Python versus Matlab: examples from geophysics to civil engineering

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May 13, 2013

Introduction

1 A bit about myself

2 Learn a new language?

3 What do people like?

4 Examples

Outline

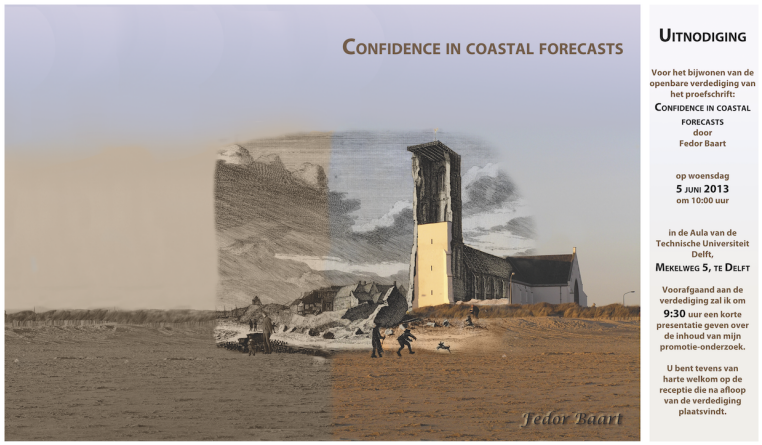
1 A bit about myself

2 Learn a new language?

3 What do people like?

4 Examples

- Senior consultant at Deltares, coastal systems and software data integration
- 1 day a week at Hydraulic Engineering at Delft University of Technology



5 June 2013 Phd: Confidence in coastal forecasts

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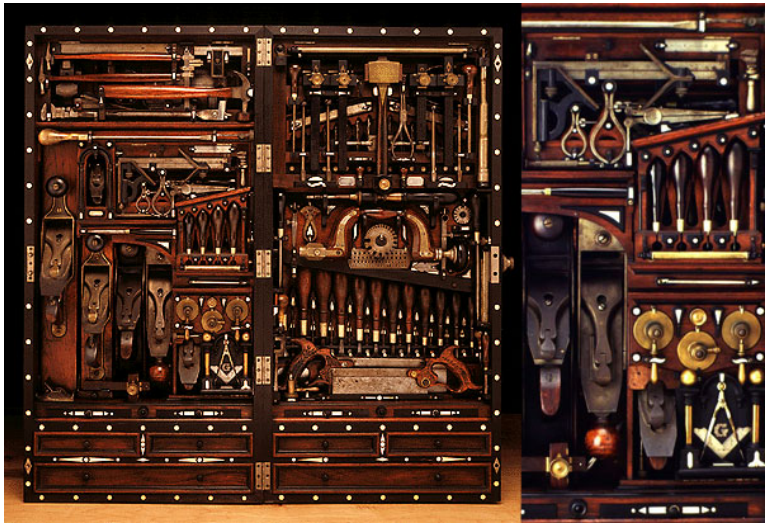
When to extend your toolbox?

What does your toolbox look like?

