What is Machine Learning?

Machine Learning Academy

Goals

1. What is Machine Learning?
2. Limitations
3. Supervised vs Unsupervised?
4. Learning with rewards?
5. Importance of Deep Learning?

Outline

1. What is Machine Learning?
2. Supervised Learning
3. Unsupervised Learning
4. Reinforcement Learning
5. Deep Learning
6. What is the goal of the Machine Learning Academy?

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What is Machine Learning ? (1)

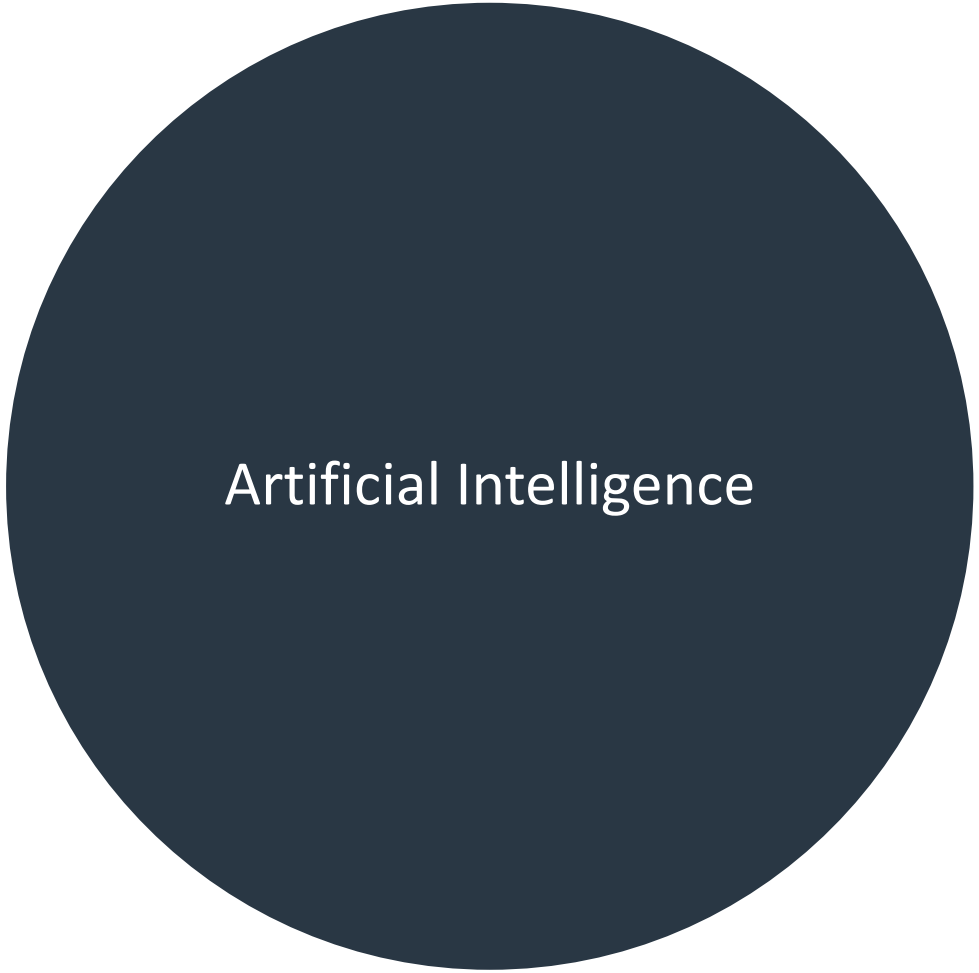
*"Machine learning is the subfield of computer science that gives computers the ability to **learn without being explictly programmed**."*

Arthur Samuel, 1959

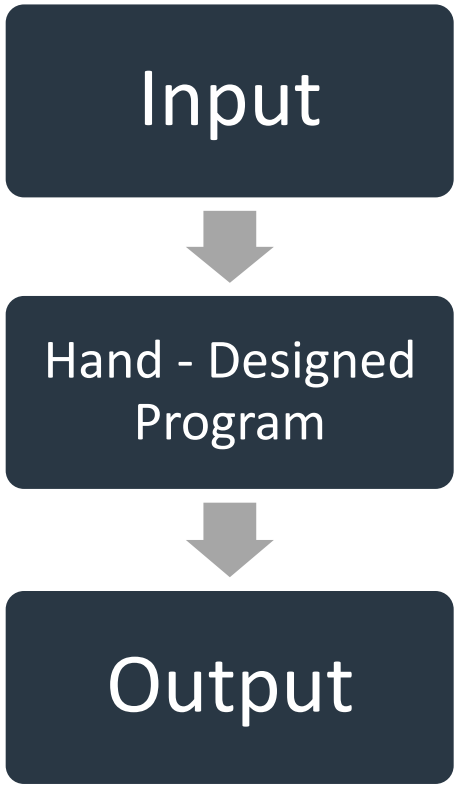
It's part of our daily routines:

