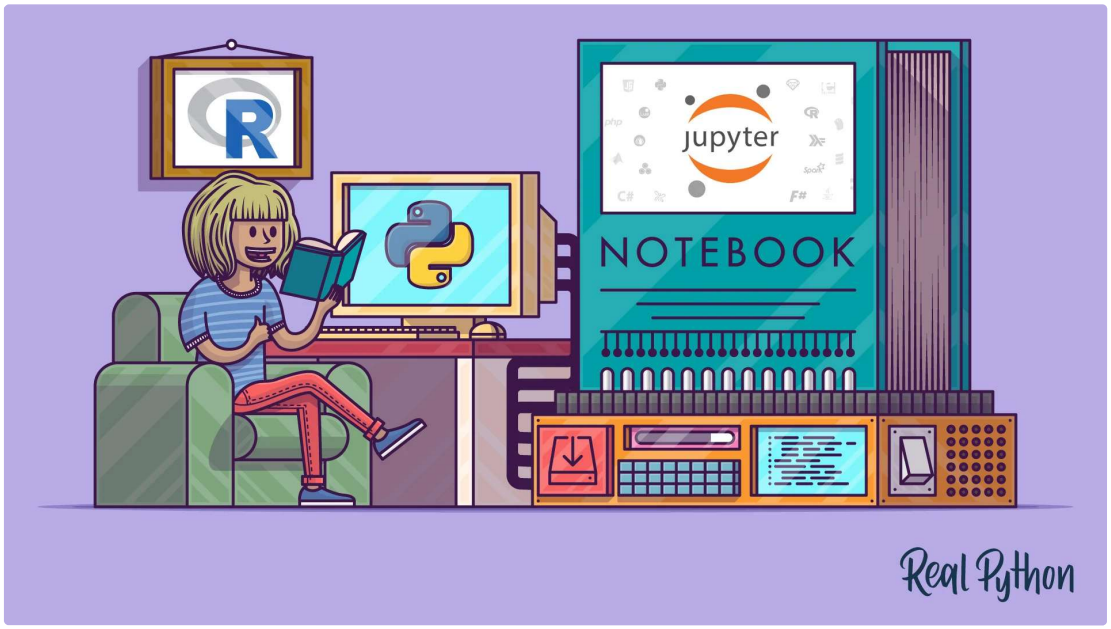

Jupyter Notebook: An Introduction

by Mike Driscoll 5 Comments intermediate tools

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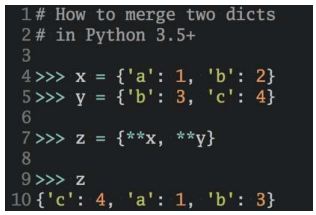
Watch Now This tutorial has a related video course created by the Real Python team. Watch it together with the written tutorial to deepen your understanding: **Using Jupyter Notebooks**

The Jupyter Notebook is an open source web application that you can use to create and share documents that contain live code, equations, visualizations, and text. Jupyter Notebook is maintained by the people at Project Jupyter.

Jupyter Notebooks are a spin-off project itself. The name, Jupyter, comes from the R. Jupyter ships with the IPython kernel, over 100 other kernels that you can also



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Getting Up and Runnir

The Jupyter Notebook is not included wi

There are many distributions of the Pyth installing Jupyter Notebook. The most po from their website. It is also assumed that you are using **Python 3**.

Installation

If so, then you can use a handy tool that comes with Python called **pip** to install Jupyter Notebook like this:

Shell

```
$ pip install jupyter
```

The next most popular distribution of Python is Anaconda. Anaconda has its own installer tool called **conda** that you could use for installing a third-party package. However, Anaconda comes with many scientific libraries preinstalled, including the Jupyter Notebook, so you don't actually need to do anything other than install Anaconda itself.

Starting the Jupyter Notebook Server

Now that you have Jupyter installed, let's learn how to use it. To get started, all you need to do is open up your terminal application and go to a folder of your choice. I recommend using something like your Documents folder to start out with and create a subfolder there called *Notebooks* or something else that is easy to remember.

