Introduction to python

Digital lab, 2017

Ludovic Dutoit


Google

Learning a language in 3h: Plan

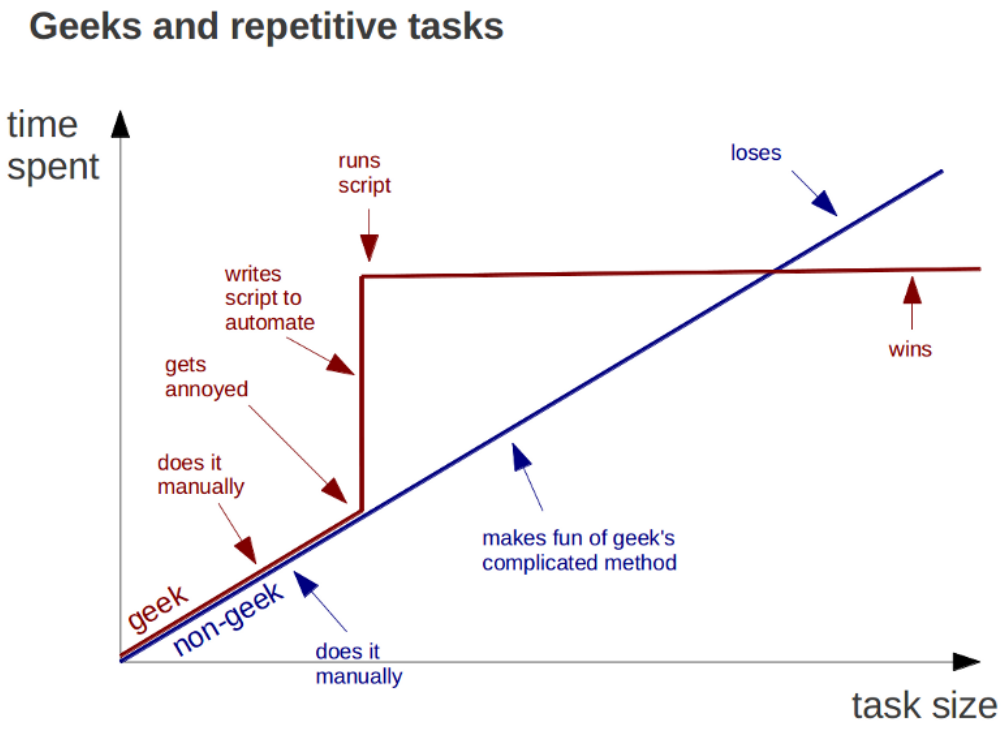
- What is python?
- Play around
- Providing resources