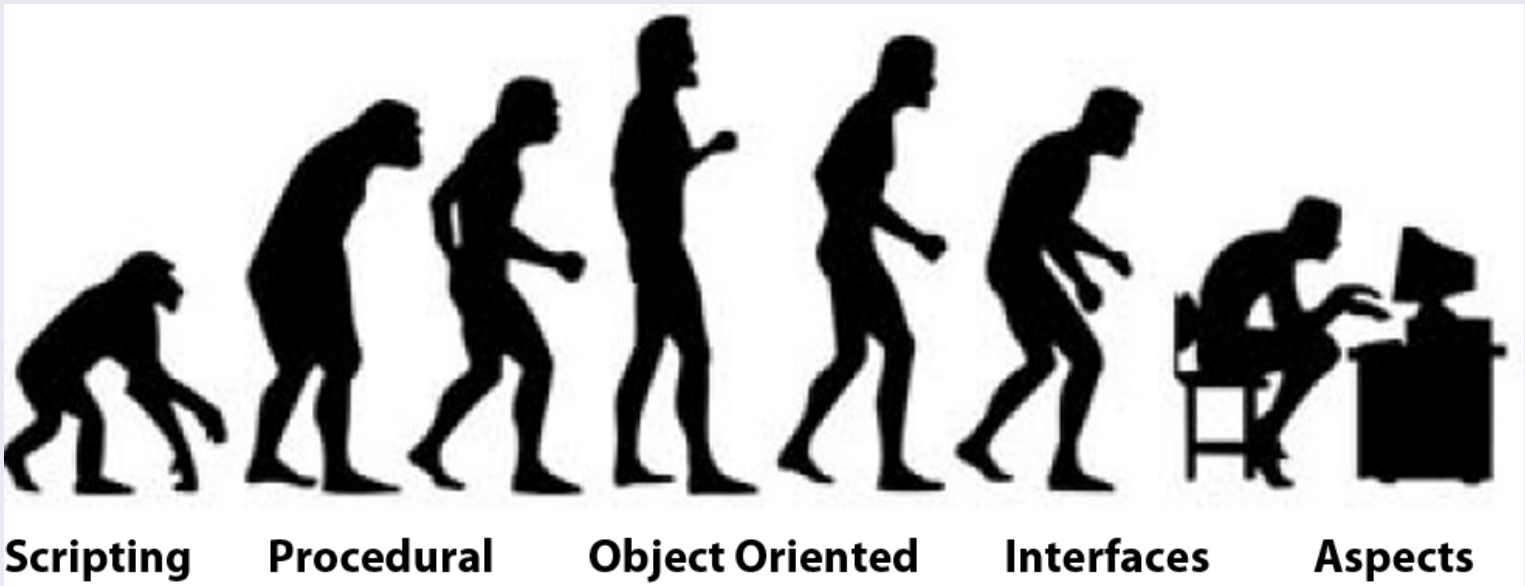


src: Norm Abram

What determines the language?

- Paradigma
- Data types (dict, list, strings, numbers, matrices, vectors)
- Syntax (Keywords, whitespace, braces)
- Type system (int a = 1 vs a = 1)

Evolution of computer paradigms



Scripting

Python

```
>>> 1 + 1
>>> print("Hello World")
```

Matlab

```
>> 1 + 1
>> disp('Hello World');
```

Procedural

Python

```
def add(a, b):
    return a + b #
        significant
        whitespace
```

Matlab

```
function total  = add(a,b)
  total = a + b
end % ends the function
```

Functional

Python

```
# anonymous function
# applied to each element
>>> map(lambda x:x**2,
    [1,2,3])
[1,4,9]
# recursive
# add(1 + reduce(add,
    [2,3]))
>>> reduce(add, [1,2,3])
6
```

Matlab

```
% apply anonymous function
% to each element
>> arrayfun(@(x) (x^2), [1
    2 3])
ans =
1     4     9
% reduce not in matlab
```

Object Oriented

Python

```
# numbers are objects
>>> 2.5.as_integer_ratio()
(5, 2)
>>> f = interp1d([0,1,2,3], [0,1,4,9], kind='cubic')
# which can be called
>>> f(1.5)
2.25
# and has properties
>>> f.fill_value
nan
```

Matlab

```
% numbers are not objected oriented
>> rat(2.5)
ans =
3 + 1/(-2)
% This is an objected oriented part of matlab
>> Hs=spectrum.periodogram
% which has properties
>> get(Hs, 'WindowName')
ans =
Rectangular
```

Interface Oriented

Python

```
class SomeModel(object):
    implements(IModel):
    def initialize(self, config):
        # initialize
    def update(self, dt)
        # do a timestep
# Register Model
registerUtility(SomeModel(), IModel)
# get a list of all the models
models = getUtilitiesFor(IModel)
```

Matlab

```
% Not used in
    matlab
...
```

Aspect Oriented

Python

```
@cache
def slow_calculation():
    time.sleep(100)
    return 1+1
slow_calculation() # slow
slow_calculation() # fast
```

Matlab

```
% Not used in
    matlab
```

Types

Python

Types: Everything is an object
Type safety:

```
# strong, dynamic
>>> x = 1
>>> x = 'a'
>>> x = 1 + 'a'
TypeError
```

Python

Types: Everything is an array
Weak dynamic, typed

```
>> x = 1
>> x = 'a'
>> x = 1 + 'a'
98
```

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What aspects determine if people like their language?