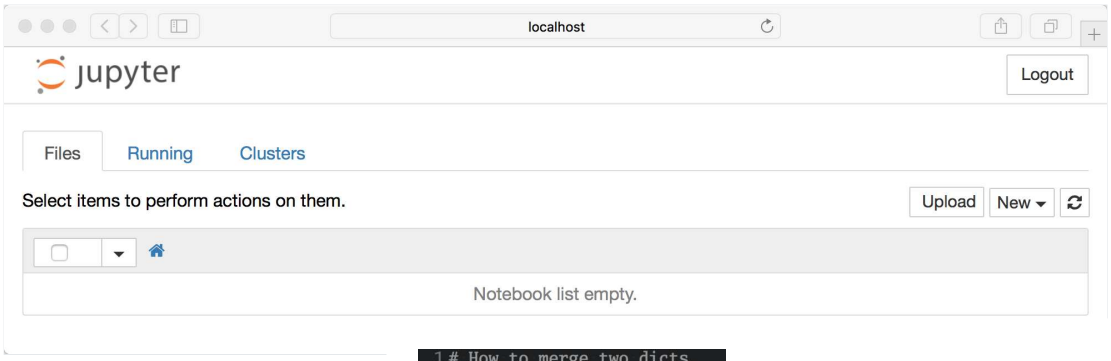
Then just go to that location in your terminal and run the following command:

Shell

```
$ jupyter notebook
```

This will start up Jupyter and your default browser should start (or open a new tab) to the following URL: http://localhost:8888/tree

Your browser should now look something like this:



Note that right now you are not actually r
Let's actually create a Notebook now!

Creating a Notebook

Now that you know how to start a Noteb
document.

All you need to do is click on the *New* but
happen to have Python 2 and Python 3 ir
sake, let's choose Python 3.

Your web page should now look like this:

```
# How to merge two dicts
# in Python 3.5+

>>> x = {'a': 1, 'b': 2}
>>> y = {'b': 3, 'c': 4}

>>> z = {**x, **y}

>>> z
{'c': 4, 'a': 1, 'b': 3}
```

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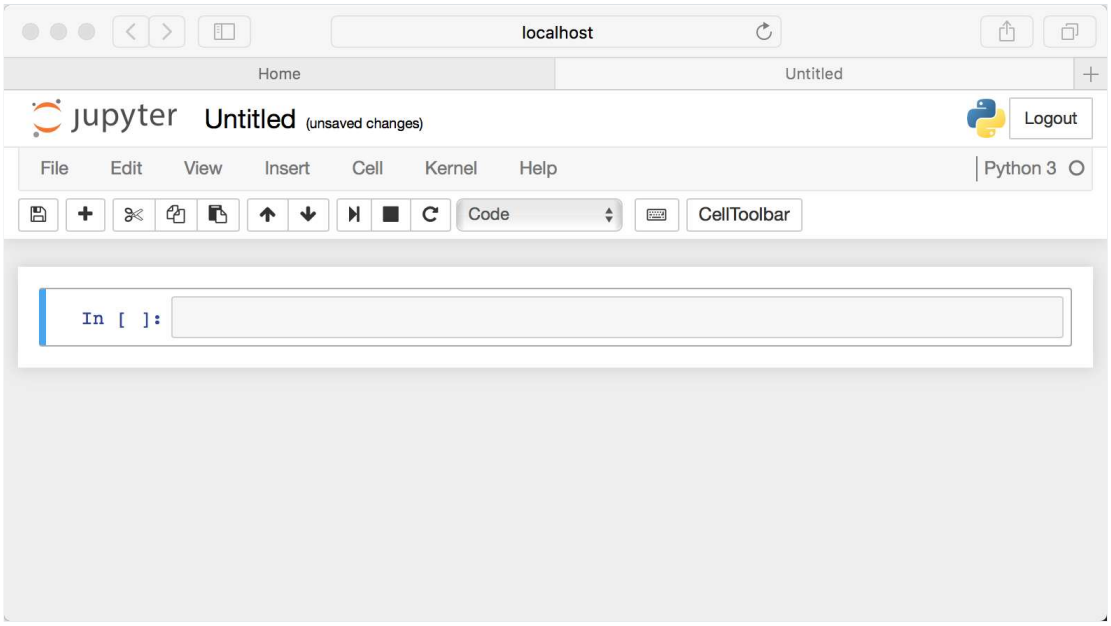
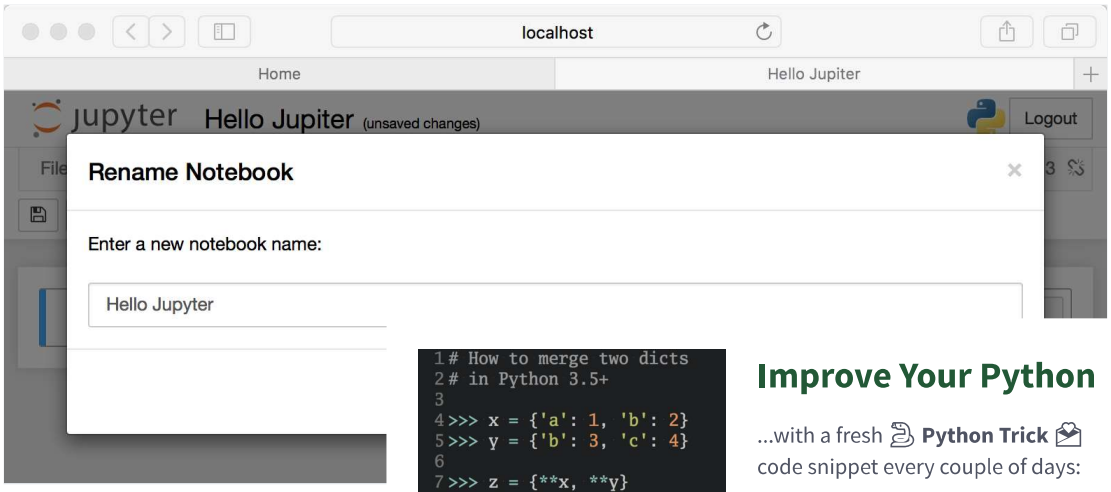


