installed.
- Try running `jupyter-notebook` (with a hyphen). This should normally be the same as `jupyter notebook` (with a space), but if there's any difference, the version with the hyphen is the 'real' launcher, and the other one wraps that.

1.4.2 Jupyter doesn't load or doesn't work in the browser

- Try in another browser (e.g. if you normally use Firefox, try with Chrome). This helps pin down where the problem is.
- Try disabling any browser extensions and/or any Jupyter extensions you have installed.
- Some internet security software can interfere with Jupyter. If you have security software, try turning it off temporarily, and look in the settings for a more long-term solution.
- In the address bar, try changing between `localhost` and `127.0.0.1`. They should be the same, but in some cases it makes a difference.

1.4.3 Jupyter can't start a kernel

Files called *kernel specs* tell Jupyter how to start different kinds of kernels. To see where these are on your system, run `jupyter kernelspec list`:

```
$ jupyter kernelspec list
Available kernels:
python3      /home/takluyver/.local/lib/python3.6/site-packages/ipykernel/resources
bash         /home/takluyver/.local/share/jupyter/kernels/bash
ir           /home/takluyver/.local/share/jupyter/kernels/ir
```

There's a special fallback for the Python kernel: if it doesn't find a real kernelspec, but it can import the `ipykernel` package, it provides a kernel which will run in the same Python environment as the notebook server. A path ending in `ipykernel/resources`, like in the example above, is this default kernel. The default often does what you want,

so if the `python3` kernelspec points somewhere else and you can't start a Python kernel, try deleting or renaming that kernelspec folder to expose the default.

If your problem is with another kernel, not the Python one we maintain, you may need to look for support about that kernel.

1.4.4 Python Environments

Multiple python environments, whether based on Anaconda or Python Virtual environments, are often the source of reported issues. In many cases, these issues stem from the Notebook server running in one environment, while the kernel and/or its resources, derive from another environment. Indicators of this scenario include:

- `import` statements within code cells producing `ImportError` or `ModuleNotFound` exceptions.
- General kernel startup failures exhibited by nothing happening when attempting to execute a cell.

In these situations, take a close look at your environment structure and ensure all packages required by your notebook's code are installed in the correct environment. If you need to run the kernel from different environments than your Notebook server, check out [IPython's documentation](#) for using kernels from different environments as this is the recommended approach. Anaconda's `nb_conda_kernels` package might also be an option for you in these scenarios.

Another thing to check is the `kernel.json` file that will be located in the aforementioned *kernel specs* directory identified by running `jupyter kernelspec list`. This file will contain an `argv` stanza that includes the actual command to run when launching the kernel. Oftentimes, when reinstalling python environments, a previous `kernel.json` will reference an python executable from an old or non-existent location. As a result, it's always a good idea when encountering kernel startup issues to validate the `argv` stanza to ensure all file references exist and are appropriate.

1.4.5 Windows Systems

Although Jupyter Notebook is primarily developed on the various flavors of the Unix operating system it also supports Microsoft Windows - which introduces its own set of commonly encountered issues, particularly in the areas of security, process management and lower-level libraries.

pywin32 Issues

The primary package for interacting with Windows' primitives is `pywin32`.

- Issues surrounding the creation of the kernel's communication file utilize `jupyter_core`'s `secure_write()` function. This function ensures a file is created in which only the owner of the file has access. If libraries like `pywin32` are not properly installed, issues can arise when it's necessary to use the native Windows libraries.

Here's a portion of such a traceback:

```
File "c:\users\jovyan\python\myenv.venv\lib\site-packages\jupyter_core\paths.py", line 424, in secure_write
win32_restrict_file_to_user(fname)
File "c:\users\jovyan\python\myenv.venv\lib\site-packages\jupyter_core\paths.py", line 359, in win32_restrict_file_to_user
import win32api
ImportError: DLL load failed: The specified module could not be found.
```

- As noted earlier, the installation of `pywin32` can be problematic on Windows configurations. When such an issue occurs, you may need to revisit how the environment was setup. Pay careful attention to whether you're running the 32 or 64 bit versions of Windows and be sure to install appropriate packages for that environment.

Here's a portion of such a traceback:

```
File "C:\Users\jovyan\AppData\Roaming\Python\Python37\site-packages\jupyter_core\
↳paths.py", line 435, in secure_write
win32_restrict_file_to_user(fname)
File "C:\Users\jovyan\AppData\Roaming\Python\Python37\site-packages\jupyter_core\
↳paths.py", line 361, in win32_restrict_file_to_user
import win32api
ImportError: DLL load failed: %1 is not a valid Win32 application
```

Resolving pywin32 Issues

In this case, your pywin32 module may not be installed correctly and the following should be attempted:

```
pip install --upgrade pywin32
```

or:

```
conda install --force-reinstall pywin32
```

followed by:

```
python.exe Scripts/pywin32_postinstall.py -install
```

where Scripts is located in the active Python's installation location.

- Another common failure specific to Windows environments is the location of various python commands. On *nix systems, these typically reside in the bin directory of the active Python environment. However, on Windows, these tend to reside in the Scripts folder - which is a sibling to bin. As a result, when encountering kernel startup issues, again, check the argv stanza and verify it's pointing to a valid file. You may find that it's pointing in bin when Scripts is correct, or the referenced file does not include its .exe extension - typically resulting in FileNotFoundError exceptions.

1.4.6 This Worked An Hour Ago

The Jupyter stack is very complex and rightfully so, there's a lot going on. On occasion you might find the system working perfectly well, then, suddenly, you can't get past a certain cell due to import failures. In these situations, it's best to ask yourself if any new python files were added to your notebook development area.

These issues are usually evident by carefully analyzing the traceback produced in the notebook error or the Notebook server's command window. In these cases, you'll typically find the Python kernel code (from IPython and ipykernel) performing *its* imports and notice a file from your Notebook development error included in that traceback followed by an AttributeError:

```
File "C:\Users\jovyan\anaconda3\lib\site-packages\ipykernel\connect.py", line 13, in
from IPython.core.profiledir import ProfileDir
File "C:\Users\jovyan\anaconda3\lib\site-packages\IPython_init.py", line 55, in
from .core.application import Application
...
File "C:\Users\jovyan\anaconda3\lib\site-packages\ipython_genutils\path.py", line 13, in
import random
File "C:\Users\jovyan\Desktop\Notebooks\random.py", line 4, in
rand_set = random.sample(english_words_lower_set, 12)
AttributeError: module 'random' has no attribute 'sample'
```

What has happened is that you have named a file that conflicts with an installed package that is used by the kernel software and now introduces a conflict preventing the kernel's startup.

Resolution: You'll need to rename your file. A best practice would be to prefix or *namespace* your files so as not to conflict with any python package.

1.4.7 Asking for help

As with any problem, try searching to see if someone has already found an answer. If you can't find an existing answer, you can ask questions at:

- The [Jupyter Discourse Forum](#)
- The [jupyter-notebook](#) tag on [Stackoverflow](#)
- Peruse the [jupyter/help](#) repository on [Github](#) (read-only)
- Or in an issue on another repository, if it's clear which component is responsible. Typical repositories include:
 - [jupyter_core](#) - `secure_write()` and file path issues
 - [jupyter_client](#) - kernel management issues found in Notebook server's command window.
 - [IPython](#) and [ipykernel](#) - kernel runtime issues typically found in Notebook server's command window and/or Notebook cell execution.

Gathering Information

Should you find that your problem warrants that an issue be opened in [notebook](#) please don't forget to provide details like the following:

- What error messages do you see (within your notebook and, more importantly, in the Notebook server's command window)?
- What platform are you on?
- How did you install Jupyter?
- What have you tried already?

The `jupyter troubleshoot` command collects a lot of information about your installation, which can also be useful.

When providing textual information, it's most helpful if you can *scrape* the contents into the issue rather than providing a screenshot. This enables others to select pieces of that content so they can search more efficiently and try to help.

Remember that it's not anyone's job to help you. We want Jupyter to work for you, but we can't always help everyone individually.

1.5 Changelog

A summary of changes in the Jupyter notebook. For more detailed information, see [GitHub](#).

Use `pip install notebook --upgrade` or `conda upgrade notebook` to upgrade to the latest release.

We strongly recommend that you upgrade pip to version 9+ of pip before upgrading notebook.

Use `pip install pip --upgrade` to upgrade pip. Check pip version with `pip --version`.