- People (What are people using it for?)
- Help (Documentation, community)
- Tools (What tools are available?)
- Speed (How does it scale?)
- Libraries (What libraries can you reuse?)

What's popular where?

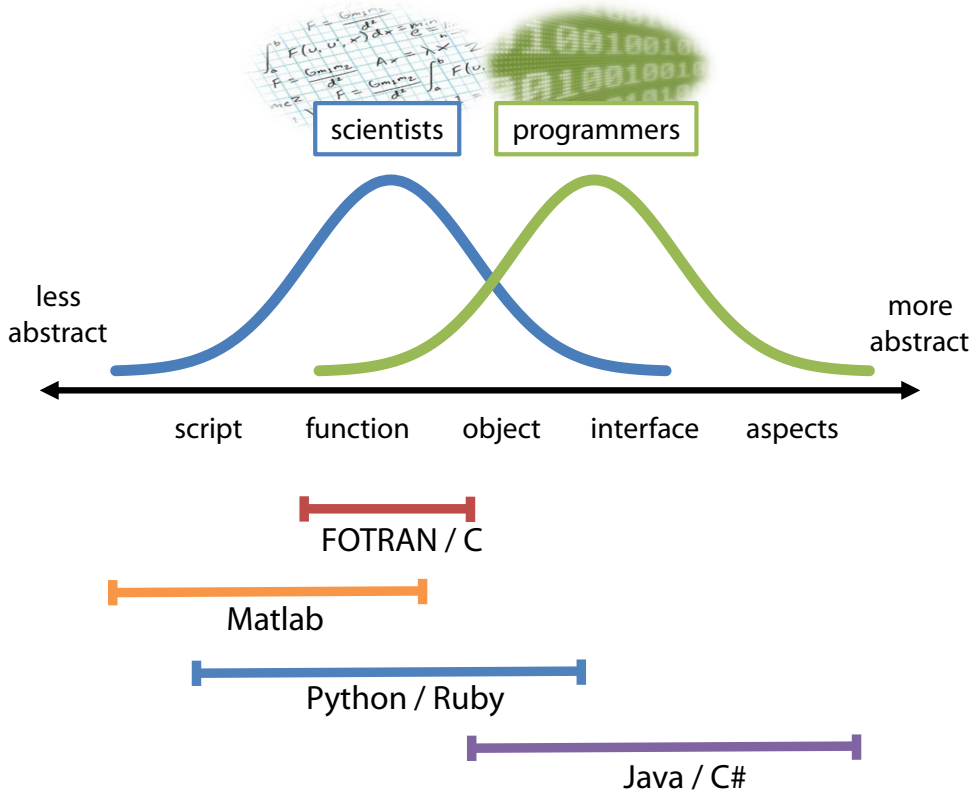
matlab

- engineering
- science

python

- science
- geospatial
- web
- system
- games

People and paradigma



python

```
help(function)
```

most python modules have a doc website:

1. docs.python.org
2. docs.scipy.org
3. matplotlib.sourceforge.net
4. readthedocs.org

[1]

matlab

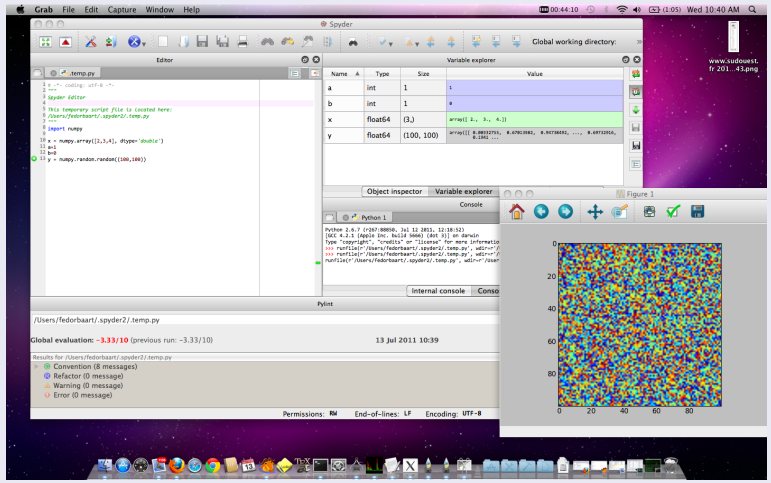
```
help function
```

All documentation in matlab gui.