Density	Total Larvae	Habitat type
3	111	A
5	1322	A
11	123	A
23	123	A
43	342	A
2	123	A
31	143	A
4	54	A
3	123	A
5	4	A
11	1235	B
23	2	B
12	879	B
2	132	B
31	1	B
4	124	B
43	32	B
6	442	B
25	615	B
12	235	B

```
1  N00001  555 .   C   T   941.40  .   AC=21;AF=0.228;AN=92;BaseQRankSum=0.431;ClippingRankSum=0.00;DP=222;ExcessHet=0.
   0000;FS=0.000;InbreedingCoeff=0.5692;MLEAC=19;MLEAF=0.207;MQ=29.01;MQRankSum=0.00;QD=20.03;ReadPosRankSum=0.00;SOR=3.611
     GT:AD:DP:GQ:PGT:PID:PL   1/1:0,2:2:6:.:.:55,6,0  1/1:0,2:2:6:.:.:58,6,0  1/1:0,2:2:6:.:.:58,6,0  0/0:3,0:3:9:.:.
   :0,9,84  0/0:7,0:7:21:.:.:0,21,194   0/0:2,0:2:6:.:.:0,6,54  0/0:9,0:9:27:.:.:0,27,250   0/0:9,0:9:27:.:.:0,27,250   ./.
   :2,0:2:.:.:.:0,0,0   0/0:5,0:5:15:.:.:0,15,137   0/0:5,0:5:15:.:.:0,15,135   0/0:8,0:8:24:.:.:0,24,221   0/0:6,0:6:18:.:
   .:0,18,165   0/1:3,5:8:94:0|1:555_C_T:112,0,94   1/1:0,7:7:21:.:.:198,21,0   0/0:4,0:4:12:.:.:0,12,108   0/1:1,2:3:36:.:
   .:49,0,36    0/0:4,0:4:12:.:.:0,12,109   0/0:4,0:4:12:.:.:0,12,111   0/0:7,0:7:21:.:.:0,21,194   0/0:3,0:3:9:.:.:0,9,83
    0/0:6,0:6:18:.:.:0,18,161   0/0:6,0:6:18:.:.:0,18,167   0/0:8,0:8:24:.:.:0,24,225   0/0:9,0:9:24:.:.:0,24,360
   0/0:2,0:2:6:.:.:0,6,53  1/1:0,8:8:24:.:.:228,24,0   0/0:1,0:1:3:.:.:0,3,27  0/0:14,0:14:39:.:.:0,39,585 1/1:0,2:2:6:.:.
   :57,6,0  1/1:0,4:4:12:.:.:120,12,0   0/0:2,0:2:6:.:.:0,6,58  0/0:3,0:3:9:.:.:0,9,82  0/0:5,0:5:15:.:.:0,15,141
   0/1:2,2:4:44:.:.:44,0,78    0/0:5,0:5:15:.:.:0,15,139   0/0:4,0:4:12:.:.:0,12,98    0/0:5,0:5:15:.:.:0,15,139
   0/0:6,0:6:18:.:.:0,18,166   0/0:1,0:1:3:.:.:0,3,28  0/0:5,0:5:15:.:.:0,15,138   1/1:0,3:3:9:.:.:85,9,0  0/0:3,0:3:0:.:.
   :0,0,27  0/0:3,0:3:0:.:.:0,0,31  0/0:3,0:3:9:.:.:0,9,85  1/1:0,2:2:6:.:.:58,6,0  0/0:6,0:6:15:.:.:0,15,225
2  N00001  564 .   C   T   2389.72 .   AC=34;AF=0.370;AN=92;BaseQRankSum=0.444;ClippingRankSum=0.00;DP=255;ExcessHet=1.
   4812;FS=4.461;InbreedingCoeff=-0.0155;MLEAC=39;MLEAF=0.424;MQ=30.27;MQRankSum=0.00;QD=14.75;ReadPosRankSum=-4.500e-
   02;SOR=2.647 GT:AD:DP:GQ:PGT:PID:PL   0/0:3,0:3:0:.:.:0,0,45  0/0:2,0:2:6:.:.:0,6,57  0/0:6,0:6:18:.:.:0,18,145
   1/1:0,4:4:12:.:.:115,12,0   1/1:0,7:7:21:.:.:201,21,0   ./.:2,0:2:.:.:.:0,0,0   0/1:5,4:9:88:.:.:88,0,110
   0/1:4,5:9:84:.:.:117,0,84   0/0:4,0:4:12:.:.:0,12,99    0/0:5,0:5:15:.:.:0,15,137   0/0:6,0:6:0:.:.:0,0,113
   0/1:4,5:9:84:.:.:118,0,84   0/1:6,3:9:59:.:.:59,0,140   0/1:5,2:7:36:1|0:555_C_T:36,0,204   0/0:8,0:8:24:.:.:0,24,227
   1/1:0,3:3:9:.:.:85,9,0  0/1:2,2:4:45:.:.:45,0,78    0/1:1,2:3:18:.:.:47,0,18    0/0:5,0:5:15:.:.:0,15,139
