A Hands-on Introduction to Neural Networks and Deep Learning with IBM Watson Studio

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Technical Evangelist Team

About Me

***David** Solomon*
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Team-wolfpack

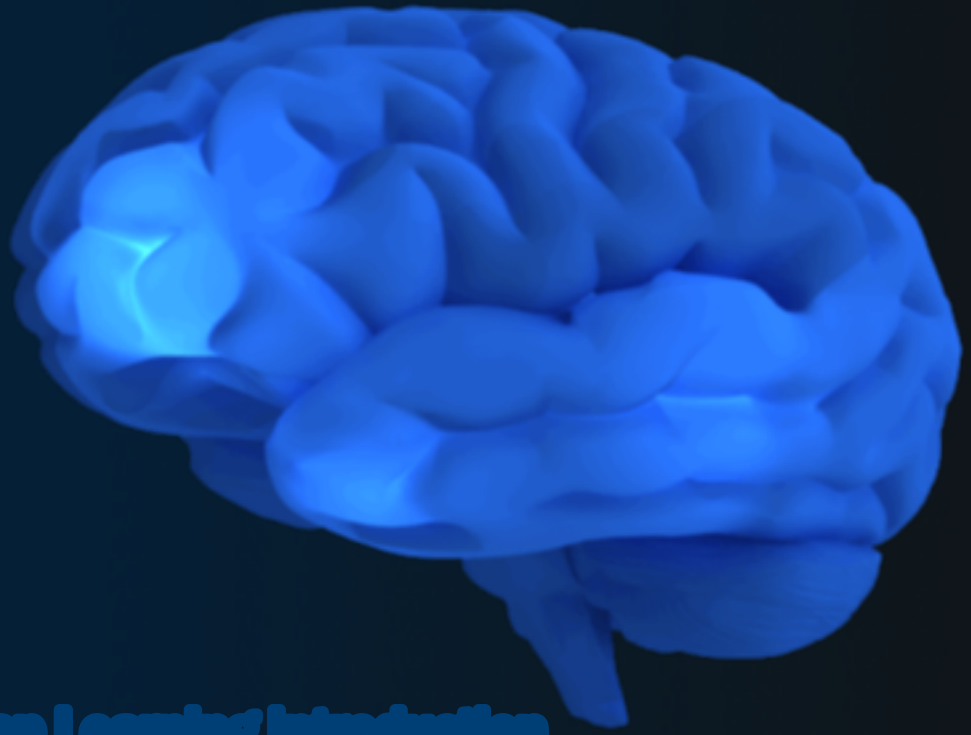
Focus / Passion

- AI, Cognitive, Emerging Technology
- Analytics
- Data (Architecture, Modeling, Integration)
- Cloud Service Architecture
- Applying the above to real-world business problems

Education & Certification

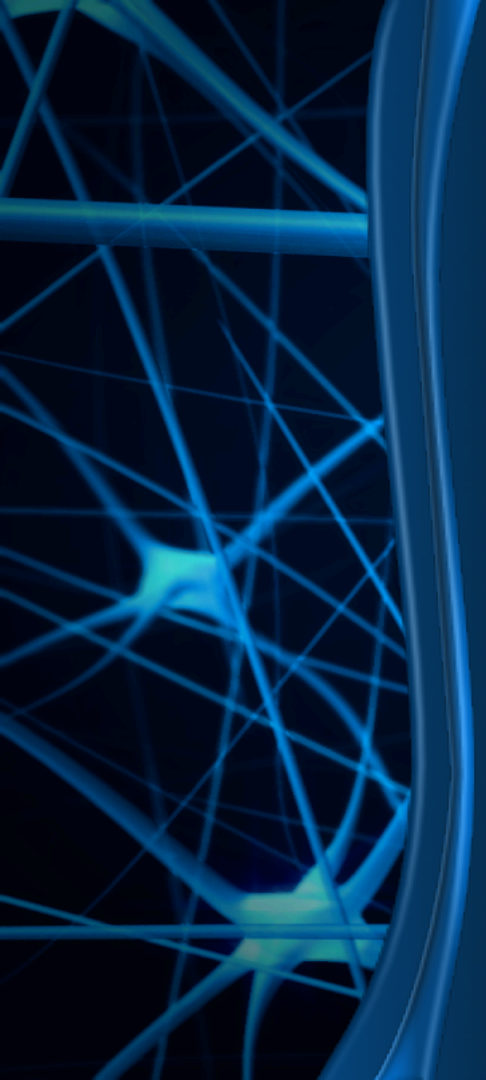
- M.S. Software Engineering
- B.S, Physics
- Data Mgmt, AI, Cloud, Docker, DevOps, …

Proud Member of the IBM WolfPack



Deep Learning Introduction

Deep Learning is inspired by the human brain, it attempts to mimic the activity in layers of neurons in the human brain where thinking occurs.

