Welcome to Applied Machine Learning

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Dept CSIS

03/10/19

Overview

We will cover:

- Module Overview
- Industry 4.0
- ML Experts
- Predictive Modelling
- The Analytic Workflow
- UCI ML Repository
- Python
- Loading ML Data
  - Pima Indians Data
  - Python, NumPy and Pandas
  - Some statistics

ILO

By the end of this module, you will be able to:

- identify and use Python tools and libraries for machine learning based analytics tasks
- evaluate and identify appropriate machine learning methods and techniques to analyse data
- critically analyse and interpret machine learning results
- use machine learning tools to solve practical problems in real-life scenarios
- demonstrate deep understanding of a range of complex real-life topics in applied machine learning.

Timetable

Week	Date	Lecture (G12, Torrington, UCL)	Lab (MAL 414-417)
1	03/10/19	Introduction, Workflow and Loading	Loading data
2	10/10/19	Data preparation	Preparing data
3	17/10/19	Feature selection and re-sampling	Selecting features and re-sampling
4	24/10/19	DT and RF	Comparing ML algorithms
5	31/10/19	LR and NN	Automating the process
6	07/11/19	TensorFlow and Keras	MLP with Keras
7	14/11/19	Project Briefing	Project (30%)
8	21/11/19		
9	28/11/19	Image processing	Deep learning - CNN
10	05/12/19	RNN and sequential data	Deep learning - RNN
11	12/12/19	Real-life case	Deep learning - LSTM

Autumn term: 30/09/2019 to 13/12/2019

Assessment

- Final exam worth 70% of your total mark
- A report (inc. individual section) of a group project worth 30% of your total mark
  - Publication Date: 11/11/19
  - Deadline: 15/12/19
  - Late cut-off deadline: 29/12/19
  - Mark return: 05/01/20
- More details will be provided at the project briefing (W7)

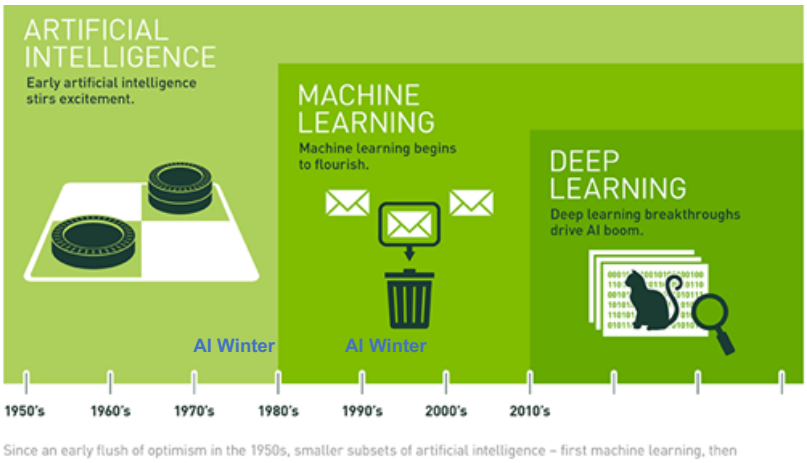
How Computers are Learning to be Creative by Blaise Agüera y Arcas

