Introduction to Deep Learning

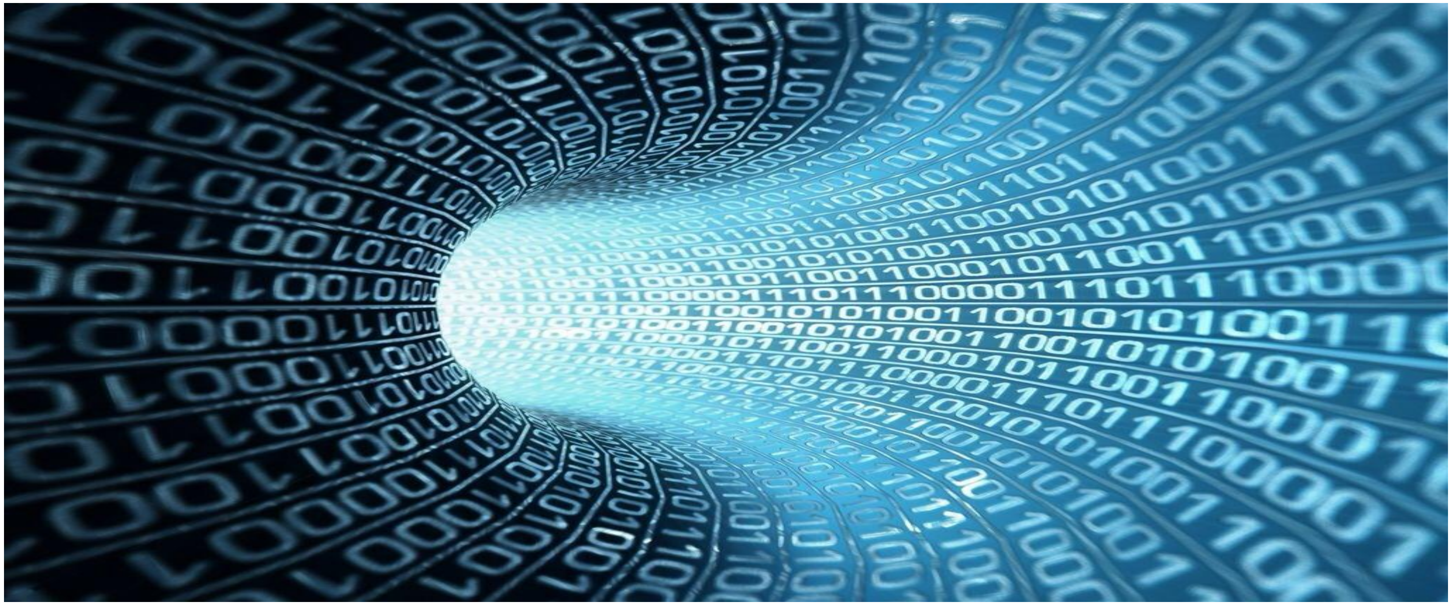
Introduction

- Learn English Alphabets with books having colorful pictures

- Why images when objective is to learn the alphabet?

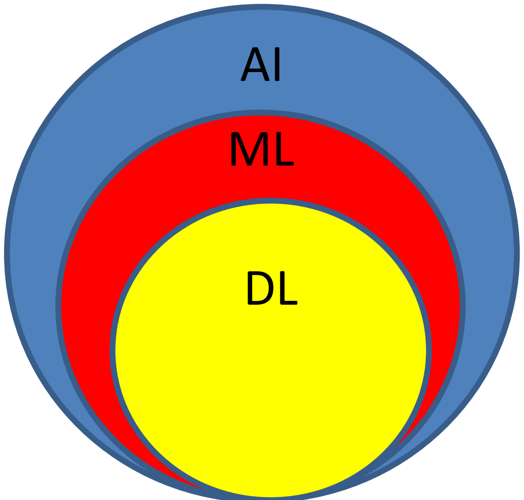
What is Deep Learning?

- Type of machine learning that imitates the way humans gain certain types of knowledge
- Extremely beneficial to data scientists for interpreting large amounts of data
  - Deep learning makes this process faster and easier



What is Deep Learning

- Intelligence – to process information which can be used for future decision
  - AI builds algorithms to achieve this and perform predictions
  - ML is subset of AI – teaches algorithms to learn from experiences without being explicitly programmed
  - DL – uses neural networks to extract useful patterns/features from raw data and using them to perform a task