Naming

You will notice that at the top of the page is the word *Untitled*. This is the title for the page and the name of your Notebook. Since that isn't a very descriptive name, let's change it!

Just move your mouse over the word *Untitled* and click on the text. You should now see an in-browser dialog titled *Rename Notebook*. Let's rename this one to *Hello Jupyter*:




```
1 # How to merge two dicts
2 # in Python 3.5+
3
4 >>> x = {'a': 1, 'b': 2}
5 >>> y = {'b': 3, 'c': 4}
6
7 >>> z = {**x, **y}
8
9 >>> z
10 {'c': 4, 'a': 1, 'b': 3}
```

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Running Cells

A Notebook's cell defaults to using code v
when you started your Notebook.

In this case, you started yours with Pytho
cells. Since your initial Notebook has onl

Thus, to verify that everything is working
contents.

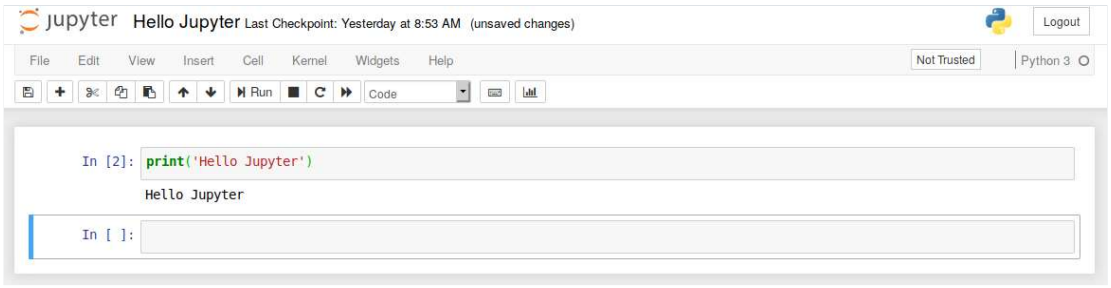
Let's try adding the following code to that cell:

Python

```
print('Hello Jupyter!')
```

Running a cell means that you will execute the cell's contents. To execute a cell, you can just select the cell and click the *Run* button that is in the row of buttons along the top. It's towards the middle. If you prefer using your keyboard, you can just press `⇧Shift` + `Enter ↩`.

