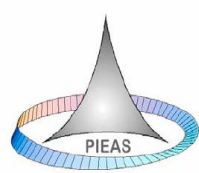


Allah says

○ عَلَّمَهُ الْبَيَانَ

He has taught him speech (and intelligence).

Al-Qur'an, 055.004 (Ar-Rahman)



Lecture-1

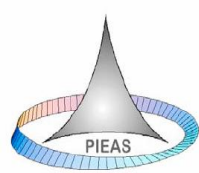
Introduction

Fayyaz ul Amir Afsar Minhas, Ph.D.

<http://faculty.pieas.edu.pk>

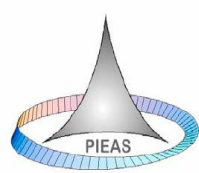
**Department of Computer and Information Sciences
Pakistan Institute of Engineering and Applied Sciences
(PIEAS)**

P.O. Nilore, Islamabad.



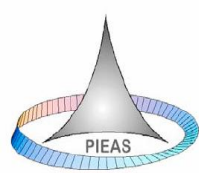
Logistics

- **Network Connections**
 - WiFi access parameters
- **Tools**
 - Install Python (x,y) from course server
 - Watch video from course server
 - Download: <https://code.google.com/p/pythonxy/>
- **Piazza Course Page: Complete Registration**
 - Course Policy / contents etc.
 - Will be used for handling course materials
 - Interactive discussions
- **Books (On Course Server)**
- **Course Server**
 - <\\ds02\LearningMaterial\Fayyaz-ul-Amir Afsar Dr\PYTHON-PIEAS-2015>



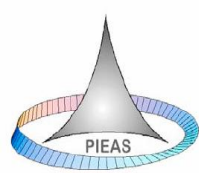
Opening Statement by Guido van Rossum





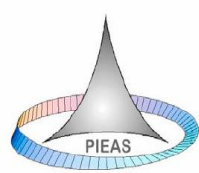
Course objectives

- **To bring novice programmers of python to an intermediate level**
 - **Introducing Python**
 - **Why Python?**
 - **Data structures, Control Flow, Modules, OOP**
- **To take intermediate level programmers to the advanced level**
 - **Numpy / Scipy / Matplotlib**
 - **Web Development**
 - **Parallel Computing**
 - **Speeding up Python code**



A for Assumptions

- **Mine**
 - **No need to introduce procedural / imperative programming concepts**
 - **No need to explain basic data structures (arrays!)**
 - **No need to explain how to write an Algorithm**
 - **You are proficient in handling computers and have basic concepts of computing**
- **Yours?**



What is Python?

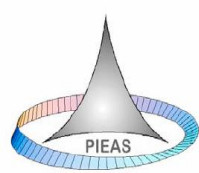
- **General Purpose High level programming language**
- **Interpreted**
- **Dynamic typed**
- **Dynamic language (used as a scripting language)**
- **Supports multiple programming styles / paradigms**
 - **Imperative**
 - **Procedural /Structured**
 - **Object Oriented**
 - **Functional / declarative**
- **Automatic memory management**
- **Free!!**



Guido van Rossum
the creator of Python



Name comes from 'Monty Python'
A British Comedy Show

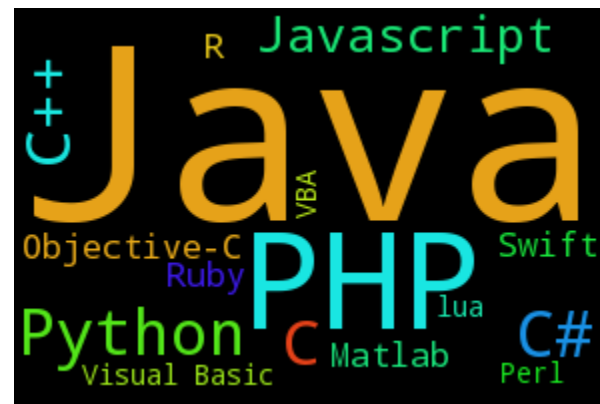


Why Python?

