# nbdime: Notebook Diffing and Merging

Vidar Tonaas Fauske - @vidartf Min Ragan-Kelley - @minrk Martin Sandve Alnæs - @martinal





### Outline

- Why we need custom diff/merge
- Demo:
  - Nbdime command line interface (CLI)
  - Nbdime web tools
  - Interfacing nbdime with git





### Outline

- Why we need custom diff/merge
- · Nbdime command line interface (CLI)
- · Nbdime web tools
- · Interfacing nbdime with git





### Notebooks in version control

• History for yourself

• Collaboration with several authors





### Why do we need custom diff/merge?

### Notebook format:

### Plotting with Matplotlib

IPython works with the Matplotlib plotting library, which integrates Matplotlib with IPython's display system and event loop handling.

### matplotlib mode

To make plots using Matplotlib, you must first enable IPython's matplotlib mode.

To do this, run the %matplotlib magic command to enable plotting in the current Notebook.

This magic takes an optional argument that specifies which Matplotlib backend should be used. Most of the time, in the Notebook, you will want to use the inline backend, which will embed plots inside the Notebook:

### In [1]: %matplotlib inline

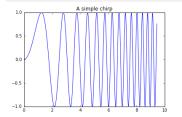
You can also use Matplotlib GUI backends in the Notebook, such as the Qt backend (<code>tmatplotlib gt</code>). This will use Matplotlib's interactive Qt UI in a floating window to the side of your browser Of course, this only works if your browser is running on the same system as the Notebook Server. You can always call the display function to paste figures into the Notebook document.

### Making a simple plot

With matplotlib enabled, plotting should just work.

In [2]: import matplotlib.pyplot as plt import numpy as np

In [3]: x = np.linspace(0, 3\*np.pi, 500)
plt.plct(x, np.sin(x\*\*2))
plt.title('A simple chirp');





### Why do we need custom diff/merge?

### Notebook format:

- Lists
- Dictionaries
- Strings

simu

 Atomic values: numbers, booleans, binary data (base64)

```
"cell_type": "code",¬
 "execution_count": 2,-
 "metadata": {-
 "collapsed": true-
 },-
 "outputs": [],¬
 "source": [-
 "from numpy.random import uniform, seed\n",-
 "from matplotlib.mlab import griddata\n",¬
  "import matplotlib.pyplot as plt\n",¬
  "import numpy as np\n",¬
  "plt.rc('image', cmap='viridis')"-
 1-
},¬
 "cell_type": "code",¬
 "execution_count": 3,-
 "metadata": {¬
 "collapsed": false,¬
  "scrolled": false-
 },¬
 "outputs": [-
   "data": {¬
    "image/png":
```

"iVBORw0KGgoAAAANSUhEUgAABGgAAAL8CAYAAAC8rYNfAAAABHNCSVQICAgIfAhkiAAAAANwSFlz\nAAAWJQAAFiUB ABJREFUeJzs3Xd8XNWZ//HPmVGXrOaKcMM2YLAp7gZcKKEECC1wE5IQ\nICGQhGVDyCYb9pcNJGGzySaQAKmkUZINuY GU2xj0wy2wTZuKrZktZnz++PckcfDjJol\nXUnzfb9e87q65dz7zGhG9n3mn0cYay0iIiIiIiIiIiHkeSNgBiIiIIII ERERERERERC\npgSNiIIIIIIIIEIILKARERERERERE0mZEiQiIIIIIIIIIFTgkZEREREREBJGRK0IIIIIIIIII



### Why do we need custom diff/merge?

Standard algorithms:

- Sequence of strings (lines)

We have a lot of a priori information!

