

Deep Learning

Hype, Reality and Applications in Manufacturing

Who Am I?



- My name is [Adam Cook](#).
- Studied Mechanical Engineering at Purdue University West Lafayette.
- Chief Technical Officer of [Alliedstrand](#) in Chicago (we also have engineers in Dallas).
- Chair of **SME Chapter 112** (Northwest Indiana and Chicagoland). Check out [sme112.org](#).
- I work with embedded systems, robotics, automation systems and industrial software.
- Contact my chapter at [hello@sme112.org](#).

SME Virtual Network Slack



Are you an SME member? Do you want access to Slack? Fill out this short form:

<http://bit.ly/2BpjMiE>

A screenshot of the Slack interface for the "SME Virtual Net..." workspace. The left sidebar shows the workspace name, a search bar, and a list of channels including #general, #python, and #virtualcommittee. Below the channels are direct messages and a list of users. The main area displays the #general channel with messages from adamjcook and curtwanderson. The messages include a reminder for a Python webinar and a welcome message for the SME Virtual Community. The interface is dark-themed with a purple sidebar and a white main area.

What is Artificial Intelligence (AI)?

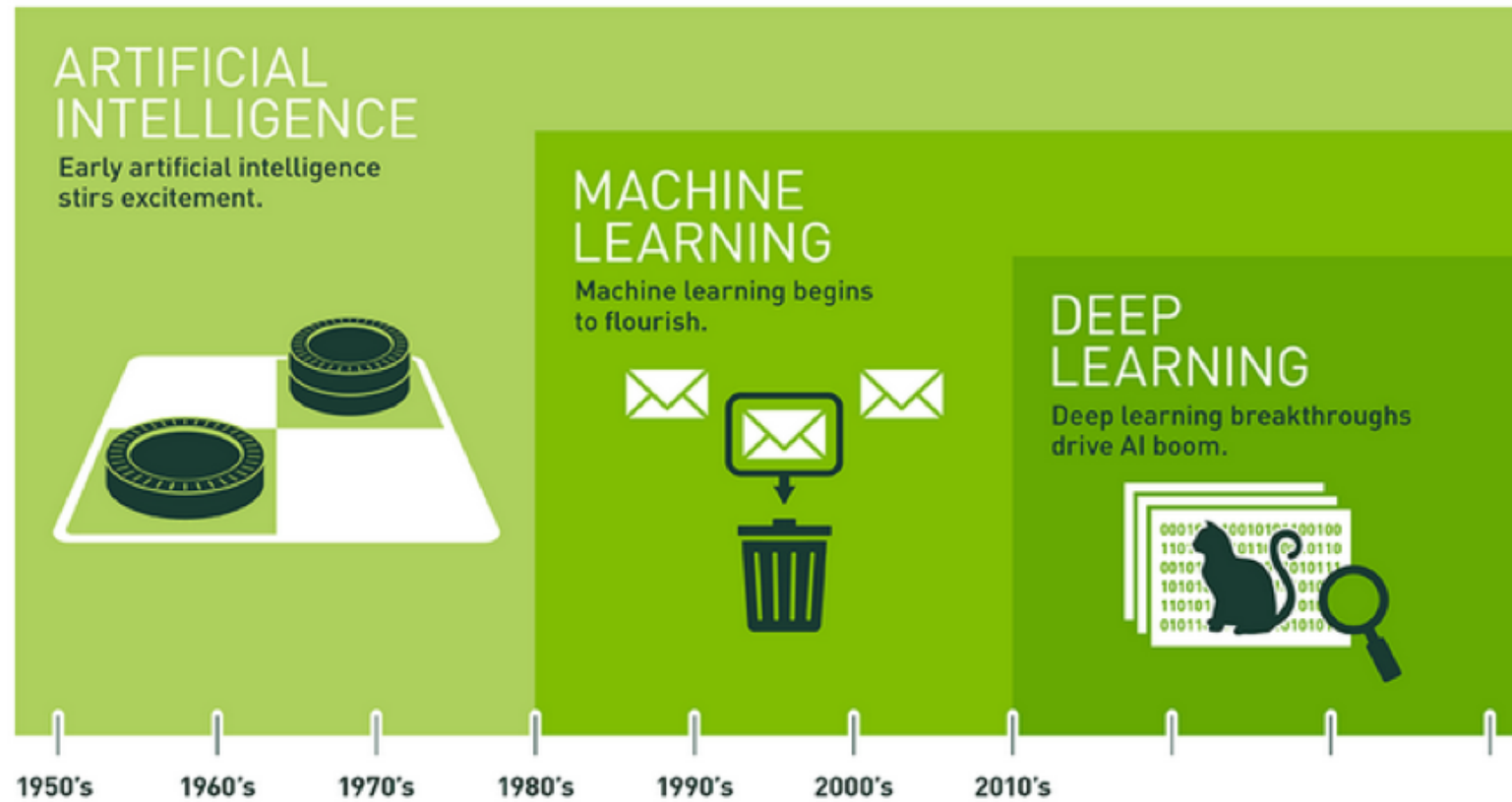


Broadly, building machines that can perform tasks as a human could.

We are here today.

Narrow AI A system capable of achieving at least human parity in a few defined tasks that humans trained it to do.

Strong AI A system which is indistinguishable in intelligence from a human.