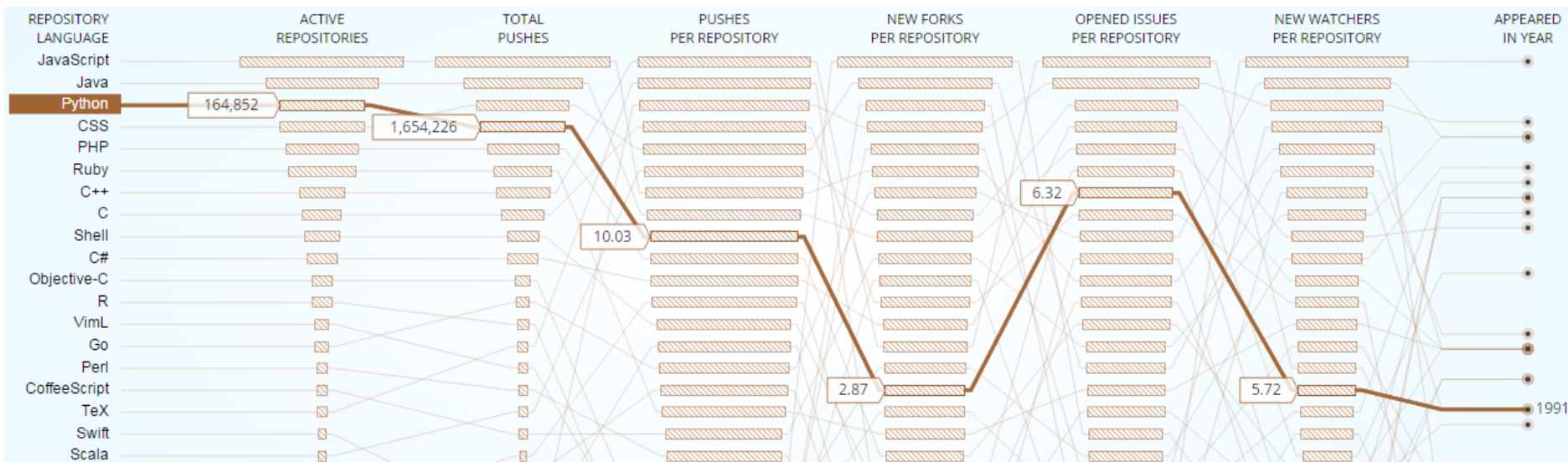
- **Depends upon who you ask**
 - **Selfish reasons in academics**
 - Better code readability, Easier Teaching
 - Lots of packages available
 - Interpreted – so debuggin is easy
 - **Software developers and Engineers**
 - Fast prototyping
 - Compact coding
 - Mixed style programming
 - Great Integration Capabilities
 - **Researchers**
 - Easy to do big tasks which will otherwise take time
 - Easy to learn
 - **Open Source Enthusiasts**
 - Free, A lot of packages available
 - **Personal reasons**
 - My programming language can eat your programming language
 - Wanna become Pythonists, Pythonistas, or Pythoneers?

Trends

| Rank | Change | Language | Share | Trend |
|------|--------|------------|--------|--------|
| 1 | | Java | 24.4 % | -0.8 % |
| 2 | | PHP | 11.5 % | -1.4 % |
| 3 | | Python | 10.9 % | +1.4 % |
| 4 | | C# | 9.1 % | -0.6 % |
| 5 | | C++ | 7.9 % | +0 % |
| 6 | | C | 7.3 % | -0.2 % |
| 7 | | Javascript | 7.1 % | -0.4 % |

