Machine Learning and Deep Learning with R

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February 15, 2017

Deep Learning so far...

AlphaGo marks stark difference between AI and human intelligence

Daniel Susskind

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Google's robot relied on processing power and data storage, writes Daniel Susskind

There are many ways of being smart that aren't smart like us." These are the words of Patrick Winston, a leading voice in the field of artificial intelligence. Although his idea is simple, its significance has been lost on most people thinking about the future of work. Yet this is the feature of AI that ought to preoccupy us the most.

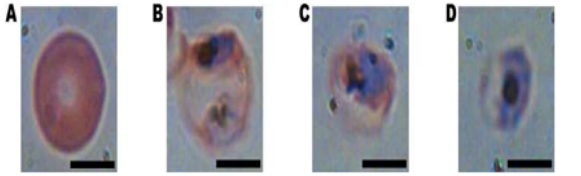
From the 1950s to the 1980s, during the "first wave" of AI research, it was generally

Google Deepmind trial to detect head and neck cancer

Image: Google's DeepMind Health is working with the University College London Hospitals NHS Foundation Trust on how it can use machine learning to improve head and neck cancer detection.

Holographic imaging and deep learning diagnose malaria

September 19, 2016 by Ken Kingery



Four cells as seen under a microscope in different stages of infection from a malarial parasite. The first image is uninfected, but as the parasite matures in images from left to right, the cell deforms. Credit: Duke University

Duke researchers have devised a computerized method to autonomously and quickly diagnose malaria with clinic accuracy—a crucial step to successfully treating the disease and halting its spread.

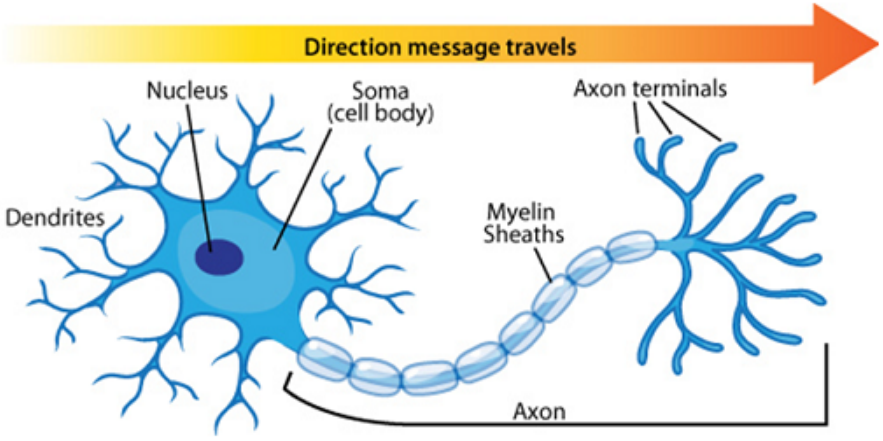
In 2015 alone, malaria infected 214 million people worldwide, killing an estimated 438,000.

While Western medicine can spot malaria with near-perfect accuracy, it can be difficult to diagnose in resource-lin where infection rates are highest.

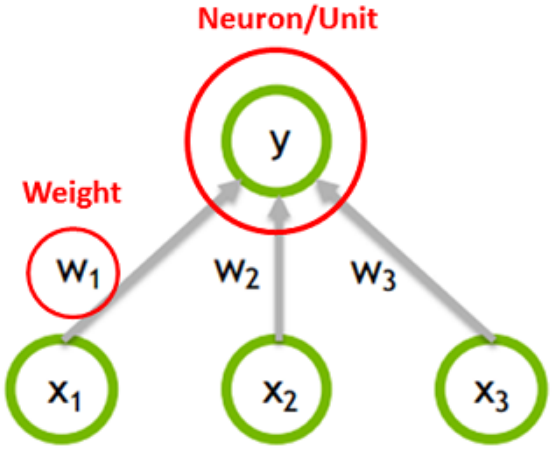
Introduction

- In the past 10 years, machine learning and Artificial Intelligence (AI) have shown tremendous progress
- The recent success can be attributed to:
  - Explosion of data
  - Cheap computing cost - CPUs and GPUs
  - Improvement of machine learning models
- Much of the current excitement concerns a subfield of it called "deep learning".