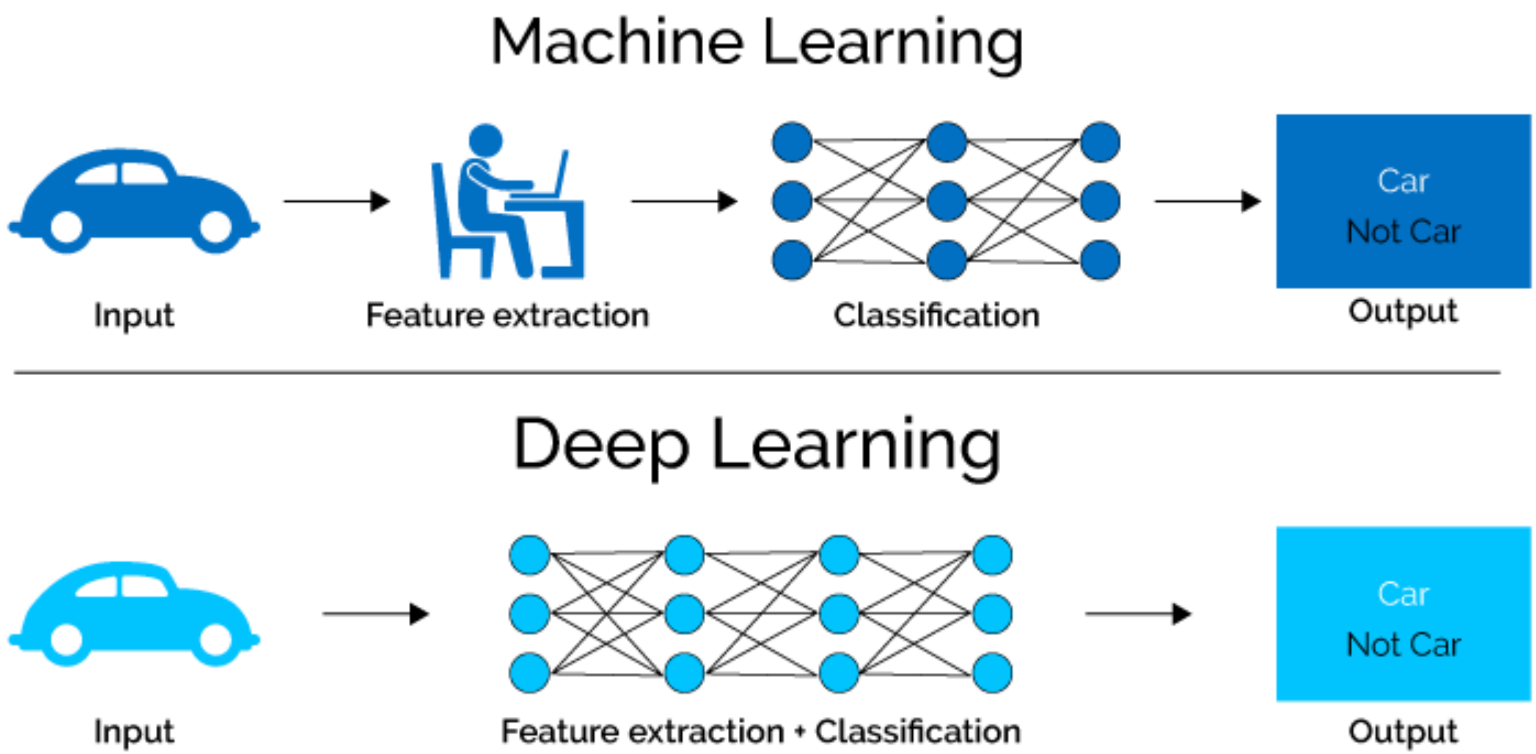


Deep Learning

- Deep learning algorithms
  - Run data through several “layers” of neural network algorithm
  - Each layer passes a simplified representation of data to next layer
- Machine Learning algorithms:
  - Work well on datasets that have up to a few hundred features
  - An unstructured dataset has large number of features – difficult for traditional machine learning algorithms to handle
  - Ex. an 800 * 1000 pixel image in RGB color has 2.4 million features

Why Deep Learning

- Hand-engineered/handcrafted features are time consuming and not scalable in practice