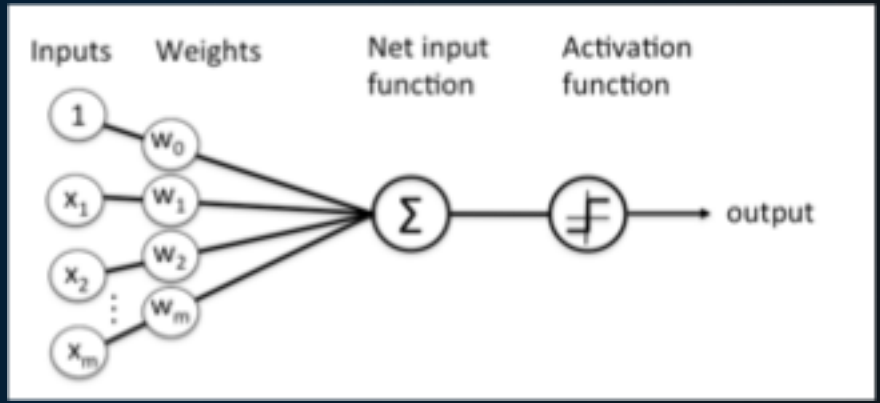


Deep Learning is...

- a collection of statistical machine learning techniques
- used to learn feature hierarchies
- based on artificial neural networks

Deep Learning Introduction

Activation of a neuron



The output from the neuron is a real number between 0 and 1

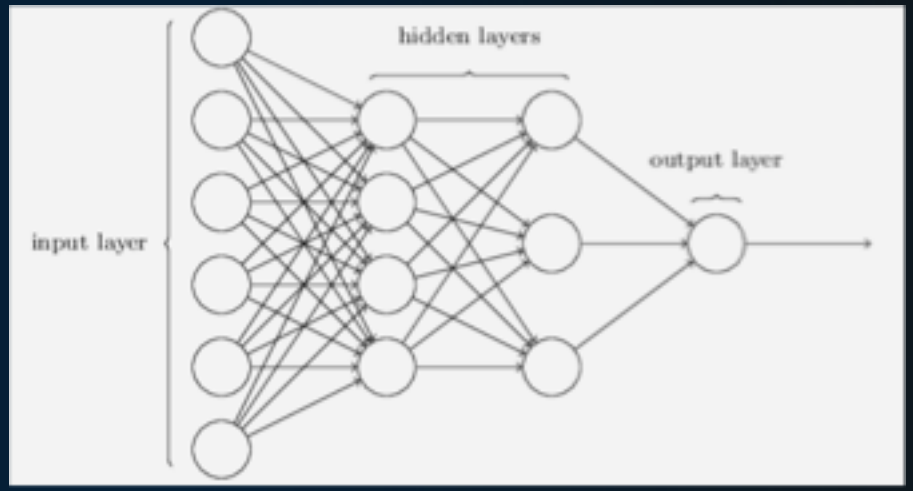
The neural net “learns” by tweaking the weights and biases step by step until the prediction closely matches the correct output, i.e. minimize the “cost value”