- Search engine queries;
- Mail spam filtering;
- Netflix, Amazon, Spotify, etc., recommendation systems;
- Facebook feed update;
- Google translator;
- Mobile typing (such as Swiftkey);
- Surveillance camera automatic monitoring;
- Fraud detection in credit card transactions;

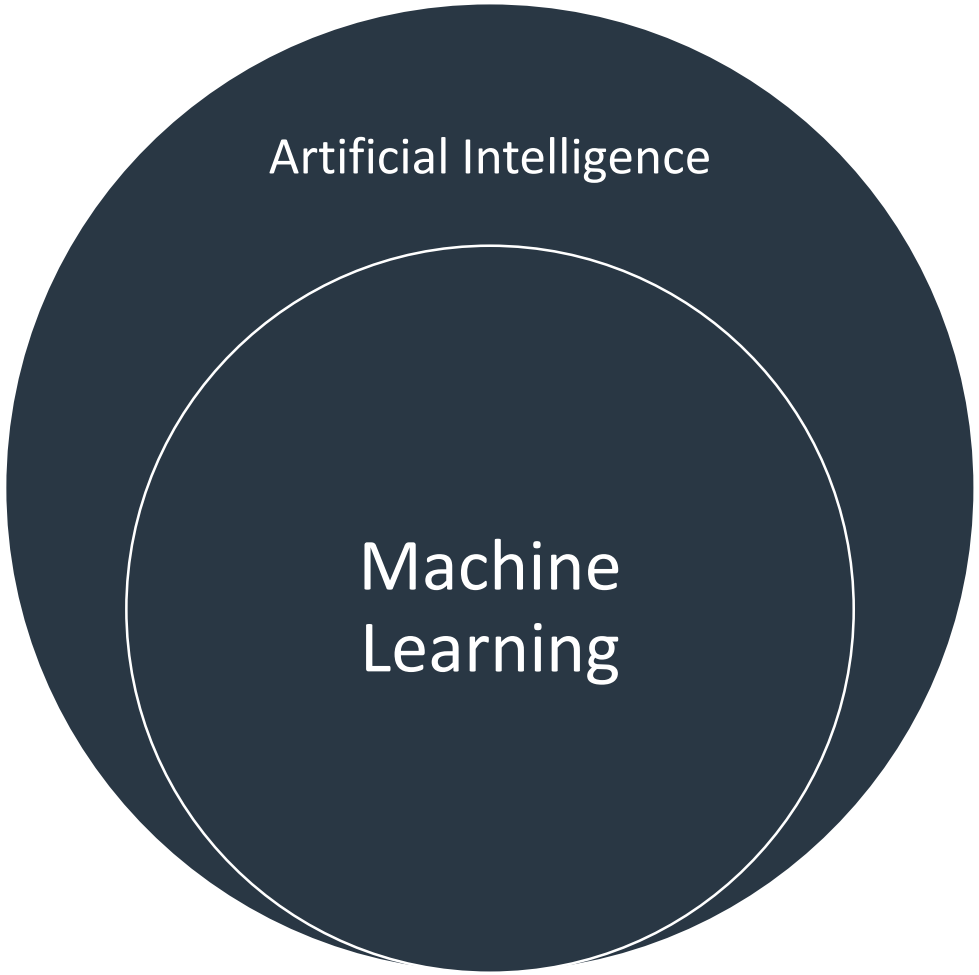
What is Machine Learning? (2)