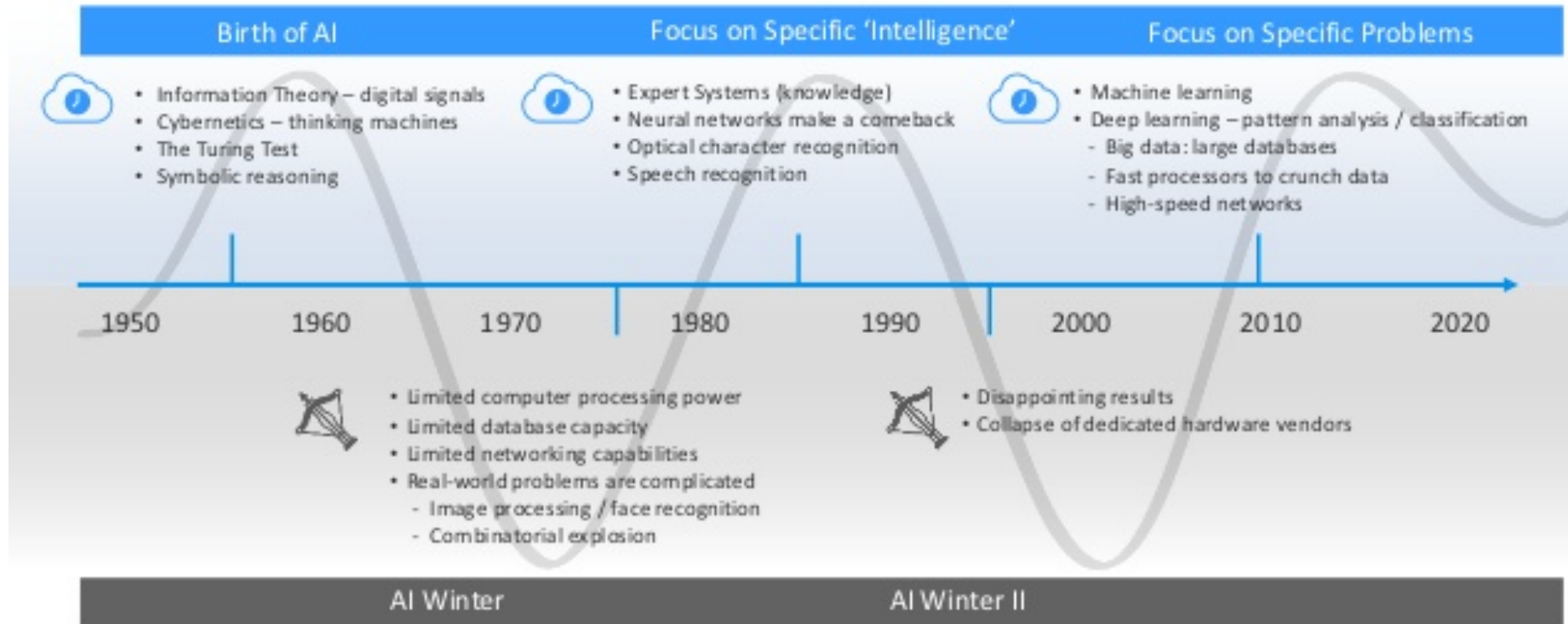
Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Artificial Intelligence (AI) Human intelligence exhibited by machines.

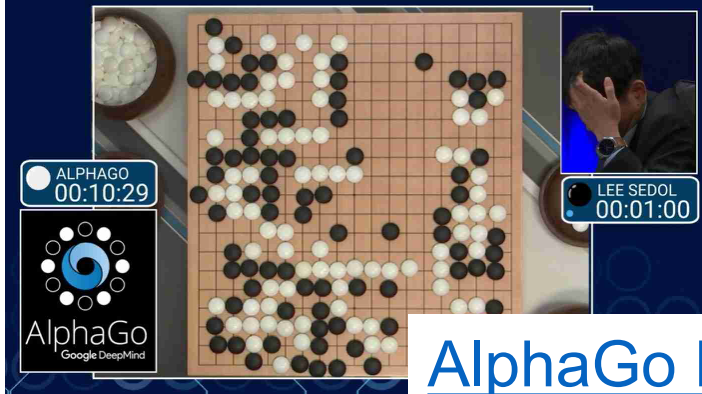
Machine Learning (ML) Machines that are capable of learning without being explicitly programmed.

Deep Learning (DL) Family of techniques to implement machine learning (e.g. deep neural networks or recurrent neural networks).

An AI Timeline



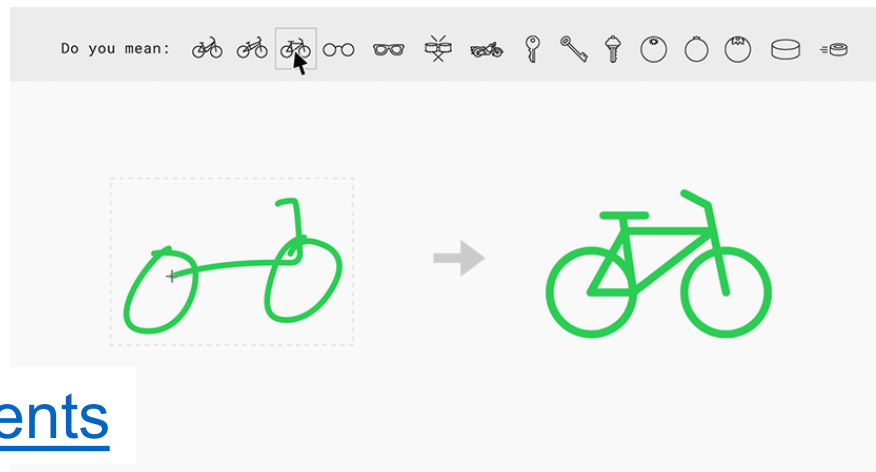
Recent Breakthroughs and Interesting Demos



AlphaGo Beats World's Best Human Player



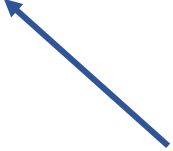
Self-driving Cars



Google AI Experiments

Simply, **Yes.**

1. Availability of **large amounts of data.**
2. Availability of **large amounts of cost effective computing resources.**



Particularly **Graphical Processing Units**
(and some custom chip architectures)

But...