When I ran the code above, the output looked like this:



If you have multiple cells in your Notebook, and you run the cells in order, you can share your variables and imports across cells. This makes it easy to separate out your code into logical chunks without needing to reimport libraries or recreate variables or functions in every cell.

When you run a cell, you will notice that there are some square braces next to the word *In* to the left of the cell. The square braces will auto fill with a number that indicates the order that you ran the cells. For example, if you open a fresh Notebook and run the first cell at the top of the Notebook, the square braces will fill with the number *1*.

The Menus

The Jupyter Notebook has several menus that you can use to interact with your Notebook. The menu runs along the top of the Notebook just like menus do in other applications. Here is a list of the current menus:

- *File*
- *Edit*

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- *View*
- *Insert*
- *Cell*
- *Kernel*
- *Widgets*
- *Help*

Let's go over the menus one by one. This article won't go into detail for every single option in every menu, but it will focus on the items that are unique to the Notebook application.

The first menu is the File menu. In it, you
would go to rename a Notebook. I think t
allows you to create checkpoints that you

Next is the *Edit* menu. Here you can cut, c
split, or merge a cell. You can reorder cell

Note that some of the items in this menu
selected cell. For example, a code cell car
greyed out menu item, try changing the c

The *View* menu is useful for toggling the v
cells on or off. This is also where you wou

```
# How to merge two dicts
# in Python 3.5+

>>> x = {'a': 1, 'b': 2}
>>> y = {'b': 3, 'c': 4}

>>> z = {**x, **y}

>>> z
{'c': 4, 'a': 1, 'b': 3}
```

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The *Insert* menu is just for inserting cells above or below the currently selected cell.

The *Cell* menu allows you to run one cell, a group of cells, or all the cells. You can also go here to change a cell's type, although I personally find the toolbar to be more intuitive for that.

The other handy feature in this menu is the ability to clear a cell's output. If you are planning to share your Notebook with others, you will probably want to clear the output first so that the next person can run the cells themselves.

The *Kernel* cell is for working with the kernel that is running in the background. Here you can restart the kernel, reconnect to it, shut it down, or even change which kernel your Notebook is using.

You probably won't be working with the Kernel all that often, but there are times when you are debugging a Notebook that you will find you need to restart the Kernel. When that happens, this is where you would go.

The *Widgets* menu is for saving and clearing widget state. Widgets are basically JavaScript widgets that you can add to your cells to make dynamic content using Python (or another Kernel).

Finally you have the *Help* menu, which is where you go to learn about the Notebook's keyboard shortcuts, a user interface tour, and lots of reference material.

Starting Terminals and Other Things

Jupyter Notebook also allows you to start more than just Notebooks. You can also create a text file, a folder, or a Terminal in your browser. Go back to the home page that opened when you first started the Jupyter server at `http://localhost:8888/tree`. Go to the *New* button and choose one of the other options.

The Terminal is probably the most interesting of the bunch, as it is running your operating systems terminal in the browser. This allows you to run bash, Powershell, and so on in your browser and run any shell command that you might need to there.

Viewing What's Running

Also on the home page of your Jupyter server (`http://localhost:8888/tree`) are two other tabs: *Running* and *Clusters*.

The *Running* tab will tell you which Notebooks and Terminals you are currently running. This is useful for when you want to shut down your server but you need to make sure that you have saved all your data. Fortunately, Notebooks auto-save pretty frequently, so you rarely lose data. But it's good to be able to see what's running when you need to.

The other nice thing about this tab is that you can go throug

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Adding Rich Content

Jupyter Notebook supports adding rich content to its cells. In this section, you will get an overview of just some of the things you can do with your cells using Markup and Code.

Cell Types

There are technically four cell types: Code, Markdown, Raw NBConvert, and Heading.

The Heading cell type is no longer supported and will display a dialog that says as much. Instead, you are supposed to use Markdown for your Headings.

The Raw NBConvert cell type is only inter
Basically it allows you to control the form
format.