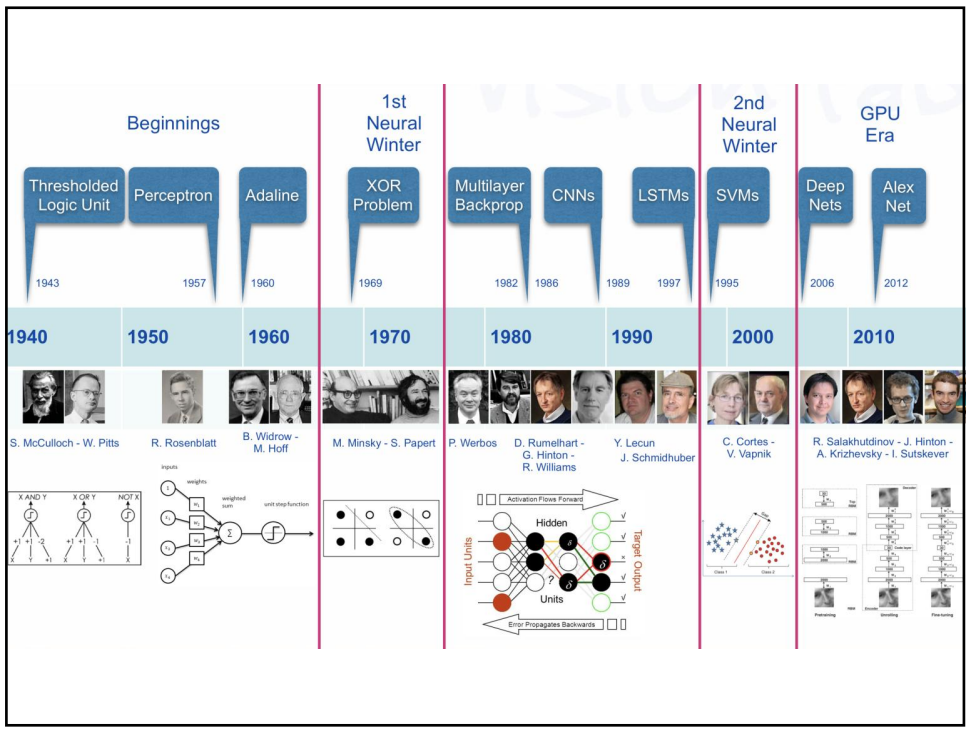
URL: https://youtu.be/uSUOdu_5MPc

5:45 – 17:34

Machine Learning Experts You Need to Know

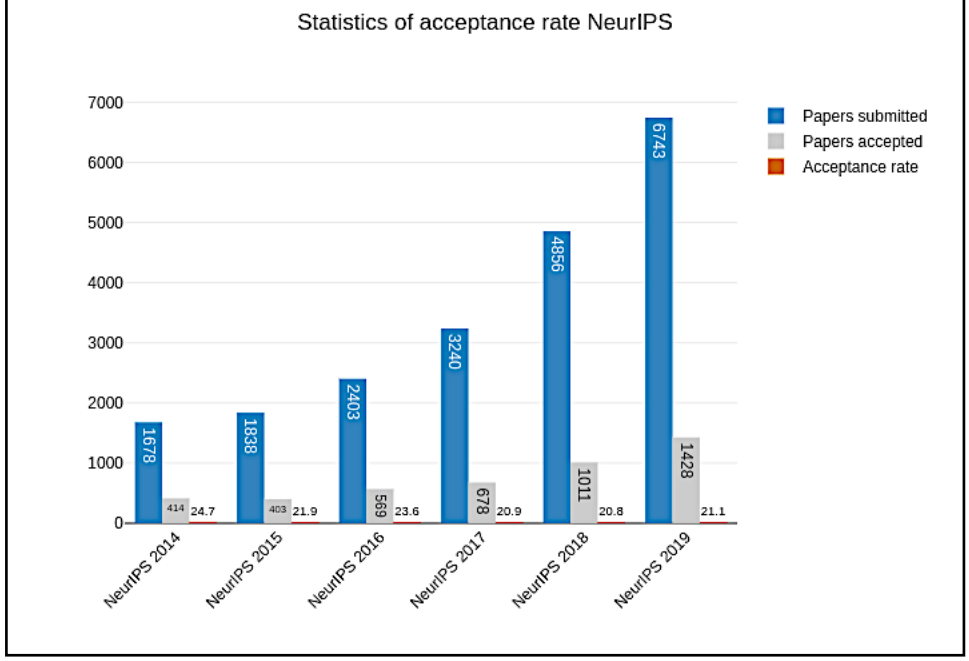
- Geoffrey Hinton – backpropagation (1980s), Boltzmann machines and CapsNet (URL: https://youtu.be/uAu3jQWaN6E)
- Michael I Jordan – RNN (1980s)
- Yann LeCun – CNN with backprogagation
- Yoshua Bengio – RNN
- Jürgen Schmidhuber - LSTM
- Andrew Ng – Coursera, deeplearning.ai, Google Brain project, Landing AI (SaaS)
- Vladimir Vapnik – SVM (1963)
- Ian Goodfellow – GANs (2014)
- Blaise Agüera y Arcas – Google TPU 3 teraops (10^{12} per sec) with 1 watt