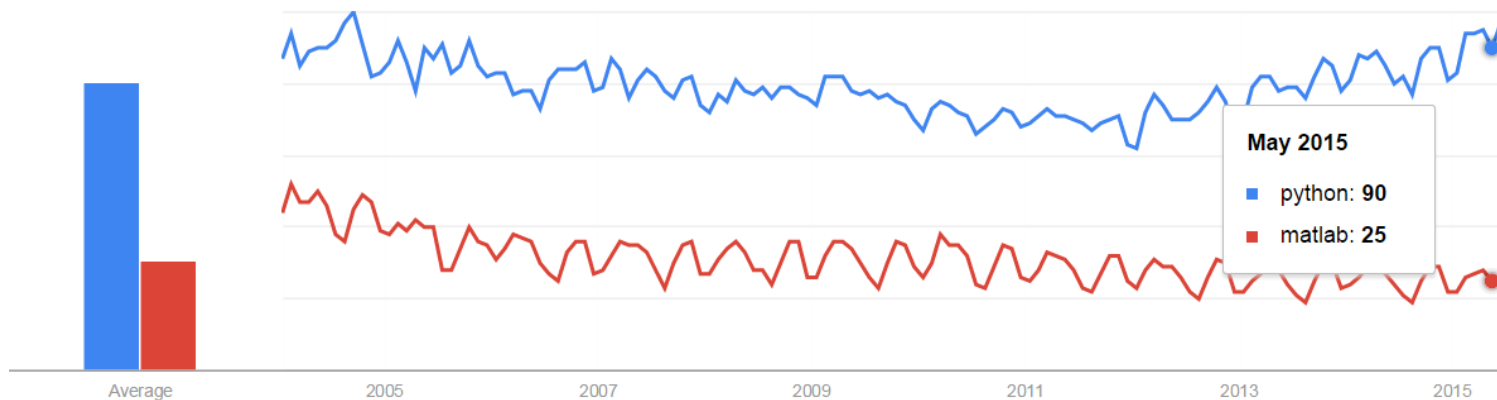
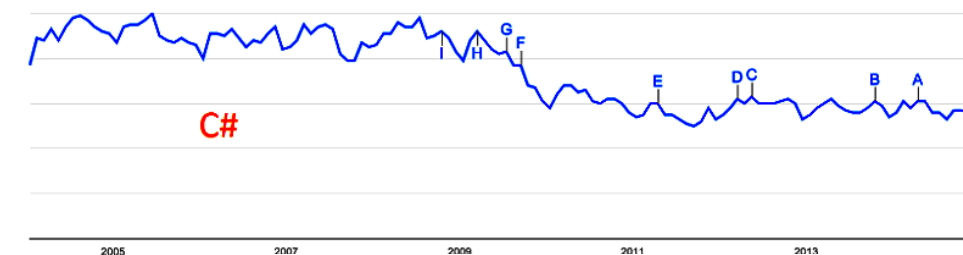
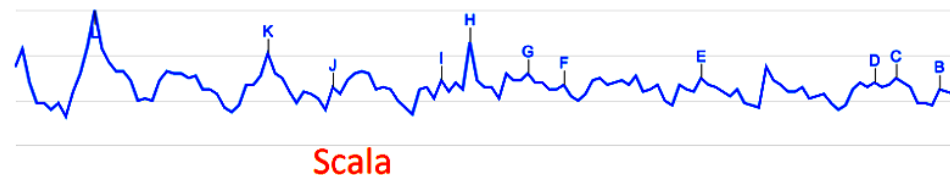
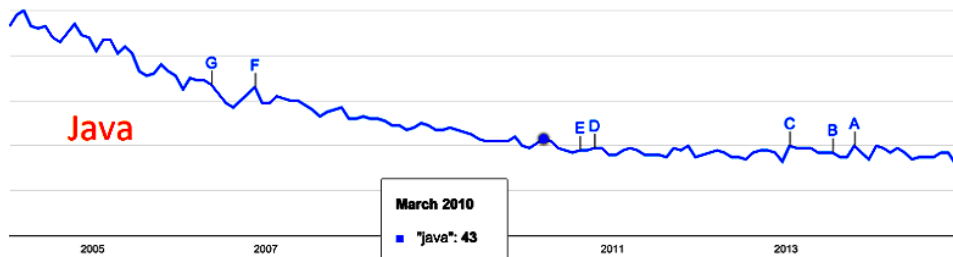