Winter can come again
(just maybe not as cold)

- **Natural Language Processing (NPL)**
Chatbots.
- **Image or Object Recognition** Vision systems in autonomous vehicles.
- **Speech Processing/Translation** Amazon Alexa or Google Home
- **Pattern Prediction** After training the system, the system correctly predicts the output based on input it has not been trained on.

Various Predictions on Strong AI Horizon

<http://bit.ly/2EqrUyh>

Facebook AI System Went Rouge
(total misrepresentation)

<http://bit.ly/2uU4Un8>

**Robots Can Now Read, Millions of Jobs
At Risk** (not really)

<http://bit.ly/2FEKMdO>

Predictions on AI (and some hype)



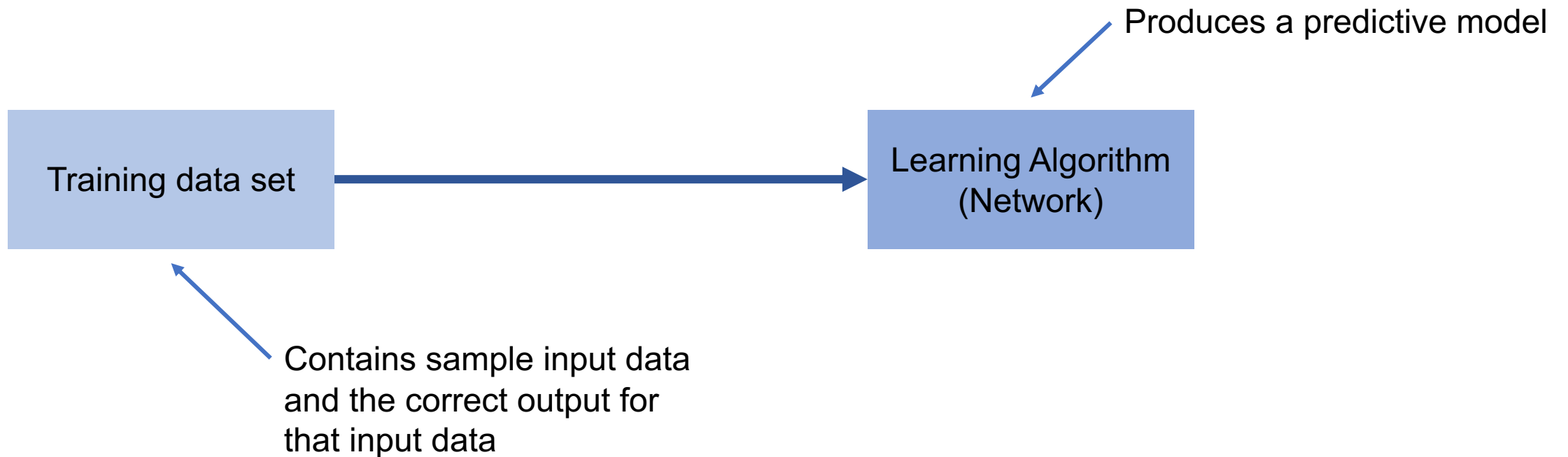
- Technology predictions which are multiple decades away are **very suspect**.
- Tend to agree more with Rodney Brooks and [Paul Allen](#) than [Ray Kurzweil](#) on the strong AI timelines.
- AI coupled with automation (or robotics) will be transformational for manufacturing, but most of the time horizons quoted are **too ambitious**.
- The knowledge requirements for many jobs will increase, but that is **not 100% AI's fault**.
- The public tends to look at a narrow AI system and, not understanding how it works, allows their imaginations to run wild.