The primary cell types that you will use a
cells work, so let's learn how to style you

```
# How to merge two dicts
# in Python 3.5+

>>> x = {'a': 1, 'b': 2}
>>> y = {'b': 3, 'c': 4}

>>> z = {**x, **y}

>>> z
{'c': 4, 'a': 1, 'b': 3}
```


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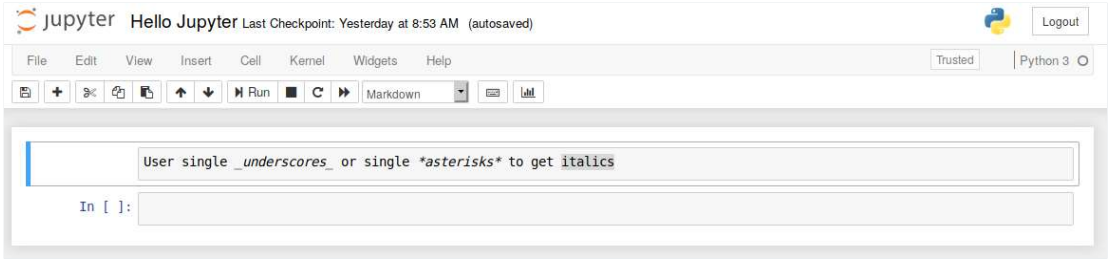
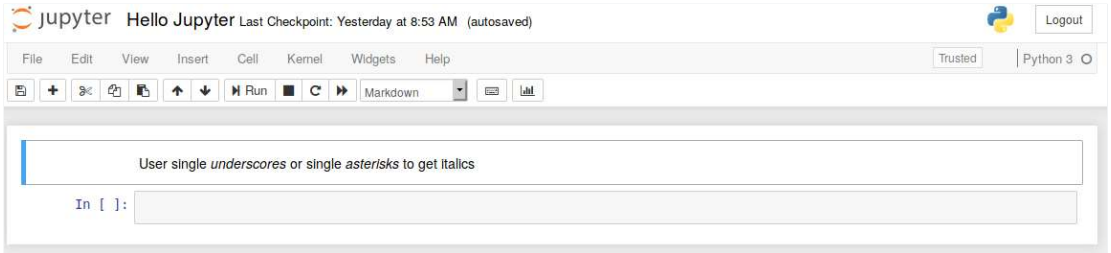
Styling Your Text

Jupyter Notebook supports Markdown, v
some of the basics of what you can do wi

Set a new cell to Markdown and then adc



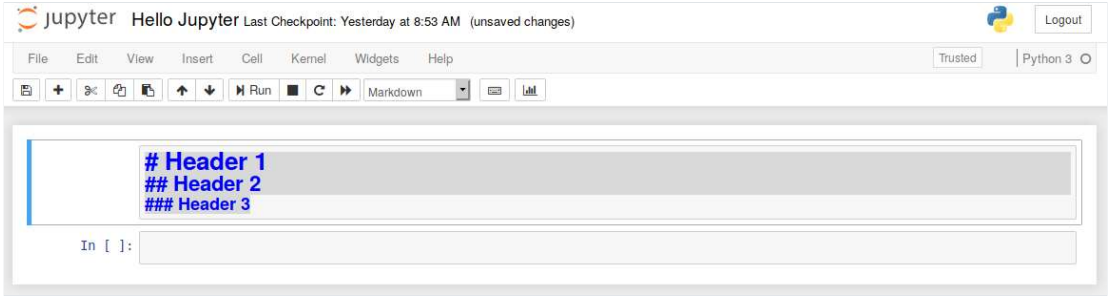
When you run the cell, the output should look like this:



If you would prefer to bold your text, use a double underscore or double asterisk.

Headers

Creating headers in Markdown is also quite simple. You just have to use the humble pound sign. The more pound signs you use, the smaller the header. Jupyter Notebook even kind of previews it for you:



Then when you run the cell, you will end up with a nicely for

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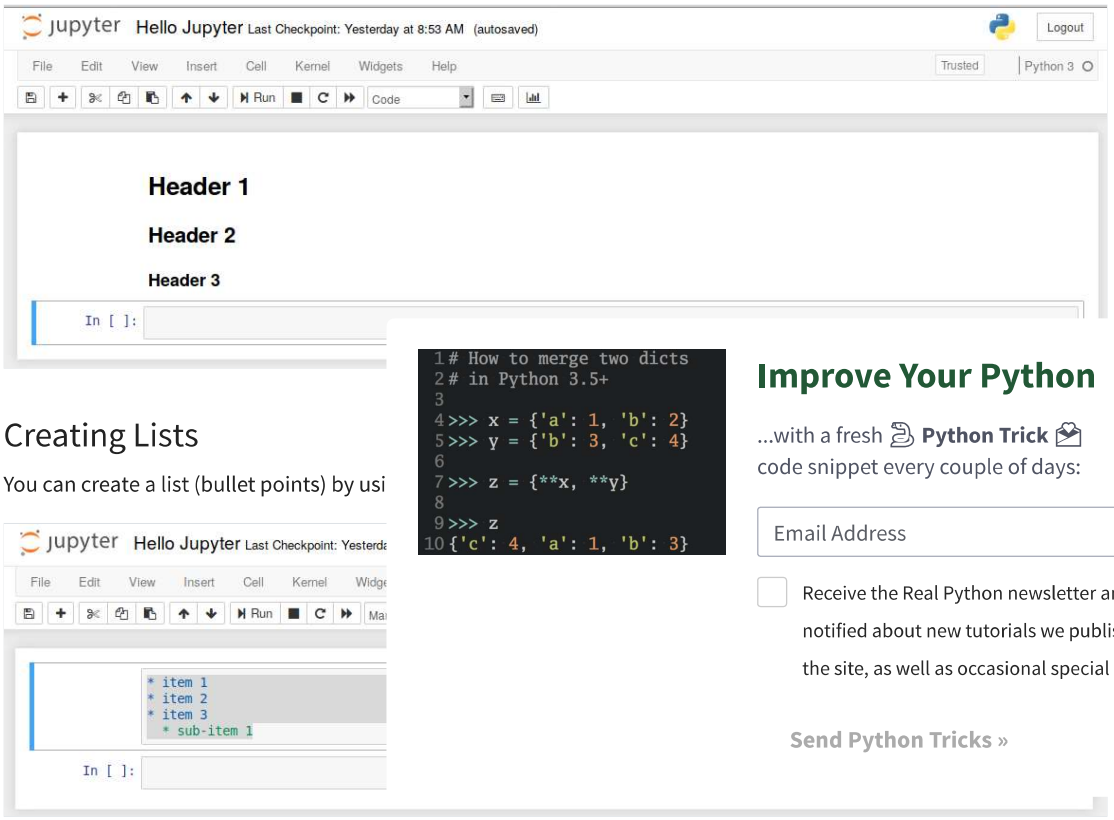

Creating Lists

You can create a list (bullet points) by usi


```
# How to merge two dicts
# in Python 3.5+

>>> x = {'a': 1, 'b': 2}
>>> y = {'b': 3, 'c': 4}

>>> z = {**x, **y}

>>> z
{'c': 4, 'a': 1, 'b': 3}
```


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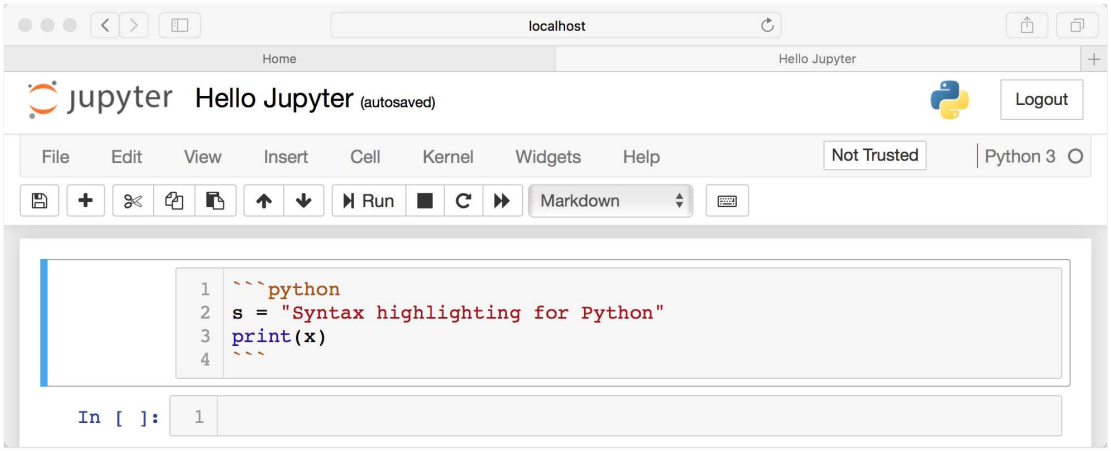
Code and Syntax Highlighting