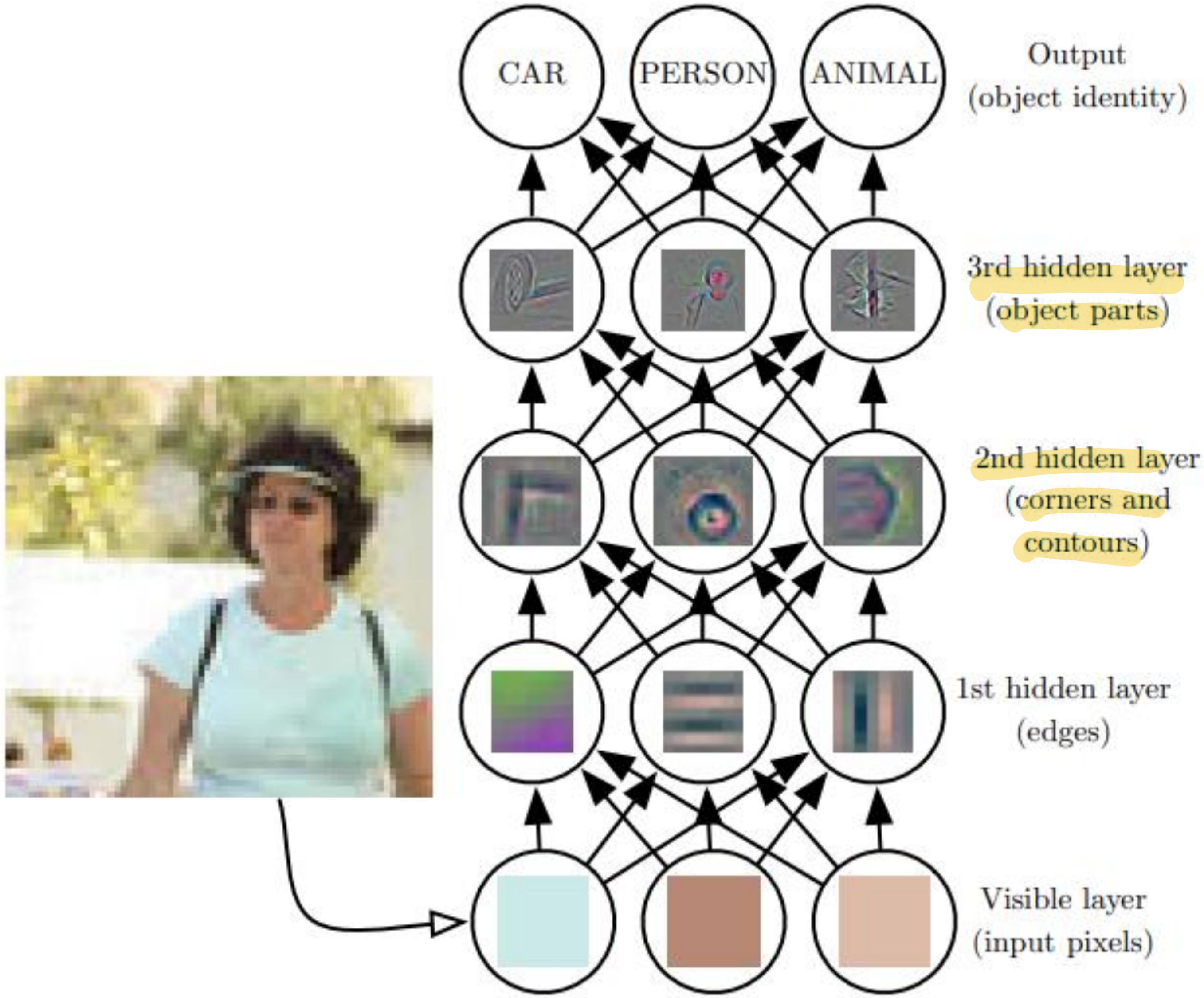
https://semiengineering.com/deep-learning-spreads/