Dated Predictions from Rodney Brooks

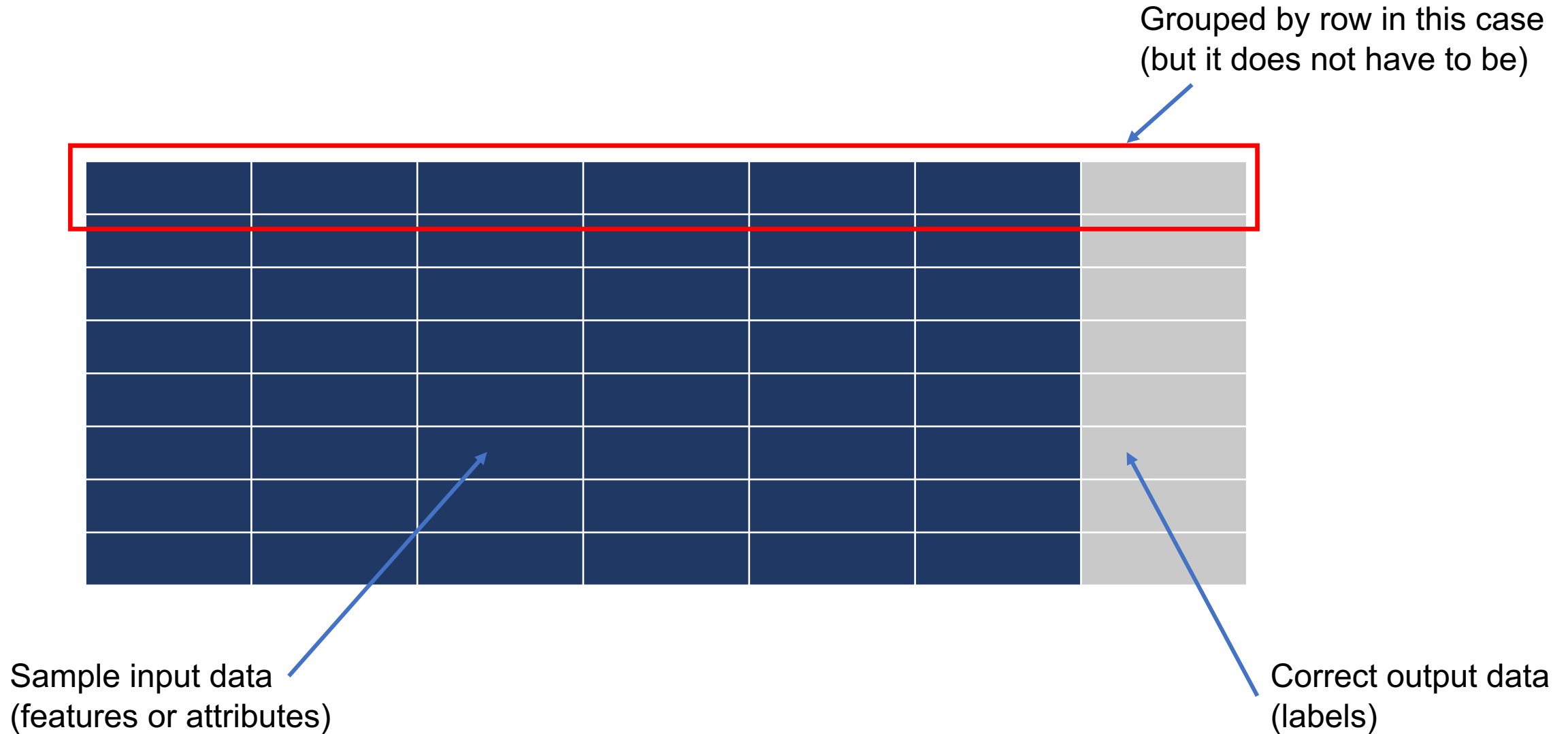
<http://bit.ly/2m8Xh8r>

Step 1 Training

This is called **Supervised Learning**



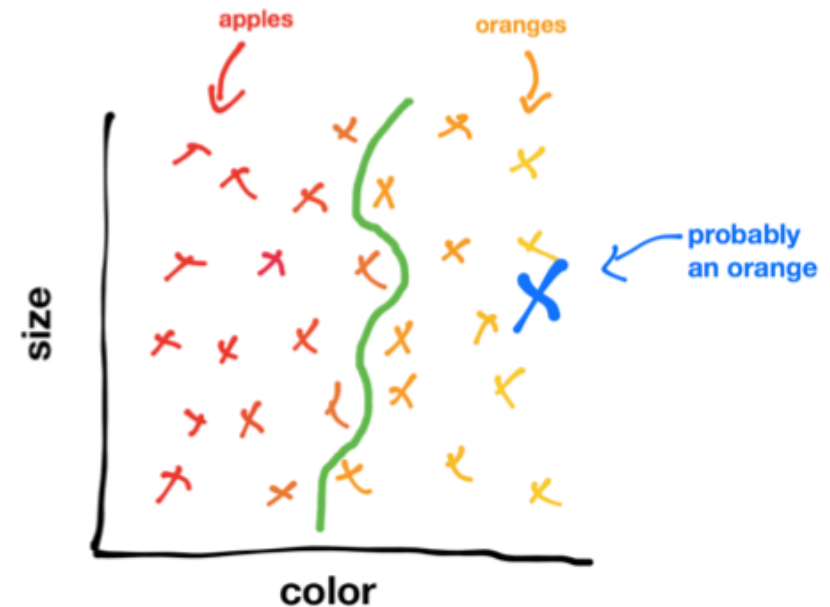
Machine Learning Basic Process



Two-Dimensional Training Data

Feature 1,1 Feature 1,2 Label for Feature 1,1 and Feature 1,2

Weight	Color	Fruit
		Apple
		Orange
		Orange
		Orange
		Apple
		Orange
		Apple
		Apple



Source <http://bit.ly/2EB7JkC>

Regression (in 2D)