\$ diff a.ipynb b.ipynb
76,77d75

"plt.rc('axes', grid=False)\n",

< "plt.rc('axes', facecolor='white')\n",

90c88

"image/png": "iVBORw0KGgoAAAANSUhEUgAABLkAAAMQCAYAAADLj7dlAAAABHNCSVQICAgIfAhki AAAAAlwSFlz\nAAAWJQAAFiUBSVIk8AAAIABJREFUeJzsvXeYZFd57b12h0maPNJII2lGOaCAkEBCFgozIxkBAp lY\n1waDyDZg8MX+zMU2F4Mx1x8PwWAwxmBjg4yNi2BfQMa20iiAQFkIjXKWRtJIE3tSz3TXuX+8vV2n\nqyucv N+9z/o9zzynprvq1D6nqqtqr1prbRNFEQghhBBCCCGEEEII8Zkh1wMghBBCCCGEEEIIISQv\nFLkIIYQQQgghhB BCiPdQ5CKEEEIIIYQQQggh3k0RixBCCCGEEEIIIYR4D0UuQgghhBBCCCGEE0I9\nFLkIIYQQQgghhBBCiPdQ5CK EEEIIIYQQQggh3kORixBCCCGEEEIIIYR4D0UuQgghhBBCCCGEEOI9\nFLkIIYQQQgghhBBCiPdQ5CKEEEIIIYQQ Qggh3kORixBCCCGEEEIIIYR4D0UuQgghbBBCCCGEEOI9\nFLkIIYQQQjzEGHOJMaZljPmo67EkZWq8D7keByGEE ELChCIXIYQQQirDGPOmKaFj3BhzkMNx/H/G\nmG3GmP/pagwFEbkeQJUYY75gjNlijHmD67EQQgghRB8UuQghhB BSJe+DCDMjAH7L4TjeAmA+gLc5\nHEMRGNcDqJi3AVgI4DddD4QQQggh+qDIRQghhJBKMMacCuBMAFsg4sy7jTH DjobzZwBuBvBxR/dP\nsvERADcC+LTrgRBCCCFEHxS5CCGEEFIVH4C4uP4SIlQcB0D1LgYSRVEziqIXR1H0fRf3 T7IRRdFf\nRlH0K1EUXe96LI000gjRB0Uu0gghhJS0MWYpgP8BoAXg7wH8HcTN9Tsux0UIIY000sKBIhchhBBC\ nquBdA0YAuDyKoscBfBvALgBnGWOe73RkhBBCCCEkCChyEUIIIaRUjDEGUjIfQRxciKJoDMB3p65C\nNxchhBBC CMkNRS5CCCGElM3FAA4HsAnAD2I/t5HFNxpjFuW5A2PMXGPMh4wxNxpjxowxO4wxdxpj\nPmGMmd/l+pcYY1rGm I92/HzB1M8np/5/mDHmr40xjxpjdhtj7jbGfMwYMy92m30NMT80xmw0xuyc\nus6njDFLeozV3veHpv5/lDHm88 aY9V0332yMuWnqfg4o4Lz8njHmp1P73WmMuXfq/g7Ls++p/c8x\nxrzfGH0lMeYZY8weY8xjxphvGmP0GHDbQ4w xf2GMeWDqdk8ZY75vjDmzz20+NnXu3tLld48YY/Z0\nXT7KGPMPxpiHjDETxphvT/38rVWde0IIIYRUD0UuQggh hJTN70BcXJdGUbTP/jCKousA3A9gLoB3\nZN35lEB2I4D/H8ApU/u8D8BxAP4YwG09RLSoy892xPb7EgC/APBWA E8DuBfAUQA+CuByY8yoMeZ/\nArgKwDkAHgRwD4AjAPwBgJ/2Ee+iqft4L4BfAng/gEUAbgfwKICTp+7nIWPMG5 Och06MMadNjfkz\nAE4H8PjU/hd03d/dxpg3Zdn31P7PhJzrLwBYDVk18xaIcPkmADcYY/68x23PhZzb3wEwBuA OAPMB\nvBrAtcaYV/e42wjdHzf70xhjXghZOfPNAMYB/BTAlZ23L/PcE0IIIcQNFLkIIYQQUhrGmGMBrJ36\n79 e7X0XvIaLIe3LczUcBnAhgHYBDovg6LYqi0wA8DvI6rYSIMDOG1/mDKIriAsp3AFwH4JCplRhf\nA0BoiHB0JoC vAfg0gK8CWDG16t8LAawC8DMAxwL4kx5iNgAaAL4E4DYAL4mi6JAoil4SRdGpAA4A\n8HEAswFcaoz5HwnPhezc