Why Deep Learning

- Key - learn underlying features directly from data in an hierarchical manner

https://ai.plainenglish.io/introduction-to-deep-learning-2e7f21cadc4e

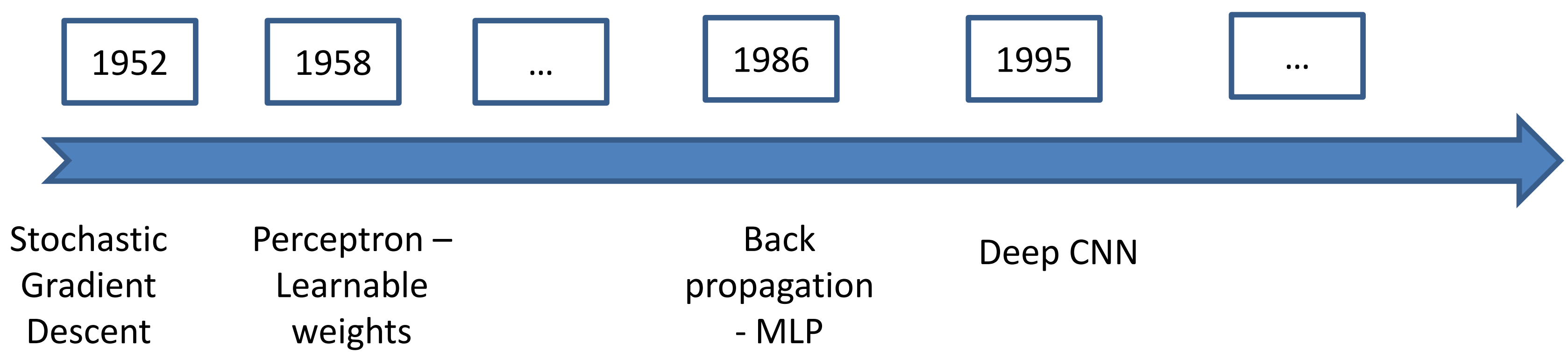
Why Deep Learning



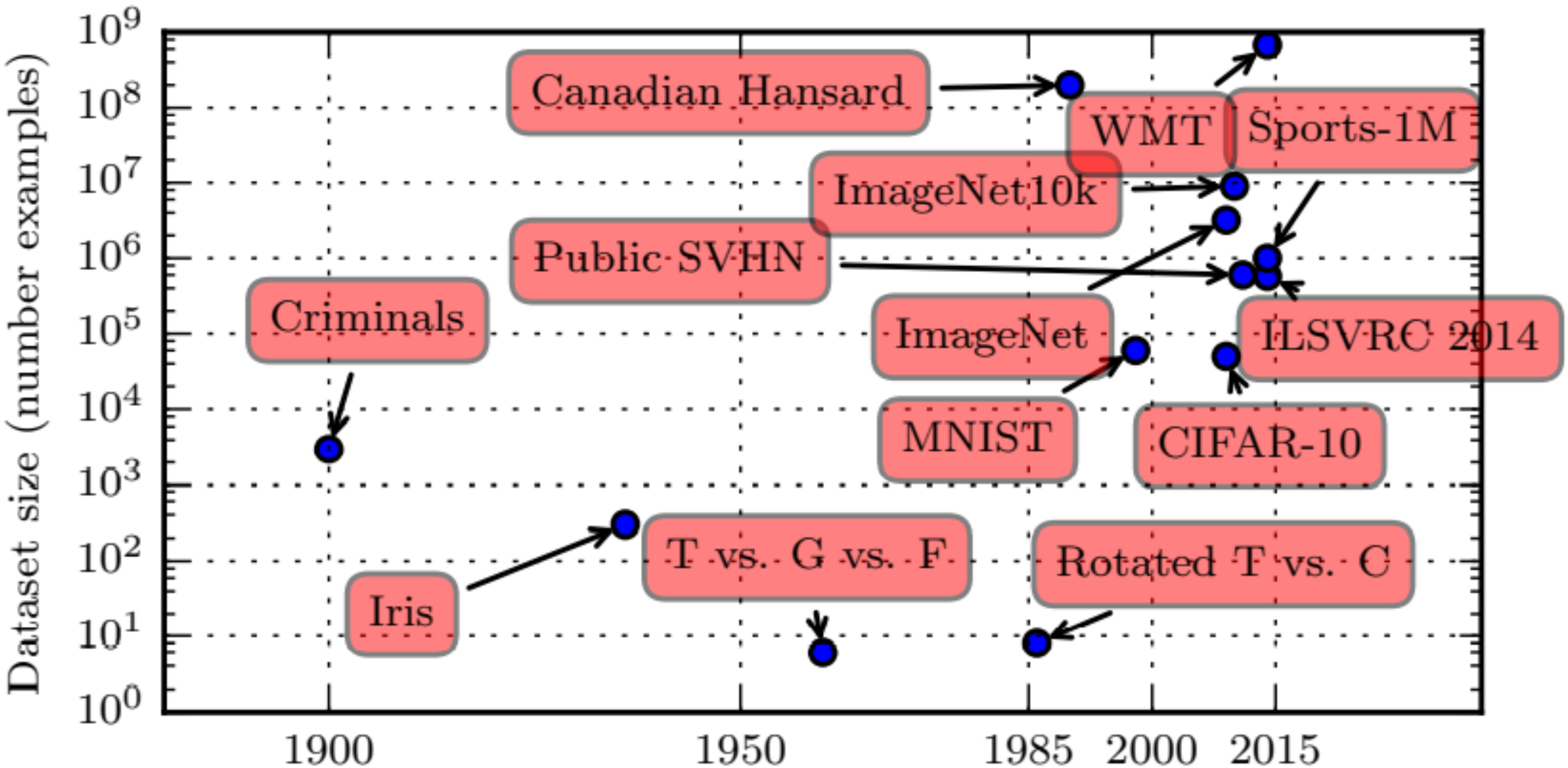
https://www.deeplearningbook.org/

Why Deep Learning Now?