Feature 1,1

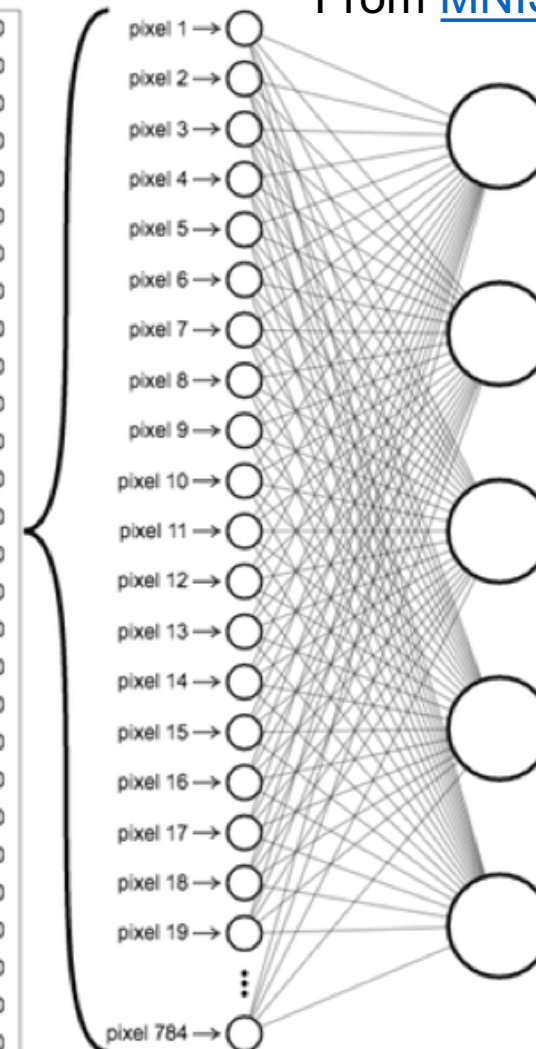
Feature 1,2

Price	Sq. Foot

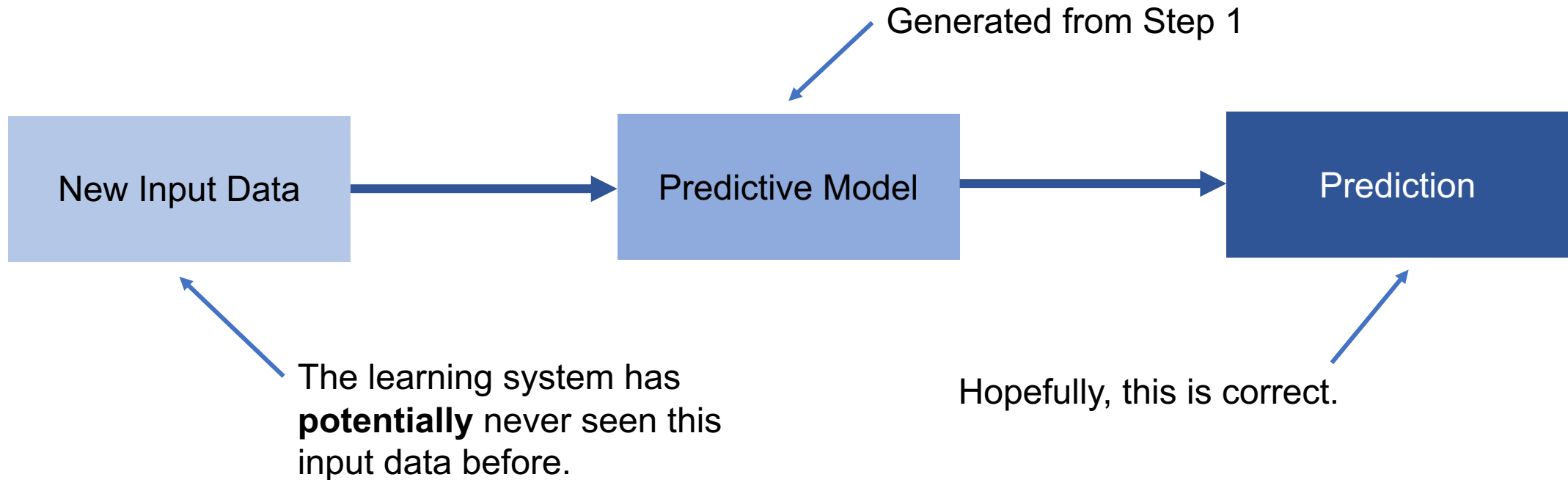


Source <http://bit.ly/2EB7JkC>

From MNIST dataset

[illegible]

Step 2 Prediction



Training Data Considerations



Source <http://bit.ly/2F19ISu>

- Data can (and it will, at times) lie to you.
- Think about data delivery – particularly if it is arriving from human sources (i.e. manual data collection on clipboard).
- Data anomalies will occur (i.e. sensor failures). How do you address them?
- Are you collecting the right data and, more importantly, enough **relevant** data? **A determination must be made of what features are important and which are not in pursuit of an ML system.**
- Careful of biases (i.e. [confirmation bias](#), [selection bias](#) and [others](#)) and [anecdotal evidence](#). **Be scientific!**
- [When facts are weapons.](#)
- Good [example](#) of selection bias. **Why?**

Questions?

Ask in the Live Chat or check the feedback link in the description!

