ARTIFICIAL INTELLIGENCE AND IoT

From concept to applications 。



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"the science and engineering of making intelligent machines."

John McCarthy, one of the godfathers of AI

Al also

A branch of computer science dealing with the simulation of intelligent behavior in computers

A computer system able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decisionmaking, and translation between languages

The capability of a machine to imitate intelligent human behavior





The if-then statements are simply rules explicitly programmed by a human hand. Taken together, these if-then statements are sometimes called rules engines, expert systems, knowledge graphs or symbolic Al

Symbolic Al

Symbolic Reasoning (Symbolic AI) is one of the AI branches

Good, Old-Fashioned AI (AI)

Example of the intelligence they mimic

An accountant with knowledge of the tax code, who takes information you feed it, runs the information through a set of static rules, and gives your the amount of taxes you owe as a result.





uses

Signs and Symbols



Signifier The physical existence (sound, word, image)



Red / Leaf / Round / Apple

Signified The mental concept

Fruit / Apple / Freshness / Healthy / Temptation / Teacher's pet / Computer Signifiers and Signifieds

Combinations of symbols that express their interrelations called reasoning.

 All men are mortal; Caius is a man; therefore Caius is mortal.

CredFinder a simple rulebased system, by Dr. Majed Al-rubaian et. al ASONAM 2016

Is it really true?



A wag would say that true AI is whatever computers can't do yet

Al Pioneer and Deep learning Heroes

"Artificial Intelligence Will Almost Certainly Surpass Humans" Geoffrey Hinton the father of deep learning

Al & Deep Learning

"AI is the new electricity" Andrew Ng the founder of deeplearning.ai

"Computer are not just going to replace manual labor but also mental labor"

Yoshua Bengio, Al Pioneer

"Al is the real science and deep learning is the way to go in the future" lan Goodfelow the founder of GANs

Machine Learning

A field of study that gives computers the ability to learn without being explicitly programmed





Machine Learning





Machine Learning





Real-life Machine learning Examples



Recommender systems

- Amazon recommender systems
- Social networks recommender systems



approving a loan application



Telecommunication Companies

Prediction of customer
 un/ subcribe

- And many others
- Chatbot, using face recognition to logging into our phones or even computer games



Supervised

- How do we supervise a machine learning model?
 - Training it with labeled dataset
- What does a labeled dataset look like?

ID	Clump	UnifSize	UnifShape	MargAdh	SingEpiSize	BareNuc	BlandChrom	NormNucl	Mit	Class
1000025	5	1	1	1	2	1	3	1	1	benign
1002945	5	4	4	5	7	10	3	2	1	benign
1015425	3	1	1	1	2	2	3	1	1	malignant
1016277	6	8	8	1	3	4	3	7	1	benign
1017023	4	1	1	3	2	1	3	1	1	benign
1017122	8	10	10	8	7	10		7	1	malignant
1018099	1	1	1	1	2	10	3	1	1	benign
1018561	2	1	2	н	2	1	3	1	1	benign
1033078	2	1	1	1	2	1	1	1	5	benign
1033078	4	2	1	1	2	1	2	1	1	benign

Classification

The process of predicting a discrete class label, or category

Regression

 The process of predicting a continuous value as opposed to predicting a categorical value in classification

Unsupervised

- What do you think unsupervised learning means?
 - Exactly as it sounds
 - Trains on the dataset
 - Draws conclusions on unlabeled data

Unsupervised machine learning techniques

	Dimension reduction	market basket analysis	Clustering
		Clustering	
خرسن ا	$\mathcal{C}_{\mathcal{C}}^{\mathcal{C}}$	999999 999	
حاث الحوسية المحيملة والمتنق	discovering structure	Summarization	anomaly detection

Supervised vs. Unsupervised

Supervised

Classification

• Classifies labeled data

Regression

- Predict trends using previous labeled data
- Has more evaluation techniques
 than unsupervised
- Controlled environment

Unsupervised

• Clustering

- Finds patterns and groupings from unlabeled data
- Has fewer evaluation techniques than supervised
- Less controlled environment



Example of Supervised and Unsupervised

Supervised Unsupervised Naïve Bayes • **Decision Tree** • Support Vector Machine ٠ K-means Random Forest • Principle Component Analysis Leaner Regression • Neural Network • K-nearst Neighbor ٠



self.file self.file self.logdupes self.logger self.logger self.logger self.file self.file self.file.