- Data is more pervasive – Big Data
  - Larger datasets, easier collection and storage
- Hardware – Graphics Processing Units (GPUs)
- Parallelizable algorithms
- Software – better techniques, new models, open source toolboxes



Growing Datasets

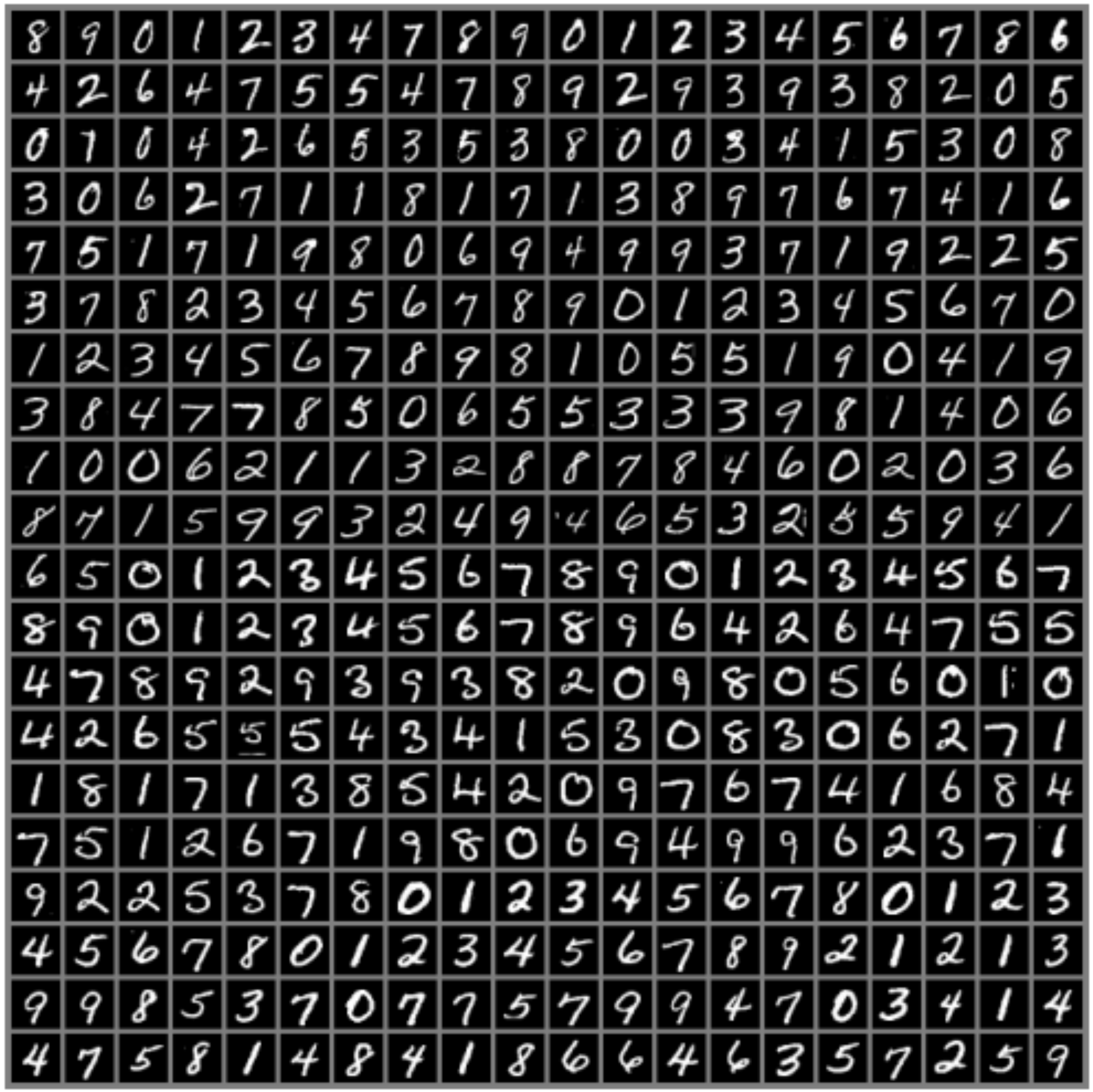


Ac

IRIS: https://archive.ics.uci.edu/ml/datasets/iris
MNIST: http://yann.lecun.com/exdb/mnist/
ImageNet: https://www.image-net.org/download.php