1.5.1 7.0.0a5

(Full Changelog)

Enhancements made

- Add shadow to cells #6433 (@trungleduc)

Maintenance and upkeep improvements

- Fix docs build #6447 (@jtpio)
- [pre-commit.ci] pre-commit autoupdate #6444 (@pre-commit-ci)
- [pre-commit.ci] pre-commit autoupdate #6439 (@pre-commit-ci)
- [pre-commit.ci] pre-commit autoupdate #6434 (@pre-commit-ci)
- Use hatch backend #6425 (@blink1073)

Contributors to this release

(GitHub contributors page for this release)

@blink1073 | @github-actions | @jtpio | @ofek | @pre-commit-ci | @trungleduc

1.5.2 7.0.0a4

(Full Changelog)

Enhancements made

- Update to JupyterLab 4.0.0a25 #6429 (@jtpio)
- Add cell toolbar extension #6418 (@jtpio)
- add the show header command to the command palette #6415 (@jeewonkoo)
- Remove the “Appearance” menu entry #6412 (@jtpio)

Maintenance and upkeep improvements

- [pre-commit.ci] pre-commit autoupdate #6426 (@pre-commit-ci)
- Allow bot PRs to be automatically labeled #6414 (@blink1073)
- Add Visual Regression Test for the export submenu #6383 (@jtpio)
- Fix ESLint config for tests #6382 (@jtpio)

Contributors to this release

(GitHub contributors page for this release)

@blink1073 | @github-actions | @jeewonkoo | @jtpio | @ofek | @pre-commit-ci

1.5.3 7.0.0a3

(Full Changelog)

Enhancements made

- Show file checkboxes by default in the file browser #6377 (@jtpio)
- Remove blank space at the bottom of the notebook #6376 (@jtpio)
- Add a label to the upload button #6374 (@jtpio)
- Update to JupyterLab 4.0.0a24 #6371 (@jtpio)
- Initialize handler page_config from Server traitlets #6366 (@bollwyvl)
- Add project URLs to setup.cfg #6346 (@tlinhart)
- Update to JupyterLab 4.0.0a23 #6336 (@jtpio)

Bugs fixed

- Fix opening JupyterLab from Notebook #6379 (@jtpio)

Maintenance and upkeep improvements

- Add UI tests for a simple notebook #6380 (@jtpio)
- Bump async from 2.6.3 to 2.6.4 in /ui-tests #6370 (@dependabot)
- Fix build workflow on CI #6369 (@jtpio)
- [pre-commit.ci] pre-commit autoupdate #6365 (@pre-commit-ci)
- [pre-commit.ci] pre-commit autoupdate #6355 (@pre-commit-ci)
- Bump moment from 2.29.1 to 2.29.2 #6352 (@dependabot)
- Bump moment from 2.29.1 to 2.29.2 in /ui-tests #6351 (@dependabot)
- Clean up pre-commit #6349 (@blink1073)
- Update to TypeScript 4.6 #6345 (@jtpio)
- [pre-commit.ci] pre-commit autoupdate #6343 (@pre-commit-ci)
- Add pytest and handle warnings #6338 (@blink1073)
- Add flake8 and git-blame-ignore-revs #6337 (@blink1073)
- Run Autoformatters #6335 (@blink1073)
- Bump minimist from 1.2.5 to 1.2.6 #6334 (@dependabot)
- Bump minimist from 1.2.5 to 1.2.6 in /ui-tests #6333 (@dependabot)

- Bump ansi-regex from 3.0.0 to 3.0.1 in /ui-tests #6332 (@dependabot)
- Adopt pre-commit #6331 (@blink1073)

Documentation improvements

- Link to v6 plan in the README #6375 (@echarles)
- Copy edits in config, edits bug report template #6364 (@jweill-aws)

Contributors to this release

(GitHub contributors page for this release)

@blink1073 | @bollwyvl | @dependabot | @echarles | @github-actions | @jtpio | @jweill-aws | @pre-commit-ci | @tlinhart

1.5.4 7.0.0a2

(Full Changelog)

Enhancements made

- Add support for opening a document with a different factory #6315 (@jtpio)
- Minor copy edit in README #6313 (@jweill-aws)

Bugs fixed

- Fix rendering of markdown #6318 (@jtpio)

Maintenance and upkeep improvements

- Update to JupyterLab 4.0.0a22 #6314 (@jtpio)

Documentation improvements

- docs: fix spelling #6317 (@dijonkitchen)
- Minor copy edit in README #6313 (@jweill-aws)
- Update example notebook on Binder #6306 (@jtpio)

Contributors to this release

(GitHub contributors page for this release)

@dijonkitchen | @fcollonval | @github-actions | @jtpio | @jweill-aws

1.5.5 7.0.0a1

(Full Changelog)

Enhancements made

- Notebook v7 scaffolding #6294 (@jtpio)

Maintenance and upkeep improvements

- Clean up CI #6304 (@blink1073)
- Remove the custom run keyboard shortcut #6303 (@jtpio)
- Bump nanoid from 3.1.30 to 3.3.1 in /ui-tests #6302 (@dependabot)
- Bump simple-get from 3.1.0 to 3.1.1 in /ui-tests #6301 (@dependabot)
- Bump url-parse from 1.5.4 to 1.5.10 in /ui-tests #6300 (@dependabot)
- Bump node-fetch from 2.6.6 to 2.6.7 in /ui-tests #6299 (@dependabot)
- Bump follow-redirects from 1.14.5 to 1.14.9 in /ui-tests #6298 (@dependabot)

Contributors to this release

(GitHub contributors page for this release)

@blink1073 | @dependabot | @github-actions | @jtpio | @kevin-bates | @Zsailer

1.5.6 6.4.8

(Full Changelog)

Bugs fixed

- Fix to remove potential memory leak on Jupyter Notebooks ZMQChannelHandler code #6251 (@Vishwa-jeet0510)

Contributors to this release

(GitHub contributors page for this release)

@Vishwajeet0510

1.5.7 6.4.7

(Full Changelog)

Bugs fixed

- Fix Chinese punctuation #6268 (@LiHua-Official)
- Add date field to kernel message header #6265 (@kevin-bates)
- Fix deprecation warning #6253 (@tornaria)

Maintenance and upkeep improvements

- Enforce labels on PRs #6235 (@blink1073)
- Fix: CI error for python 3.6 & macOS #6215 (@penguinolog)

Other merged PRs

- handle KeyError when get session #6245 (@ccw630)
- Updated doc for passwd #6209 (@antoinecarme)

Contributors to this release

(GitHub contributors page for this release)

@antoinecarme | @blink1073 | @ccw630 | @kevin-bates | @LiHua-Official | @penguinolog | @tornaria

1.5.8 6.4.6

(Full Changelog)

Bugs fixed

- Fix asyncio error when opening notebooks #6221 (@dleen)
- Change to use a universal Chinese translation on certain words #6218 (@jackexu)
- Fix Chinese translation typo #6211 (@maliubiao)
- Fix send2trash tests failing on Windows #6127 (@dolfinus)

Maintenance and upkeep improvements

- TST: don't look in user site for serverextensions #6233 (@bnavigator)
- Enable terminal tests as pywinpty is ported for python 3.9 #6228 (@nsait-linaro)

Contributors to this release

(GitHub contributors page for this release)

@bnavigator | @dleen | @dolfinus | @jackexu | @kevin-bates | @maliubiao | @nsait-linaro | @takluyver | @Zsailer

1.5.9 6.4.5

(Full Changelog)

Bug fixes

- Recover from failure to render mimetype #6181 (@martinRenou)

Maintenance and upkeep improvements

- Fix crypto handling #6197 (@blink1073)
- Fix jupyter_client warning #6178 (@martinRenou)

Documentation improvements

- Fix nbsphinx settings #6200 (@mgeier)
- Fully revert the pinning of nbsphinx to 0.8.6 #6201 (@kevin-bates)
- Pin nbsphinx to 0.8.6, clean up orphaned resources #6194 (@kevin-bates)
- Fix typo in docstring #6188 (@jgarte)

Contributors to this release

(GitHub contributors page for this release)

@blink1073 | @jgarte | @kevin-bates | @martinRenou | @mgeier

1.5.10 6.4.4

(Full Changelog)

Documentation improvements

- Update Manual Release Instructions #6152 (@blink1073)

Other merged PRs

- Use default JupyterLab CSS sanitizer options for Markdown #6160 (@krassowski)
- Fix syntax highlight #6128 (@massongit)

Contributors to this release

(GitHub contributors page for this release)

@blink1073 | @kevin-bates | @krassowski | @massongit | @minrk | @Zsailer

1.5.11 6.4.3

(Full Changelog)

Bugs fixed

- Add @babel/core dependency #6133 (@afshin)
- Switch webpack to production mode #6131 (@afshin)

Maintenance and upkeep improvements

- Clean up link checking #6130 (@blink1073)

Contributors to this release

(GitHub contributors page for this release)

@afshin | @blink1073 | @Zsailer

1.5.12 6.4.2

(Full Changelog)

Bugs fixed

- Add missing file to manifest #6122 (@afshin)
- Fix issue #3218 #6108 (@Nazeeh21)
- Fix version of jupyter-packaging in pyproject.toml #6101 (@frenzymadness)
- “#element”.tooltip is not a function on home page fixed. #6070 @ilayh123

Maintenance and upkeep improvements

- Enhancements to the desktop entry #6099 (@Amr-Ibra)
- Add missing spaces to help messages in config file #6085 (@saiwing-yeung)

Contributors to this release

(GitHub contributors page for this release)

@afshin | @Amr-Ibra | @frenzymadness | @ilayh123 | @kevin-bates | @Nazeeh21 | @saiwing-yeung

1.5.13 6.4.0

(Full Changelog)

Bugs fixed

- Fix Handling of Encoded Paths in Save As Dialog #6030 (@afshin)
- Fix: split_cell doesn't always split cell #6017 (@gamestrUS)
- Correct 'Content-Type' headers #6026 (@faucet)
- Fix skipped tests & remove deprecation warnings #6018 (@befeleme)
- [Gateway] Track only this server's kernels #5980 (@kevin-bates)
- Bind the HTTPServer in start #6061