Building a basic ML Model using python

if fp in self.fingerprints.add(fp)
self.fingerprints.add(fp)
if self.file:
 self.file.write(fp
def request_fingerprint(self.fingerprin

Python ML Frameworks and Libraries









Basic ML Example using Scikit-learn

from sklearn import preprocessing
X = preprocessing.StandardScaler().fit(X).transform(X)

from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33)

from sklearn import svm
clf = svm.SVC(gamma=0.001, C=100.)

```
clf.fit(X_train, y_train)
```

clf.predict(X_test)

from sklearn.metrics import confusion_matrix
print(confusion_matrix(y_test, yhat, labels=[1,0]))

import pickle
s = pickle.dumps(clf)



Artificial Intelligence (AI) vs. Machine Learning vs. Deep Learning and also Deep symbolic learning



Deep learning



Why Now? Scale drives deep learning progress



Deep learning

Two things have to be considered to get high level of performance

Being able to train a big enough NN

Huge amount of labeled data

That only works up to a point because

eventually you run out of data

or eventually then your network is so big that it takes too long to train

Deep learning

It is important to have a fast computation unit

Example of DNN training time

Word error rates from MSR, IBM, & Google (Hinton et. al. IEEE Signal Processing Magazine, Nov 2012)

The task	Hours of training data	Deep neural network	Gaussian Mixture Model	GMM with more data
Switchboard (Microsoft Research)	309	18.5%	27.4%	18.6% (2000 hrs)
English broadcast news (IBM)	50	17.5%	18.8%	
Google voice search (android 4.1)	5,870	12.3% (and falling)		16.0% (>>5,870 hrs)

Example of simple NN

Linear neurons

- These are simple but computationally limited
 - If we can make them learn we may get insight into more complicated neurons.

Activation functions

Deep learning Frameworks and Libraries

Choosing deep learning frameworks

- Ease of programming (development and deployment)
- Running speed
- Truly open (open source with good governance)

Building a basic DL Model using python

```
import numpy as np import tensorflow as tf
```

```
coefficients = np.array([[1], [-20], [25]])
```

```
w = tf.Variable([0],dtype=tf.float32)
x = tf.placeholder(tf.float32, [3,1])
cost = x[0][0]*w**2 + x[1][0]*w + x[2][0] # (w-5)**2
train = tf.train.GradientDescentOptimizer(0.01).minimize(cost)
init = tf.global_variables_initializer()
with tf.Session() as session:
    session.run(init)
    print(session.run(w))
for i in range(1000):
    session.run(train, feed_dict={x:coefficients})
print(session.run(w))
```


Deep learning resources

- Book : Deep learning by lan Goodfelow et. al
- Deeplearning.ai
- FastAl
- OpenAl
- DeepMind
- FacebookAI
- Google Brain

Symbolic AI vs. Deep learning

- The main drawback is the difficulty of revising beliefs once they were encoded in a rules engine
- Expert systems are monotonic;
 - The more rules you add, the more knowledge is encoded in the system, but additional rules can't undo old knowledge
- Open research line:
 - Can we fuse the ability of deep neural nets to learn probabilistic correlations from scratch alongside abstract and higher-order concepts, which are useful in compressing data and combining it in new ways?
 - Deep symbolic learning
 - Enabling deep neural networks to manipulate, generate and otherwise cohabitate with concepts expressed in strings of characters, could help solve explainability, because, after all, humans communicate with signs and symbols, and that is what we desire from machines

Symbolic AI vs. Deep learning

Deep learning biggest weaknesses are

- Model Explanation
- Data hungry
- Geoff Hinton himself has expressed skepticism about whether backpropagation, the workhorse of deep neural nets, will be the way forward for AI.
- Open research:
 - Hyper-parameters
 - Work on unsupervised learning (learning from unlabeled data) will lead to our next breakthroughs.
 - GANs and CycleGANs

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Internet of Things

What is the IoT?

Typical shopping

IoT-based shopping

IoT device is no a Computer

- Special purpose thing
- Can be good for one task or multi-task that all related to one thing, but terrible for another
 - such as audio player is great for playing but not good in playing video
- Computer can do both
 - But less efficiently (Froe example camera of the laptop)

What Support IoT

- Cost of Hardware and software are cheaper than before
 - You can get a laptop 1500SAR
 - IoT will be cheaper, the computational ability of it is a lot less than laptops
 - You can add IoT to old machines with low cost (example, car)
- Hardware size
 - IoT is small and light
 - Computational technology has also adaptable to that
- Speed of the computational technology
 - Speech-to-Text, audio processing and network communication

What Support IoT

- Internet Access
 - Internet access has improved
 - Internet is reachable from a lot of places
- Wi-Fi
 - Cheaper than wired
 - Makes IoT technology much more usable and much more possible
- Data usage it not that expensive
- High bandwidth
 - Transmit lots of data fast (YouTube videos)

Pervasive and Cloud computing

- Pervasive nature of IoT
 - IoT is not only everywhere, but also networked
- Can be an interface to the cloud (example refrigerator search)
 - A window to massive database and some massive computational resource
 - The actual computation is the one send to the cloud
 - The cloud process it and give the result back
 - You can think of many examples
 - IoT can work as an access points for something much bigger

IoT Privacy-and-security

- Depending on Technology and Infrastructure
 - Big risk if something goes down
 - power outages
 - Network outages
 - Blackout
- IoT devices are observing us:
 - Location (reporting you GPS)
 - Health monitoring (store)
 - Media system
 - Purchasing systems

IoT frameworks and library

Percent Computer Computer of C

https://phodal.github.io/awesome-iot/

Thank You