https://www.deeplearningbook.org/

MNIST Dataset



https://www.deeplearningbook.org/

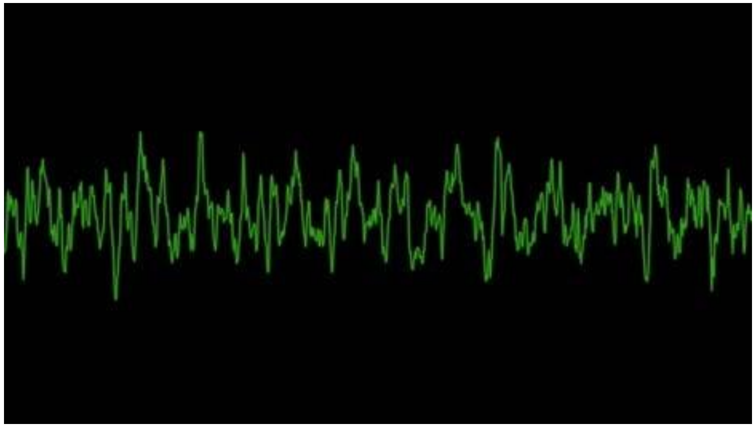
Structured vs. Unstructured Data

Size	No. of bedrooms	Price (in Lakhs)
150	2	80
200	3	120
380	4	250

Age	Ad Id	Click
25	10682	1
16	2051	0
58	31289	1

Image

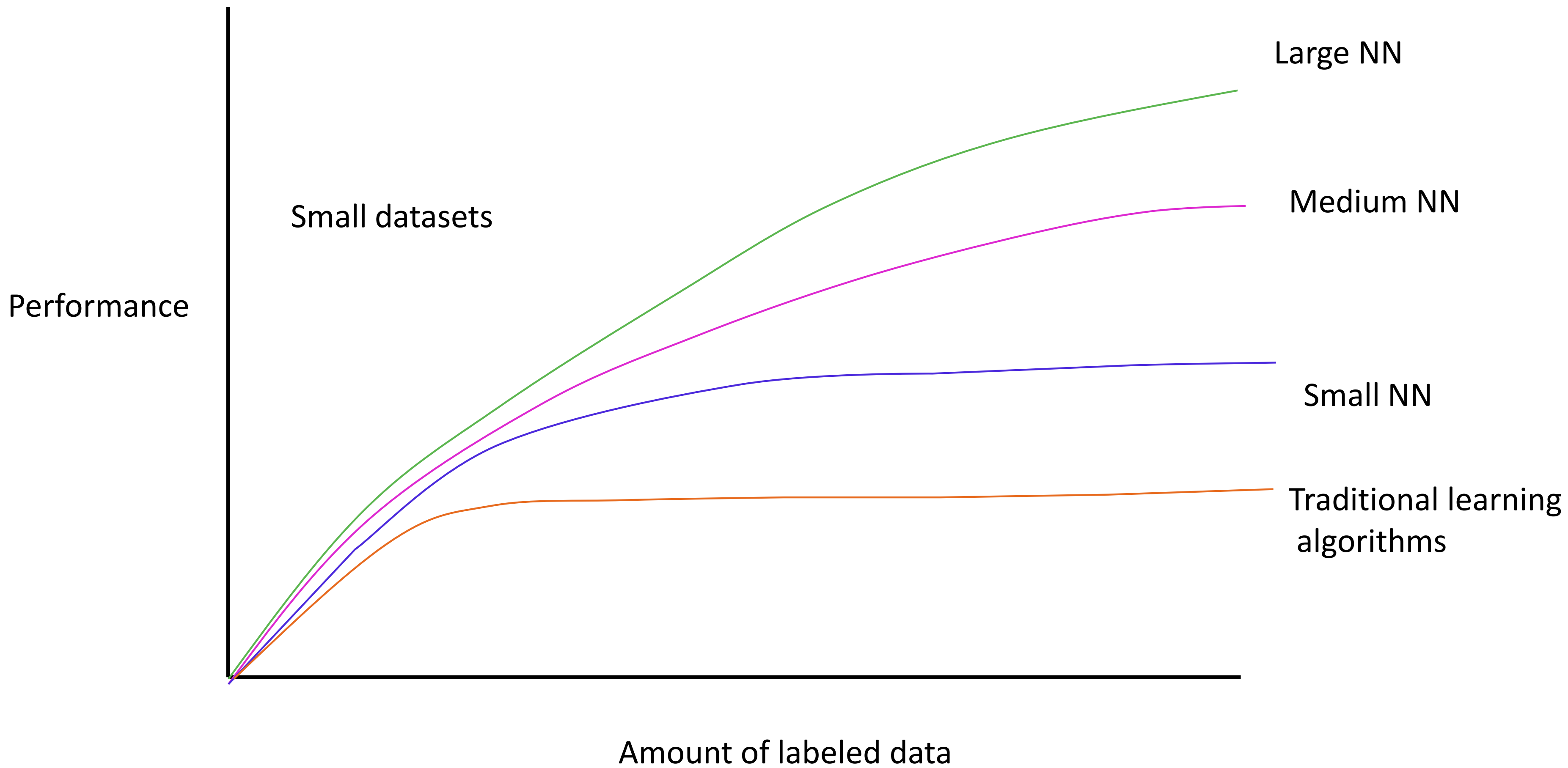
Audio



Text

Once upon a time, in a land far far away ….