## Merging notebooks

- Challenge: Hierarchical merge
- Major unit: Cell
- Input is more important than outputs!
- Input is "traditional" string merge
- Outputs are best treated as atomic
- Certain fields can typically be ignored



## What can nbdime offer?

- Backend/library for diffing and merging notebooks
- CLI applications
  - Diff/merge
  - Nbshow
- Web applications (rich diff/merge view)
- git drivers (diff/merge) and mergetool (web)



### **Command Line Interface**

### > nbshow notebook1.ipynb

width: 604

markdown cell 3:

\$ nbshow -s -o c.ipynb markdown cell 0: source: # Plotting with Matplotlib IPython works with the [Matplotlib](http://matplotlib.org/) plotting library, which integrates Matplotlib with IPython's display system and event loop handling. ## matplotlib mode To make plots using Matplotlib, you must first enable IPython's matplotlib code cell 2: mode. source: To do this, run the `%matplotlib` magic command to enable x = np.linspace(0, 3\*np.pi, 500)current Notebook. plt.plot(x, np.sin(x\*\*2)) This magic takes an optional argument that specifies which plt.title('A simple chirp'); should be used. Most of the time, in the Notebook, outputs: you will want to use the `inline` backend, which will embed the Notebook: output 0: code cell 1: output\_type: display\_data source: %matplotlib inline data: import matplotlib.pyplot as plt image/png: iVBORw0K...<snip base64, md5=7665fcc01cfdaa71...> import numpy as np code cell 2: text/plain: <matplotlib.figure.Figure at 0x10ea05940> source: metadata (unknown keys): x = np.linspace(0, 3\*np.pi, 500)plt.plot(x, np.sin(x\*\*2)) image/png: plt.title('A simple chirp'); height: 392 outputs: output 0: width: 604 output\_type: display\_data data: image/png: iVBORw0K...<snip base64, md5=7665fcc01cfdaa71...> text/plain: <matplotlib.figure.Figure at 0x10ea05940> metadata (unknown keys): image/png: height: 392

## **Command Line Interface**

### > nbdiff notebook1.ipynb notebook2.ipynb

```
$ nbdiff c.ipynb b.ipynb
nbdiff c.ipynb b.ipynb
--- c.ipynb 2016-11-30 15:12:21
+++ b.ipynb 2016-11-30 15:12:30
## modified /cells/9/outputs/0/data/text/plain:
- <matplotlib.figure.Figure at 0x10ea05940
+ <matplotlib.figure.Figure at 0x10eb21860
                                      ##
                                          replaced /cells/14/outputs/0/data/image/png:
                                          iVBORw0K...<snip base64, md5=3f7d4e61ee33aaae...>
## replaced /cells/14/outputs/0/data/image/ -

    iVBORw0K...<snip base64, md5=3f7d4e61ee3</li>

                                          iVBORwOK...<snip base64, md5=1d6960ad89e9de61...>
+ iVBORw0K...<snip base64, md5=1d6960ad89e +
## modified /cells/14/outputs/0/data/text/plain:
- <matplotlib.figure.Figure at 0x1110200b8>
                                              ## modified /cells/14/source:
+ <matplotlib.figure.Figure at 0x11112bf28>
                                              @@ -25,14 + 25,14 @@ x = np.linspace(0, 10)
## modified /cells/14/source:
                                              y = func(x)
@@ -25,14 + 25,14 @@ x = np.linspace(0, 10)
y = func(x)
fig, ax = plt.subplots()
                                              fig, ax = plt.subplots()
plt.plot(x, y, 'g', 'r', linewidth=2)
                                              plt.plot(x, y, 'g', 'r', linewidth=2)
plt.ylim(ymin=0)
                                              plt.ylim(ymin=0)
# Make the shaded region
ix = np.linspace(a, b)
iy = func(ix)
verts = [(a, 0)] + list(zip(ix, iy)) + [(b, 0)]
poly = Polygon(verts, facecolor='0.9', edgecolor='0')facecolor='0.6', edgecolor='0.5')
ax.add patch(polv)
```