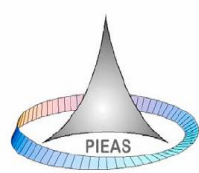
<http://pypl.github.io/PYPL.html>



<http://github.info/>

Trends



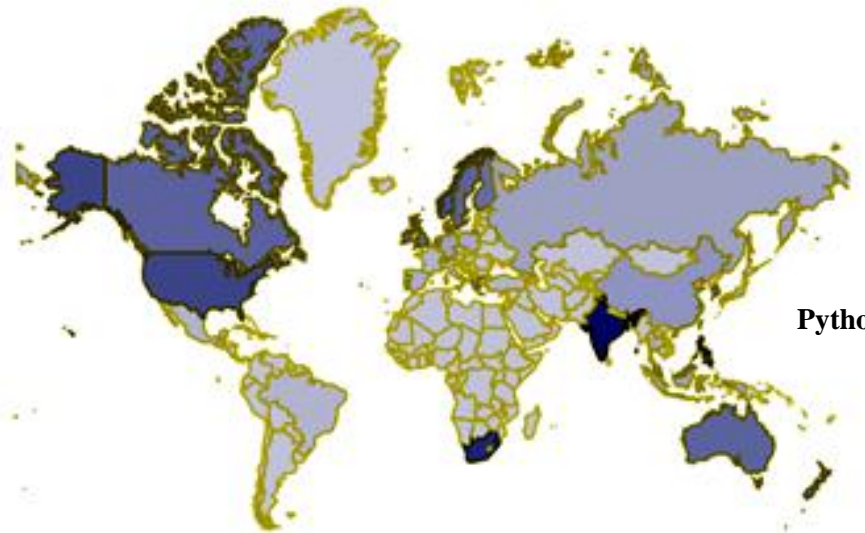


Trends

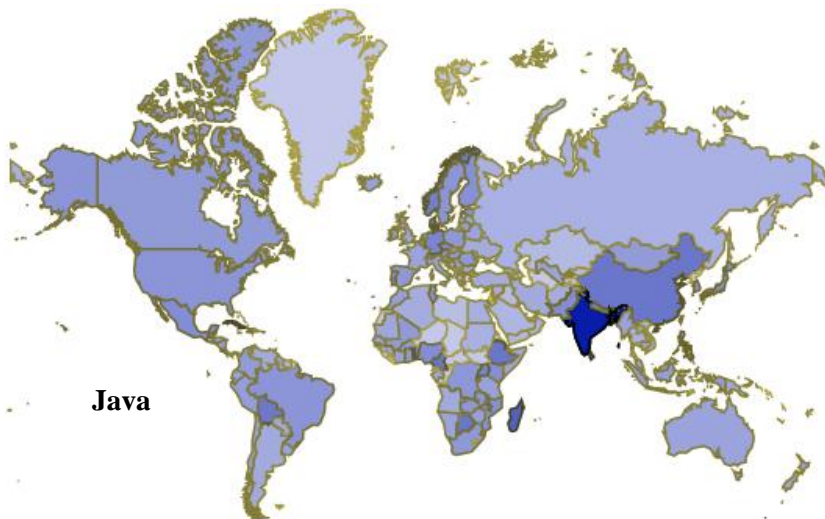
C++



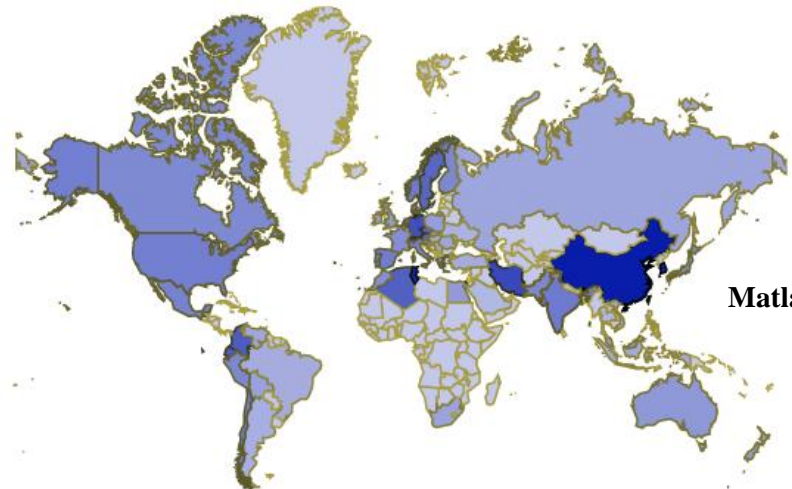
Python

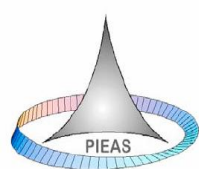


Java



Matlab





In Pakistan



Jobs in Pakistan Python Jobs in Pakistan

Python Jobs in Pakistan

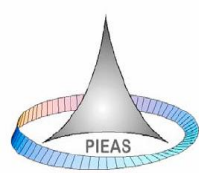
Employers

PHP Developer (17)
 Software Engineer (14)
 Web Developer (14)
 Senior PHP Devel. (13)
 Android Developer (9)
 Senior Software ... (7)
 SEO Expert (6)
 SQA Engineer (6)