$$Y = \sum (weight * input) + bias$$

Activation function A = "activated" if Y > threshold else not

Alternatively, A = 1 if y> threshold, 0 otherwise

Deep Learning Introduction



Forward Propagation

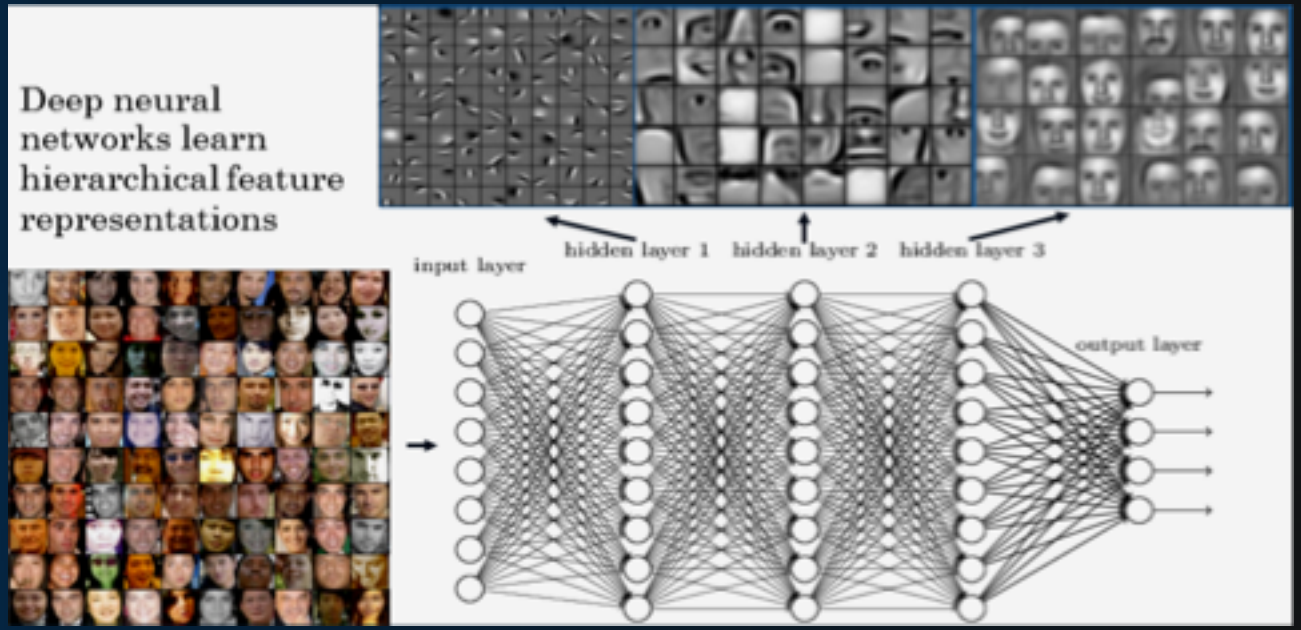
Scores are passed on as input to the next layer