If you want to insert a code example that you don't want your end user to actually run, you can use Markdown to insert it. For inline code highlighting, just surround the code with backticks. If you want to insert a block of code, you can use triple backticks and also specify the programming language:



Exporting Notebooks

When you are working with Jupyter Notebooks, you will find that you need to share your results with non-technical people. When that happens, you can use the `nbconvert` tool which comes with Jupyter Notebook to convert or export your Notebook into one of the following formats:

- HTML
- LaTeX
- PDF
- RevealJS
- Markdown
- ReStructured Text
- Executable script

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The `nbconvert` tool uses Jinja templates under the covers to convert your Notebook files (`.ipynb`) into these other formats.

Jinja is a template engine that was made for Python. Also note that `nbconvert` also depends on Pandoc and TeX to be able to export to all the formats above. If you don't have one or more of these, some of the export types may not work. For more information, you should check out the documentation.

How to Use `nbconvert`

The `nbconvert` command does not take very many parameters, which makes learning how to use it easier. Open up a terminal and navigate to the folder that c

looks like this:

Shell

```
$ jupyter nbconvert <input notebook>
```


```
# How to merge two dicts
# in Python 3.5+

>>> x = {'a': 1, 'b': 2}
>>> y = {'b': 3, 'c': 4}

>>> z = {**x, **y}

>>> z
{'c': 4, 'a': 1, 'b': 3}
```

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Example Usage

Let's pretend that you have a Notebook r

command you would use to do that:

Shell

```
$ jupyter nbconvert py_examples.ipynb
```

When you run this command, you should see some output that tells you about the conversion process. `nbconvert` will display warnings and errors if there are any. Assuming everything goes according to plan, you will now have a `py_examples.pdf` file in your folder.

The conversion process for the other file types is quite similar. You just have to tell `nbconvert` what type to convert to (PDF, Markdown, HTML, and so on).

Use the Menu

You can also export your currently running Notebook by going to the *File* menu and choosing the *Download as* option.

This option allows you to download in all the formats that `nbconvert` supports. The benefit of using the menu is that you don't need to learn the `nbconvert` at all if you don't want to. However I recommend doing so as you can use `nbconvert` to export multiple Notebooks at once, which is something that the menu does not support.

Notebook Extensions

While Jupyter Notebooks have lots of functionality built in, you can add new functionality through extensions. Jupyter actually supports four types of extensions:

- Kernel
- IPython kernel
- Notebook
- Notebook server

This tutorial will focus on Notebook extensions.

What Are Extensions?

A Notebook extension (`nbextension`) is a JavaScript module that you load in most of the views in the Notebook's frontend. If you are handy with JavaScript, you can even write your own extension. An extension can access the page's DOM and the Jupyter JavaScript API.

Where Do I Get Extensions?

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You can use Google or search for Jupyter Notebook extensions. There are actually quite a few out there. One of the most popular extension sets is called **jupyter_contrib_nbextensions**, which you can get from GitHub. This is actually a collection of extensions that is provided by the Jupyter community and installed with `pip`.

How Do I Install Them?

Most Jupyter Notebook extensions can be installed using Python's `pip` tool. If you find an extension that can't be installed with `pip`, then you will likely have to use the following command:

Shell

```
$ jupyter nbextension install EXTENSI
```

This only installs the extension but does
running the following:

Shell

```
$ jupyter nbextension enable EXTENSIC
```

You may need to restart your Jupyter Not

There is a nice meta extension called **Jup**
extensions. It allows you to enable and d
also shows all the currently installed exte

```
# How to merge two dicts
# in Python 3.5+

>>> x = {'a': 1, 'b': 2}
>>> y = {'b': 3, 'c': 4}

>>> z = {**x, **y}

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{'c': 4, 'a': 1, 'b': 3}
```


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Conclusion

The Jupyter Notebook is quite useful not only for learning and teaching a programming language such as Python but also for sharing your data.