Or

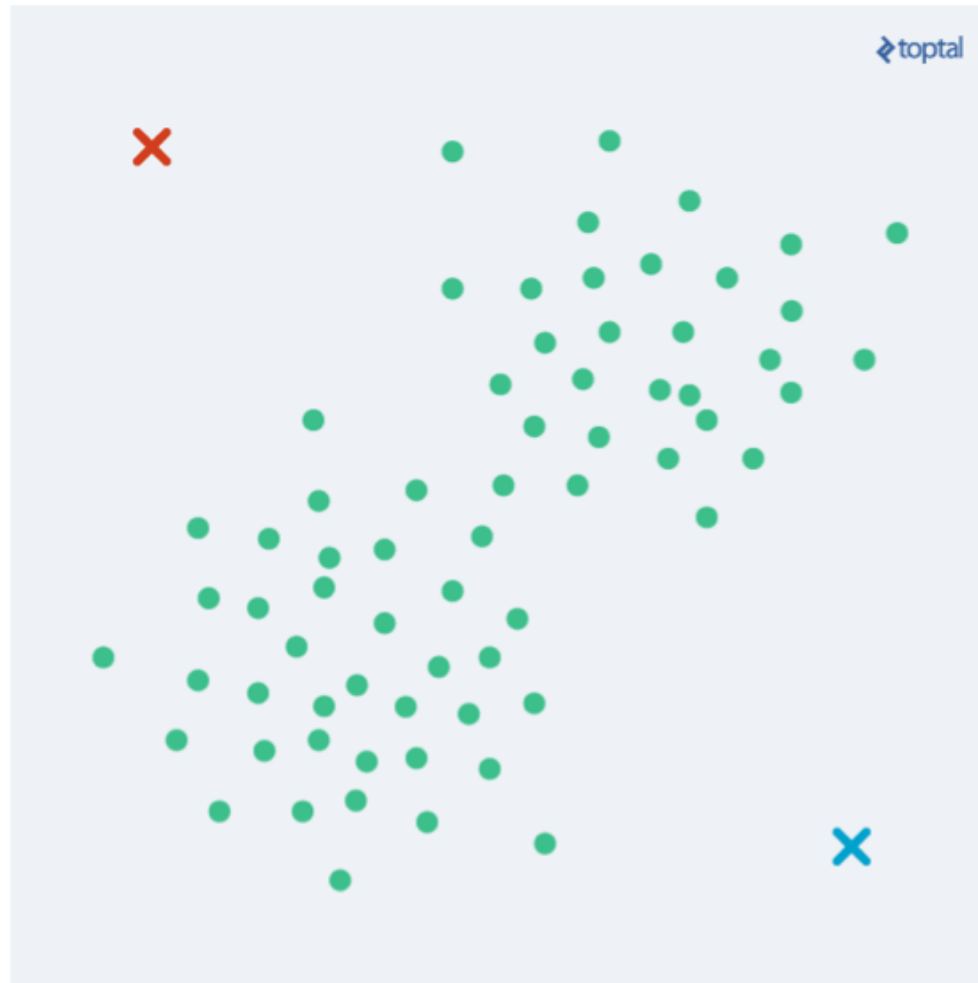
Watch <http://bit.ly/2ED471m>

Supervised Learning ML system is trained with a **labeled** data set