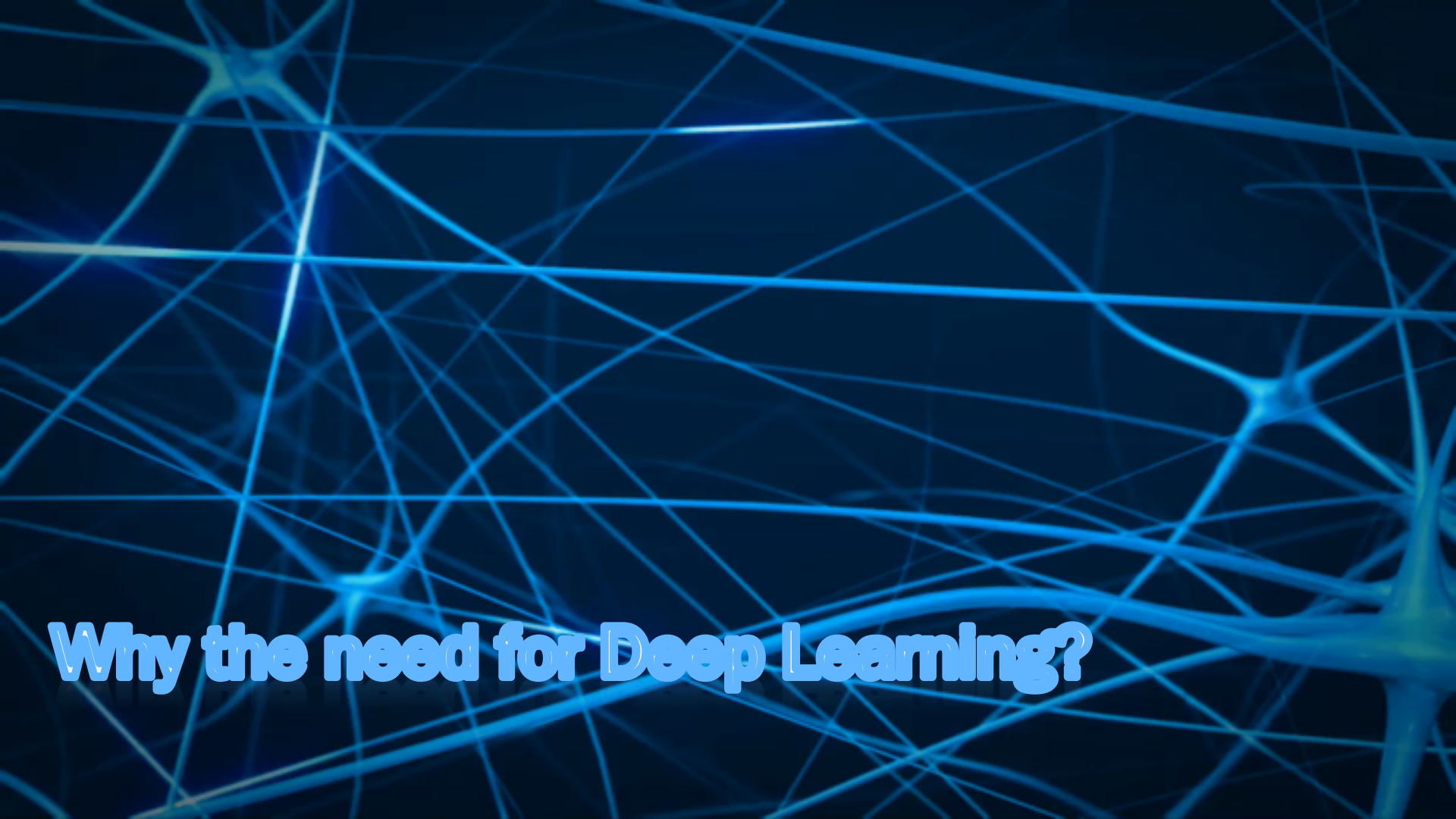
Input layer: Ingest input values, e.g. pixels of an image, vital statistics of a patient

Output layer: The predicted value. e.g. the category of the image or if the patient is sick

Deep Learning Introduction

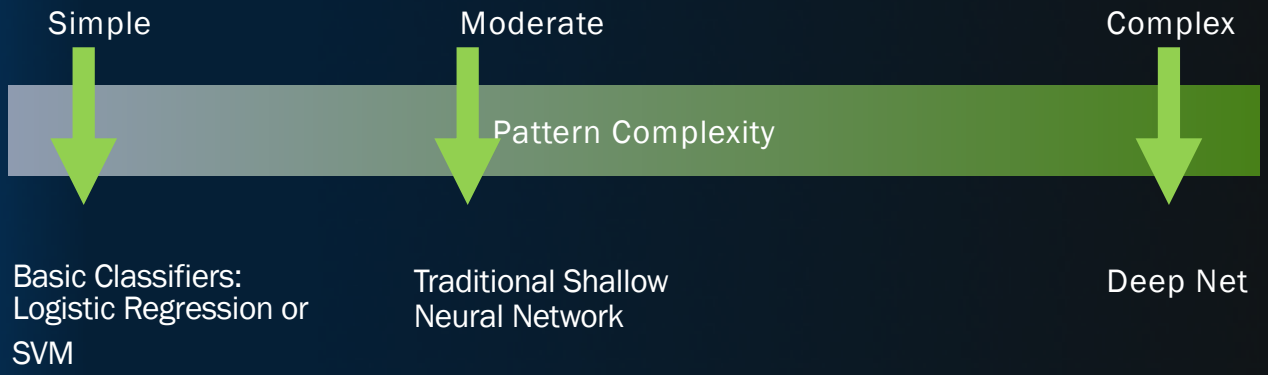
Deep Learning algorithms learn “Feature Hierarchies” as they progresses through their hidden layers




Why the need for Deep Learning?