## **Command Line Interface**

### > nbmerge base.ipynb local.ipynb remote.ipynb

- \$ nbmerge v1.ipynb v2.ipynb v3.ipynb -o merged.ipynb
- [W autoresolve:162] autoresolving conflict at /cells/0/outputs with inline-outputs [W autoresolve:162] autoresolving conflict at /cells/0/execution\_count with clear [W autoresolve:162] autoresolving conflict at /cells/1/execution\_count with clear [W nbmergeapp:47] Conflicts occured during merge operation.
- [I nbmergeapp:60] Merge result written to merged.ipynb





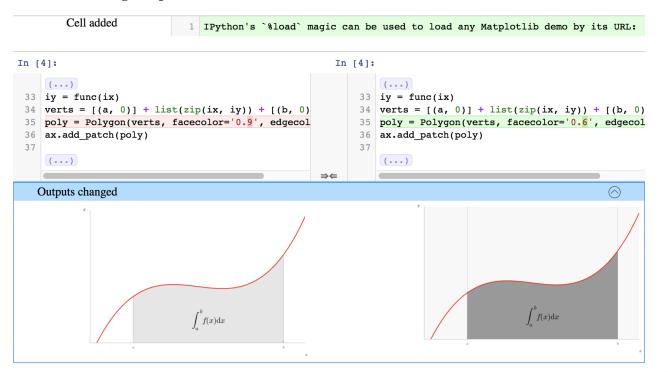
### git mergedriver

- Associate ipynb files with our merger
- Fewer conflict than default merger





# Web applications: Diff

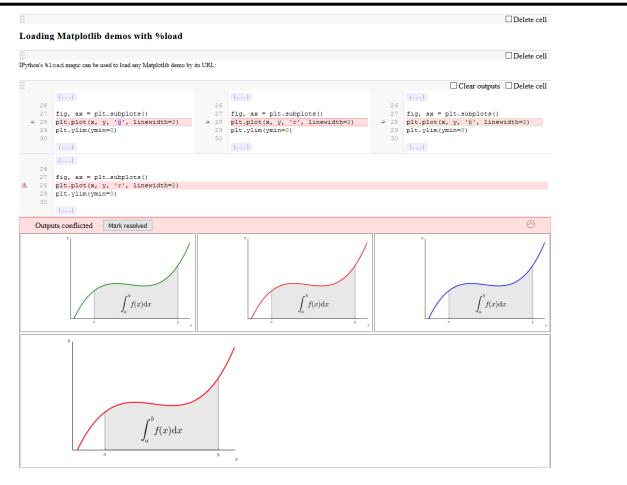


### Loading Matplotlib demos with %load



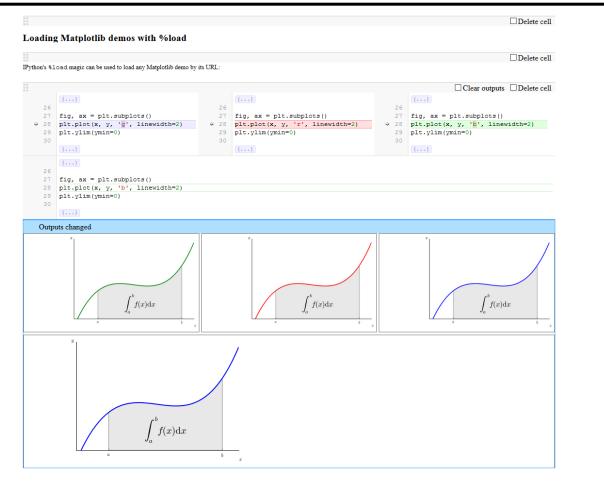


# Web applications: Merge





# Web applications: Merge





### Demo





### Getting it

- Current version 0.1.1
  - > pip install nbdime

• Helper scripts for integrating with git







- Nbdime: Custom diff/merge because of structured format
  - Also allows us to make informed merges
- Integrates with git
- Rich rendering allows for better oversight









### Thanks!



OpenDreamKit Horizon 2020 European Research Infrastructures project (#676541)