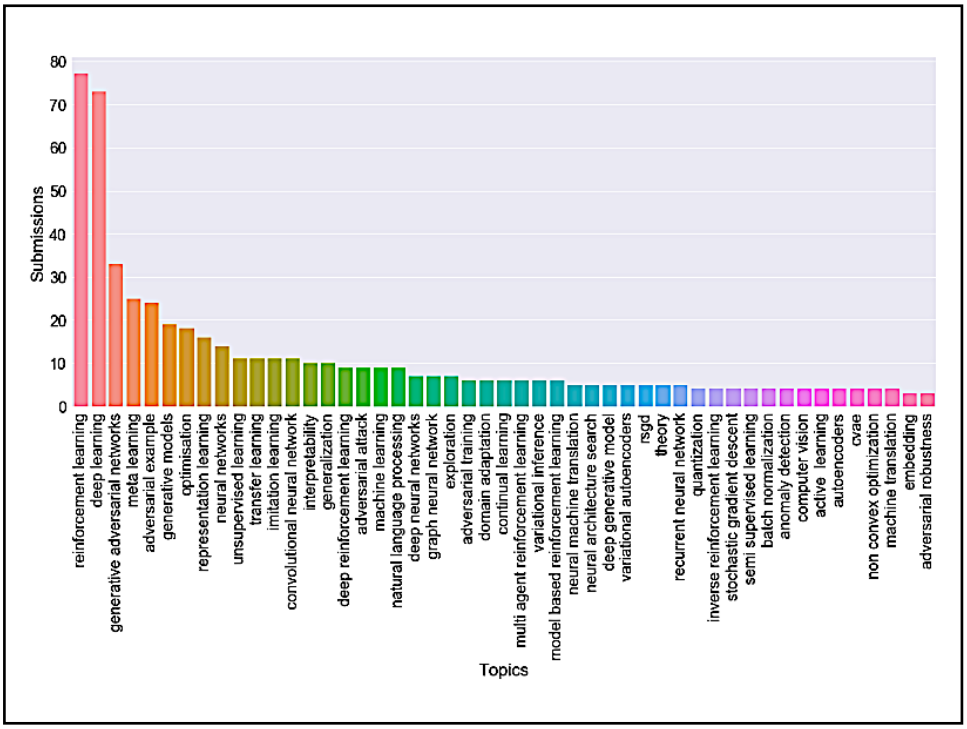


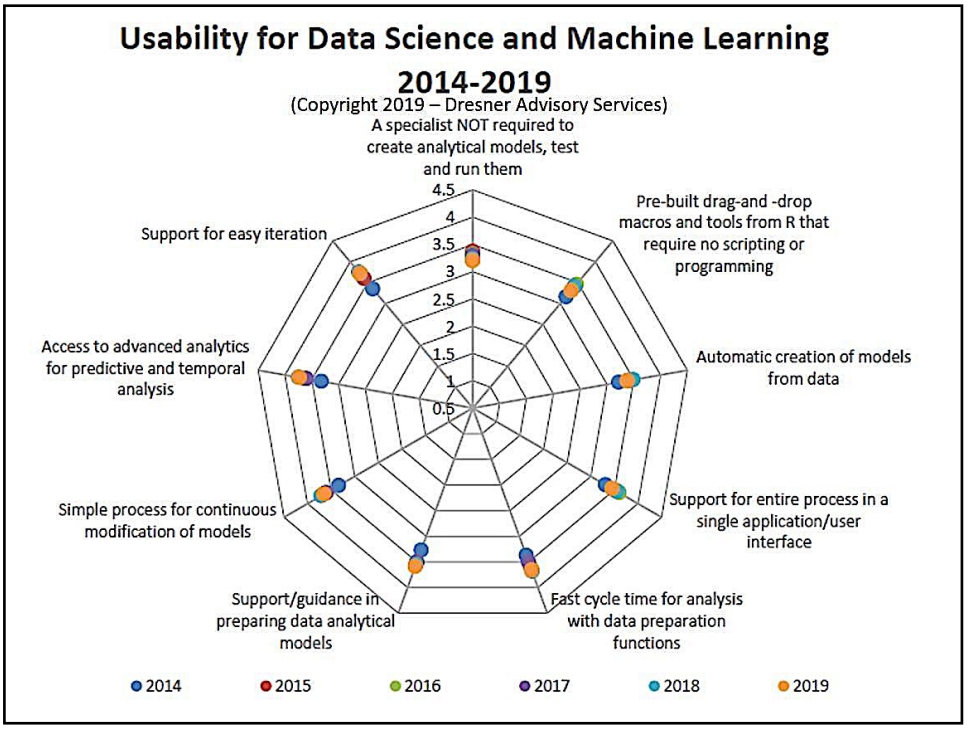


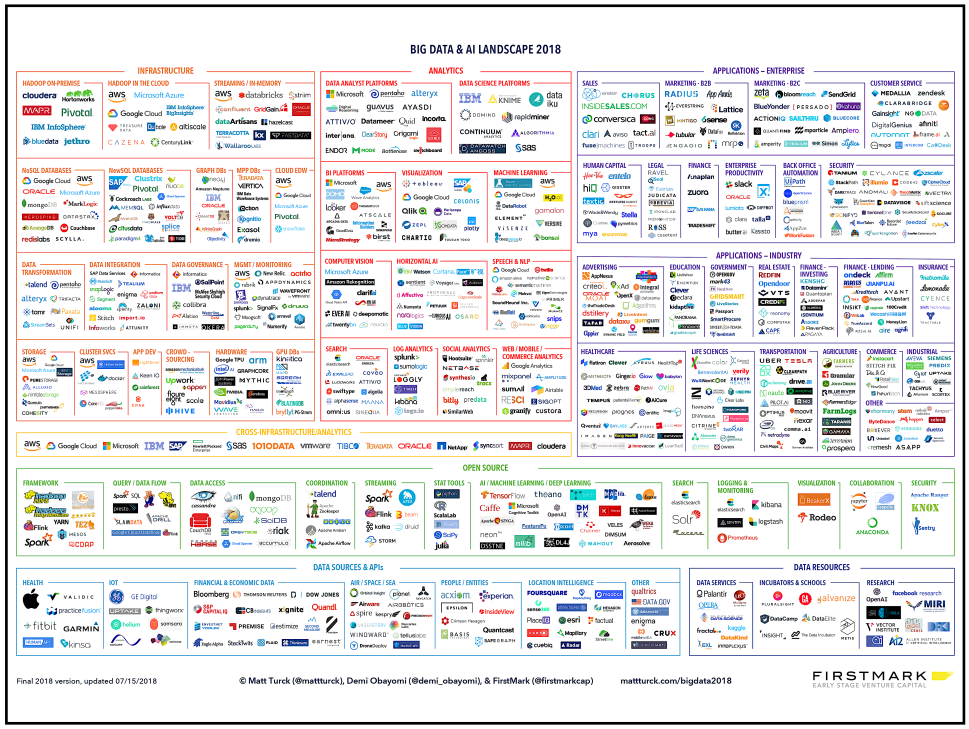
The 33rd Neural Information Processing Systems Conference, Vancouver, Canada (2019)

URL: https://neurips.cc




Submissions
80
70
60
50
40
30
20
10
0
reinforcement learning
deep learning
generative adversarial networks
meta learning
adversarial example
generative models
optimisation
representation learning
neural networks
unsupervised learning
transfer learning
imitation learning
convolutional neural network
interpretability
generalization
deep reinforcement learning
adversarial attack
machine learning
natural language processing
deep neural networks
graph neural network
exploration
adversarial training
domain adaptation
continual learning
multi agent reinforcement learning
variational inference
model based reinforcement learning
neural machine translation
neural architecture search
deep generative model
variational autoencoders
rsgd
theory
recurrent neural network
quantization
inverse reinforcement learning
stochastic gradient descent
semi supervised learning
batch normalization
anomaly detection
computer vision
active learning
autoencoders
cvae
non convex optimization
machine translation
embedding
adversarial robustness
Topics


