When to use Python ?

Python's strengths and weaknesses

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Marc-André Lemburg :: eGenix.com GmbH

Speaker Introduction

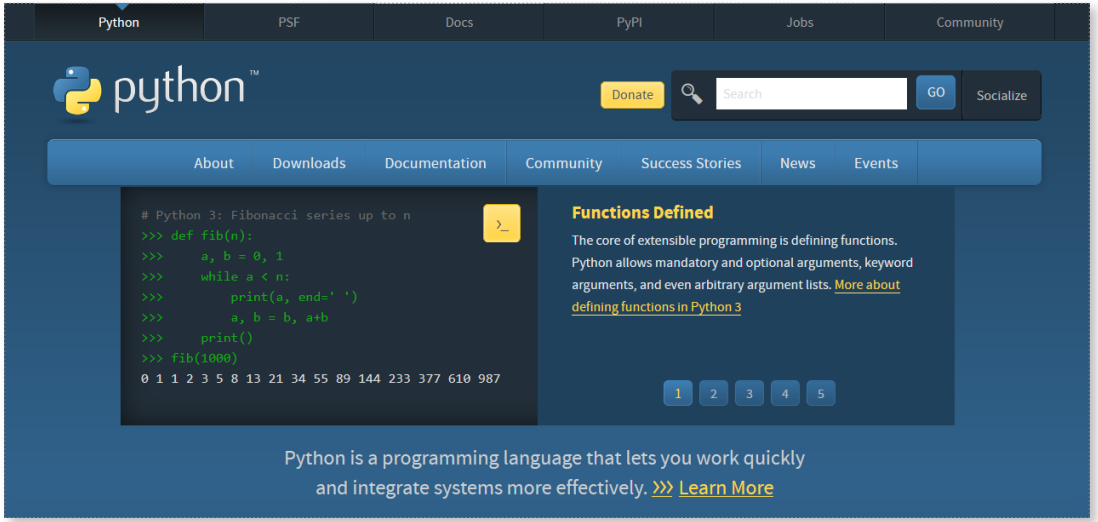
- Marc-André Lemburg
  - Python since 1994
  - Studied Mathematics
  - CEO eGenix.com GmbH
  - Consulting CTO and Senior Solutions Architect
  - Former EuroPython Society Chair
  - Python Software Foundation Fellow
  - Python Core Developer
  - Based in Düsseldorf, Germany
  - More at https://malemburg.com

Agenda: When to use Python ?

- Introduction
- What is Python ?
- Closer look
- Checklists
- Perspective

Python, the programming language

- Started in 1989 by Guido van Rossum
- Very popular due to its clear syntax
- Big in data science, AI/ML, cloud and web
  - PyTorch
  - Keras / Tensorflow
  - Ansible, SaltStack
  - Django / Flask
  - FastAPI



Python: Modern programming

- Modern syntax
  - Very expressive
  - Easy to read
  - Intuitive logic
- Modern concepts
  - Everything is an object
  - Comprehensions, Iterators, Generators
  - Asynchronous Support
  - Decorators
  - Type Annotations
- Fully object-oriented

```
import os
from fastapi import FastAPI

# Create app
app = FastAPI()

# Create root endpoint
@app.get("/")
async def hello_world():
    return {"message": "Hello World"}

# Function call endpoint
@app.get("/list")
async def list():
    return {"listing": os.listdir(".")}
```

Python: Leading the Indexes

TIOBE Index for October 2021

October Headline: Python programming language number 1!

For the first time in more than 20 years we have a new leader of the pack: the Python programming language. The long-standing hegemony of Java and C is over. Python, which started as a simple scripting language, as an alternative to Perl, has become mature. Its ease of learning, its huge amount of libraries, and its widespread use in all kinds of domains, has made it the most popular programming language of today. Congratulations Guido van Rossum! Proficiat! -- *Paul Jansen CEO TIOBE Software*

The TIOBE Programming Community index is an indicator of the popularity of programming languages. The index is updated once a month. The ratings are based on the number of skilled engineers world-wide, courses and third party vendors. Popular search engines such as Google, Bing, Yahoo!, Wikipedia, Amazon, YouTube and Baidu are used to calculate the ratings. It is important to note that the TIOBE index is not about the *best* programming language or the language in which *most lines of code* have been written.