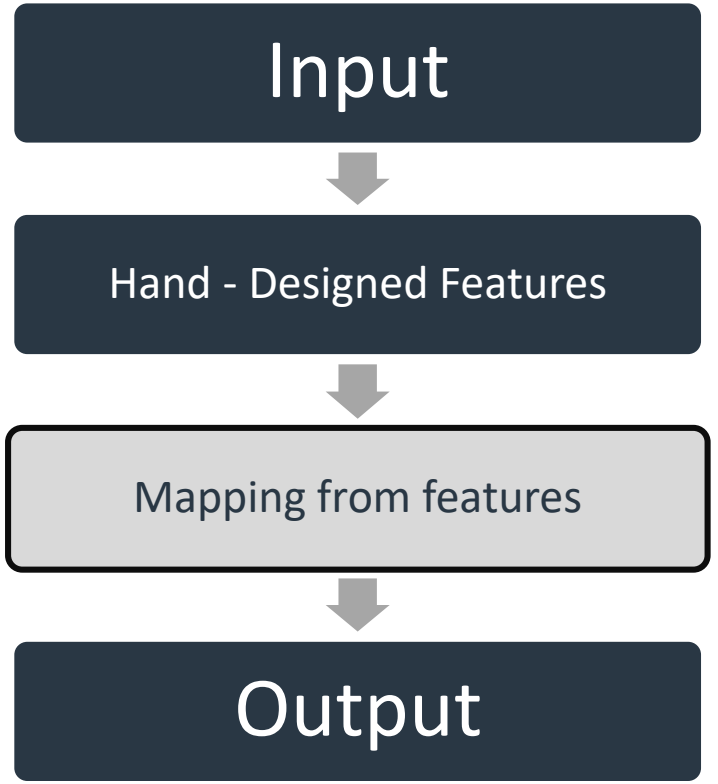
Rule based system



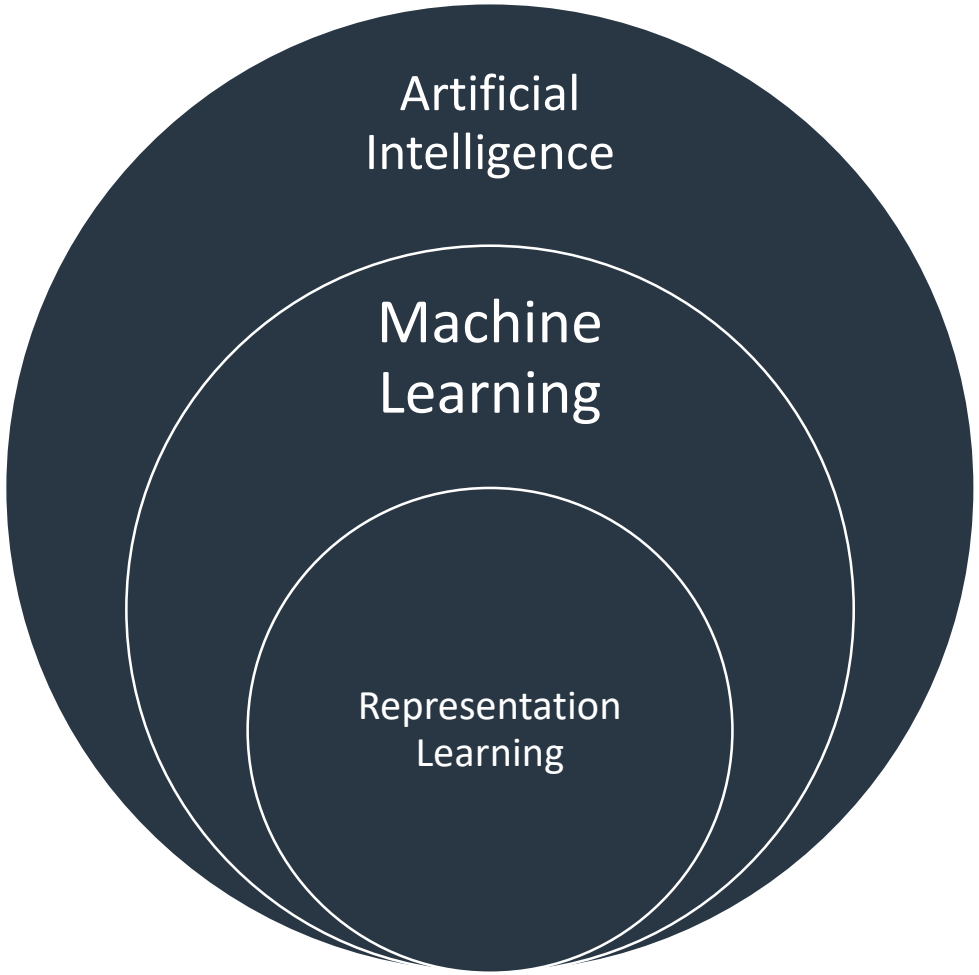
What is Machine Learning? (3)