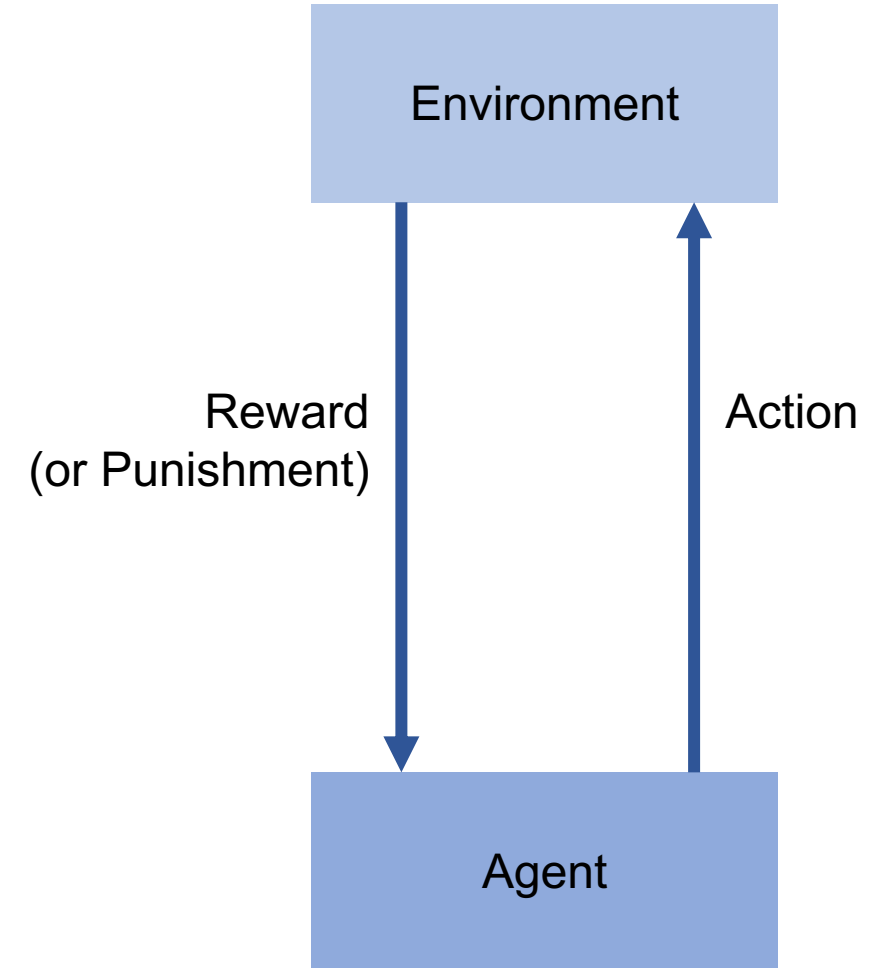
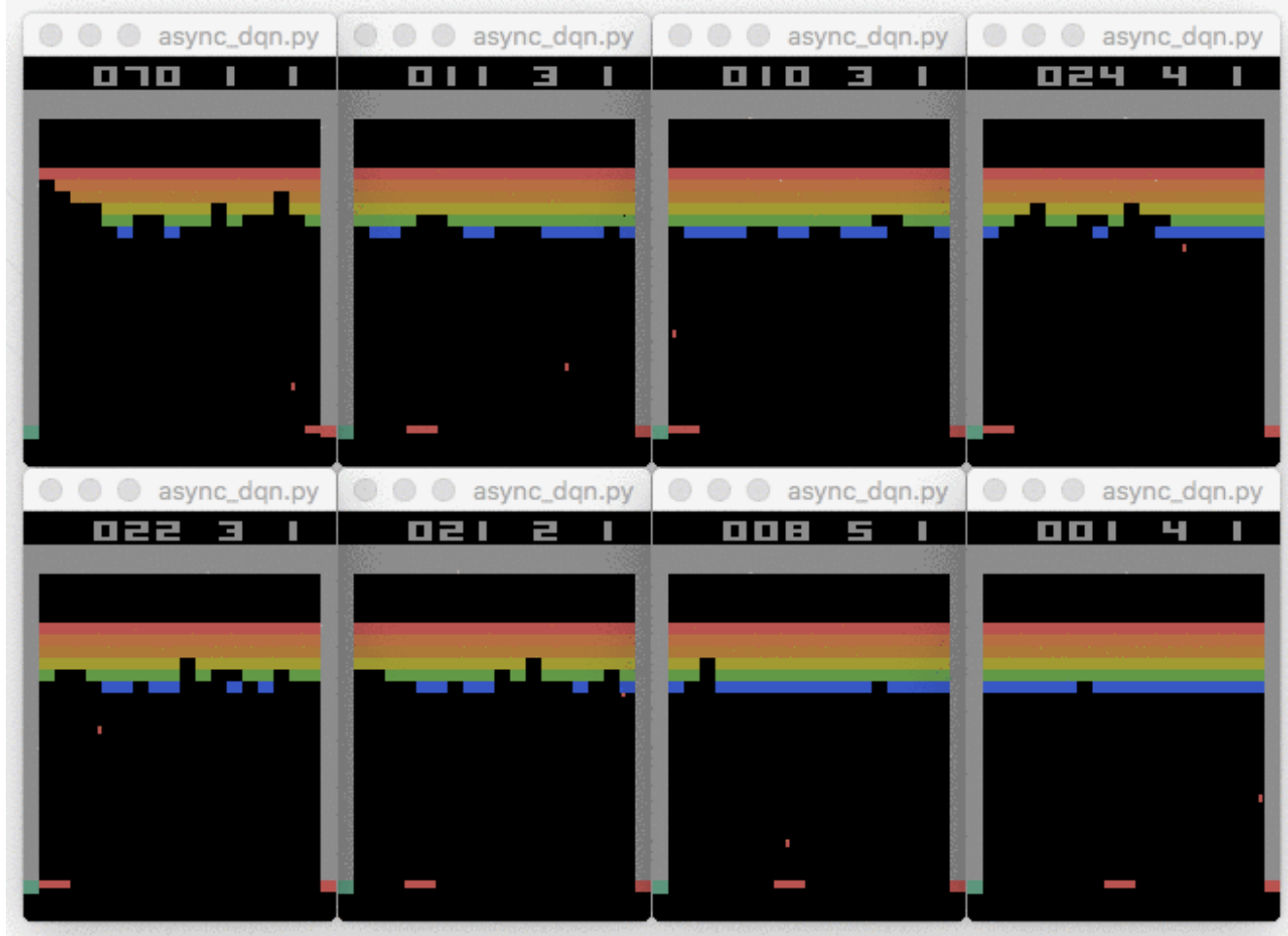
Unsupervised Learning ML system is trained with an **unlabeled** data set