Maintenance and upkeep improvements

- Revert "do not apply asyncio patch for tornado >=6.1" #6052 (@minrk)
- Use Jupyter Releaser #6048 (@afshin)
- Add Workflow Permissions for Lock Bot #6042 (@jtpio)
- Fixes related to the recent changes in the documentation #6021 (@frenzymadness)
- Add maths checks in CSS reference test #6035 (@stef4k)
- Add Issue Lock and Answered Bots #6019 (@afshin)

Documentation improvements

- Spelling correction #6045 (@wggillen)
- Minor typographical and comment changes #6025 (@misterhay)
- Fixes related to the recent changes in the documentation #6021 (@frenzymadness)
- Fix readthedocs environment #6020 (@blink1073)

Contributors to this release

(GitHub contributors page for this release)

@afshin | @befeleme | @blink1073 | @faucet | @frenzymadness | @gamestrUS | @jtpio | @kevin-bates | @minrk | @misterhay | @stef4k | @wggillen

1.5.14 6.3.0

Merged PRs

- Add square logo and desktop entry files #6010 (@befeleme)
- Modernize Changelog #6008 (@afshin)
- Add missing “import inspect” #5999 (@mgeier)
- Add Codecov badge to README #5989 (@thomasrockhu)
- Remove configuration for nosetests from setup.cfg #5986 (@frenzymadness)
- Update security.rst #5978 (@dlrice)
- Docs-Translations: Updated Hindi and Chinese Readme.md #5976 (@rjn01)
- Allow /metrics by default if auth is off #5974 (@blairdrummond)
- Skip terminal tests on Windows 3.9+ (temporary) #5968 (@kevin-bates)
- Update GatewayKernelManager to derive from AsyncMappingKernelManager #5966 (@kevin-bates)
- Drop use of deprecated pyzmq.ioloop #5965 (@kevin-bates)
- Drop support for Python 3.5 #5962 (@kevin-bates)
- Allow jupyter_server-based contents managers in notebook #5957 (@afshin)
- Russian translation fixes #5954 (@insolor)
- Increase culling test idle timeout #5952 (@kevin-bates)
- Re-enable support for answer_yes flag #5941 (@afshin)
- Replace Travis and Appveyor with Github Actions #5938 (@kevin-bates)
- DOC: Server extension, extra docs on configuration/authentication. #5937 (@Carreau)

Contributors to this release

(GitHub contributors page for this release)

@abielhammonds | @afshin | @ajharry | @Alokrar | @befeleme | @blairdrummond | @blink1073 | @bollwyvl | @Carreau | @ChenChenDS | @cosmoscalibur | @dlrice | @dwanneruchi | @ElisonSherton | @FazeelUsmani | @frenzymadness | @goerz | @insolor | @jasongrout | @JianghuiDu | @JuzerShakir | @kevin-bates | @Khalilsqu | @meeseeksdev | @mgeier | @michaelpedota | @mjbright | @MSeal | @ncoughlin | @NTimmons | @ProsperousHeart | @rjn01 | @slw07g | @stenivan | @takluyver | @thomasrockhu | @wgilpin | @wxtt522 | @yuvipanda | @Zsailer

1.5.15 6.2.0

1.5.16 Merged PRs

- Increase minimum tornado version (5933)
- Adjust skip decorators to avoid remaining dependency on nose (5932)
- Ensure that cell ids persist after save (5928)
- Add reconnection to Gateway (form nb2kg) (5924)
- Fix some typos (5917)
- Handle TrashPermissionError, now that it exist (5894)

Thank you to all the contributors:

- @kevin-bates
- @mishaschwartz
- @oyvsyo
- @user202729
- @stefanor

1.5.17 6.1.6

1.5.18 Merged PRs

- do not require nose for testing (5826)
- [docs] Update Chinese and Hindi readme.md (5823)
- Add support for creating terminals via GET (5813)
- Made doc translations in Hindi and Chinese (5787)

Thank you to all the contributors:

- @pgajdos
- @rjn01
- @kevin-bates
- @virejdasani

1.5.19 6.1.5

6.1.5 is a security release, fixing one vulnerability:

- Fix open redirect vulnerability GHSA-c7vm-f5p4-8fqh (CVE to be assigned)

1.5.20 6.1.4

- Fix broken links to jupyter documentation (5686)
- Add additional entries to troubleshooting section (5695)
- Revert change in page alignment (5703)
- Bug fix: remove double encoding in download files (5720)
- Fix typo for Check in zh_CN (5730)
- Require a file name in the “Save As” dialog (5733)

Thank you to all the contributors:

- bdbai
- Jaipreet Singh
- Kevin Bates
- Pavel Panchekha
- Zach Sailer

1.5.21 6.1.3

- Title new buttons with label if action undefined (5676)

Thank you to all the contributors:

- Kyle Kelley

1.5.22 6.1.2

- Fix russian message format for delete/duplicate actions (5662)
- Remove unnecessary import of bind_unix_socket (5666)
- Tooltip style scope fix (5672)

Thank you to all the contributors:

- Dmitry Akatov
- Kevin Bates
- Magda Stenius

1.5.23 6.1.1

- Prevent inclusion of requests_unixsocket on Windows (5650)

Thank you to all the contributors:

- Kevin Bates

1.5.24 6.1.0

Please note that this repository is currently maintained by a skeleton crew of maintainers from the Jupyter community. For our approach moving forward, please see this [notice](#) from the README. Thank you.

Here is an enumeration of changes made since the last release and included in 6.1.0.

- Remove deprecated encoding parameter for Python 3.9 compatibility. (5174)
- Add support for async kernel management (4479)
- Fix typo in password_required help message (5320)
- Gateway only: Ensure launch and request timeouts are in sync (5317)
- Update Markdown Cells example to HTML5 video tag (5411)
- Integrated LoginWidget into edit to enable users to logout from the t... (5406)
- Update message about minimum Tornado version (5222)
- Logged notebook type (5425)
- Added nl language (5354)
- Add UNIX socket support to notebook server. (4835)
- Update CodeMirror dependency (5198)
- Tree added download multiple files (5351)
- Toolbar buttons tooltip: show help instead of label (5107)
- Remove unnecessary import of requests_unixsocket (5451)
- Add ability to cull terminals and track last activity (5372)
- Code refactoring notebook.js (5352)
- Install terminado for docs build (5462)
- Convert notifications JS test to selenium (5455)
- Add cell attachments to markdown example (5412)
- Add Japanese document (5231)
- Migrate Move multiselection test to selenium (5158)
- Use `cmdtrl-enter` to run a cell (5120)
- Fix broken “Raw cell MIME type” dialog (5385)
- Make a notebook writable after successful save-as (5296)
- Add actual watch script (4738)
- Added `--autoreload` flag to `NotebookApp` (4795)
- Enable `check_origin` on gateway websocket communication (5471)
- Restore detection of missing terminado package (5465)
- Culling: ensure `last_activity` attr exists before use (5355)
- Added functionality to allow filter kernels by Jupyter Enterprise Gat... (5484)
- ‘Play’ icon for run-cell toolbar button (2922)
- Bump minimum version of jQuery to 3.5.0 (5491)

- Remove old JS markdown tests, add a new one in selenium (5497)
- Add support for more RTL languages (5036)
- Make markdown cells stay RTL in edit mode (5037)
- Unforce RTL output display (5039)
- Fixed multicursor backspacing (4880)
- Implemented Split Cell for multicursor (4824)
- Alignment issue [FIXED] (3173)
- MathJax: Support for `\gdef` (4407)
- Another (Minor) Duplicate Code Reduction (5316)
- Update readme regarding maintenance (5500)
- Document contents chunks (5508)
- Backspace deletes empty line (5516)
- The dropdown submenu at notebook page is not keyboard accessible (4732)
- Tooltips visible through keyboard navigation for specified buttons (4729)
- Fix for recursive symlink (4670)
- Fix for the terminal shutdown issue (4180)
- Add japanese translation files (4490)
- Workaround for socket permission errors on Cygwin (4584)
- Implement optional markdown header and footer files (4043)
- Remove double link when using `custom_display_url` (5544)
- Respect `cell.is_editable` during find-and-replace (5545)
- Fix exception causes all over the codebase (5556)
- Improve login shell heuristics (5588)
- Added support for `JUPYTER_TOKEN_FILE` (5587)
- Kill notebook itself when server cull idle kernel (5593)
- Implement password hashing with bcrypt (3793)
- Fix broken links (5600)
- Russian internationalization support (5571)
- Add a metadata tag to override notebook direction (ltr/rtl) (5052)
- Paste two images from clipboard in markdown cell (5598)
- Add keyboard shortcuts to menu dropdowns (5525)
- Update codemirror to 5.56.0+components1 (5637)

Thank you to all the contributors:

- Aaron Myatt
- Adam Blake
- Afshin Taylor Darian

- Aman Bansal
- Ben Thayer
- berendjan
- Bruno P. Kinoshita
- bzinberg
- Christophe Cadilhac
- Daiki Katsuragawa
- David Lukes
- Dmitriy Q
- dmpe
- dylanzjy
- dSchurch
- E. M. Bray
- ErwinRussel
- Felix Mönckemeyer
- Grant Nestor
- Jarrad Whitaker
- Jesus Panales Castillo
- Joshua Zeltser
- Karthikeyan Singaravelan
- Kenichi Ito
- Kevin Bates
- Koki Nishihara
- Kris Wilson
- Kyle Kelley
- Laura Merlo
- levinxo
- Luciano Resende
- Luis Cabezon Manchado
- Madhusudhan Srinivasa
- Matthias Geier
- mattn
- Max Klein
- Min RK
- Mingxuan Lin
- Mohammad Mostafa Farzan

- Niko Felger
- Norah Abanumay
- Onno Broekmans
- PierreMB
- pinarkavak
- Ram Rachum
- Reece Hart
- Remi Rampin
- Rohit Sanjay
- Shane Canon
- Simon Li
- Steinar Sturlaugsson
- Steven Silvester
- taohan16
- Thew Dhanat
- Thomas Kluyver
- Toon Baeyens
- Vidar Tonaas Fauske
- Zachary Sailer

1.5.25 6.0.3

- Dependency updates to fix startup issues on Windows platform
- Add support for nbconvert 6.x
- Creation of recent tab

Thanks for all the contributors:

- Luciano Resende
- Kevin Bates
- ahangleben
- Zachary Sailer
- Pallavi Bharadwaj
- Thomas Kluyver
- Min RK
- forest0
- Bibo Hao
- Michal Charemza
- Sergey Shevelev

- Shuichiro MAKIGAKI
- krinsman
- TPartida
- Landen McDonald
- Tres DuBiel

1.5.26 6.0.2

- Update JQuery dependency to version 3.4.1 to fix security vulnerability (CVE-2019-11358)
- Update CodeMirror to version 5.48.4 to fix Python formatting issues
- Continue removing obsolete Python 2.x code/dependencies
- Multiple documentation updates

Thanks for all the contributors:

- David Robles
- Jason Grout
- Kerwin Sun
- Kevin Bates
- Kyle Kelley
- Luciano Resende
- Marcus D Sherman
- Sasaki Takeru
- Tom Jarosz
- Vidar Tonaas Fauske
- Wes Turner
- Zachary Sailer

1.5.27 6.0.1

- Attempt to re-establish websocket connection to Gateway ([4777](#))
- Add missing react-dom js to package data ([4772](#))

Thanks for all the contributors:

- Eunsoo Park
- Min RK

1.5.28 6.0

This is the first major release of the Jupyter Notebook since version 5.0 (March 2017).

We encourage users to start trying JupyterLab, which has just announced it's 1.0 release in preparation for a future transition.

- Remove Python 2.x support in favor of Python 3.5 and higher.
- Multiple accessibility enhancements and bug-fixes.
- Multiple translation enhancements and bug-fixes.
- Remove deprecated ANSI CSS styles.
- Native support to forward requests to Jupyter Gateway(s) (Embedded NB2KG).
- Use JavaScript to redirect users to notebook homepage.
- Enhanced SSL/TLS security by using `PROTOCOL_TLS` which selects the highest ssl/tls protocol version available that both the client and server support. When `PROTOCOL_TLS` is not available use `PROTOCOL_SSLv23`.
- Add `?no_track_activity=1` argument to allow API requests. to not be registered as activity (e.g. API calls by external activity monitors).
- Kernels shutting down due to an idle timeout is no longer considered an activity-updating event.
- Further improve compatibility with tornado 6 with improved checks for when websockets are closed.
- Launch the browser with a local file which redirects to the server address including the authentication token. This prevents another logged-in user from stealing the token from command line arguments and authenticating to the server. The single-use token previously used to mitigate this has been removed. Thanks to Dr. Owain Kenway for suggesting the local file approach.
- Respect `nbconvert` entrypoints as sources for exporters
- Update to `CodeMirror` to 5.37, which includes f-string syntax for Python 3.6.
- Update `jquery-ui` to 1.12
- Execute cells by clicking icon in input prompt.
- New “Save as” menu option.
- When serving on a loopback interface, protect against DNS rebinding by checking the `Host` header from the browser. This check can be disabled if necessary by setting `NotebookApp.allow_remote_access`. (Disabled by default while we work out some Mac issues in [3754](#)).
- Add `kernel_info_timeout` traitlet to enable restarting slow kernels.
- Add `custom_display_host` config option to override displayed URL.
- Add `/metrics` endpoint for Prometheus Metrics.
- Optimize large file uploads.
- Allow access control headers to be overridden in `jupyter_notebook_config.py` to support greater CORS and proxy configuration flexibility.
- Add support for terminals on windows.
- Add a “restart and run all” button to the toolbar.
- Frontend/extension-config: allow default json files in a `.d` directory.
- Allow setting token via `jupyter_token` env.
- Cull idle kernels using `--MappingKernelManager.cull_idle_timeout`.

- Allow read-only notebooks to be trusted.
- Convert JS tests to Selenium.

Security Fixes included in previous minor releases of Jupyter Notebook and also included in version 6.0.

- Fix Open Redirect vulnerability (CVE-2019-10255) where certain malicious URLs could redirect from the Jupyter login page to a malicious site after a successful login.
- Contains a security fix for a cross-site inclusion (XSSI) vulnerability (CVE-2019-9644), where files at a known URL could be included in a page from an unauthorized website if the user is logged into a Jupyter server. The fix involves setting the `X-Content-Type-Options: nosniff` header, and applying CSRF checks previously on all non-GET API requests to GET requests to API endpoints and the `/files/` endpoint.
- Check Host header to more securely protect localhost deployments from DNS rebinding. This is a pre-emptive measure, not fixing a known vulnerability. Use `.NotebookApp.allow_remote_access` and `.NotebookApp.local_hostnames` to configure access.
- Upgrade bootstrap to 3.4, fixing an XSS vulnerability, which has been assigned [CVE-2018-14041](#).
- Contains a security fix preventing malicious directory names from being able to execute javascript.
- Contains a security fix preventing nbconvert endpoints from executing javascript with access to the server API. CVE request pending.

Thanks for all the contributors:

- AAYUSH SINHA
- Aaron Hall, MBA
- Abhinav Sagar
- Adam Rule
- Adeel Ahmad
- Alex Rothberg
- Amy Skerry-Ryan
- Anastasis Germanidis
- Andrés Sánchez
- Arjun Radhakrishna
- Arovit Narula
- Benda Xu
- Björn Grüning
- Brian E. Granger
- Carol Willing
- Celina Kilcrease
- Chris Holdgraf
- Chris Miller
- Ciaran Langton
- Damian Avila
- Dana Lee

- Daniel Farrell
- Daniel Nicolai
- Darío Hereñú
- Dave Aitken
- Dave Foster
- Dave Hirschfeld
- Denis Ledoux
- Dmitry Mikushin
- Dominic Kuang
- Douglas Hanley
- Elliott Sales de Andrade
- Emilio Talamante Lugo
- Eric Perry
- Ethan T. Hendrix
- Evan Van Dam
- Francesco Franchina
- Frédéric Chapoton
- Félix-Antoine Fortin
- Gabriel
- Gabriel Nützi
- Gabriel Ruiz
- Gestalt LUR
- Grant Nestor
- Gustavo Efeiche
- Harsh Vardhan
- Heng GAO
- Hisham Elsheshtawy
- Hong Xu
- Ian Rose
- Ivan Ogasawara
- J Forde
- Jason Grout
- Jessica B. Hamrick
- Jiaqi Liu
- John Emmons
- Josh Barnes

- Karthik Balakrishnan
- Kevin Bates
- Kirit Thadaka
- Kristian Gregorius Hustad
- Kyle Kelley
- Leo Gallucci
- Lilian Besson
- Lucas Seiki Oshiro
- Luciano Resende
- Luis Angel Rodriguez Guerrero
- M Pacer
- Maarten Breddels
- Mac Knight
- Madicken Munk
- Maitiú Ó Ciaráin
- Marc Udoff
- Mathis HAMMEL
- Mathis Rosenhauer
- Matthias Bussonnier
- Matthias Geier
- Max Vovshin
- Maxime Mouchet
- Michael Chirico
- Michael Droettboom
- Michael Heilman
- Michael Scott Cuthbert
- Michal Charemza
- Mike Boyle
- Milos Miljkovic
- Min RK
- Miro Hrončok
- Nicholas Bollweg
- Nitesh Sawant
- Ondrej Jariabka
- Park Hae Jin
- Paul Ivanov

- Paul Masson
- Peter Parente
- Pierre Tholoniati
- Remco Verhoef
- Roland Weber
- Roman Kornev
- Rosa Swaby
- Roy Hyunjin Han
- Sally
- Sam Lau
- Samar Sultan
- Shiti Saxena
- Simon Biggs
- Spencer Park
- Stephen Ward
- Steve (Gadget) Barnes
- Steven Silvester
- Surya Prakash Susarla
- Syed Shah
- Sylvain Corlay
- Thomas Aarholt
- Thomas Kluyver
- Tim
- Tim Head
- Tim Klever
- Tim Metzler
- Todd
- Tom Jorquera
- Tyler Makaro
- Vaibhav Sagar
- Victor
- Vidar Tonaas Fauske
- Vu Minh Tam
- Vít Tuček
- Will Costello
- Will Starns

- William Hosford
- Xiaohan Li
- Yuvi Panda
- ashley teoh
- nullptr

1.5.29 5.7.8

- Fix regression in restarting kernels in 5.7.5. The restart handler would return before restart was completed.
- Further improve compatibility with tornado 6 with improved checks for when websockets are closed.
- Fix regression in 5.7.6 on Windows where .js files could have the wrong mime-type.
- Fix Open Redirect vulnerability (CVE-2019-10255) where certain malicious URLs could redirect from the Jupyter login page to a malicious site after a successful login. 5.7.7 contained only a partial fix for this issue.