Human Brain



Biological Neuron



$$y=F(w_1x_1+w_2x_2+w_3x_3)$$

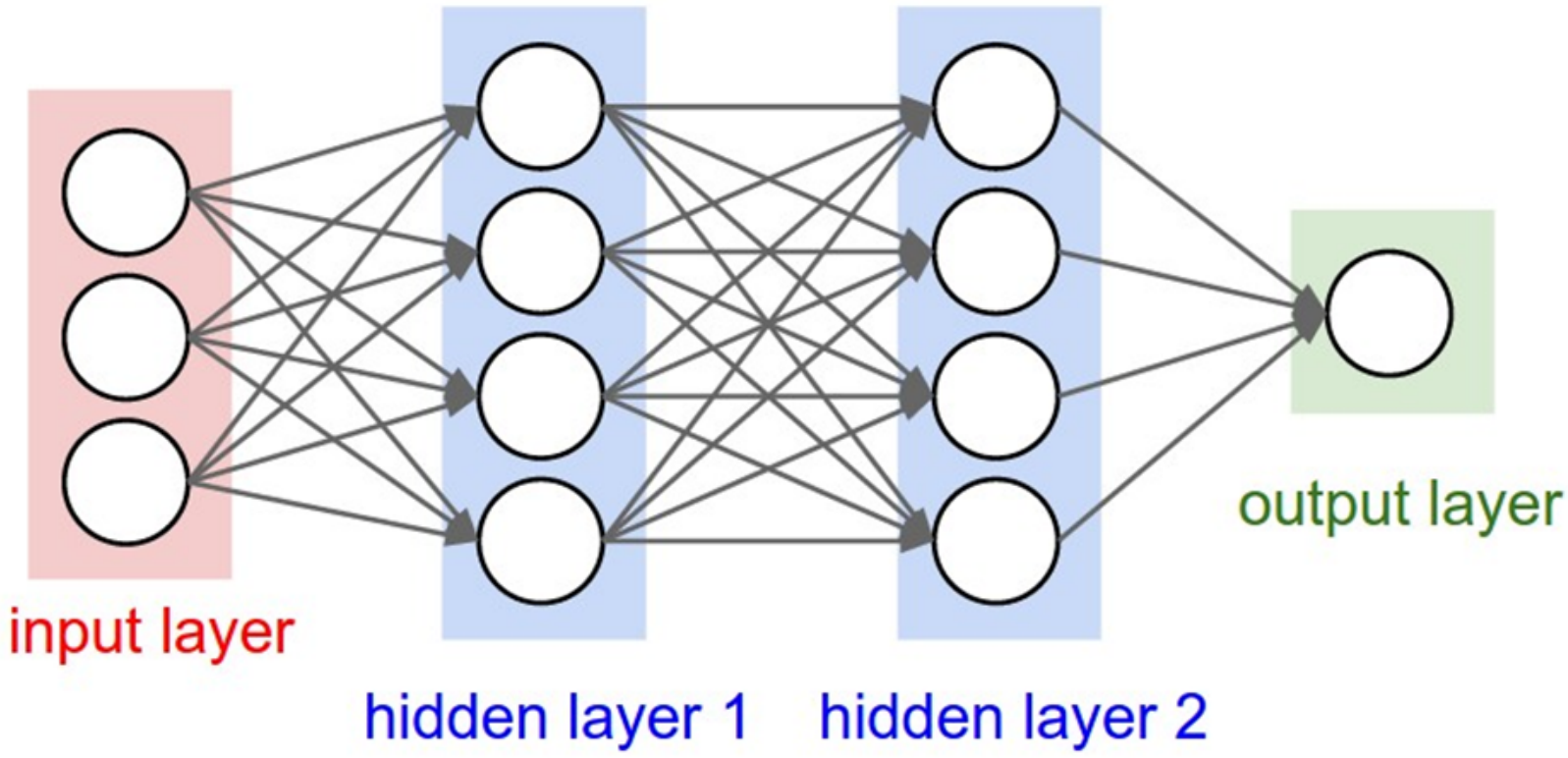
$$F(x)=\max(0,x)$$

Artificial Neuron

Neural Networks

- Deep Learning is primarily about neural networks, where a network is an interconnected web of nodes and edges.
- Neural nets were designed to perform complex tasks, such as the task of placing objects into categories based on a few attributes.
- Neural nets are highly structured networks, and have three kinds of layers - an input, an output, and so called hidden layers, which refer to any layers between the input and the output layers.
- Each node (also called a neuron) in the hidden and output layers has a classifier.