Most popular python IDE (@SO)

15 Spyder

Screenshot



Most popular python IDE (@SO)

3 emacs

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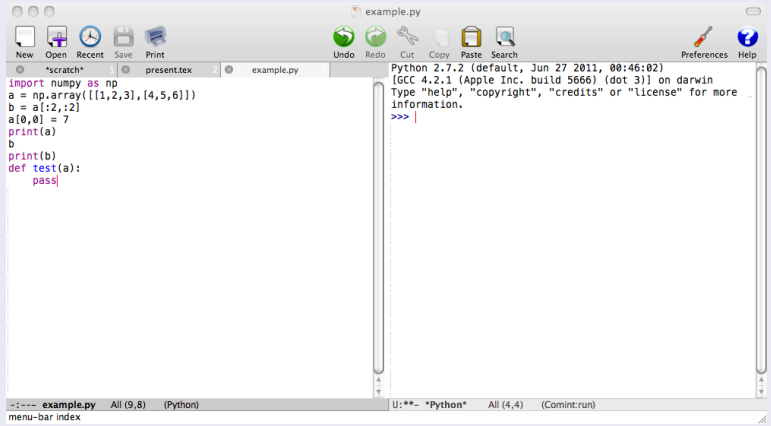
Screenshot



Most popular python IDE (@SO)

new ipython notebook

1 vim

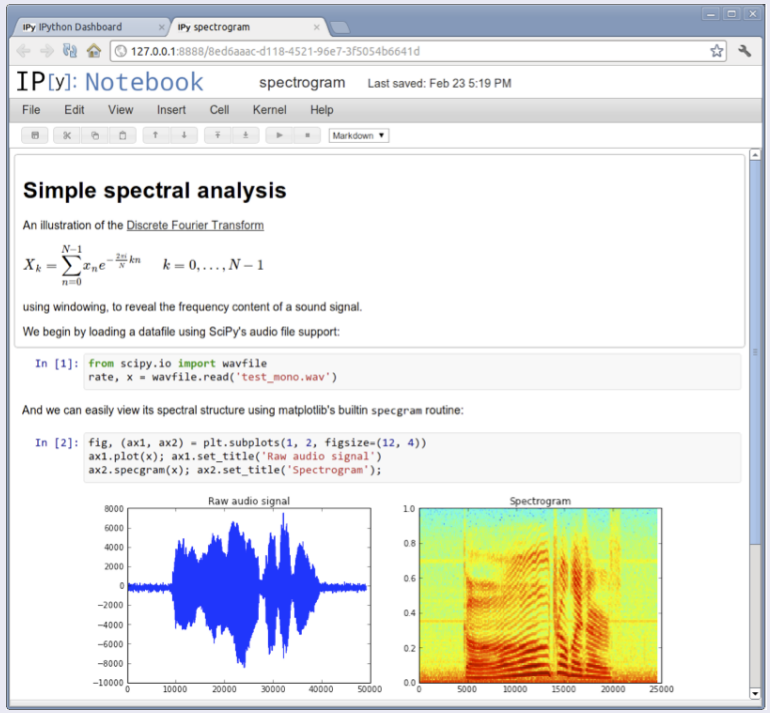
2 PyDev

3 emacs

4 PyCharm

15 Spyder

Screenshot



Python

Startup do nothing and shutdown time.

```
$time python -c"pass"
real    0m0.038s
user    0m0.022s
sys     0m0.012s
```

Matlab

Startup do nothing and shutdown time.

```
$ time matlab -r exit
real    1m8.891s
user    0m11.889s
sys     0m3.184s
```

Other languages

C: 0.000s, Java: 0.3s, Perl 0.001s, Bash 0.001s

Python

```
>>> timeit.timeit('a=x.dot(x)'number=10)
1.5948209762573242
```

Matlab

```
>> x=zeros(1000);
>> tic;for i=1:10;a=x*x;end;toc
Elapsed time is 1.796690 seconds.
```

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BMI

fortran + web

Kustviewer

data + gis + web

Argus

notebook (calculator) + computer vision

Leap

Interaction + 2d, 3d plotting