1.5.30 5.7.6

5.7.6 contains a security fix for a cross-site inclusion (XSSI) vulnerability (CVE-2019-9644), where files at a known URL could be included in a page from an unauthorized website if the user is logged into a Jupyter server. The fix involves setting the `X-Content-Type-Options: nosniff` header, and applying CSRF checks previously on all non-GET API requests to GET requests to API endpoints and the `/files/` endpoint.

The attacking page is able to access some contents of files when using Internet Explorer through script errors, but this has not been demonstrated with other browsers.

1.5.31 5.7.5

- Fix compatibility with tornado 6 ([4392](#), [4449](#)).
- Fix opening integer filedescriptor during startup on Python 2 ([4349](#))
- Fix compatibility with asynchronous `[KernelManager.restart_kernel]{.title-ref}` methods ([4412](#))

1.5.32 5.7.4

5.7.4 fixes a bug introduced in 5.7.3, in which the `list_running_servers()` function attempts to parse HTML files as JSON, and consequently crashes ([4284](#)).

1.5.33 5.7.3

5.7.3 contains one security improvement and one security fix:

- Launch the browser with a local file which redirects to the server address including the authentication token ([4260](#)). This prevents another logged-in user from stealing the token from command line arguments and authenticating to the server. The single-use token previously used to mitigate this has been removed. Thanks to Dr. Owain Kenway for suggesting the local file approach.
- Upgrade bootstrap to 3.4, fixing an XSS vulnerability, which has been assigned [CVE-2018-14041](#) ([4271](#)).

1.5.34 5.7.2

5.7.2 contains a security fix preventing malicious directory names from being able to execute javascript. CVE request pending.

1.5.35 5.7.1

5.7.1 contains a security fix preventing nbconvert endpoints from executing javascript with access to the server API. CVE request pending.

1.5.36 5.7.0

New features:

- Update to CodeMirror to 5.37, which includes f-string syntax for Python 3.6 (3816)
- Update jquery-ui to 1.12 (3836)
- Check Host header to more securely protect localhost deployments from DNS rebinding. This is a pre-emptive measure, not fixing a known vulnerability (3766). Use `.NotebookApp.allow_remote_access` and `.NotebookApp.local_hostnames` to configure access.
- Allow access-control-allow-headers to be overridden (3886)
- Allow configuring `max_body_size` and `max_buffer_size` (3829)
- Allow configuring `get_secure_cookie` keyword-args (3778)
- Respect nbconvert entrypoints as sources for exporters (3879)
- Include translation sources in source distributions (3925, 3931)
- Various improvements to documentation (3799, 3800, 3806, 3883, 3908)

Fixing problems:

- Fix breadcrumb link when running with a base url (3905)
- Fix possible type error when closing activity stream (3907)
- Disable metadata editing for non-editable cells (3744)
- Fix some styling and alignment of prompts caused by regressions in 5.6.0.
- Enter causing page reload in shortcuts editor (3871)
- Fix uploading to the same file twice (3712)

See the 5.7 milestone on GitHub for a complete list of [pull requests](#) involved in this release.

Thanks to the following contributors:

- Aaron Hall
- Benjamin Ragan-Kelley
- Bill Major
- bxy007
- Dave Aitken
- Denis Ledoux
- Félix-Antoine Fortin

- Gabriel
- Grant Nestor
- Kevin Bates
- Kristian Gregorius Hustad
- M Pacer
- Madicken Munk
- Maitiu O Ciarain
- Matthias Bussonnier
- Michael Boyle
- Michael Chirico
- Mokkapati, Praneet(ES)
- Peter Parente
- Sally Wilsak
- Steven Silvester
- Thomas Kluyver
- Walter Martin

1.5.37 5.6.0

New features:

- Execute cells by clicking icon in input prompt (3535, 3687)
- New “Save as” menu option (3289)
- When serving on a loopback interface, protect against DNS rebinding by checking the Host header from the browser (3714). This check can be disabled if necessary by setting `NotebookApp.allow_remote_access`. (Disabled by default while we work out some Mac issues in 3754).
- Add `kernel_info_timeout` traitlet to enable restarting slow kernels (3665)
- Add `custom_display_host` config option to override displayed URL (3668)
- Add `/metrics` endpoint for Prometheus Metrics (3490)
- Update to MathJax 2.7.4 (3751)
- Update to jQuery 3.3 (3655)
- Update marked to 0.4 (3686)

Fixing problems:

- Don’t duplicate token in displayed URL (3656)
- Clarify displayed URL when listening on all interfaces (3703)
- Don’t trash non-empty directories on Windows (3673)
- Include LICENSE file in wheels (3671)
- Don’t show “0 active kernels” when starting the notebook (3696)

Testing:

- Add find replace test (3630)
- Selenium test for deleting all cells (3601)
- Make creating a new notebook more robust (3726)

Thanks to the following contributors:

- Arovit Narula ([arovit](#))
- lucasoshiro ([lucasoshiro](#))
- M Pacer ([mpacer](#))
- Thomas Kluyver ([takluyver](#))
- Todd ([toddrme2178](#))
- Yuvi Panda ([yuvipanda](#))

See the 5.6 milestone on GitHub for a complete list of [pull requests](#) involved in this release.

1.5.38 5.5.0

New features:

- The files list now shows file sizes (3539)
- Add a quit button in the dashboard (3004)
- Display hostname in the terminal when running remotely (3356, 3593)
- Add slides exportation/download to the menu (3287)
- Add any extra installed nbconvert exporters to the “Download as” menu (3323)
- Editor: warning when overwriting a file that is modified on disk (2783)
- Display a warning message if cookies are not enabled (3511)
- Basic `__version__` reporting for extensions (3541)
- Add `NotebookApp.terminals_enabled` config option (3478)
- Make buffer time between last modified on disk and last modified on last save configurable (3273)
- Allow binding custom shortcuts for ‘close and halt’ (3314)
- Add description for ‘Trusted’ notification (3386)
- Add `settings['activity_sources']` (3401)
- Add an `output_updated.OutputArea` event (3560)

Fixing problems:

- Fixes to improve web accessibility (3507)
- Fixed color contrast issue in `tree.less` (3336)
- Allow cancelling upload of large files (3373)
- Don’t clear login cookie on requests without cookie (3380)
- Don’t trash files on different device to home dir on Linux (3304)
- Clear waiting asterisks when restarting kernel (3494)
- Fix output prompt when `execution_count` missing (3236)

- Make the ‘changed on disk’ dialog work when displayed twice (3589)
- Fix going back to root directory with history in notebook list (3411)
- Allow defining keyboard shortcuts for missing actions (3561)
- Prevent default on pageup/pagedown when completer is active (3500)
- Prevent default event handling on new terminal (3497)
- ConfigManager should not write out default values found in the .d directory (3485)
- Fix leak of iopub object in activity monitoring (3424)
- Javascript lint in notebooklist.js (3409)
- Some Javascript syntax fixes (3294)
- Convert native for loop to `Array.forEach()` (3477)
- Disable cache when downloading nbconvert output (3484)
- Add missing digestmod arg to HMAC (3399)
- Log OSError failing to create less-critical files during startup (3384)
- Use powershell on Windows (3379)
- API spec improvements, API handler improvements (3368)
- Set notebook to dirty state after change to kernel metadata (3350)
- Use CSP header to treat served files as belonging to a separate origin (3341)
- Don’t install gettext into builtins (3330)
- Add missing `import _` (3316, 3326)
- Write `notebook.json` file atomically (3305)
- Fix clicking with modifiers, page title updates (3282)
- Upgrade jQuery to version 2.2 (3428)
- Upgrade xterm.js to 3.1.0 (3189)
- Upgrade moment.js to 2.19.3 (3562)
- Upgrade CodeMirror to 5.35 (3372)
- “Require” `pzmq` ≥ 17 (3586)

Documentation:

- Documentation updates and organisation (3584)
- Add section in docs about privacy (3571)
- Add explanation on how to change the type of a cell to Markdown (3377)
- Update docs with `confd` implementation details (3520)
- Add more information for where `jupyter_notebook_config.py` is located (3346)
- Document options to enable nbextensions in specific sections (3525)
- jQuery attribute selector value MUST be surrounded by quotes (3527)
- Do not execute special notebooks with nbsphinx (3360)
- Other minor fixes in 3288, 3528, 3293, 3367

Testing:

- Testing with Selenium & Sauce labs ([3321](#))
- Selenium utils + markdown rendering tests ([3458](#))
- Convert insert cell tests to Selenium ([3508](#))
- Convert prompt numbers tests to Selenium ([3554](#))
- Convert delete cells tests to Selenium ([3465](#))
- Convert undelete cell tests to Selenium ([3475](#))
- More selenium testing utilities ([3412](#))
- Only check links when build is trigger by Travis Cron job ([3493](#))
- Fix Appveyor build errors ([3430](#))
- Undo patches in teardown before attempting to delete files ([3459](#))
- Get tests running with tornado 5 ([3398](#))
- Unpin ipykernel version on Travis ([3223](#))

Thanks to the following contributors:

- Arovit Narula ([arovit](#))
- Ashley Teoh ([ashleytqy](#))
- Nicholas Bollweg ([bollwyvl](#))
- Alex Rothberg ([cancan101](#))
- Celina Kilcrease ([ckilcrease](#))
- dabuside ([dabuside](#))
- Damian Avila ([damianavila](#))
- Dana Lee ([danagilliann](#))
- Dave Hirschfeld ([dhirschfeld](#))
- Heng GAO ([chengao](#))
- Leo Gallucci ([elgalu](#))
- Evan Van Dam ([evandam](#))
- forbxy ([forbxy](#))
- Grant Nestor ([gnestor](#))
- Ethan T. Hendrix ([hendrixet](#))
- Miro Hrončok ([hroncok](#))
- Paul Ivanov ([ivanov](#))
- Darío Hereñú ([kant](#))
- Kevin Bates ([kevin-bates](#))
- Maarten Breddels ([maartenbreddels](#))
- Michael Droettboom ([mdboom](#))
- Min RK ([minrk](#))

- M Pacer ([mpacer](#))
- Peter Parente ([parente](#))
- Paul Masson ([paulmasson](#))
- Philipp Rudiger ([philippjfr](#))
- Mac Knight ([Shels1909](#))
- Hisham Elsheshtawy ([Sheshtawy](#))
- Simon Biggs ([SimonBiggs](#))
- Sunil Hari ([@sunilhari](#))
- Thomas Kluyver ([takluyver](#))
- Tim Klever ([tklever](#))
- Gabriel Ruiz ([unnamedplay-r](#))
- Vaibhav Sagar ([vaibhavsagar](#))
- William Hosford ([whosford](#))
- Hong ([xuhdev](#))

See the 5.5 milestone on GitHub for a complete list of [pull requests](#) involved in this release.

1.5.39 5.4.1

A security release to fix [CVE-2018-8768](#).

Thanks to [Alex](#) for identifying this bug, and Jonathan Kamens and Scott Sanderson at Quantopian for verifying it and bringing it to our attention.

1.5.40 5.4.0

- Fix creating files and folders after navigating directories in the dashboard ([3264](#)).
- Enable printing notebooks in colour, removing the CSS that made everything black and white ([3212](#)).
- Limit the completion options displayed in the notebook to 1000, to avoid performance issues with very long lists ([3195](#)).
- Accessibility improvements in `tree.html` ([3271](#)).
- Added alt-text to the kernel logo image in the notebook UI ([3228](#)).
- Added a test on Travis CI to flag if symlinks are accidentally introduced in the future. This should prevent the issue that necessitated `release-5.3.1{.interpreted-text role="ref"}` ([3227](#)).
- Use lowercase letters for random IDs generated in our Javascript ([3264](#)).
- Removed duplicate code setting `TextCell.notebook` ([3256](#)).

Thanks to the following contributors:

- Alex Soderman ([asoderman](#))
- Matthias Bussonnier ([Carreau](#))
- Min RK ([minrk](#))
- Nitesh Sawant ([ns23](#))

- Thomas Kluyver ([takluyver](#))
- Yuvi Panda ([yuvipanda](#))

See the 5.4 milestone on GitHub for a complete list of [pull requests](#) involved in this release.

1.5.41 5.3.1

Replaced a symlink in the repository with a copy, to fix issues installing on Windows ([3220](#)).

1.5.42 5.3.0

This release introduces a couple notable improvements, such as terminal support for Windows and support for OS trash (files deleted from the notebook dashboard are moved to the OS trash vs. deleted permanently).

- Add support for terminals on windows ([3087](#)).
- Add a “restart and run all” button to the toolbar ([2965](#)).
- Send files to os trash mechanism on delete ([1968](#)).
- Allow programmatic copy to clipboard ([3088](#)).
- Use DOM History API for navigating between directories in the file browser ([3115](#)).
- Add translated files to folder(docs-translations) ([3065](#)).
- Allow non empty dirs to be deleted ([3108](#)).
- Set cookie on base_url ([2959](#)).
- Allow token-authenticated requests cross-origin by default ([2920](#)).
- Change cull_idle_timeout_minimum to 1 from 300 ([2910](#)).
- Config option to shut down server after n seconds with no kernels ([2963](#)).
- Display a “close” button on load notebook error ([3176](#)).
- Add action to command palette to run CodeMirror’s “indentAuto” on selection ([3175](#)).
- Add option to specify extra services ([3158](#)).
- Warn_bad_name should not use global name ([3160](#)).
- Avoid overflow of hidden form ([3148](#)).
- Fix shutdown trans loss ([3147](#)).
- Find available kernelspecs more efficiently ([3136](#)).
- Don’t try to translate missing help strings ([3122](#)).
- Frontend/extension-config: allow default json files in a .d directory ([3116](#)).
- Use [requirejs]{.title-ref} vs. [require]{.title-ref} ([3097](#)).
- Fixes some ui bugs in firefox #3044 ([3058](#)).
- Compare non-specific language code when choosing to use arabic numerals ([3055](#)).
- Fix save-script deprecation ([3053](#)).
- Include moment locales in package_data ([3051](#)).
- Fix moment locale loading in bidi support ([3048](#)).

- Tornado 5: periodiccallback loop arg will be removed (3034).
- Use `[/files]{.title-ref}` prefix for pdf-like files (3031).
- Add folder for document translation (3022).
- When login-in via token, let a chance for user to set the password (3008).
- Switch to jupyter_core implementation of `ensure_dir_exists` (3002).
- Send http shutdown request on 'stop' subcommand (3000).
- Work on loading ui translations (2969).
- Fix ansi inverse (2967).
- Add `send2trash` to requirements for building docs (2964).
- I18n readme.md improvement (2962).
- Add 'reason' field to json error responses (2958).
- Add some padding for stream outputs (3194).
- Always use `setuptools` in `setup.py` (3206).
- Fix clearing cookies on logout when `base_url` is configured (3207).

Thanks to the following contributors:

- bacboc ([bacboc](#))
- Steven Silvester ([blink1073](#))
- Matthias Bussonnier ([Carreau](#))
- ChungJooHo ([ChungJooHo](#))
- edida ([edida](#))
- Francesco Franchina ([ferdas](#))
- forbxy ([forbxy](#))
- Grant Nestor ([gnestor](#))
- Josh Barnes ([jcb91](#))
- JocelynDelalande ([JocelynDelalande](#))
- Karthik Balakrishnan ([karthikb351](#))
- Kevin Bates ([kevin-bates](#))
- Kirit Thadaka ([kirit93](#))
- Lilian Besson ([Naareen](#))
- Maarten Breddels ([maartenbreddels](#))
- Madhu94 ([Madhu94](#))
- Matthias Geier ([mgeier](#))
- Michael Heilman ([mheilman](#))
- Min RK ([minrk](#))
- PHaeJin ([PHaeJin](#))
- Sukneet ([Sukneet](#))

- Thomas Kluyver ([takluyver](#))

See the 5.3 milestone on GitHub for a complete list of [pull requests](#) involved in this release.

1.5.43 5.2.1

- Fix invisible CodeMirror cursor at specific browser zoom levels (2983).
- Fix nbconvert handler causing broken export to PDF (2981).
- Fix the prompt_area argument of the output area constructor. (2961).
- Handle a compound extension in newUntitled (2949).
- Allow disabling offline message buffering (2916).

Thanks to the following contributors:

- Steven Silvester ([blink1073](#))
- Grant Nestor ([gnestor](#))
- Jason Grout ([jasongrout](#))
- Min RK ([minrk](#))
- M Pacer ([mpacer](#))

See the 5.2.1 milestone on GitHub for a complete list of [pull requests](#) involved in this release.

1.5.44 5.2.0

- Allow setting token via jupyter_token env (2921).
- Fix some errors caused by raising 403 in get_current_user (2919).
- Register contents_manager.files_handler_class directly (2917).
- Update viewable_extensions (2913).
- Show edit shortcuts modal after shortcuts modal is hidden (2912).
- Improve edit/view behavior (2911).
- The root directory of the notebook server should never be hidden (2907).
- Fix notebook require config to match tools/build-main (2888).
- Give page constructor default arguments (2887).
- Fix codemirror.less to match codemirror's expected padding layout (2880).
- Add x-xsrftoken to access-control-allow-headers (2876).
- Buffer messages when websocket connection is interrupted (2871).
- Load locale dynamically only when not en-us (2866).
- Changed key strength to 2048 bits (2861).
- Resync jsversion with python version (2860).
- Allow copy operation on modified, read-only notebook (2854).
- Update error handling on apihandlers (2853).
- Test python 3.6 on travis, drop 3.3 (2852).