The index can be used to check whether your programming skills are still up to date or to make a strategic decision about what programming language should be adopted when starting to build a new software system. The definition of the TIOBE index can be found here.

Oct 2021	Oct 2020	Change	Programming Language	Ratings	Change
1	3	↑	Python	11.27%	-0.00%
2	1	↓	C	11.16%	-5.79%
3	2	↓	Java	10.46%	-2.11%
4	4		C++	7.50%	+0.57%

The industry loves Python

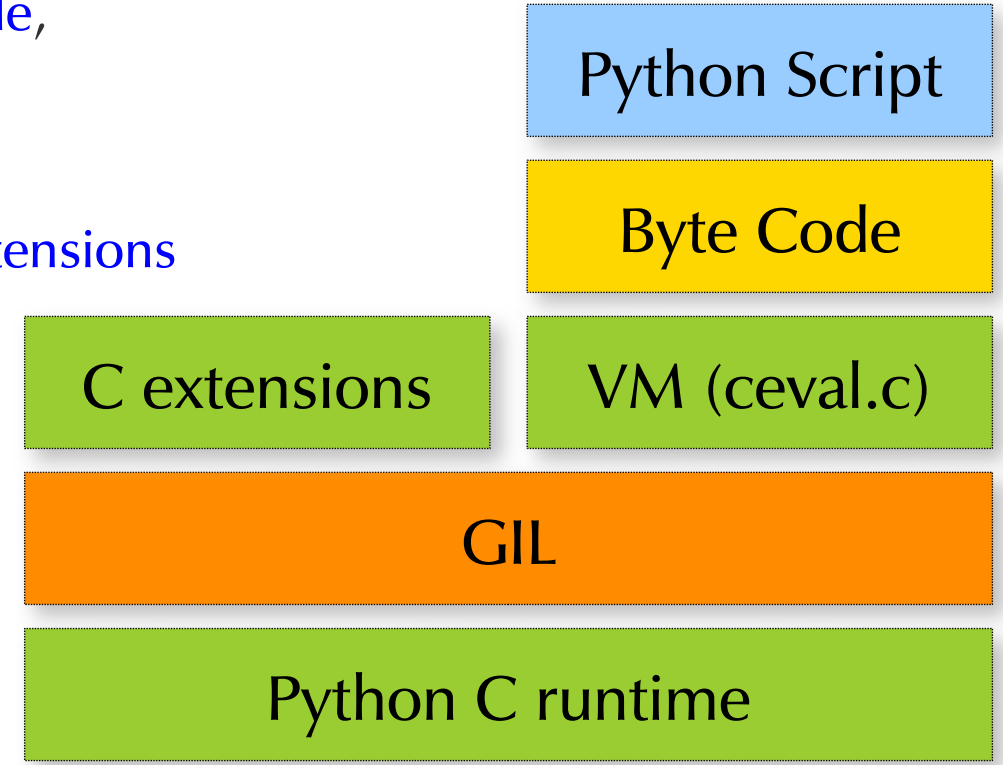
- Big in a wide range of industries
- Internet
  - Google, Microsoft, Facebook, Dropbox, Instagram, Netflix, etc.
- Finance
  - BAML, Bloomberg, JPM, Deutsche Bank, MUFG, Stripe, etc.
- Pharma
  - GSK, Moderna, Roche, Bayer, etc.

- Retail
  - Salesforce, Shopify, Tesco, etc.
- Research
  - CERN, Hubble, LIGO, NASA, etc.
- Utilities
  - E.ON, BP, etc.