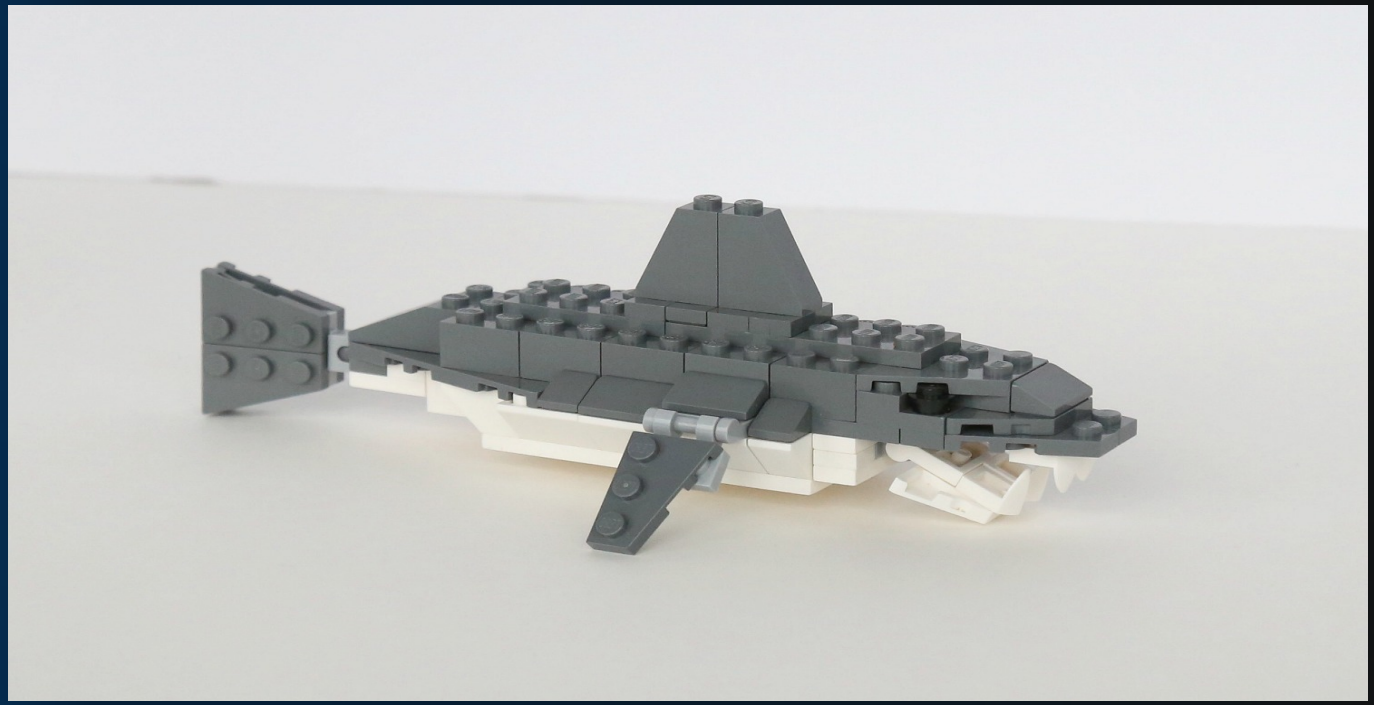
Why Deep Learning? Why now?

DL algorithms learn more complex patterns than is possible with traditional machine learning algorithms



- Increased availability of labelled data
- Deep nets take a long time to train
- Availability of high performance GPUs speeds up training of a deep net
- GPU is approximately 250 times faster than CPU, i.e. the difference between one day of training and over eight months.

Make me a lego shark!