You can turn your Notebook into a slideshow or share it online with GitHub. If you want to share a Notebook without requiring your users to install anything, you can use binder for that.

Google and Microsoft both have their own version of the Notebook that you can use to create and share your Notebooks at Google Colaboratory and Microsoft Azure Notebooks respectively. You can browse really interesting Notebooks there as well.

Project Jupyter recently launched their latest product, JupyterLab. JupyterLab incorporates Jupyter Notebook into an Integrated Development type Editor that you run in your browser. You can kind of think of JupyterLab as an advanced version of Jupyter Notebook. JupyterLab allows you to run terminals, text editors and code consoles in your browser in addition to Notebooks.

As always, it is best to try out a new piece of software yourself to see if it suits you and is worth using. I encourage you to give Jupyter Notebook or JupyterLab a spin and see what you think!

Further Reading

If you want to learn more about Jupyter Notebook, you can take a moment and read their excellent documentation.

For more information on Integrated Development Environments, you might want to check out the following articles:

- Python IDEs and Code Editors (Guide)
- Thonny: The Beginner-Friendly Python Editor

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```

Email Address


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{'c': 4, 'a': 1, 'b': 3}
```


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About **Mike Driscoll**

Mik

» M

Each tutorial at Real Python is created by a team of developers so that it meets our high quality standards. The team members who worked on this tutorial are:

Aldren

Joanna

Kyle

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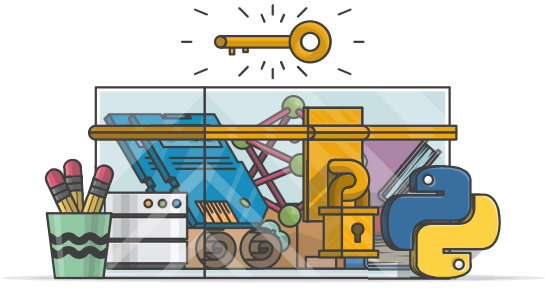

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Leave a comment below and let us kn

```
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>>> y = {'b': 3, 'c': 4}

>>> z = {**x, **y}

>>> z
{'c': 4, 'a': 1, 'b': 3}
```

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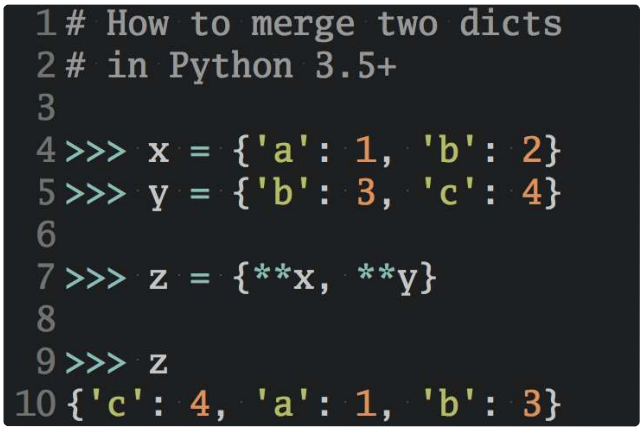

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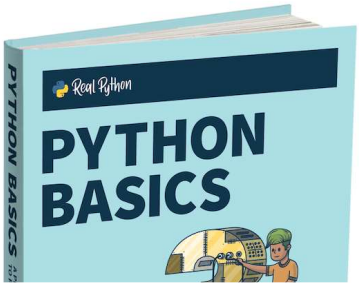

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```


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This is a small demonstration .pdf file -

just for use in the Virtual Mechanics tutorials. More text. And more text. And more text. And more text. And more text.

And more text. And more text. And more text. And more text. And more text. And more text. Boring, zzzzz. And more text. And more text. And more text. And more text. And more text. And more text. And more text. And more text. And more text.

And more text. And more text. And more text. And more text. And more text. And more text. And more text. Even more. Continued on page 2 ...

Simple PDF File 2

...continued from page 1. Yet more text. And more text. And more text. And more text. And more text. And more text. And more text. Oh, how boring typing this stuff. But not as boring as watching paint dry. And more text. And more text. And more text. And more text. Boring. More, a little more text. The end, and just as well.