A closer look at Python

Under the hood: Byte Code Virtual Machine

- Python compiles to byte code, which is then run by a VM implemented in C
- The VM can call out to C extensions
- A GIL (global interpreter lock) prevents concurrent execution of Python byte code in other threads



Is Python slow ? … Not really

- Compute can be pushed to C, Rust, assembler
  - Online… JIT helpers such as PyPy, Numba, Bodo, Pyston
  - Offline… Cython, Nuitka
- or to GPUs
  - Using RAPIDS, CuPy, Vulkan
- Python is excellent at managing compute
  and can help tap into fast executing
  C, Rust or CUDA

Parallel computing: Scale from single core to cluster

- Single process
  - Asynchronous processing
    - Single threaded
    - Efficient use of CPU cores

    FastAPI 

  - Threads
    - Not ideal for Python code
    - *But*:
      C level compute and I/O
      can use free threading

- Multiple processes
  - multiprocessing module
  - Shared memory communication
  - Managed processes gunicorn
- Cluster
  - Distributed programming
    with smart scheduling
    - Dask, Ray, PySpark, Bodo
  - Scale up locally or in the cloud

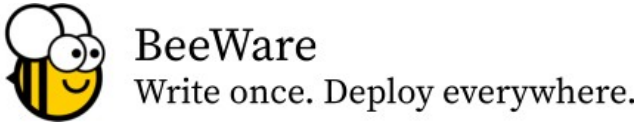
    DASK RAY Spark

Python runs everywhere

- CPython
  - Reference implementation
  - Linux, macOS, Windows
  - Embedded in other applications
- Brython, Skulpt
  - Javascript in the browser
- Pyodide
  - WebAssembly
- MicroPython, CircuitPython
  - Microcontrollers
- Pyston, PyPy, StacklessPython, Nuitka, Numba, Cython
  - JIT or compiled Python
  - Linux, macOS, Windows
- IronPython
  - .NET platform
- Jython
  - Java

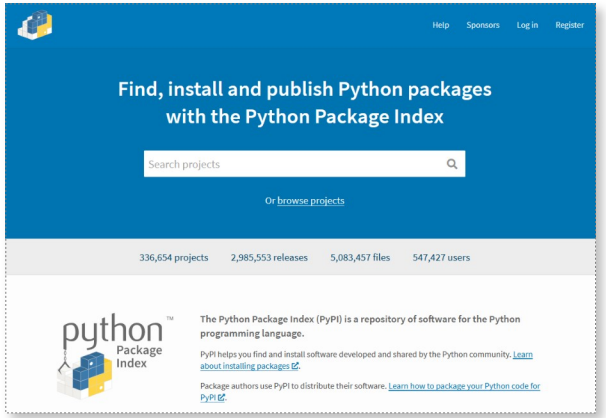
Mobile programming... still in the works