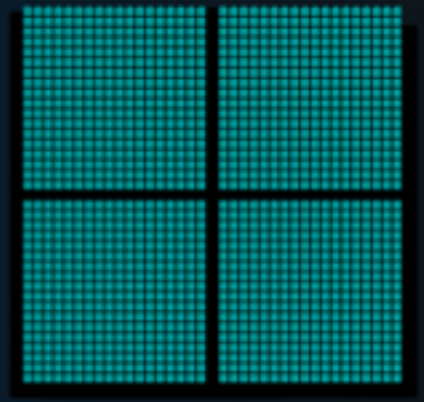


Make me a Lego shark with deep learning

CPUs have multiple cores, whereas GPUs have thousands of cores

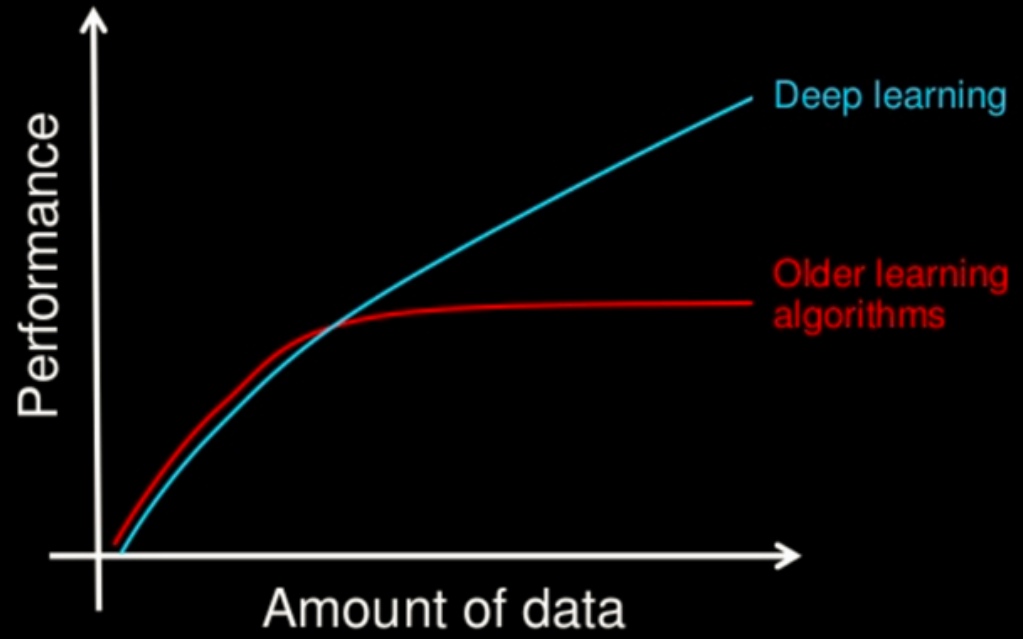
https://www.youtube.com/watch?v=-P28LKWTzrI

CPU
Multiple Cores



GPU
Thousands of Cores

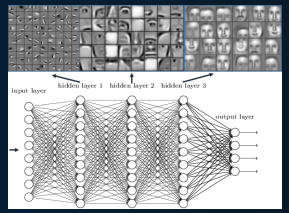
Why deep learning



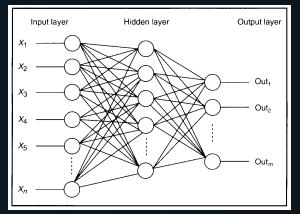
How do data science techniques scale with amount of data?

Deep Learning is...

- a collection of statistical machine learning techniques
  - *Deep Boltzmann Machine (DBM)*
  - *Deep Belief Networks (DBN)*
  - *Recurrent Neural Networks (RNN)*
  - *Convolutional Neural Networks (CNN), etc.*
- used to learn feature hierarchies



- based on artificial neural networks



Deep Learning is structured to be effective in problem domains which have an inherently Hierarchical Composition

VISION

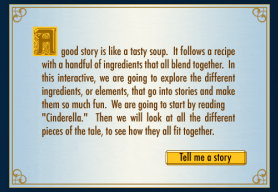
pixels -> edge -> texton -> motif -> part -> object