Neural Network Layers



Deep Learning

- Deep learning refers to artificial neural networks that are composed of many layers.
- It's a growing trend in Machine Learning due to some favorable results in applications where the target function is very complex and the datasets are large.

Deep Learning: Benefits

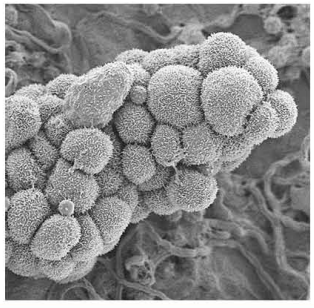
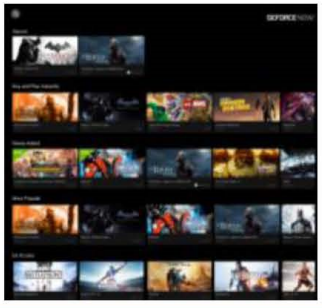
- Robust
  - No need to design the features ahead of time - features are automatically learned to be optimal for the task at hand
  - Robustness to natural variations in the data is automatically learned
- Generalizable
  - The same neural net approach can be used for many different applications and data types
- Scalable
  - Performance improves with more data, method is massively parallelizable

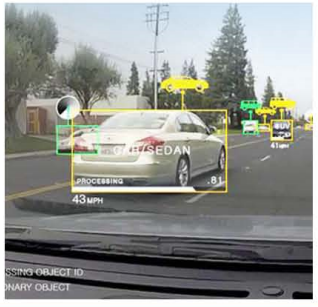
Deep Learning: Weaknesses

- Deep Learning **requires a large dataset**, hence long training period.
- In term of cost, Machine Learning methods like SVMs and other tree ensembles are very easily deployed even by relative machine learning novices and can usually get you reasonably good results.
- Deep learning methods **tend to learn everything**. It's better to encode prior knowledge about structure of images (or audio or text).
- The learned features are often **difficult to understand**. Many vision features are also not really human-understandable (e.g, concatenations/combinations of different features).
- Requires **a good understanding of how to model** multiple modalities with traditional tools.

Deep Learning: Applications

DEEP LEARNING EVERYWHERE



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Recommendation

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Diabetic Grading
Drug Discovery

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Video Search
Real Time Translation

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Satellite Imagery

AUTONOMOUS MACHINES

Pedestrian Detection
Lane Tracking
Recognize Traffic Sign

Deep Learning: R Libraries

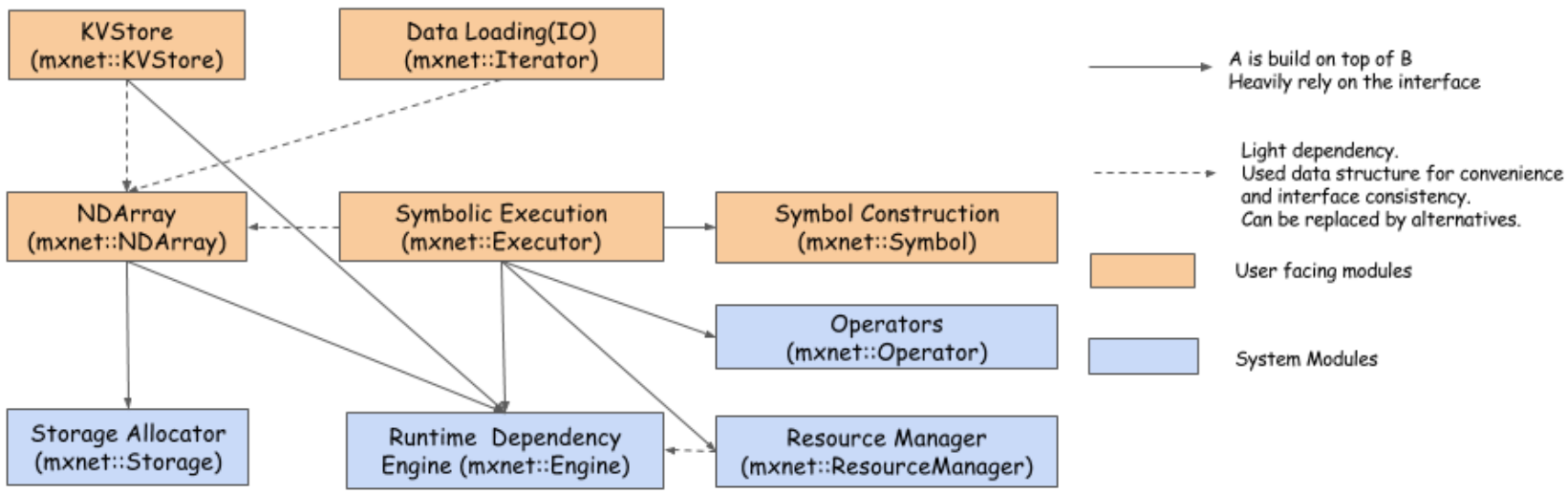
- MXNet: The R interface to the MXNet deep learning library.
- darch: An R package for deep architectures and restricted Boltzmann machines.
- deepnet: An R package implementing feed-forward neural networks, restricted Boltzmann machines, deep belief networks, and stacked autoencoders.
- h2o: The R interface to the H2O deep-learning framework.