Usability for Data Science and Machine Learning
2014-2019
(Copyright 2019 – Dresner Advisory Services)
A specialist NOT required to create analytical models, test and run them
Pre-built drag-and -drop macros and tools from R that require no scripting or programming
Automatic creation of models from data
Support for entire process in a single application/user interface
Fast cycle time for analysis with data preparation functions
Support/guidance in preparing data analytical models
Simple process for continuous modification of models
Access to advanced analytics for predictive and temporal analysis
Support for easy iteration
4.5
4
3.5
3
2.5
2
1.5
1
0.5
2014
2015
2016
2017
2018
2019


BIG DATA & AI LANDSCAPE 2018
INFRASTRUCTURE
ANALYTICS
APPLICATIONS – ENTERPRISE
APPLICATIONS – INDUSTRY
CROSS-INFRASTRUCTURE/ANALYTICS
OPEN SOURCE
DATA SOURCES & APIs
DATA RESOURCES
Final 2018 version, updated 07/15/2018
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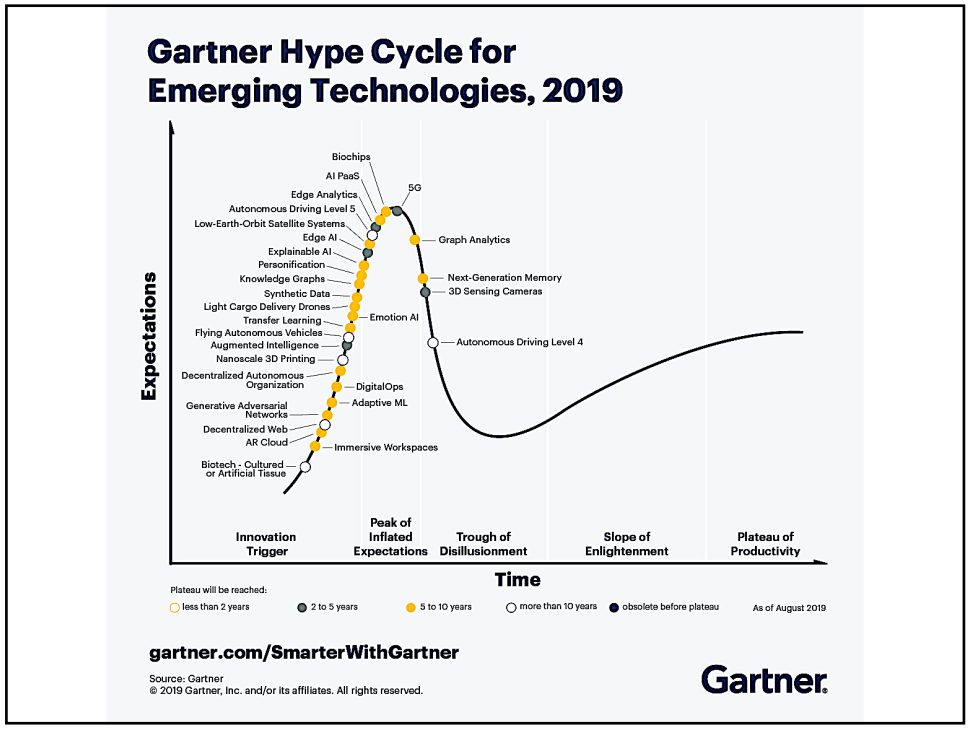
mattturck.com/bigdata2018
FIRSTMARK
EARLY STAGE VENTURE CAPITAL