   0/1:4,3:7:60:.:.:60,0,91    0/1:3,2:5:42:.:.:42,0,71    0/0:6,0:6:18:.:.:0,18,161   0/1:4,2:6:37:.:.:37,0,94
   0/0:9,0:9:0:.:.:0,0,146 1/1:0,9:9:27:.:.:237,27,0   0/0:2,0:2:6:.:.:0,6,53  0/0:10,0:10:30:.:.:0,30,277 0/0:1,0:1:3:.:.
   :0,3,27  0/1:7,8:15:99:.:.:183,0,152 0/0:3,0:3:0:.:.:0,0,28  0/0:4,0:4:12:.:.:0,12,111   0/1:2,3:5:43:.:.:72,0,43
   1/1:0,7:7:21:.:.:201,21,0   0/1:2,3:5:42:.:.:69,0,42    0/1:2,2:4:43:.:.:43,0,78    1/1:0,6:6:18:.:.:172,18,0
   1/1:0,4:4:12:.:.:115,12,0   0/0:5,0:5:12:.:.:0,12,180   0/1:3,4:7:64:.:.:75,0,64    0/0:1,0:1:3:.:.:0,3,28
   0/1:2,3:5:41:.:.:68,0,41    0/0:4,0:4:0:.:.:0,0,53  0/1:1,2:3:20:.:.:47,0,20    0/1:1,3:4:17:.:.:75,0,17    0/0:3,0:3:9:
   .:.:0,9,77  0/0:4,0:4:0:.:.:0,0,58  1/1:0,6:6:18:.:.:169,18,0
3  N00001  636 .   A   T   506.60  .   AC=4;AF=0.043;AN=94;BaseQRankSum=0.00;ClippingRankSum=0.00;DP=482;ExcessHet=3.
   2983;FS=0.000;InbreedingCoeff=-0.0427;MLEAC=4;MLEAF=0.043;MQ=32.87;MQRankSum=1.38;QD=14.90;ReadPosRankSum=0.319;SOR=1.
   329 GT:AD:DP:GQ:PL   0/0:7,0:7:21:0,21,192   0/0:6,0:6:18:0,18,166   0/0:11,0:11:33:0,33,316 0/0:8,0:8:24:0,24,224
   0/0:13,0:13:36:0,36,540 0/0:5,0:5:15:0,15,140   0/0:20,0:20:57:0,57,855 0/1:7,7:14:99:162,0,163 0/0:8,0:8:24:0,24,231
   0/0:6,0:6:18:0,18,169   0/0:15,0:15:45:0,45,413 0/0:16,0:16:48:0,48,446 0/0:16,0:16:48:0,48,447 0/0:7,0:7:18:0,18,270
   0/0:17,0:17:51:0,51,459 0/0:3,0:3:9:0,9,81  0/0:7,0:7:21:0,21,196   0/0:8,0:8:24:0,24,207   0/0:8,0:8:24:0,24,227
   0/0:11,0:11:30:0,30,450 0/1:2,11:13:19:279,0,19 0/0:12,0:12:36:0,36,327 0/0:10,0:10:30:0,30,290 0/0:10,0:10:30:0,30,280
   0/0:10,0:10:27:0,27,405 0/0:4,0:4:12:0,12,110   0/0:17,0:17:51:0,51,460 0/1:3,1:4:16:16,0,54    0/0:24,0:24:72:0,72,667
   0/0:6,0:6:18:0,18,170   0/0:16,0:16:48:0,48,461 0/0:7,0:7:21:0,21,195   0/0:13,0:13:39:0,39,367 0/0:7,0:7:18:0,18,270
   0/0:6,0:6:18:0,18,171   0/0:11,0:11:33:0,33,313 0/0:5,0:5:15:0,15,140   0/0:8,0:8:24:0,24,223   0/0:12,0:12:36:0,36,336
   0/0:7,0:7:21:0,21,198   0/0:10,0:10:30:0,30,284 0/0:13,0:13:39:0,39,364 0/0:11,0:11:33:0,33,312 0/0:9,0:9:27:0,27,254
   0/1:2,5:7:35:124,0,35   0/0:10,0:10:30:0,30,287 0/0:14,0:14:42:0,42,390
4  N00001  648 .   A   G   6378.34 .   AC=51;AF=0.543;AN=94;BaseQRankSum=-9.570e-01;ClippingRankSum=0.00;DP=521;ExcessHet=1
   .4574;FS=0.000;InbreedingCoeff=0.0661;MLEAC=52;MLEAF=0.553;MQ=32.36;MQRankSum=0.114;QD=14.97;ReadPosRankSum=-1.910e-
   01;SOR=1.474    GT:AD:DP:GQ:PL   0/0:8,0:8:24:0,24,217   1/1:0,7:7:21:195,21,0   0/0:11,0:11:33:0,33,303