e.g. self-driving cars, reading medical images

SPEECH

sample -> spectral band -> formant -> motif -> phone -> word

e.g. Alexa



NATURAL LANGUAGE PROCESSING

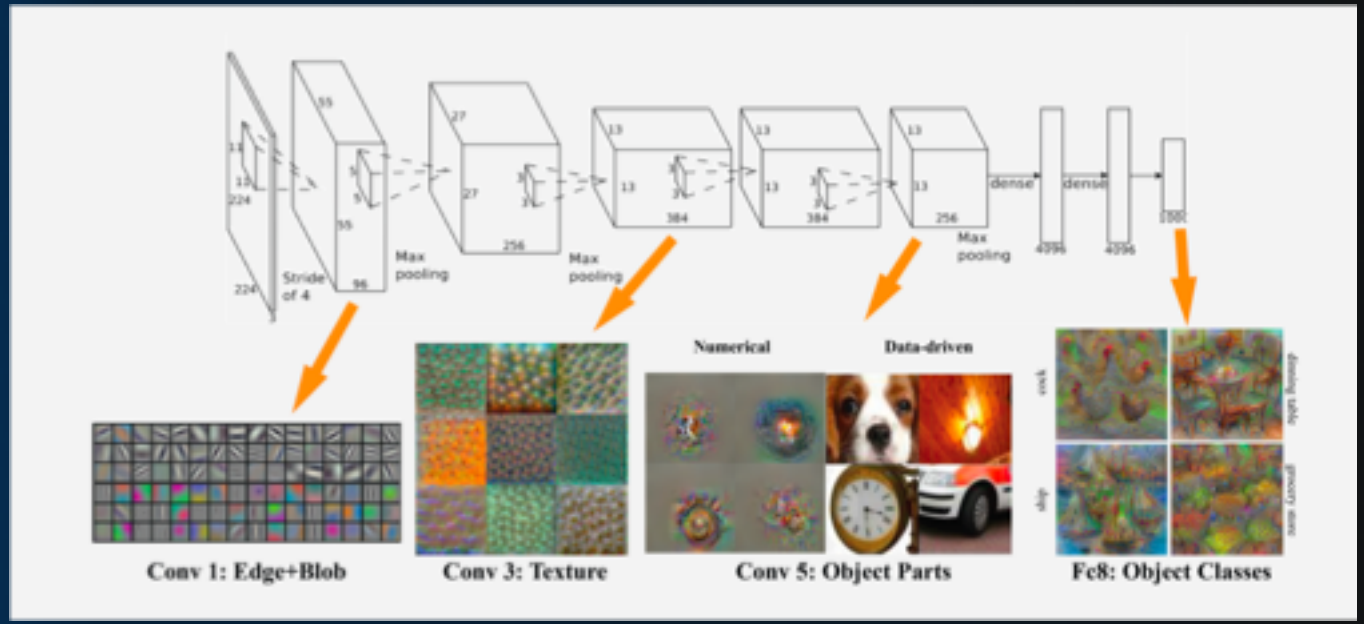
character -> word -> clause -> sentence -> story

e.g. DeepText: Facebook's text understanding engine

Key Differences between traditional "Machine Learning" and "Deep Learning"

	Machine Learning	Deep Learning
Data Volumes	Can work on small data volumes	Needs large data volumes
Feature Engineering	Needs a lot of data preparation and feature engineering	Feature engineering is implicitly performed during training
Hardware	CPU and/or GPU	Needs accelerators such as GPUs
Model Interpretability	Models are easy to interpret (e.g., Decision Trees)	Difficult to understand why the model produces a given prediction

Convolutional Neural Networks



Use Cases

Restore Colors to B/W Photos

Pixel Restoration: CSI Style

Self Driving Cars

Popular Machine Learning Frameworks

- Tensorflow
- Keras
- Caffe
- PyTorch

Watson Studio: accelerating value from AI for enterprises

Watson Studio accelerates the machine and deep learning workflows required to infuse AI into your business to drive innovation. It provides a suite of tools for data scientists, application developers and subject matter experts to collaboratively and easily work with data and use that data to build, train and deploy models at scale.

AI Requires Teamwork

- AI is not magic
- AI is algorithms + data + team

Watson Studio
Built for AI teams – enabling team productivity and collaboration

Tanya
Domain Expert

Her Job:
To transfer knowledge to Watson for a successful user experience.

What she does:
- Range of domain knowledge and uses that to teach Watson and develop a custom models
- As Tanya gains more experience she optimizes her knowledge to teach Watson to design better end-user experiences.

Sometimes known as:
Subject matter expert, content strategist.

Mike
Data Scientist

His Job:
Transform data into knowledge for solving business problems.

What he does:
- Runs experiments to build custom models that solve business problems.
- Use techniques such as Machine Learning or Deep Learning and works with Tanya to validate success of trained models.

Sometimes known as:
ML/DL engineer, Modeler, Data Miner

Ed
Data Engineer

His Job:
Architects how data is organized and ensures operability

What he does:
- Builds data infrastructure and ETL pipelines. Works with Spark, Hadoop, and HDFS.
- Works with data scientist to transform research models into production quality systems.