Gartner Hype Cycle for Emerging Technologies, 2019
Biochips
AI PaaS
5G
Edge Analytics
Autonomous Driving Level 5
Low-Earth-Orbit Satellite Systems
Edge AI
Explainable AI
Personification
Knowledge Graphs
Synthetic Data
Light Cargo Delivery Drones
Transfer Learning
Flying Autonomous Vehicles
Augmented Intelligence
Nanoscale 3D Printing
Decentralized Autonomous Organization
Generative Adversarial Networks
Decentralized Web
AR Cloud
Biotech - Cultured or Artificial Tissue
Graph Analytics
Next-Generation Memory
3D Sensing Cameras
Emotion AI
Autonomous Driving Level 4
DigitalOps
Adaptive ML
Immersive Workspaces
Expectations
Innovation Trigger
Peak of Inflated Expectations
Trough of Disillusionment
Slope of Enlightenment
Plateau of Productivity
Time
Plateau will be reached:
less than 2 years
2 to 5 years
5 to 10 years
more than 10 years
obsolete before plateau
As of August 2019
gartner.com/SmarterWithGartner
Source: Gartner
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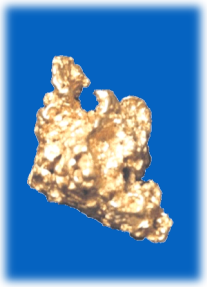
Gartner

Predictive Modelling



The Essence of Data Mining

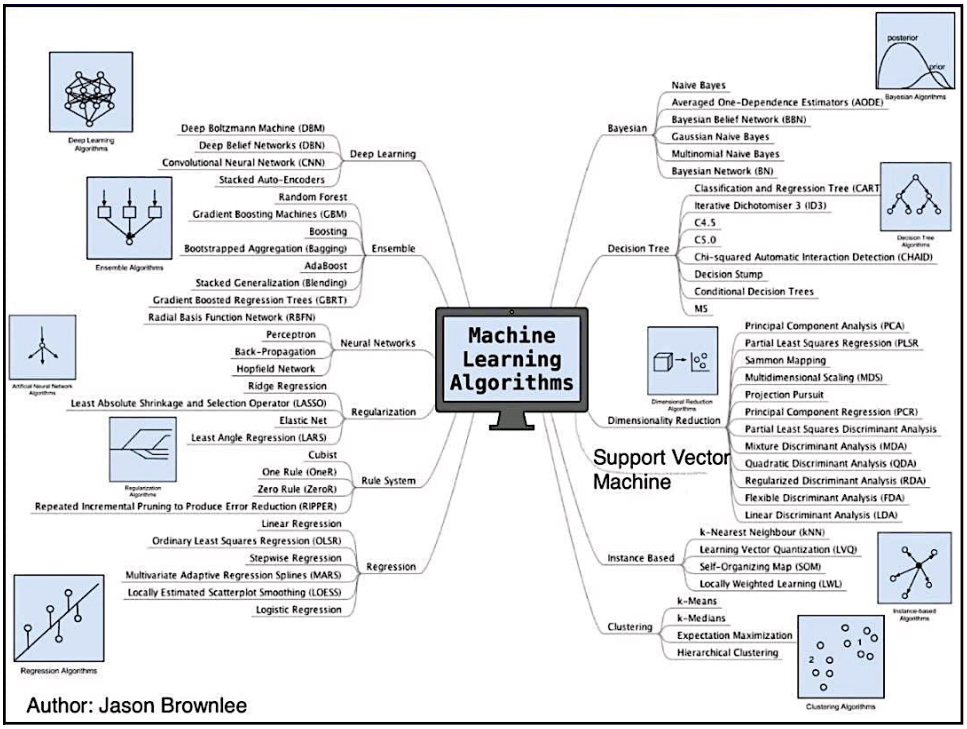
"Most of the big payoff [in data mining] has been in predictive modeling."

– Herb Edelstein

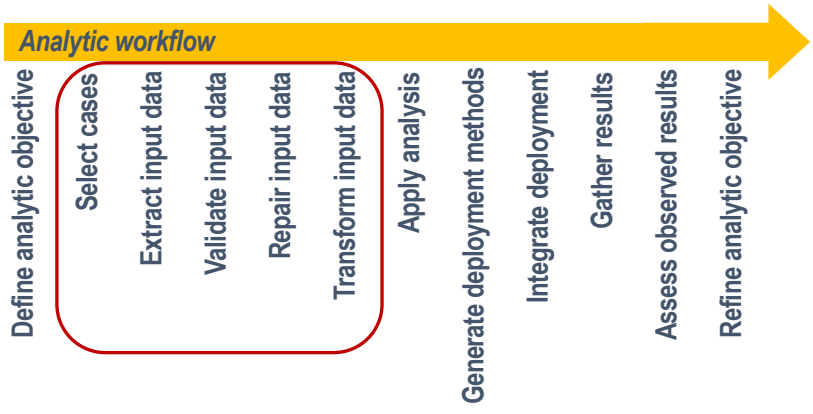
This module focuses on a specific sub-field of machine learning called predictive modeling.

