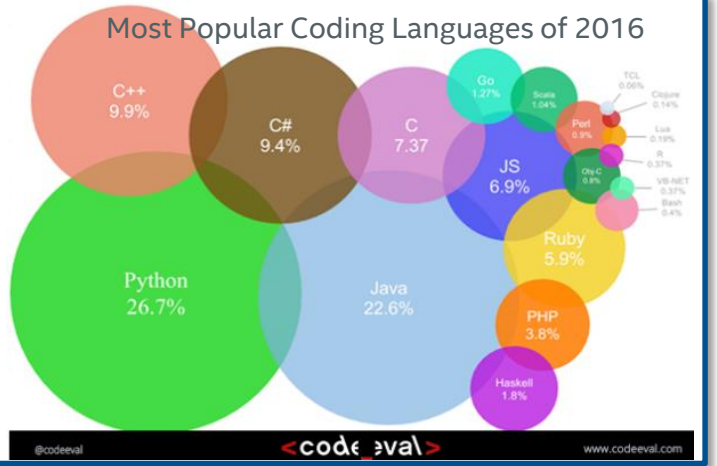
BENCHMARKS INTEL® DISTRIBUTION FOR PYTHON*

Python* Landscape

Adoption of Python continues to grow among domain experts & developers for its productivity benefits



Challenge#1

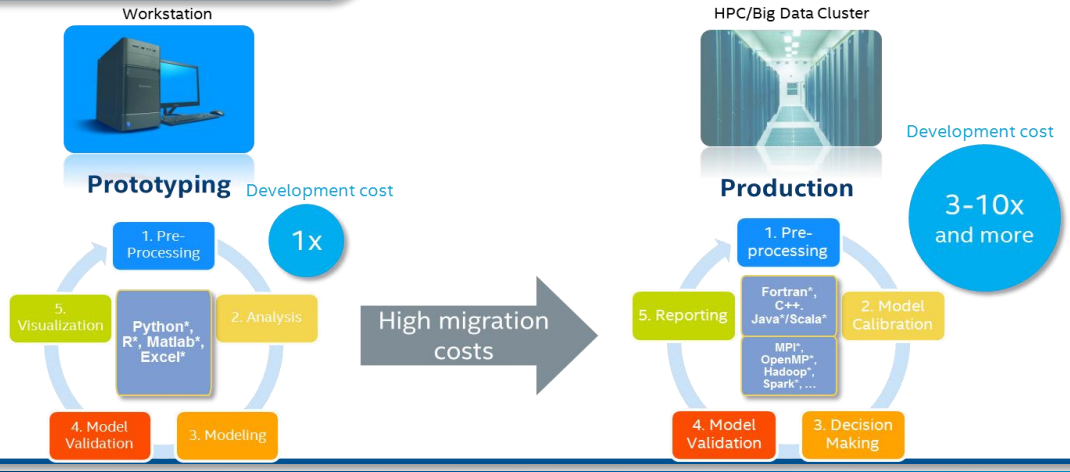
Domain experts are not professional software programmers

Intel's Python Tools

- Accelerate Python performance
- Enable easy access
- Empower the community

Challenge#2

Python performance limits migration to production systems



What's inside Intel® Distribution for Python

High Performance Python* for Scientific Computing, Data Analytics, Machine Learning

FASTER PERFORMANCE	GREATER PRODUCTIVITY	ECOSYSTEM COMPATIBILITY
Performance Libraries, Parallelism, Multithreading, Language Extensions	**Prebuilt & Accelerated Packages**	**Supports Python 2.7 & 3.6, conda, pip**
Accelerated NumPy/SciPy/scikit-learn with Intel® MKL[1] & Intel® DAAL[2]	Prebuilt & optimized packages for numerical computing, machine/deep learning, HPC, & data analytics	Compatible & powered by Anaconda*, supports conda & pip
Data analytics, machine learning & deep learning with scikit-learn, pyDAAL	Drop in replacement for existing Python - No code changes required	Distribution & individual optimized packages also available at conda & Anaconda.org, YUM/APT, Docker image on DockerHub
Scale with Numba* & Cython*	Jupyter* notebooks, Matplotlib included	Optimizations upstreamed to main Python trunk
Includes optimized mpi4py, works with Dask* & PySpark*	Conda build recipes included in packages	Commercial support through Intel® Parallel Studio XE 2017
Optimized for latest Intel® architecture	Free download & free for all uses including commercial deployment	

Intel® Architecture Platforms

Operating System: Windows*, Linux*, MacOS[1]*

[1]Intel® Math Kernel Library
[2]Intel® Data Analytics Acceleration Library

[1] Available only in Intel® Parallel Studio Composer Edition.

