# Software Packages for Deep Learning

Chensong Zhang

with Zheng Li and Ronghong Fan

DL Seminar — April 27, 2017

# Outline

# Machine Learning

- ML gives computers the ability to learn without being explicitly programmed [Samuel 1959]
- ML explores the study and construction of algorithms that can learn from and make predictions on data
- Data mining, computational statistics, optimization, ...
- Fourth paradigm, big data, deep learning, artificial intelligence

# General Tasks of ML

- Classification: Inputs are divided into two or more classes, and the learner must produce a model that assigns unseen inputs to one or more (multi-label classification) of these classes
- Clustering: Inputs are divided into groups. Unlike in classification, the groups are not known beforehand, making this typically an unsupervised task
- Regression: Similar to classification, but the outputs are continuous rather than discrete
- Other tasks: density estimation, dimensionality reduction, ...

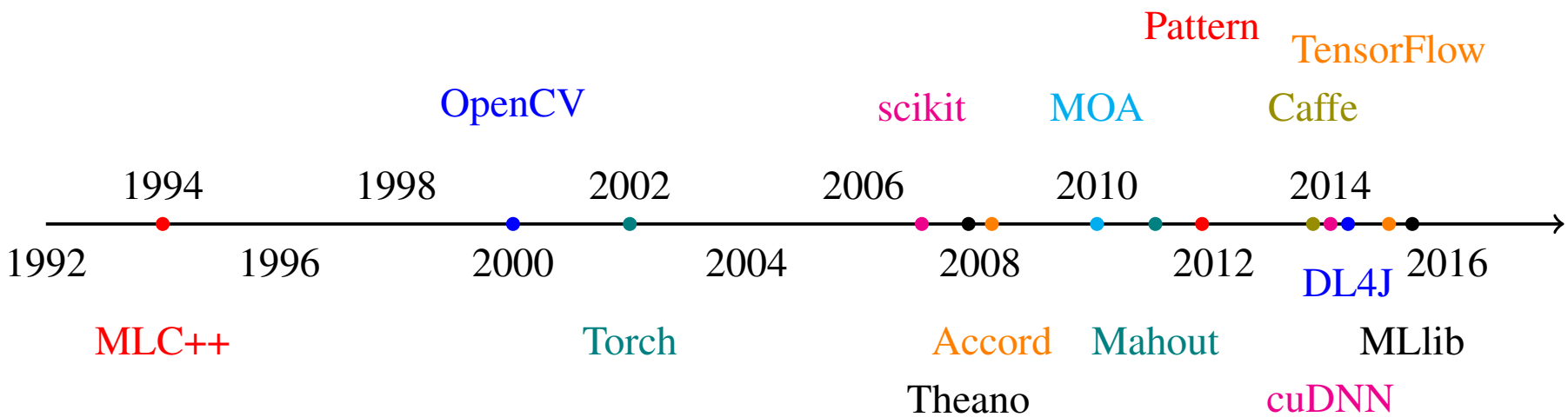
# Packages for General Machine Learning

## What is the purpose?

- Solving problems from practical applications (user interface)
- Developing algorithms and optimizing implementation (development)
- Theoretical analysis for machine learning

## What do we want for a ML package?

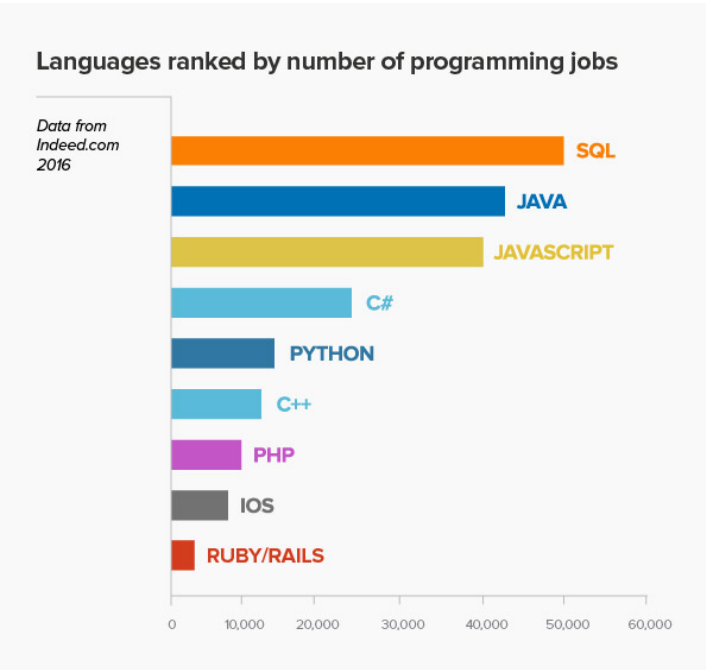
- Easy for new tasks and new network structures (less steep learning curve)
- Easy for debugging (with good support and large community)
- Performance and scalability



# Deep Learning

# Python: A general-purpose programming language

- Created by Guido van Rossum in 1989 and first released in 1991
- Named after "the Monty Python" (British comedy group)
- An interpreted language—simple, clear, and readable
- Python has many excellent packages for machine learning
- The language of choice in introductory programming courses




| 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 % |

# Python for Scientific Computing

## Why Python for scientific computing?

- Strong introspection capabilities (???What does even mean???)
- Full modularity, supporting hierarchical packages
- Exception-based error handling
- Dynamic data types and automatic memory management

## Why consider such a slow language for simulation?

- Good for proof-of-concept
- Implementation time versus execution time
- Code readability and maintenance — short code, fewer bugs
- Well-written Python code is “fast enough” for most computational tasks
- Time critical parts executed through compiled language or available packages

# Built-in Data Structures

- Numeric types–int, float, complex, ex: a=1, b=1.0, c=1L, d=0xf, e=010, f=1+2j
- Sequence types–list, tuple, str, dict, ex: g=[3.14, True, 'Yes', [1], (1L,)] + [False] + [None]*3, h=(3.14, True, 'Yes', [1], ()), i='Hello' + ',' + "'world!"', j={1: 'int', 'pi': 3.14}

# Control Flow

- If-then-else
- For loop
- While loop

# Functions and Modules

- Defining functions
- Using modules

# Computational graph

# Programming interface

# Visualization

# Example 1

# Programming interface

# Example 1

# Programming interface

# Example 1

# Programming interface

# Example 1

# Programming interface

# Numerical tests

# Numerical tests


Thank You!