Magic keywords

Magic keywords are special commands you can run in cells that let you control the notebook itself or perform system calls such as changing directories. For example, you can set up matplotlib to work interactively in the notebook with `%matplotlib`.

Magic commands are preceded with one or two percent signs (`%` or `%%`) for line magics and cell magics, respectively. Line magics apply only to the line the magic command is written on, while cell magics apply to the whole cell.

NOTE: These magic keywords are specific to the normal Python kernel. If you are using other kernels, these most likely won't work.

Timing code

At some point, you'll probably spend some effort optimizing code to run faster. Timing how quickly your code runs is essential for this optimization. You can use the `timeit` magic command to time how long it takes for a function to run, like so:

```
In [21]: from math import sqrt

         def fibo1(n): # Recursive Fibonacci number
             if n == 0:
                 return 0
             elif n == 1:
                 return 1
             return fibo1(n-1) + fibo1(n-2)

         def fibo2(n): # Closed form
             return ((1+sqrt(5))**n-(1-sqrt(5))**n)/(2**n*sqrt(5))

In [22]: %timeit fibo1(20)
         100 loops, best of 3: 3.49 ms per loop

In [23]: %timeit fibo2(20)
         The slowest run took 16.75 times longer than the fastest. This could mean
          that an intermediate result is being cached.
         1000000 loops, best of 3: 1.08 µs per loop
```

If you want to time how long it takes for a whole cell to run, you'd use `%%timeit` like so:

```
In [24]: import random

In [97]: %%timeit
         prize = 0
         for ii in range(100):
             # roll a die
             roll = random.randint(1, 6)
             if roll%2 == 0:
                 prize += roll
             else:
                 prize -= 1
         10000 loops, best of 3: 148 µs per loop

In [98]: %%timeit
         rolls = (random.randint(1,6) for _ in range(100))
         prize = sum(roll if roll%2 == 0 else -1 for roll in rolls)
         10000 loops, best of 3: 154 µs per loop
```

Embedding visualizations in notebooks

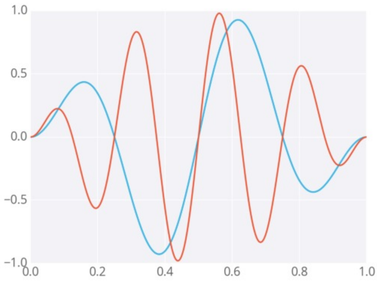
As mentioned before, notebooks let you embed images along with text and code. This is most useful when you're using `matplotlib` or other plotting packages to create visualizations. You can use `%matplotlib` to set up `matplotlib` for interactive use in the notebook. By default figures will render in their own window. However, you can pass arguments to the command to select a specific "backend", the software that renders the image. To render figures directly in the notebook, you should use the inline backend with the command `%matplotlib inline`.

> ***Tip:*** *On higher resolution screens such as Retina displays, the default images in notebooks can look blurry. Use* `%config InlineBackend.figure_format = 'retina'` *after* `%matplotlib inline` *to render higher resolution images.*

```
In [103]: %matplotlib inline
          %config InlineBackend.figure_format = 'retina'

          import matplotlib.pyplot as plt
          import numpy as np

In [134]: x = np.linspace(0, 1, 300)
          for w in range(2, 6, 2):
              plt.plot(x, np.sin(np.pi*x)*np.sin(2*w*np.pi*x))
```



Example figure in a notebook

Debugging in the Notebook

With the Python kernel, you can turn on the interactive debugger using the magic command `%pdb`. When you cause an error, you'll be able to inspect the variables in the current namespace.

```
In [99]: %pdb
         Automatic pdb calling has been turned ON

In [*]: numbers = 'hello'
        sum(numbers)
        ---------------------------------------------------------------------------
        TypeError                                 Traceback (most recent call
         last)
        <ipython-input-101-7a179164921f> in <module>()
              1 numbers = 'hello'
        ----> 2 sum(numbers)

        TypeError: unsupported operand type(s) for +: 'int' and 'str'


        > <ipython-input-101-7a179164921f>(2)<module>()
              1 numbers = 'hello'
        ----> 2 sum(numbers)

        ipdb> numbers
        'hello'

        ipdb>
```

Debugging in a notebook

Above you can see I tried to sum up a string which gives an error. The debugger raises the error and provides a prompt for inspecting your code.

Read more about `pdb` in the documentation. To quit the debugger, simply enter `q` in the prompt.

More reading

There are a whole bunch of other magic commands, I just touched on a few of the ones you'll use the most often. To learn more about them, here's the list of all available magic commands.