   1/1:0,8:8:24:222,24,0   1/1:0,14:14:42:371,42,0 0/1:4,4:8:88:88,0,88    0/1:11,9:20:99:192,0,246
   0/1:7,7:14:99:155,0,155 0/0:11,0:11:30:0,30,450 0/0:6,0:6:18:0,18,170   0/1:7,7:14:99:152,0,149 0/1:7,11:18:99:246,0,142
    0/1:10,6:16:99:122,0,212    1/1:0,4:4:12:111,12,0   0/1:12,9:21:99:183,0,247    1/1:0,6:6:18:162,18,0
   1/1:0,7:7:21:196,21,0   0/1:3,6:9:55:118,0,55   0/0:10,0:10:30:0,30,276 0/1:5,6:11:99:114,0,109 0/1:11,2:13:18:18,0,266
   0/0:12,0:12:36:0,36,327 0/1:8,4:12:59:59,0,187  0/1:6,5:11:99:107,0,139 1/1:0,9:9:27:249,27,0   0/0:5,0:5:0:0,0,89
   0/1:9,11:20:99:208,0,194    0/0:6,0:6:18:0,18,170   0/1:11,15:26:99:338,0,238   1/1:0,8:8:24:221,24,0
   1/1:1,14:15:15:322,15,0 0/1:3,5:8:62:109,0,62   1/1:0,14:14:42:385,42,0 0/1:4,2:6:37:37,0,95    1/1:0,6:6:18:165,18,0
   1/1:0,10:10:30:276,30,0 1/1:0,5:5:15:140,15,0   0/0:8,0:8:24:0,24,222   0/1:9,4:13:71:71,0,218  0/0:10,0:10:30:0,30,272
   0/1:3,5:8:62:113,0,62   0/1:8,5:13:97:97,0,189  1/1:0,13:13:39:357,39,0 0/1:4,8:12:79:183,0,79  0/0:8,0:8:13:0,13,189
   0/1:7,5:12:99:104,0,164 1/1:0,15:15:45:415,45,0
5  N00001  833 .   T   C   1408.78 .   AC=5;AF=0.053;AN=94;BaseQRankSum=-2.020e-01;ClippingRankSum=0.00;DP=1114;ExcessHet=3
   .4957;FS=0.000;InbreedingCoeff=-0.0552;MLEAC=5;MLEAF=0.053;MQ=41.48;MQRankSum=0.831;QD=12.81;ReadPosRankSum=-2.690e-
   01;SOR=0.733    GT:AD:DP:GQ:PL   0/0:12,0:12:35:0,35,262 0/0:17,0:17:51:0,51,485 0/1:3,17:20:26:387,0,26
   0/0:15,0:15:45:0,45,427 0/0:32,0:32:90:0,90,1350    0/0:19,0:19:57:0,57,526 0/0:27,0:27:69:0,69,1035
   0/0:20,0:20:60:0,60,583 0/0:29,0:29:84:0,84,1260    0/0:12,0:12:36:0,36,339 0/0:32,0:32:87:0,87,1305
   0/0:30,0:30:90:0,90,834 0/0:34,0:34:99:0,99,935 0/0:25,0:25:75:0,75,621 0/0:35,0:35:99:0,99,1485
   0/0:27,0:27:80:0,80,685 0/0:24,0:24:63:0,63,945 0/0:23,0:23:63:0,63,945 0/0:24,0:24:72:0,72,657 0/0:27,0:27:81:0,81,759
   0/0:32,0:32:90:0,90,901 0/0:21,0:21:60:0,60,586 0/0:30,0:30:90:0,90,834 0/0:30,0:30:90:0,90,845 0/0:28,0:28:81:0,81,711
   0/0:19,0:19:57:0,57,550 0/1:13,14:27:99:292,0,289   0/0:19,0:19:57:0,57,519 0/0:34,0:34:99:0,101,895
   0/0:16,0:16:23:0,23,392 0/0:28,0:28:81:0,81,738 0/0:22,0:22:63:0,63,596 0/0:13,0:13:39:0,39,368 0/0:27,0:27:81:0,81,752
   0/0:15,0:15:42:0,42,630 0/0:24,0:24:69:0,69,1035    0/0:15,0:15:45:0,45,416 0/0:27,0:27:81:0,81,746
   0/0:23,0:23:69:0,69,627 0/0:26,0:26:75:0,75,1125    0/0:27,0:27:81:0,81,739 0/1:8,15:23:99:347,0,152
   0/0:17,0:17:48:0,48,720 0/1:10,12:22:99:266,0,211   0/0:20,0:20:60:0,60,512 0/1:9,9:18:99:202,0,184
   0/0:27,0:27:81:0,81,712
```