- Avoid base64-literals in image tests (2851).
- Upgrade xterm.js to 2.9.2 (2849).
- Changed all python variables named file to file_name to not override built_in file (2830).
- Add more doc tests (2823).
- Typos fix (2815).
- Rename and update license [ci skip] (2810).
- Travis builds doc (2808).
- Pull request i18n (2804).
- Factor out output_prompt_function, as is done with input prompt (2774).
- Use rfc5987 encoding for filenames (2767).
- Added path to the resources metadata, the same as in from_filename(...) in nbconvert.exporters.py (2753).
- Make “extrakeys” consistent for notebook and editor (2745).
- Bidi support (2357).

Special thanks to [samarsultan](#) and the Arabic Competence and Globalization Center Team at IBM Egypt for adding RTL (right-to-left) support to the notebook!

See the 5.2 milestone on GitHub for a complete list of [issues](#) and [pull requests](#) involved in this release.

1.5.45 5.1.0

- Preliminary i18n implementation (2140).
- Expose URL with auth token in notebook UI (2666).
- Fix search background style (2387).
- List running notebooks without requiring --allow-root (2421).
- Allow session of type other than notebook (2559).
- Fix search background style (2387).
- Fix some Markdown styling issues (2571), (2691) and (2534).
- Remove keymaps that conflict with non-English keyboards (2535).
- Add session-specific favicons (notebook, terminal, file) (2452).
- Add /api/shutdown handler (2507).
- Include metadata when copying a cell (2349).
- Stop notebook server from command line (2388).
- Improve “View” and “Edit” file handling in dashboard (2449) and (2402).
- Provide a promise to replace use of the app_initialized.NotebookApp event (2710).
- Fix disabled collapse/expand output button (2681).
- Cull idle kernels using --MappingKernelManager.cull_idle_timeout (2215).
- Allow read-only notebooks to be trusted (2718).

See the 5.1 milestone on GitHub for a complete list of [issues](#) and [pull requests](#) involved in this release.

1.5.46 5.0.0

This is the first major release of the Jupyter Notebook since version 4.0 was created by the “Big Split” of IPython and Jupyter.

We encourage users to start trying JupyterLab in preparation for a future transition.

We have merged more than 300 pull requests since 4.0. Some of the major user-facing changes are described here.

File sorting in the dashboard

Files in the dashboard may now be sorted by last modified date or name (943):

Cell tags

There is a new cell toolbar for adding *cell tags* (2048):

Cell tags are a lightweight way to customise the behaviour of tools working with notebooks; we’re working on building support for them into tools like `nbconvert` and `nbval`. To start using tags, select Tags in the View > Cell Toolbar menu in a notebook.

The UI for editing cell tags is basic for now; we hope to improve it in future releases.

Table style

The default styling for tables in the notebook has been updated (1776).

Customise keyboard shortcuts

You can now edit keyboard shortcuts for *Command Mode* within the UI (1347):

See the Help > Edit Keyboard Shortcuts menu item and follow the instructions.

Other additions

- You can copy and paste cells between notebooks, using `Ctrl-C`{.interpreted-text role="kbd"} and `Ctrl-V`{.interpreted-text role="kbd"} (Cmd-C{.interpreted-text role="kbd"} and Cmd-V{.interpreted-text role="kbd"} on Mac).
- It’s easier to configure a password for the notebook with the new `jupyter notebook password` command (2007).
- The file list can now be ordered by *last modified* or by *name* (943).
- Markdown cells now support attachments. Simply drag and drop an image from your desktop to a markdown cell to add it. Unlike relative links that you enter manually, attachments are embedded in the notebook itself. An unreferenced attachment will be automatically scrubbed from the notebook on save (621).
- Undoing cell deletion now supports undeleting multiple cells. Cells may not be in the same order as before their deletion, depending on the actions you did on the meantime, but this should help reduce the impact of accidentally deleting code.
- The file browser now has *Edit* and *View* buttons.
- The file browser now supports moving multiple files at once (1088).

- The Notebook will refuse to run as root unless the `--allow-root` flag is given (1115).
- Keyboard shortcuts are now declarative (1234).
- Toggling line numbers can now affect all cells (1312).
- Add more visible *Trusted* and *Untrusted* notifications (1658).
- The favicon (browser shortcut icon) now changes to indicate when the kernel is busy (1837).
- Header and toolbar visibility is now persisted in nbconfig and across sessions (1769).
- Load server extensions with ConfigManager so that merge happens recursively, unlike normal config values, to make it load more consistently with frontend extensions(2108).
- The notebook server now supports the bundler API from the `jupyter_cms incubator project` (1579).
- The notebook server now provides information about kernel activity in its kernel resource API (1827).

Remember that upgrading notebook only affects the user interface. Upgrading kernels and libraries may also provide new features, better stability and integration with the notebook interface.

1.5.47 4.4.0

- Allow override of output callbacks to redirect output messages. This is used to implement the ipywidgets Output widget, for example.
- Fix an async bug in message handling by allowing comm message handlers to return a promise which halts message processing until the promise resolves.

See the 4.4 milestone on GitHub for a complete list of [issues](#) and [pull requests](#) involved in this release.

1.5.48 4.3.2

4.3.2 is a patch release with a bug fix for CodeMirror and improved handling of the “editable” cell metadata field.

- Monkey-patch for CodeMirror that resolves [#2037](#) without breaking [#1967](#)
- Read-only (`"editable": false`) cells can be executed but cannot be split, merged, or deleted

See the 4.3.2 milestone on GitHub for a complete list of [issues](#) and [pull requests](#) involved in this release.

1.5.49 4.3.1

4.3.1 is a patch release with a security patch, a couple bug fixes, and improvements to the newly-released token authentication.

Security fix:

- CVE-2016-9971. Fix CSRF vulnerability, where malicious forms could create untitled files and start kernels (no remote execution or modification of existing files) for users of certain browsers (Firefox, Internet Explorer / Edge). All previous notebook releases are affected.

Bug fixes:

- Fix carriage return handling
- Make the font size more robust against fickle browsers
- Ignore resize events that bubbled up and didn’t come from window
- Add Authorization to allowed CORS headers

- Downgrade CodeMirror to 5.16 while we figure out issues in Safari

Other improvements:

- Better docs for token-based authentication
- Further highlight token info in log output when autogenerated

See the 4.3.1 milestone on GitHub for a complete list of [issues](#) and [pull requests](#) involved in this release.

1.5.50 4.3.0

4.3 is a minor release with many bug fixes and improvements. The biggest user-facing change is the addition of token authentication, which is enabled by default. A token is generated and used when your browser is opened automatically, so you shouldn't have to enter anything in the default circumstances. If you see a login page (e.g. by switching browsers, or launching on a new port with `--no-browser`), you get a login URL with the token from the command `jupyter notebook list`, which you can paste into your browser.

Highlights:

- API for creating mime-type based renderer extensions using `OutputArea.register_mime_type` and `Notebook.render_cell_output` methods. See [mimerender-cookiecutter](#) for reference implementations and cookiecutter.
- Enable token authentication by default. See `server_security{.interpreted-text role="ref"}` for more details.
- Update security docs to reflect new signature system
- Switched from `term.js` to `xterm.js`

Bug fixes:

- Ensure variable is set if `exc_info` is falsey
- Catch and log handler exceptions in `events.trigger`
- Add debug log for static file paths
- Don't check origin on token-authenticated requests
- Remove leftover print statement
- Fix highlighting of Python code blocks
- `json_errors` should be outermost decorator on API handlers
- Fix remove old nbserver info files
- Fix notebook mime type on download links
- Fix carriage symbol behavior
- Fix terminal styles
- Update dead links in docs
- If kernel is broken, start a new session
- Include cross-origin check when allowing login URL redirects

Other improvements:

- Allow JSON output data with mime type `application/*+json`
- Allow kernelspecs to have spaces in them for backward compat
- Allow websocket connections from scripts

- Allow None for post_save_hook
- Upgrade CodeMirror to 5.21
- Upgrade xterm to 2.1.0
- Docs for using comms
- Set dirty flag when output arrives
- Set ws-url data attribute when accessing a notebook terminal
- Add base aliases for nbextensions
- Include @ operator in CodeMirror IPython mode
- Extend mathjax_url docstring
- Load nbextension in predictable order
- Improve the error messages for nbextensions
- Include cross-origin check when allowing login URL redirects

See the 4.3 milestone on GitHub for a complete list of [issues](#) and [pull requests](#) involved in this release.

1.5.51 4.2.3

4.2.3 is a small bugfix release on 4.2.

Highlights:

- Fix regression in 4.2.2 that delayed loading custom.js until after notebook_loaded and app_initialized events have fired.
- Fix some outdated docs and links.

1.5.52 4.2.2

4.2.2 is a small bugfix release on 4.2, with an important security fix. All users are strongly encouraged to upgrade to 4.2.2.

Highlights:

- **Security fix:** CVE-2016-6524, where untrusted latex output could be added to the page in a way that could execute javascript.
- Fix missing POST in OPTIONS responses.
- Fix for downloading non-ascii filenames.
- Avoid clobbering ssl_options, so that users can specify more detailed SSL configuration.
- Fix inverted load order in nbconfig, so user config has highest priority.
- Improved error messages here and there.