ROZEE.PK is providing latest Python Jobs in Pakistan. Register with ROZEE.PK and Apply for Python Jobs in Pakistan. Apply online on below listed Python jobs in all major cities of Pakistan

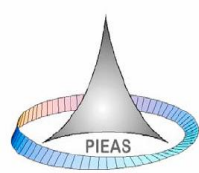
| Job Title | Language | Hits |
|-----------------|---------------|------------------------------------|
| Software Engin | | |
| Team Lead- .N | Java | 288 |
| Senior System | | |
| Web Application | PHP | 176 |
| Web Developel | | |
| Software & App | C++ | 29 |
| ERP Software | | |
| PHP Developer | Python | 27 (Co-occurs with PHP, Java, C++) |
| Software & App | | |
| Online Media C | C Programming | 10 |
| Java Developel | | |
| PON System S | | |
| Engineer HW/S | Matlab | 3 |
| PHP Backend I | | |

| | | | | |
|--------------------------|-----------------------------|-----------|------------|-------|
| Quickbase Developer | Bilytica (Pvt) Ltd | Lahore | May 29, 15 | Apply |
| Software & App Developer | Storm Studio London | Islamabad | May 29, 15 | Apply |
| Staff Engineer | Mentor Graphics Pakistan... | Lahore | May 28, 15 | Apply |
| PHP Developer | NOMA Technologies | Karachi | May 28, 15 | Apply |
| Bioinformatics Analyst | Genetech | Karachi | May 27, 15 | Apply |
| Web Developer | Crovate Offshore | Karachi | May 25, 15 | Apply |
| PHP/App Developer | Smash Cloud Media | Lahore | Jun 1, 15 | Apply |



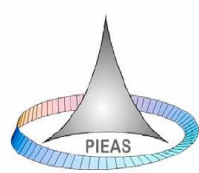
So Python...

- **Using it for data analysis / numerical computing**
- **But it is not limited to that!**
 - **Unlike Matlab, which is a development language, Python is a full fledged programming language**



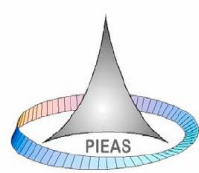
Python

- **Fully object oriented**
- **Readability**
- **Spectrum of low level and high level language**
- **Python as a glue**
- **Documentation system**
- **Namespaces: Hierarchical module system (no global functions)**
- **Available libraries**
- **Fast enough!**
- **String manipulation**
- **Portable**
- **FREE!**



Better Readability

```
10 import Image
11 import ImageDraw
12 import ImageFont
13 import clipboard
14
15 def draw_caption(img, text, top=False):
16     draw = ImageDraw.Draw(img)
17     #Find a suitable font size to fill the entire width:
18     w = img.size[0] _____ initializing a variable
19     s = 100
20     while w >= (img.size[0] - 20):
21         font = ImageFont.truetype('Futura-Medium', s)
22         w, h = draw.textsize(text, font=font)
23         s -= 1
24         if s <= 12: break
25     #Draw the text multiple times in black to get the outline:
26     for x in xrange(-3, 4):
27         for y in xrange(-3, 4):
28             draw_y = y if top else img.size[1] - h + y
29             draw.text((10 + x, draw_y), text, font=font, fill='black')
30     #Draw the text once more in white:
```



Compact coding

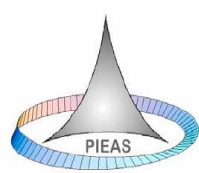
- `X = [x**2 for x in range(10)]`
- `double X[10];`
- `for (int i; i<10;i++)`
 - `X[i]=i*i`

Python myths

- **But Python is slow...**
 - **Yes, because it is interpreted**
 - **But you can also, very easily, use packages such as PyPy and Numba to do Just-In-Time Compilation to compile the code and make it fast**
 - **It also integrates with C (through Cython or SWIG)**