Why programming

- After some size, hand is impossible!
- Reproducible
- Adaptable
- Tools available



https://www.gapintelligence.com/blog/2016/understanding-r-programming-over-excel-for-data-analysis

Why python?

Why python?

Matlab

Java

Ruby

Perl

Fortran

C

R

C++

Why python?

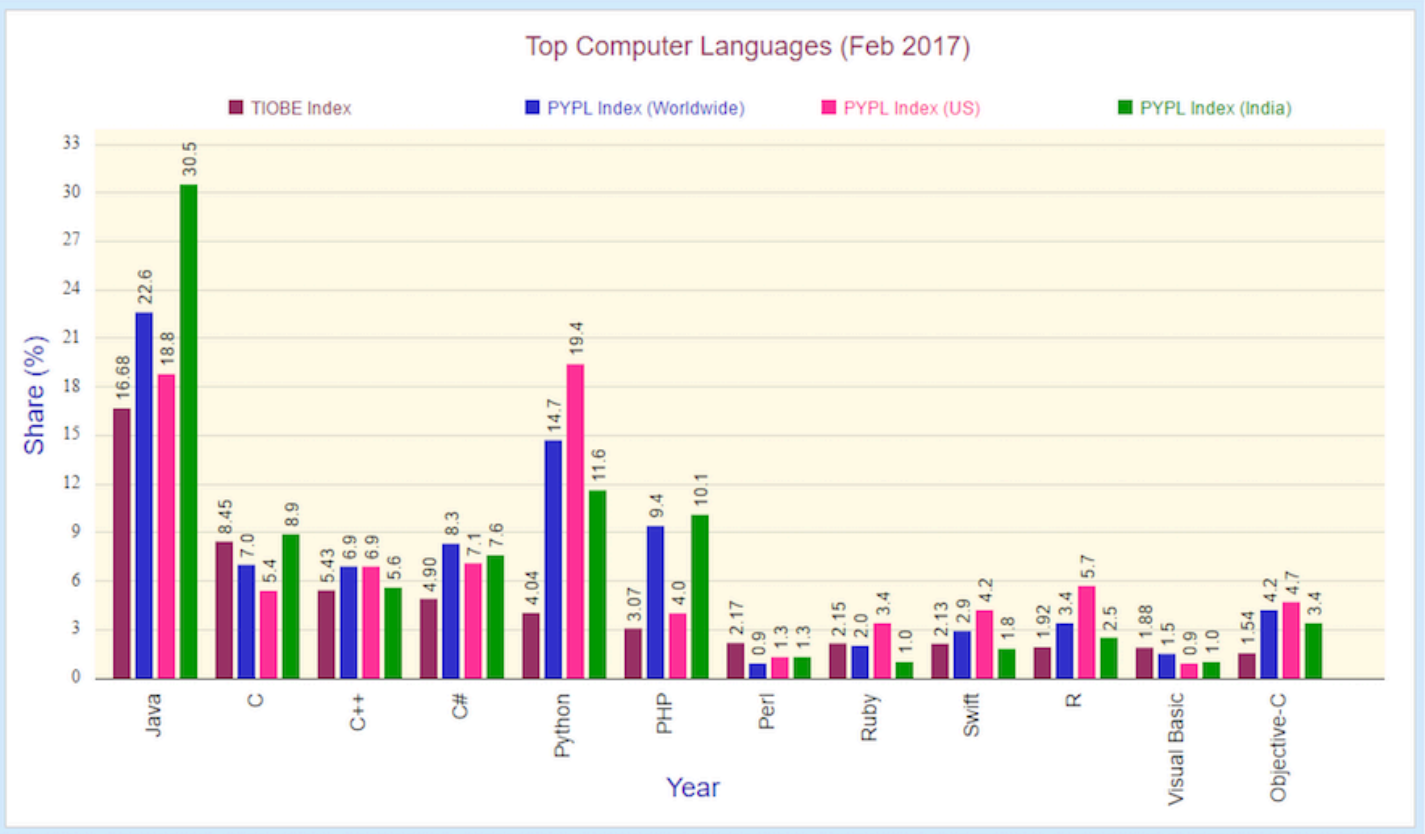
+

1. Modern
2. Widely used (in Science too!)
3. High level
4. Highly transferable skill
5. Free

Bonus: considered good for learning

-

1. Learning a new language is in investment
2. You might not need to master all languages!
3. Field tradition



TIOBE Index

Feb 2017	Feb 2016	Change	Programming language	Ratings	Change
1	1		Java	16.676 %	-4.47 %
2	2		C	8.445 %	-7.15 %
3	3		C++	5.429 %	-1.48 %
4	4		C#	4.902 %	+0.50 %
5	5		Python	4.043 %	-0.14 %
6	6		PHP	3.072 %	+0.30 %
7	9	↑	JavaScript	2.872 %	+0.67 %
8	7	↓	Visual Basic .NET	2.824 %	+0.37 %
9	10	↑	Delphi/Object Pascal	2.479 %	+0.32 %
10	8	↓	Perl	2.171 %	-0.08 %