Effect of Data Scaling



Two things to be considered for high level of performance:

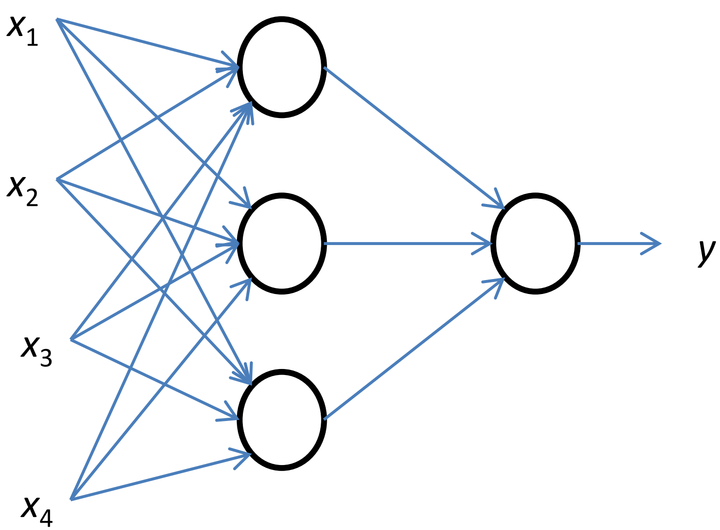
1. Able to train a big enough neural network
2. Large amount of labeled data

Supervised Learning

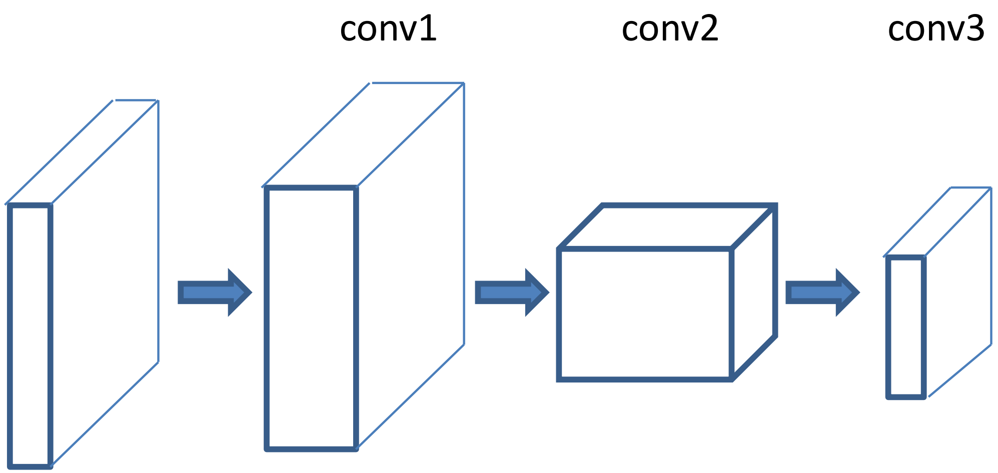
- Given a data set and correct output - relationship between input and output

Input	Output	Application	Type of NN
Home features	Price	Real estate	Standard NN
Image	Object (1..2000)	Photo tagging	CNN
Audio	Text transcript	Speech recognition	RNN
English	French	Machine translation	RNN
Sensor information	Position of objects on road	Autonomous driving	Hybrid
Ad, user information	Ad click?	Online advertising	Standard NN
Sensor information	Sunny?	Weather forecasting	Standard NN

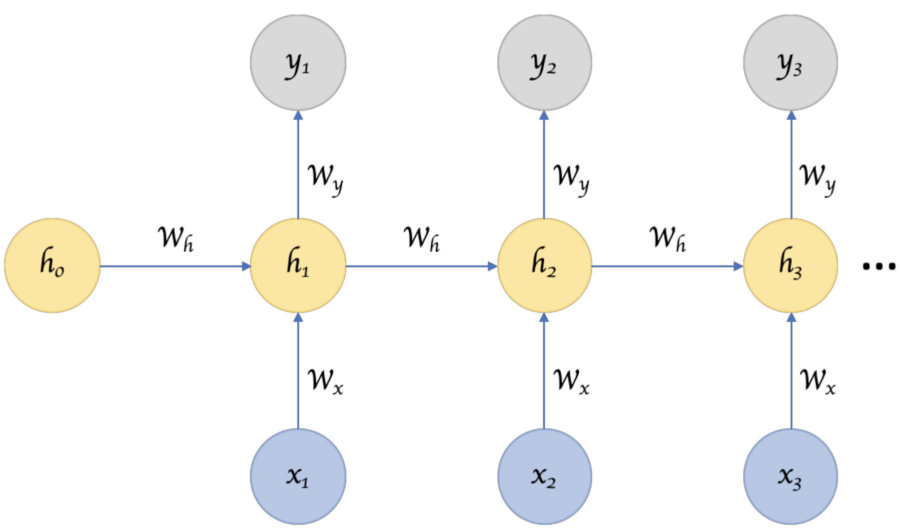
NN examples



Standard Neural Network



Convolutional Neural Network



Recurrent Neural Network

https://gotensor.com/2019/02/28/recurrent-neural-networks-remembering-whats-important/