<http://blog.dhananjaynene.com/2008/07/performance-comparison-c-java-python-ruby-jython-jruby-groovy/>

| Language | Version | Lines of Code | Time per iteration (microseconds) |
|----------|--|---------------|-----------------------------------|
| Java | Sun JDK 1.6.0.03 | 86 | 1.6 |
| | 4.1.3 20070929 (prerelease) (Ubuntu 4.1.2-16ubuntu2) Compiled with optimisation - O3 | 86 | 3 |
| C++ | gcc version 4.2.3 (Ubuntu 4.2.3-2ubuntu7) Compiled with optimisation - O3 | 124 | ~0 |
| | 2.5.1 | | 192 |
| Python | 2.5.1 with psyco | 41 | 33 |

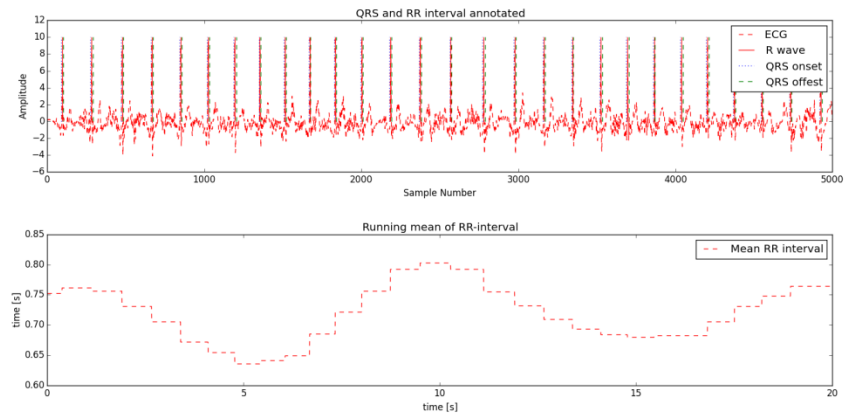


A few success stories

- **Implementation of time critical applications**
- **Parallel Implementation**
- **Using GPGPUs**
- **Visualization**
- **Android Programming**
- **Hardware Interfacing**
- **Computer Vision**
- **Machine Learning**

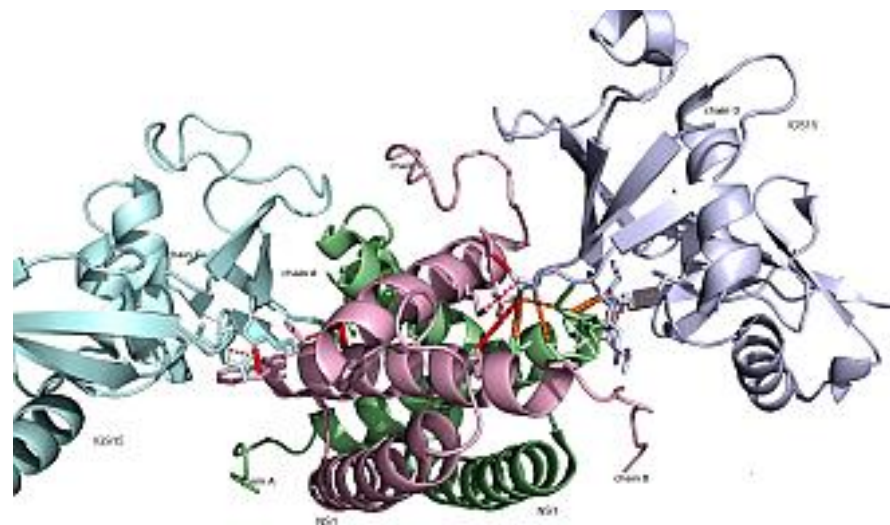
Detecting Abnormal Cardiac Beats

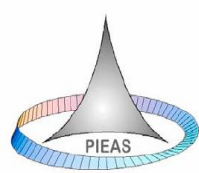
- **USB Interface**
- **Signal Analysis**
 - **Filtering**
 - **Extracting Signal Properties**
- **Machine Learning**
- **User Interface (GUI)**
- **Plotting**
- **Multithreading**
- **Cross-platform: PC, Windows, Linux, Raspberry Pi**
- **No previous Python Programming Experience**



Predicting Protein Interactions

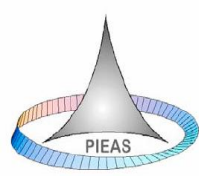
- Implementing a complete machine learning method for predicting how protein molecules interact
- How proteins interface / fold
- Working with large data: ~18GB
Memory for a single matrix
- Incorporating C++ Code
- GPGPU Computing
- Parallel Computing ~ up to 300 cores
- Webserver Development
- Visualization



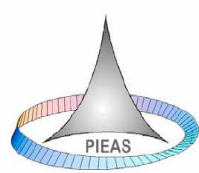


Android Programming

- **Developing an android application to find your location etc.**
- **Sensor access**



QUESTIONS?