PYPL Index (Worldwide)

Feb 2017	Change	Programming language	Share	Trends
1		Java	22.6 %	-1.3 %
2		Python	14.7 %	+2.8 %
3		PHP	9.4 %	-1.2 %
4		C#	8.3 %	-0.3 %
5	↑↑	Javascript	7.7 %	+0.4 %
6		C	7.0 %	-0.2 %
7	↓↓	C++	6.9 %	-0.6 %
8		Objective-C	4.2 %	-0.6 %
9	↑	R	3.4 %	+0.4 %
10	↓	Swift	2.9 %	+0.1 %

Duck typed

```
#In C
int x;
x = 4;
```

```
#In Python
x = 4
```

“If it walks like a duck if it quacks like a duck, let’s just assume it is a a duck”

```
# whatever is after # is not read,
it is a comment

x = 4 # x is an integer
y = “4” # y is a string or
z = 4. # is a float
test = True # boolean: True/False
```

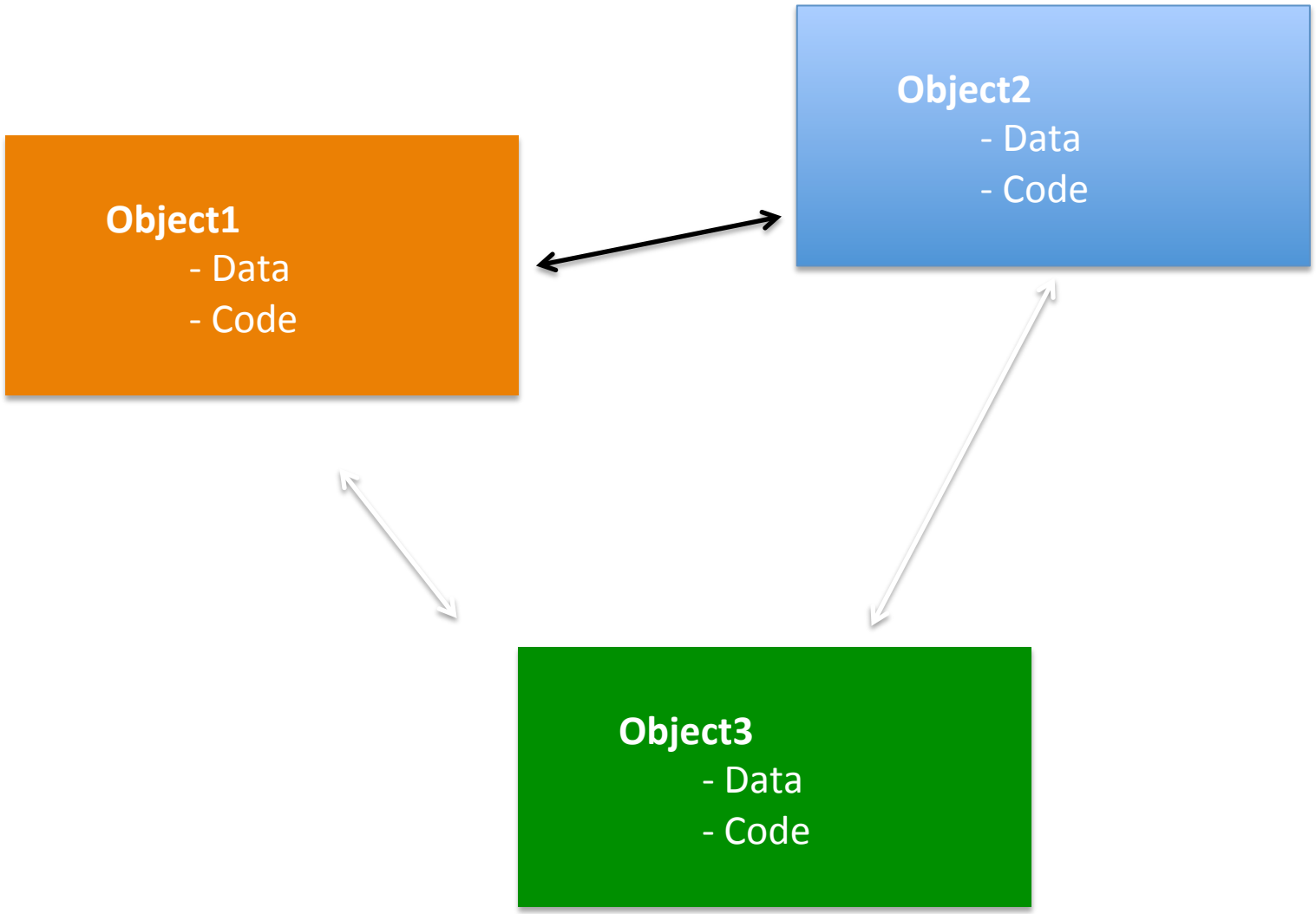
Some more

```
list_a = [4,’3’] # list
list_b = [[2,3],[1]] # list of list

set_d = set([1,2])

dict_e = {“days”: [“Mon”,”Tue”], month :
[“Jan”] }
```