Predictive Modelling ML Steps

1. **Define Problem:** Investigate and characterise the problem in order to better understand the goals of the project.
2. **Analyse Data:** Use descriptive statistics and visualisation to better understand the data you have available.
3. **Prepare Data:** Use data transforms in order to better expose the structure of the prediction problem to modeling algorithms.
4. **Evaluate Algorithms:** Design a test harness to evaluate a number of standard algorithms on the data and select the top few to investigate further.
5. **Improve Results:** Use algorithm tuning and ensemble methods to get the most out of well-performing algorithms on your data.
6. **Present Results:** Finalise the model, make predictions and present results.



The Analytic Workflow



UCI Machine Learning repository

http://archive.ics.uci.edu/ml/index.php

- Small – fit into memory and model them in reasonable time
- Well behaved – don't need to do a lot of feature engineering
- Benchmarks – many people have used them

UCI Machine Learning Repository
Center for Machine Learning and Intelligent Systems

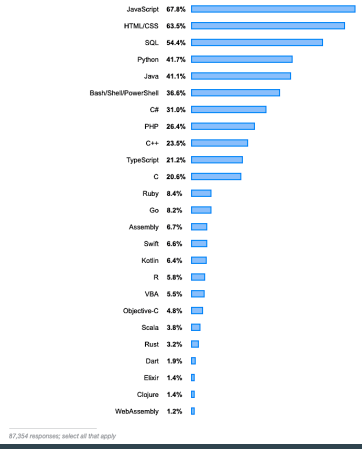
Python

It is consistently appearing in the top 10 programming languages in surveys on StackOverflow.

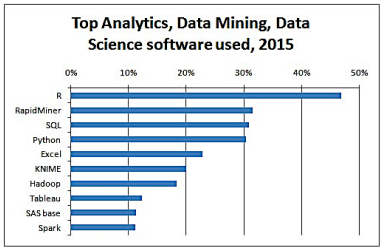
Overview

This year, nearly 90,000 developers told us how they learn and level up, which tools they're using, and what they want.

URL: https://insights.stackoverflow.com/survey/2019



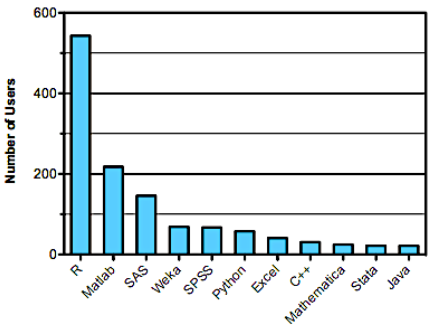
KDD Nuggets tool survey in 2015



The top 10 tools by share of users were

1. **R**, 46.9% share (38.5% in 2014)
2. **RapidMiner**, 31.5% (44.2% in 2014)
3. **SQL**, 30.9% (25.3% in 2014)
4. **Python**, 30.3% (19.5% in 2014)
5. **Excel**, 22.9% (25.8% in 2014)
6. **KNIME**, 20.0% (15.0% in 2014)
7. **Hadoop**, 18.4% (12.7% in 2014)
8. **Tableau**, 12.4% (9.1% in 2014)
9. **SAS**, 11.3 (10.9% in 2014)
0. **Spark**, 11.3% (2.6% in 2014)

Kaggle platform survey in 2011



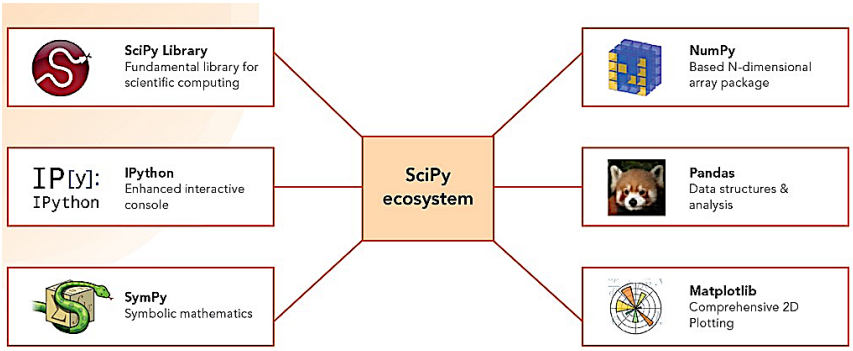
SciPy

SciPy is a free and open-source Python library used for scientific computing and technical computing.