Intel® Distribution for Python* 2018, Installing

Standalone Installer

Download full installer from
https://software.intel.com/en-us/intel-distribution-for-python

Anaconda.org
Anaconda.org/intel channel

```
> conda config --add channels intel
> conda install intelpython3_full
> conda install intelpython3_core
```

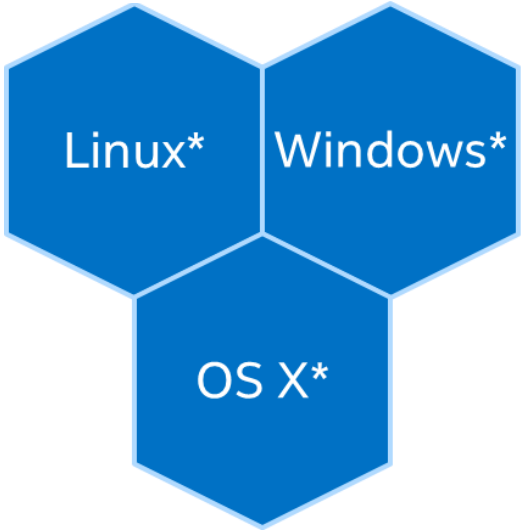
Docker Hub

```
docker pull intelpython/intelpython3_full
```

YUM/APT

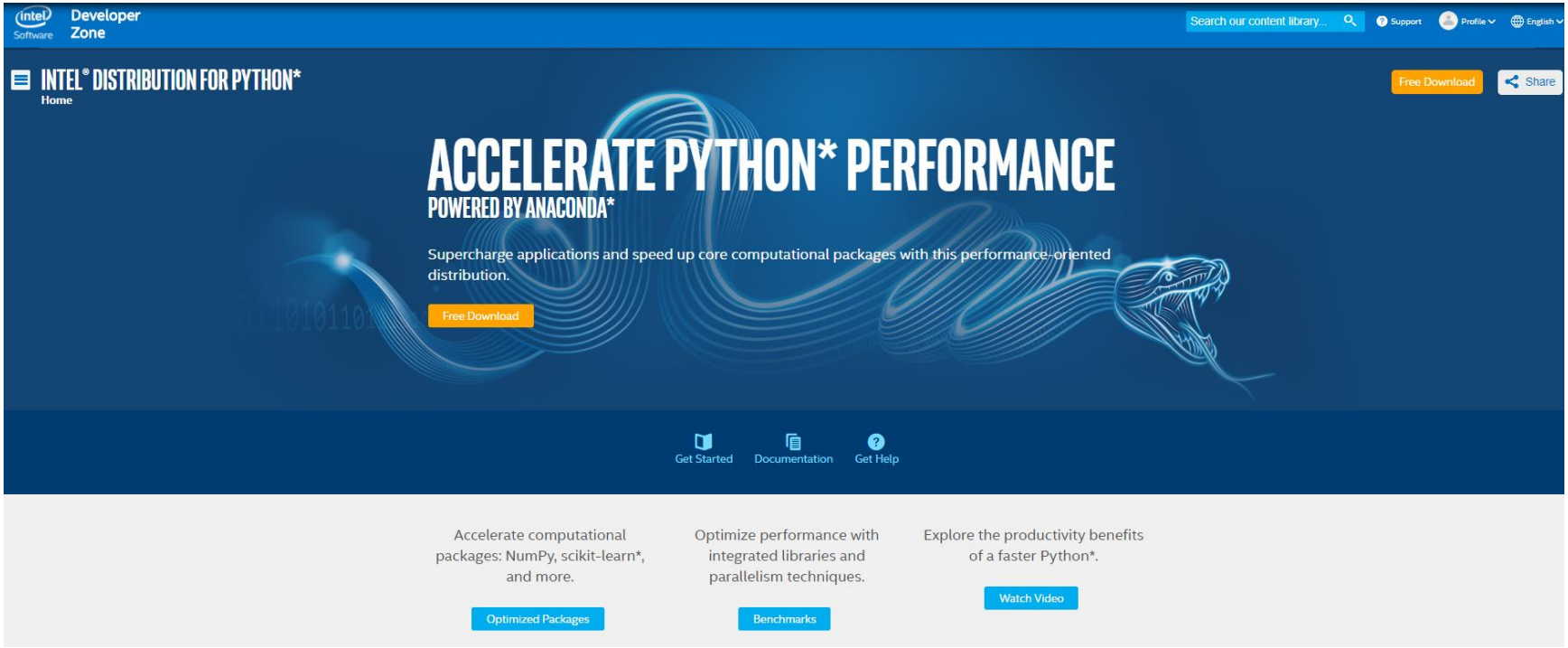
Access for yum/apt:
https://software.intel.com/en-us/articles/installing-intel-free-libs-and-python