Sometimes known as:
Data infrastructure engineer

Deb
The Developer

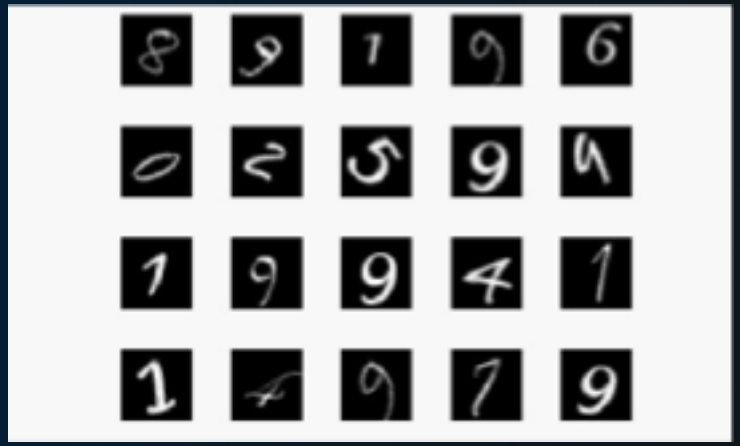
Her Job:
Builds AI application that meet the requirements of the business.

What she does:
- Starts PoCs which includes gathering content, dialog building and model training
- Focus is on app building for the team or company to use. Will handle ML Ops as needed

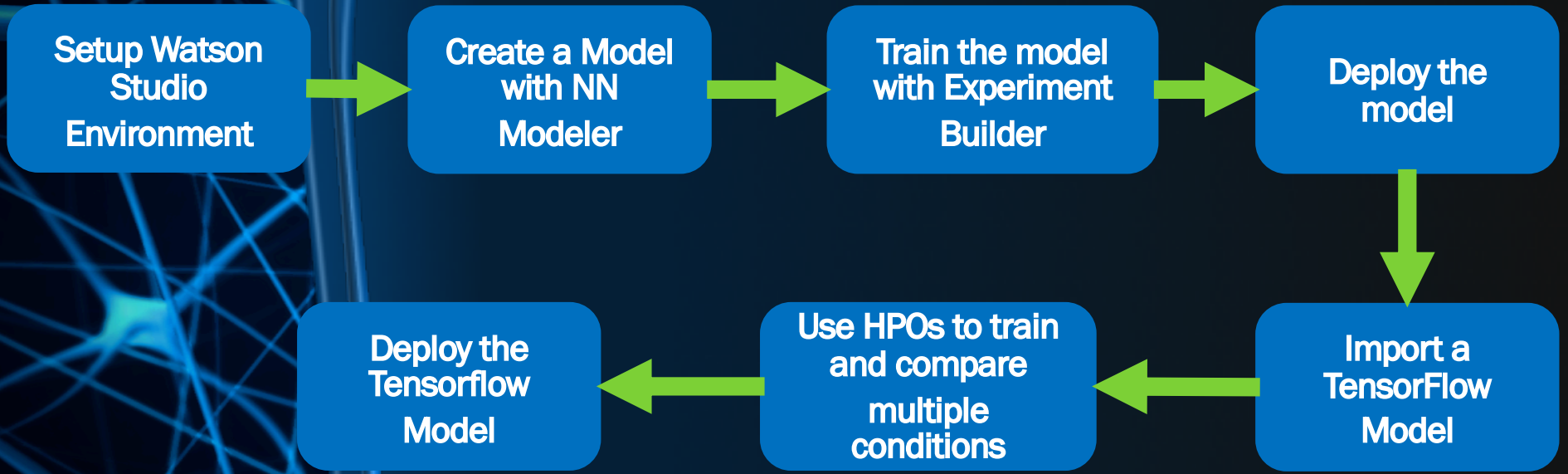
Sometimes known as:
Front-end, back-end, full stack, mobile or low-code developer

Deep Learning Lab Exercise- MNIST Dataset

- For the lab, you will be using the the MNIST dataset of handwritten digits 0-9
- This dataset contains 60,000 images and will be used for training our model



Deep Learning Lab Exercise Flow



http://bit.ly/2smqznW

Survey

http://ibm.biz/WPL_TORONTO_DL_SURVEY