MXNet

- **Founded by:** Uni. Washington & Carnegie Mellon Uni (~1.5 years old)
- **Supports most OS:** Runs on Amazon Linux, Ubuntu/Debian, OS X, and Windows OS
- **State of the art model support:** Flexible and efficient GPU computing and state-of-art deep learning i.e. CNN, LSTM to R.
- **Ultra Scalable:** Seamless tensor/matrix computation with multiple GPUs in R.
- **Ease of USe:** Construct and customize the state-of-art deep learning models in R, and apply them to tasks, such as image classification and data science challenges
- **Multi-language:** Supports the Python, R, Julia and Scala languages
- **Ecosystem:** Vibrant community from Academia and Industry

MXNet Architecture

- You can specify the `Context` of the function to be executed within. This usually includes whether the function should be run on a CPU or a GPU, and if you specify a GPU, which GPU to use.



MXNet R Package

- The R Package can be downloaded using the following commands:

```
install.packages("drat", repos="https://cran.rstudio.com")
drat:::addRepo("dmlc")
install.packages("mxnet")
```

Amazon & MXNet for Deep Learning

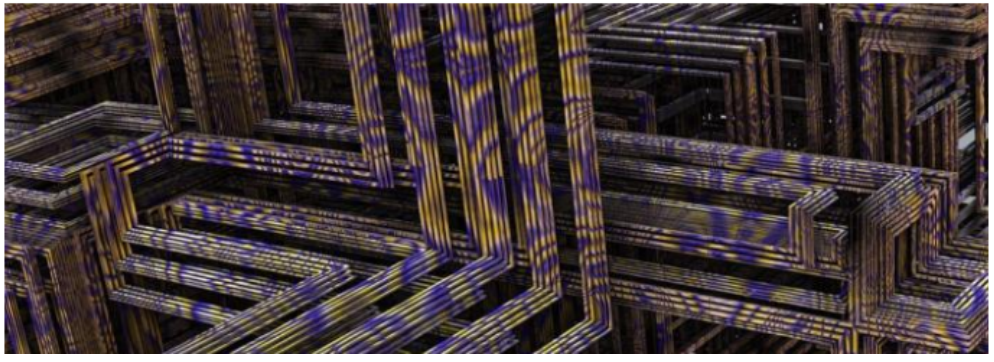
InfoWorld FROM IDG

INSIDER Sig

Why Amazon picked MXNet for deep learning

Amazon plans to further develop this compact and versatile machine learning framework. Hosting it at scale would also fit the company's overall plans