Reinforcement Learning ML system learns by trial-and-error combined with a reward (or punishment) system

Unsupervised Learning - Clustering



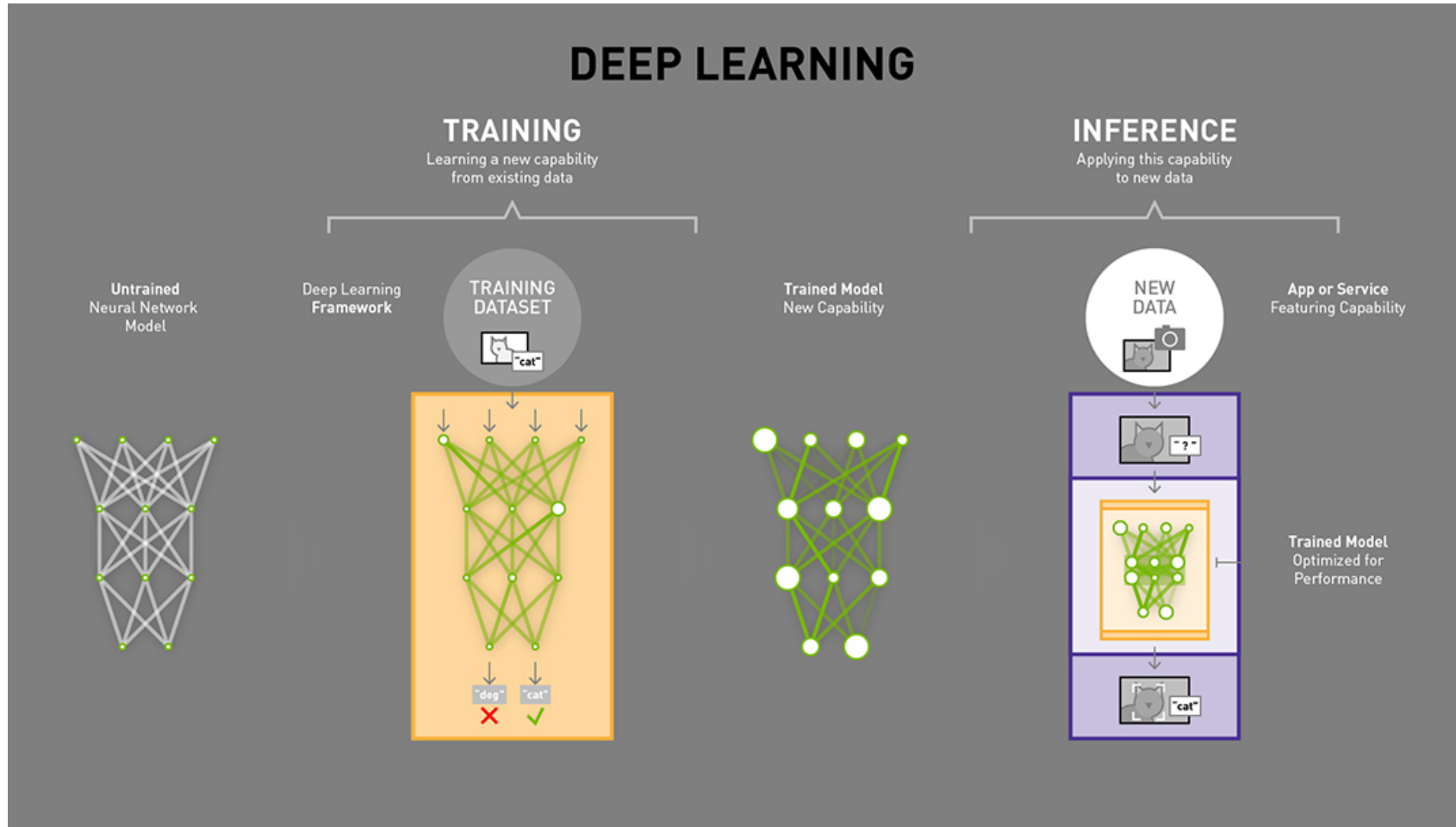
Reinforcement Learning



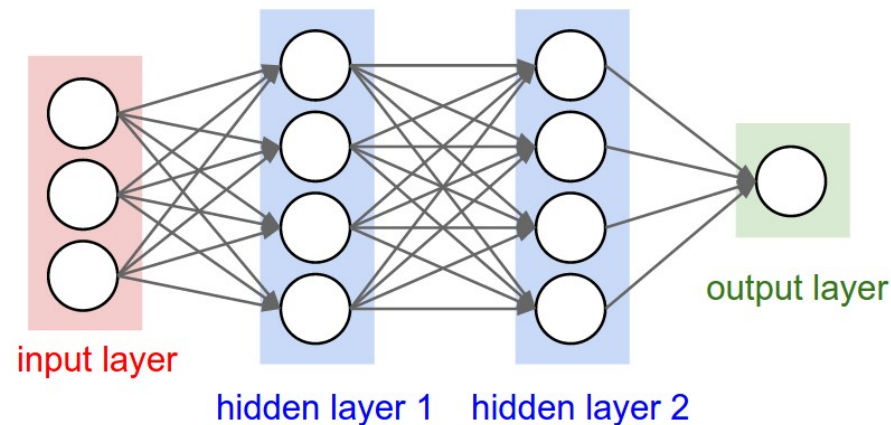
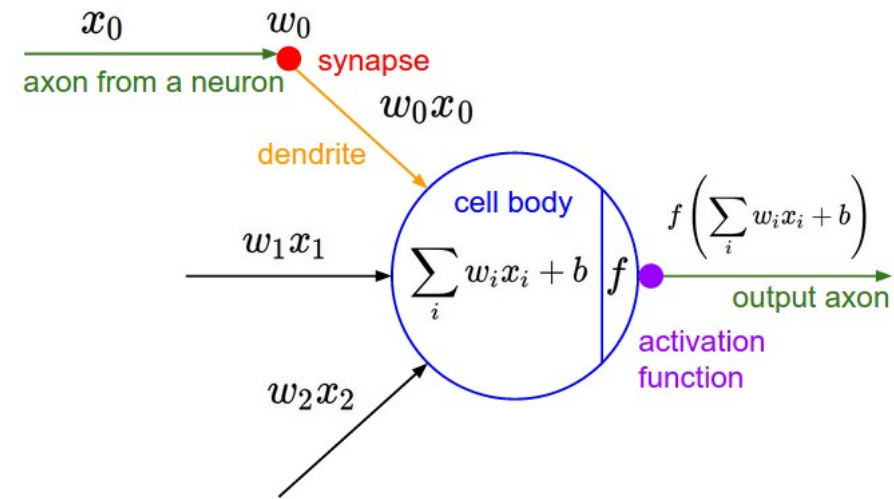
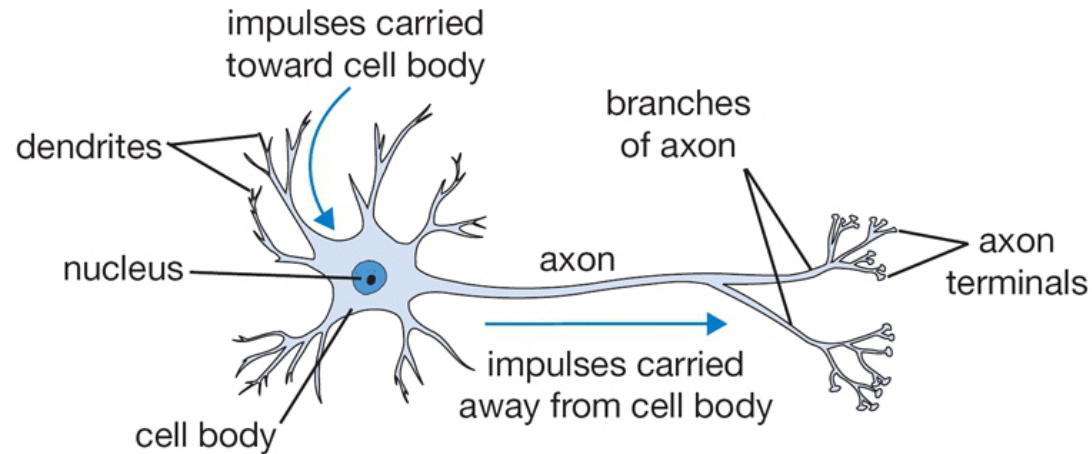
Great video on the basics of neural networks. Do not pass this one up!

<http://bit.ly/2fMZljF>

Neural Network Basics



Neural Network Basics



b, Bias
w, Weight

These are tunable parameters during the training process.

- No out-of-the-box solutions for manufacturing (not yet, anyways).
- Need data experts.
- Need IT/OT expertise.
- Adoption can be **very** expensive.
- AI gets you that “last mile” of value, it is **not magic**.

Some progress to address the first two points for SMMs via [Google's Cloud AutoML](#) product. Jury still out on its generality...

- Predictive equipment maintenance
- Digital twin
- Dynamic processing (micro)
- Dynamic production (macro)
- Automated visual inspection and decision making

Popular ML Frameworks and Libraries



Some ML Hardware Options (for GPUs)



NVIDIA JETSON

The embedded platform for autonomous everything



Google Cloud Platform



Microsoft
Azure



[Machine Learning Course on Coursera](#)

[Practical Deep Learning for Coders](#)

[Udacity Machine Learning Nanodegree](#)

Webinar March 6 at 11:00 am CST

IIoT Fundamentals and Applications

3-Day Workshop Starts March 2

Python Fundamentals for Engineers and Manufacturers

Webinar March 21 at 11:00 am CST

Setting Up Python on Your Computer

3-Day Workshop Starts March 28

Python Fundamentals for Engineers and Manufacturers

Webinar May 15 at 11:00 am CST

Introduction to Machine Vision

Thank you!



Want to learn more about  **?**

Check out sme.org

Questions?

Ask in the Live Chat or check the feedback link in the description!