APPLICATIONS

Language Modeling

S = Where are we going

Previous words (Context)

Word being predicted

P(S) = P(Where) x P(are | Where) x P(we | Where are) x P(going | Where are we)

https://thegradient.pub/understanding-evaluation-metrics-for-language-models/

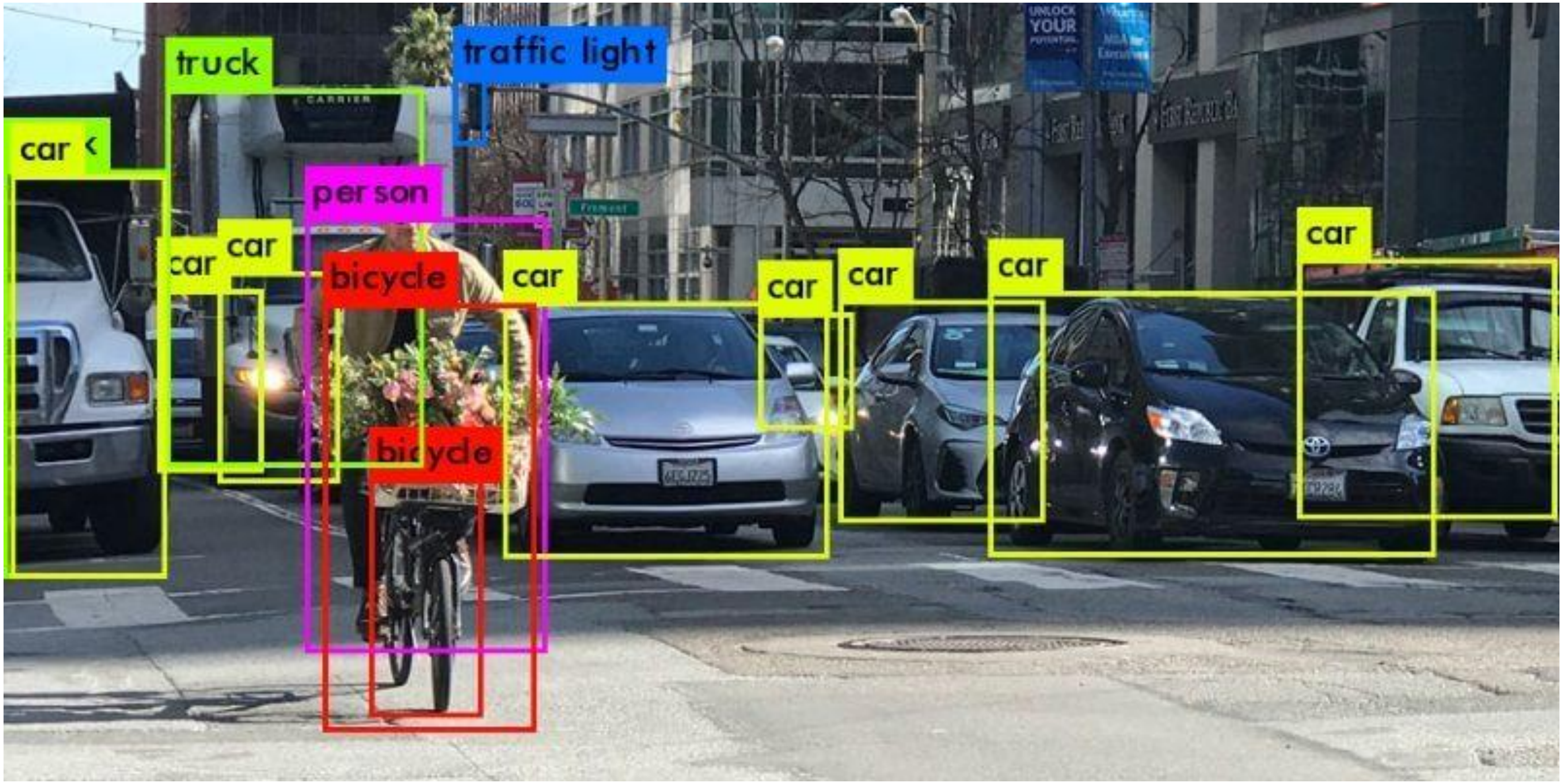
Speech Recognition

https://www.xrtoday.com/virtual-reality/what-is-speech-recognition-technology-in-vr/

Machine Translation

https://livesalesman.com/why-you-cant-depend-on-machine-translation-for-multilingual-customer-support/

Object Detection/Recognition



https://azati.ai/image-detection-recognition-and-classification-with-machine-learning/

Image Captioning

https://evergreen.team/articles/automatic-image-captioning.html

Generating Authentic Photos

https://www.bbvaopenmind.com/en/technology/artificial-intelligence/gan-the-rise-of-imagination-in-machines/

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Speech Recognition

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Machine Translation

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