- It is an add-on to Python that you will need for machine learning.
- It contains modules for optimisation, linear algebra, integration, interpolation, special functions, FFT, signal and image processing, ODE solvers and other tasks common in science and engineering.
- It is comprised of the following core modules relevant to machine learning:
  - NumPy: A foundation for SciPy that allows you to efficiently work with data in arrays.
  - Matplotlib: Allows you to create 2D charts and plots from data.
  - Pandas: Tools and data structures to organise and analyse your data.

    (to load explore and better understand your data)

SciPy ecosystem



scikit-learn

The scikit-learn library is how you can develop and practice ML in Python.

- scikit = SciPy +toolkit
- It is built upon and requires the SciPy.
- ML algorithms for classification, regression, clustering and etc.
- Tools for evaluating models, tuning parameters and pre-processing data.

Python Installation

Python 3.7.2

- Python Beginners Guide
  https://wiki.python.org/moin/BeginnersGuide/Download
- python --version
- pip - Python package management tool
- *pip install jupyter scipy numpy matplotlib pandas sklearn tensorflow theano keras seaborn subprocess.run graphviz pydot*
- *Anaconda 2019.03 for Windows Installer (Python 3.7 version)*

Some Python codes

```
# define an array
import numpy
mylist = [1, 2, 3]
myarray = numpy.array(mylist)
print(myarray)
print(myarray.shape)


# access values
import numpy
mylist = [[1, 2, 3], [3, 4, 5]]
myarray = numpy.array(mylist)
print(myarray)
print(myarray.shape)
print("First row: %s" % myarray[0])
print("Last row: %s" % myarray[-1])
print("Specific row and col: %s" % myarray[0, 2])
print("Whole col: %s" % myarray[:, 2])
```



```
# arithmetic
import numpy
myarray1 = numpy.array([2, 2, 2])
myarray2 = numpy.array([3, 3, 3])
print("Addition: %s" % (myarray1 + myarray2))
print("Multiplication: %s" % (myarray1 * myarray2))

# basic line plot
import matplotlib.pyplot as plt
import numpy
myarray = numpy.array([1, 2, 3])
plt.plot(myarray)
plt.xlabel('some x axis')
plt.ylabel('some y axis')
plt.show()

# basic scatter plot
import matplotlib.pyplot as plt
import numpy
x = numpy.array([1, 2, 3])
y = numpy.array([2, 4, 6])
plt.scatter(x,y)
plt.xlabel('some x axis')
plt.ylabel('some y axis')
plt.show()
```

```
Addition: [5 5 5]
Multiplication: [6 6 6]
```



```
# series
import numpy
import pandas
myarray = numpy.array([1, 2, 3])
rownames = ['a', 'b', 'c']
myseries = pandas.Series(myarray, index=rownames)
print(myseries)


print(myseries[0])
print(myseries['a'])


# dataframe
import numpy
import pandas
myarray = numpy.array([[1, 2, 3], [4, 5, 6]])
rownames = ['a', 'b']
colnames = ['one', 'two', 'three']
mydataframe = pandas.DataFrame(myarray, index=rownames, columns=colnames)
print(mydataframe)



print("method 1:")
print("one column:\n%s" % mydataframe['one'])
print("method 2:")
print("one column:\n%s" % mydataframe.one)
```


Summary

This lecture we've covered the basics of AML including:

- Module Overview
- Industry 4.0
- ML Experts
- Predictive Modelling
- The Analytic Workflow
- UCI ML Repository
- Python, NumPy and Pandas

Next week

- Data Preparation

Labs

- MAL 414–417

Questions?

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