A simple python program

■ Problem

- A ball is dropped vertically down from the top of the Minar-e-Pakistan with an initial velocity of 5 m/s

- Find the distance travelled by the ball in 3s

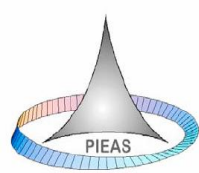
- $y(t) = V_i t + \frac{1}{2} g t^2$

- In our case:

- $5*1+0.5*9.8*3*3$ or $5*1+0.5*9.8*3**2$

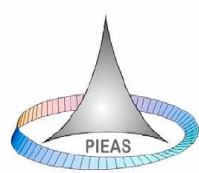
- Let's use Python for this

- `print "Distance Travelled is:",5*1+0.5*9.8*3**2`



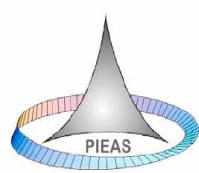
Getting input

- `x=input("x: ")`
- `print x**3`
- Creating files



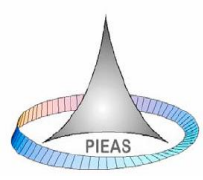
Comments

- `#This is just a comment`
- `"""`
- `These are comments too!`
- `"""`



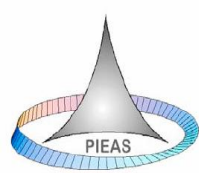
Class Assignment - 1

- **1. Create a simple program that computes the distance traveled by a ball dropped down from a roof with a certain velocity (take as input) in a certain time (take as input)**



Installation on laptops

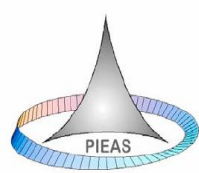
- **From data server**



Assignment-0: Installation

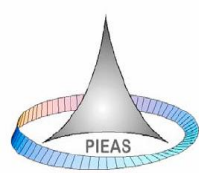
- **Install ‘Anaconda’, ‘WinPython’ or ‘Python(x,y)’ (includes Spyder) {Preferred}**
 - <https://store.continuum.io/cshop/anaconda/>
 - <https://code.google.com/p/winpython/>
 - <https://code.google.com/p/pythonxy/>
- **Or Install ‘Spyder’ (includes Ipython)**
 - <https://code.google.com/p/spyderlib/>
- **Or**
 - **Install Python**
 - <https://www.python.org/download/releases/2.7.6/>
 - **Install ‘pip’ or ‘easy_install’**
 - <http://pip.readthedocs.org/en/latest/installing.html>
 - https://pythonhosted.org/setuptools/easy_install.html
 - **Use ‘pip’ or ‘easy_install’ to install ‘Ipython’**
 - ipython.org/install.html
- **Whatever you do, python should be on the system path**

Why 2.7 and not 3.x?
Larger free code base
and libraries
3.0 is not backward
compatible



Assignment-0: Running a program file in python

- Can edit in any text editor (Notepad++ for windows and gedit for Linux) or you can use the attached file 'test.py'
- Can run a file 'test.py' as:
 - `python test.py`
- Can open a python interpreter by the command
 - `python`
 - Then you can run the file through the command in the interpreter
 - `execfile('test.py')`
- Run from the directory containing 'test.py' or give the complete path
- You can also run a program using 'ipython'
 - Start ipython by typing ipython in the command window
 - Use: `%run test.py`
- Spyder includes both the traditional python interpreter and ipython
- Try running the file in spyder



End of Lecture-1

Intelligence is quickness to apprehend as distinct from ability, which is capacity to act wisely on the thing apprehended.

A. N. Whitehead (1861–1947), English philosopher and mathematician.