Procedural programming

- Procedural programming focuses on the series of actions.
- It contains data and actions all mixed together.
- Very linear!

- C, Fortran



https://www.youtube.com/watch?v=SS-9y0H3Si8

Objects

```
a = “awekjbcbdba” # string
type(a) # print out the type of a, a is a
dir(a)string
help(a.count()) # print help for the count
method
a.count(“b”) # count the b
a.split(“j”) # split a in a list
```

Indentation in python

```
if a == 2 and len(b) = 3: #check
    print a,b
else:
    print a

for i in range(10):
    print i,i*2,i**2,i.bit_length()
```

Indentation in python

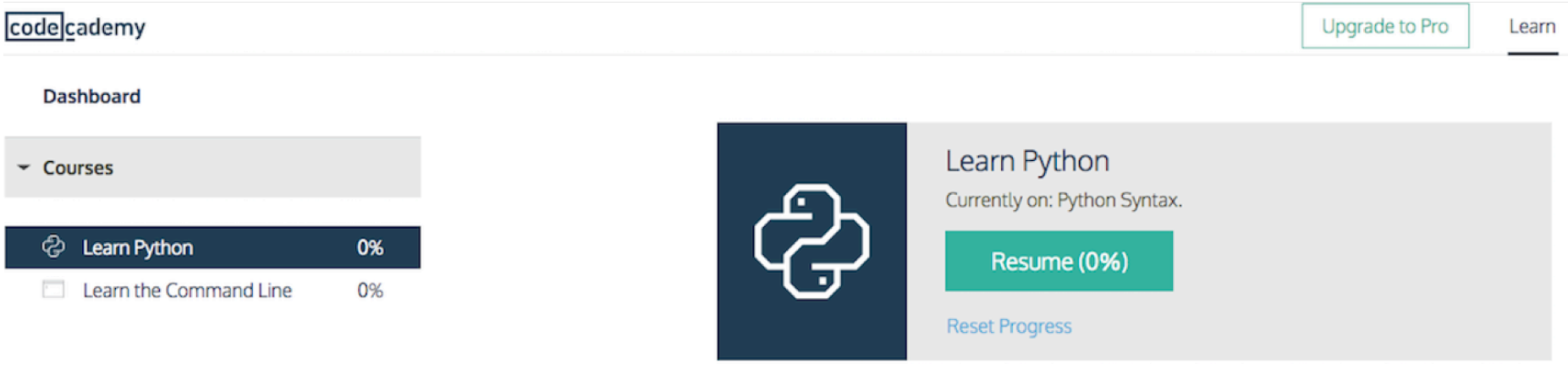
```
def is_even(x): #create your own funct
  return x%2 == 0

is_even(2)

#module
import os # import the module os
help(os) # list possibilities of os
os.listdir() # function listdir of os
```

Today’s goal

You play around and familiarise yourself with python

BONUS: You try to see if you can apply it to your own needs.

If you have never programmed



Codecademy.com

http://tinyurl.com/k9ore9o

- AdvancedBasics.py
  - data structures and python basics
- Summary_fasta.py
  - Output a brief summary from an input file
- data_and_plotting.py
  - process data using python and easy plotting
- resources.txt
  - Some links to a few nice resources