2.7, 3.5 & 3.6



Intel® Distribution for Python* 2017/2018, How to Get

https://software.intel.com/en-us/distribution-for-python



Introduction

- Objective:
  - In these activities, you will Install Conda*, IDP, pip numpy, run Intel® IDP and Intel® MKL based codes and
  - make the performance comparisons
- Requirements:
  - Intel® Parallel Studio XE 2018 Composer Edition with Intel® C++ Compiler
  - Intel® Distribution for Python* 2018
  - **Linux*** OS supported by Intel® C++ Compiler
  - Recommended to have at least 3**nd** **generation Intel® Core™ processor** (with Intel® AVX2)
- **Time : 25 min**

Install Conda*

Activity #1

Package, dependency and environment management for any language—Python, R, Ruby, Lua, Scala, Java, JavaScript, C/ C++, FORTRAN

- Download miniconda
  $ **wget https://repo.continuum.io/miniconda/Miniconda3-latest-Linux-x86_64.sh**
- Setup
  $ **bash ./Miniconda3-latest-Linux-x86_64.sh**

Install NumPy* (OpenBLAS)

Activity #1

- **pip install numpy**
- **source activate**

#open and navigate cat/less dgemm_pip.py file

- run: **python dgemm_pip.py**
- record execution time ____
- Uninstall numpy : **pip uninstall numpy**

Intel® Distribution for Python* Activity #1,cont

Use transparently with Conda

- Add IDP channel
  $ **conda create -y -n intel3 -c intel python=3 numpy scipy**
- Activate IDP
  $ **source activate intel3**

Intel® Distribution for Python: BLAS, Activity #2

- **. ./mklunset.sh**
- #open and navigate cat/less dgemm_idp.py
- # Run python execution by:
  - **python dgemm_idp.py**
  - record execution times _____
- # Check if mkl is used:
  - **export MKL_VERBOSE=1**
- **Run the code: python dgemm_idp.py**

Intel® Distribution for Python: BLAS, Activity #2,cont

- # Open and navigate mkl_dgemm.cpp file
- # Set mkl and compiler's environments and build the native code:
  - **source /opt/intel/compilers_and_libraries/linux/bin/compilervars.sh intel64**
- # Check version of icc: icc --version or which icc
- # Build the executable:
  - **icc -mkl mkl_dgemm.cpp**
- # Disable verbose mode (mkl_get_version is used)
  - **export MKL_VERBOSE=0**

Intel® Distribution for Python: BLAS, Activity #2,cont

- Run
  - **./a.out**
  - **record execution times _____**
- # compare the overhead:
- # check the overhear and performance results
  - Pip NumPy : ~ 16sec
  - IDP NumPy : ~ 9 sec
  - Intel MKL : ~ 8 sec
- Note: MxNxK = 10K x 10K x 10K

Intel® Distribution for Python, LAPACK, Activity #3

- #Open and navigate LU.py and LU_mkl.cpp files
- # Run python execution by:
  - **python LU.py**
  - record execution times _____
- # Check Check the backend
  - **export MKL_VERBOSE=1**
  - **python.py LU.py**
  - **See the outputs….**

```
Numpy + Intel(R) MKL: THREADING LAYER: (null)
Numpy + Intel(R) MKL: setting Intel(R) MKL to use INTEL OpenMP runtime
Numpy + Intel(R) MKL: preloading libiomp5.so runtime
MKL_VERBOSE Intel(R) MKL 2018.0 Update 2 Product build 20180127 for Intel(R) 64
architecture Intel(R) Advanced Vector Extensions 512 (Intel(R) AVX-512) enabled
processors, Lnx 2.30GHz lp64 intel_thread
DGETRF(1000,1000,0x7f75b6544040,1000,0x564b37b3a140,0) 9.42ms CNR:OFF
Dyn:1 FastMM:1 TID:0  NThr:4
MKL_VERBOSE DLASWP(1000,0x7f75b4e5e040,1000,1,1000,0x564b37b3a140,-1)
2.37ms CNR:OFF Dyn:1 FastMM:1 TID:0  NThr:4

M x N  ==  1000 1000 ... SciPy LU Execution Time ==  0.18822526931762695 sec
```

Intel® Distribution for Python, LAPACK, Activity #3. cont

- #Compile and execute mkl code:
  - icc -mkl LU_mkl.cpp
  - ./a.out
  - record execution times _____
  - # compare the overhead:
    - M x N == 1000 x 1000 … SciPy LU Execution Time ~ t1 sec
    - M x N == 1000 x 1000 … Intel MKL LU Execution Time ~ t2 sec

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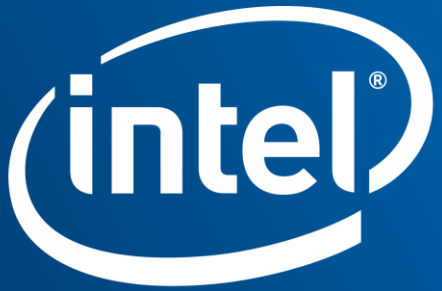

Software