- No great story yet
  - Kivy
  - Project BeeWare

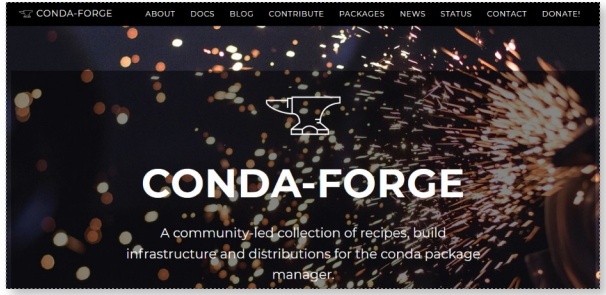


- Jython
  - Java apps on Android

Huge Python Ecosystem… all just a click away



More than 330k Python packages available
on PyPI and Conda-Forge



Huge world-wide Python Community

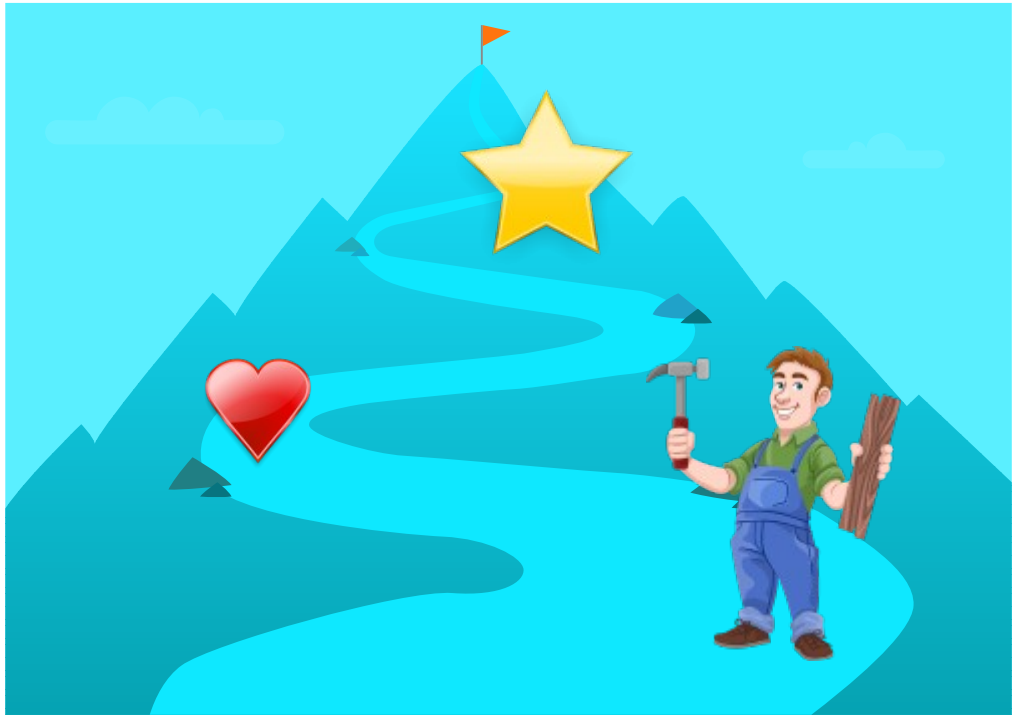
- Python community
  - Mailing lists
  - News groups
  - Forums
  - Chat

- Many project communities
  - Python conferences
  - Project specific conferences
  - PyData, PyLadies, DjangoGirls
  - Meetups, user groups

- Python companies
  - First class support for Python and its many projects
  - Projects
  - Consulting
  - Maintenance

Checklists: When to use Python ?

- Python is ideal for ...
- Python is great for ...
- Python is not ideal for ...



Python is ideal for...

- Learning to program
  - Easy to start
  - Great perspective to grow
- Fast prototyping
  - Prototype can often be used as basis for production
- Starting with embedded programming
  - Raspberry Pi, ESP, Arduino
  - MicroPython, CircuitPython
- Web applications
  - Many frameworks to choose from, both sync and async
  - Wide range of integrations
- Data science, Machine Learning
  - Python and R are the two standard programming languages
  - All major data science tools come with a Python API or are written in Python

Python is great for...

- Micro-Services (publishing APIs)
  - Django or Flask REST frameworks
  - async FastAPI
- Numeric applications
  - Tabular data: numpy, pandas
  - Use optimized C / Fortran code
  - Scale up with Dask, Ray
- Database programming
  - APIs for all major databases
  - Standard interface DB-API
  - ORMs: SQLAlchemy, Picollo ORM
- Making low level code easily accessible
  - Wrapping C libraries: Cython
  - Testing low level applications
- Managing processes
  - Deployments / DevOps: Ansible, SaltStack
  - CI/CD: pytest
  - Observability / Monitoring: logging, whylogs
  - Workflows: Airflow, Flyte, Dagster, MLFlow

Python is not ideal for…

- Compute intense programming directly in Python
  - Better done in C or Rust and then wrapped as Python extensions
  - JITs like Numba or PyPy can help
- System level / low latency coding
  - C and Rust are better at this
- Multi-threaded Python code
  - GIL prevents parallel Python code execution
  - Free threading is still possible for pure C code
- Mobile apps
  - Still in development

Python has a bright future ahead

Thank you for your attention !

Time for discussion

Contact

eGenix.com Software, Skills and Services GmbH
Marc-André Lemburg
Pastor-Löh-Str. 48
D-40764 Langenfeld
Germany

eMail: mal@egenix.com
Phone: +49 211 9304112
Fax: +49 211 3005250
Web: http://www.egenix.com/

References

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