InfoWorld | NOV 23, 2016



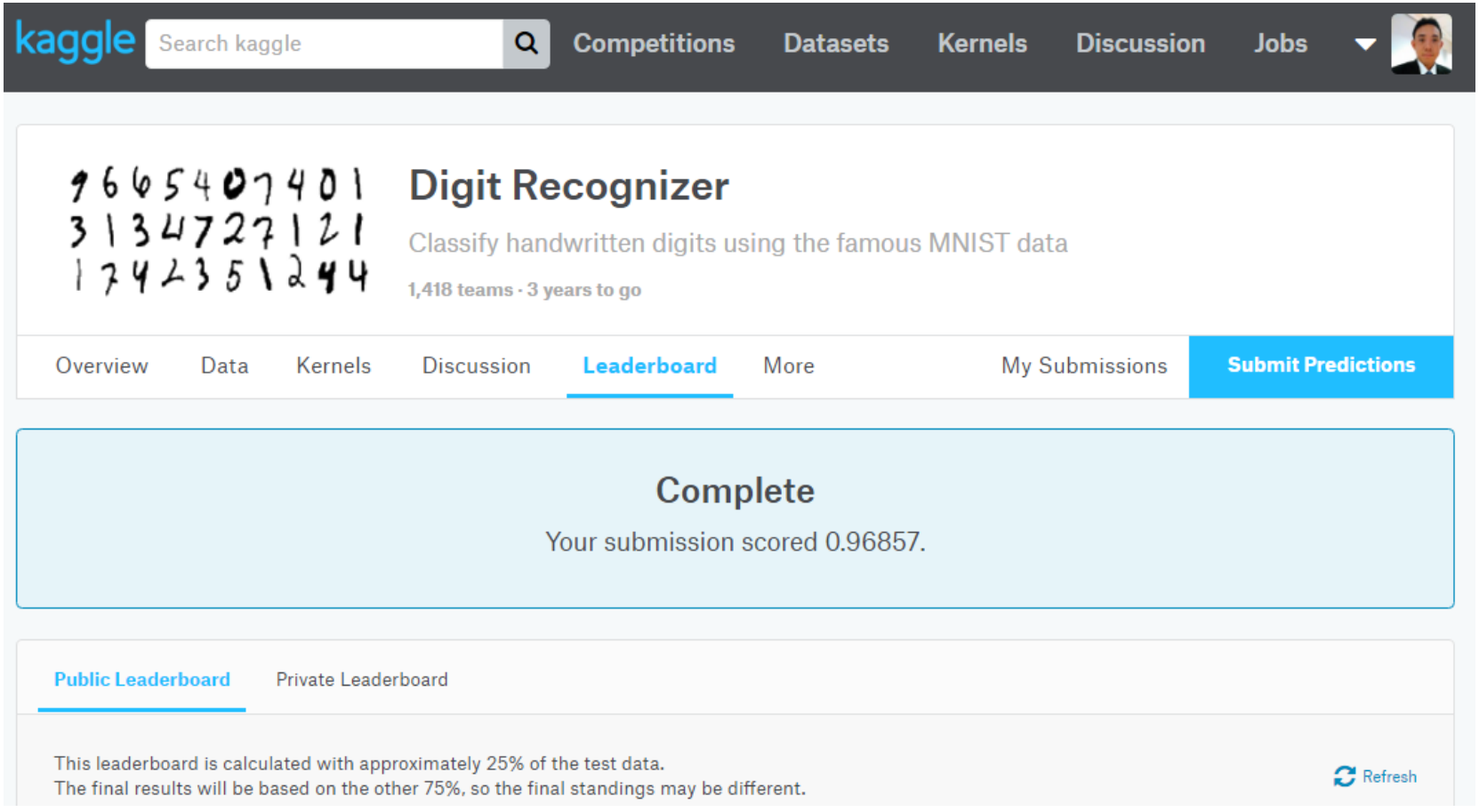
MNIST Handwritten Dataset

- The MNIST database consists of handwritten digits.
- The training set has 60,000 examples, and the test set has 10,000 examples.
- The MNIST database is a subset of a larger set available from NIST. The digits have been size-normalized and centered in a fixed-size image
- For this demo, the Kaggle pre-processed training and testing dataset were used. The training dataset, (train.csv), has 42000 rows and 785 columns.

Demo

- Sourcecode available here `https://github.com/kuanhoong/deeplearning-malaysia`

Result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Your submission scored 0.96857.
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This leaderboard is calculated with approximately 25% of the test data.
The final results will be based on the other 75%, so the final standings may be different.
Refresh

Lastly. . .

Thanks!

Questions?

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