1.5.53 4.2.1

4.2.1 is a small bugfix release on 4.2. Highlights:

- Compatibility fixes for some versions of ipywidgets
- Fix for ignored CSS on Windows
- Fix specifying destination when installing nbextensions

1.5.54 4.2.0

Release 4.2 adds a new API for enabling and installing extensions. Extensions can now be enabled at the system-level, rather than just per-user. An API is defined for installing directly from a Python package, as well.

Highlighted changes:

- Upgrade MathJax to 2.6 to fix vertical-bar appearing on some equations.
- Restore ability for notebook directory to be root (4.1 regression)
- Large outputs are now throttled, reducing the ability of output floods to kill the browser.
- Fix the notebook ignoring cell executions while a kernel is starting by queueing the messages.
- Fix handling of url prefixes (e.g. JupyterHub) in terminal and edit pages.
- Support nested SVGs in output.

And various other fixes and improvements.

1.5.55 4.1.0

Bug fixes:

- Properly reap zombie subprocesses
- Fix cross-origin problems
- Fix double-escaping of the base URL prefix
- Handle invalid unicode filenames more gracefully
- Fix ANSI color-processing
- Send keepalive messages for web terminals
- Fix bugs in the notebook tour

UI changes:

- Moved the cell toolbar selector into the *View* menu. Added a button that triggers a “hint” animation to the main toolbar so users can find the new location. (Click here to see a [screencast](#))
- Added *Restart & Run All* to the *Kernel* menu. Users can also bind it to a keyboard shortcut on action `restart-kernel-and-run-all-cells`.
- Added multiple-cell selection. Users press `Shift-Up/Down` or `Shift-K/J` to extend selection in command mode. Various actions such as cut/copy/paste, execute, and cell type conversions apply to all selected cells.
- Added a command palette for executing Jupyter actions by name. Users press `Cmd/Ctrl-Shift-P` or click the new command palette icon on the toolbar.
- Added a *Find and Replace* dialog to the *Edit* menu. Users can also press `F` in command mode to show the dialog.

Other improvements:

- Custom KernelManager methods can be Tornado coroutines, allowing async operations.
- Make clearing output optional when rewriting input with `set_next_input(replace=True)`.
- Added support for TLS client authentication via `--NotebookApp.client-ca`.
- Added tags to jupyter/notebook releases on DockerHub. `latest` continues to track the master branch.

See the 4.1 milestone on GitHub for a complete list of [issues](#) and [pull requests](#) handled.

1.5.56 4.0.x

4.0.6

- fix installation of mathjax support files
- fix some double-escape regressions in 4.0.5
- fix a couple of cases where errors could prevent opening a notebook

4.0.5

Security fixes for maliciously crafted files.

- [CVE-2015-6938](#): malicious filenames
- [CVE-2015-7337](#): malicious binary files in text editor.

Thanks to Jonathan Kamens at Quantopian and Juan Broullón for the reports.

4.0.4

- Fix inclusion of mathjax-safe extension

4.0.2

- Fix launching the notebook on Windows
- Fix the path searched for frontend config

4.0.0

First release of the notebook as a standalone package.

CONFIGURATION

2.1 Configuration Overview

Beyond the default configuration settings, you can configure a rich array of options to suit your workflow. Here are areas that are commonly configured when using Jupyter Notebook:

- *Jupyter's common configuration system*
- *Jupyter Server*
- *Notebook extensions*

Let's look at highlights of each area.

2.1.1 Jupyter's Common Configuration system

Jupyter applications, from the Notebook to JupyterHub to nbgrader, share a common configuration system. The process for creating a configuration file and editing settings is similar for all the Jupyter applications.

- [Jupyter's Common Configuration Approach](#)
- [Common Directories and File Locations](#)
- [Language kernels](#)
- [traitlets](#) provide a low-level architecture for configuration.

2.1.2 Jupyter server

The Jupyter Server runs the language kernel and communicates with the front-end Notebook client (i.e. the familiar notebook interface).

- [Configuring the Jupyter Server](#)

To create a `jupyter_server_config.py` file in the `.jupyter` directory, with all the defaults commented out, use the following command:

```
$ jupyter server --generate-config
```

- [Running a Jupyter Server](#)
- [Related: Configuring a language kernel](#) to run in the Jupyter Server enables your server to run other languages, like R or Julia.

2.1.3 Notebook extensions

The Notebook frontend can be extended with JupyterLab extensions.

See the *Frontend Extension Guide* for more information.

Security in Jupyter notebooks: Since security policies vary from organization to organization, we encourage you to consult with your security team on settings that would be best for your use cases. Our documentation offers some responsible security practices, and we recommend becoming familiar with the practices.

2.2 Extending the Notebook

Certain subsystems of the notebook server are designed to be extended or overridden by users. These documents explain these systems, and show how to override the notebook's defaults with your own custom behavior.

2.2.1 Custom front-end extensions

This describes the basic steps to write a TypeScript extension for the Jupyter notebook front-end. This allows you to customize the behaviour of the various pages like the dashboard, the notebook, or the text editor.

Starting with Notebook v7, front-end extensions for the notebook can be developed as prebuilt JupyterLab extensions.

This means Notebook v7 is able to reuse many of the existing extensions from the JupyterLab ecosystem as is.

If you would like to develop a prebuilt extension for Notebook v7, check out:

- [JupyterLab Extension Tutorial](#): A tutorial to learn how to make a simple JupyterLab extension.
- [The JupyterLab Extension Examples Repository](#): A short tutorial series to learn how to develop extensions for JupyterLab by example.

3.1 Contributing to Jupyter Notebook

Thanks for contributing to Jupyter Notebook!

Make sure to follow [Project Jupyter's Code of Conduct](#) for a friendly and welcoming collaborative environment.

3.1.1 Setting up a development environment

Note: You will need NodeJS to build the extension package.

The `jlpm` command is JupyterLab's pinned version of `yarn` that is installed with JupyterLab. You may use `yarn` or `npm` in lieu of `jlpm` below.

Note: we recommend using `mamba` to speed the creating of the environment.

```
# create a new environment
mamba create -n notebook -c conda-forge python nodejs -y

# activate the environment
mamba activate notebook

# Install package in development mode
pip install -e ".[dev,test]"

# Link the notebook extension and @jupyter-notebook schemas
jlpm develop

# Enable the server extension
jupyter server extension enable notebook
```

notebook follows a monorepo structure. To build all the packages at once:

```
jlpm build
```

There is also a `watch` script to watch for changes and rebuild the app automatically:

```
jlpm watch
```

To make sure the notebook server extension is installed:

```
$ jupyter server extension list
Config dir: /home/username/.jupyter

Config dir: /home/username/miniforge3/envs/notebook/etc/jupyter
  jupyterlab enabled
    - Validating jupyterlab...
      jupyterlab 3.0.0 OK
  notebook enabled
    - Validating notebook...
      notebook 7.0.0a0 OK

Config dir: /usr/local/etc/jupyter
```

Then start Jupyter Notebook with:

```
jupyter notebook
```

3.1.2 Running Tests

To run the tests:

```
jlpm run build:test
jlpm run test
```

There are also end to end tests to cover higher level user interactions, located in the `ui-tests` folder. To run these tests:

```
cd ui-tests
# start a new Jupyter server in a terminal
jlpm start

# in a new terminal, run the tests
jlpm test
```

The test script calls the Playwright test runner. You can pass additional arguments to `playwright` by appending parameters to the command. For example to run the test in headed mode, `jlpm test --headed`.

Checkout the [Playwright Command Line Reference](#) for more information about the available command line options.

Running the end to end tests in headful mode will trigger something like the following:

3.1.3 Code Styling

All non-python source code is formatted using `prettier` and python source code is formatted using `blacks` When code is modified and committed, all staged files will be automatically formatted using pre-commit git hooks (with help from `pre-commit`). The benefit of using a code formatters like `prettier` and `black` is that it removes the topic of code style from the conversation when reviewing pull requests, thereby speeding up the review process.

As long as your code is valid, the pre-commit hook should take care of how it should look. `pre-commit` and its associated hooks will automatically be installed when you run `pip install -e "[dev,test]"`

To install `pre-commit` manually, run the following:


```
pip install pre-commit  
pre-commit install
```

You can invoke the pre-commit hook by hand at any time with:

```
pre-commit run
```

which should run any autoformatting on your code and tell you about any errors it couldn't fix automatically. You may also install [black integration](#) into your text editor to format code automatically.

If you have already committed files before setting up the pre-commit hook with `pre-commit install`, you can fix everything up using `pre-commit run --all-files`. You need to make the fixing commit yourself after that.

You may also use the prettier npm script (e.g. `npm run prettier` or `yarn prettier` or `jlpm prettier`) to format the entire code base. We recommend installing a prettier extension for your code editor and configuring it to format your code with a keyboard shortcut or automatically on save.

Some of the hooks only run on CI by default, but you can invoke them by running with the `--hook-stage manual` argument.

3.2 Developer FAQ

1. How do I install a prerelease version such as a beta or release candidate?

```
python -m pip install notebook --pre --upgrade
```