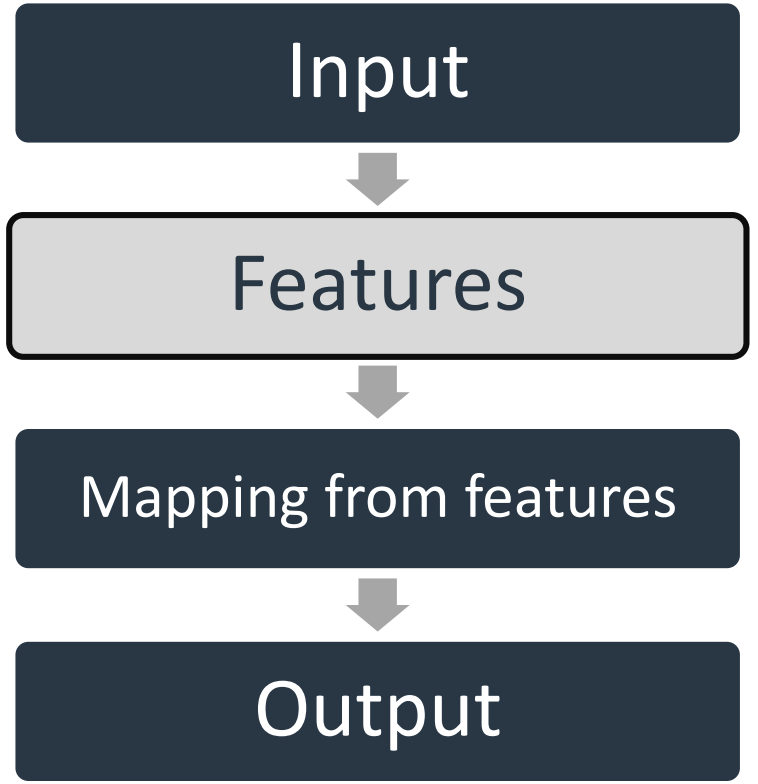
Classic machine learning



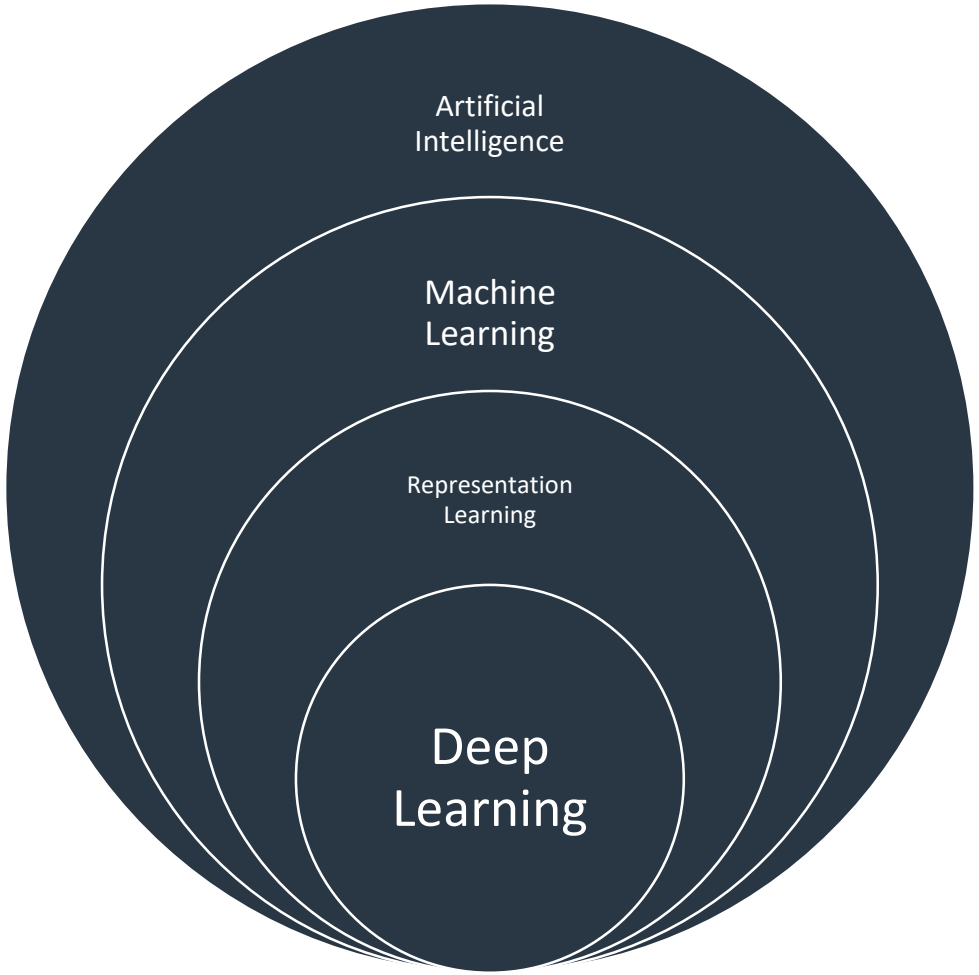
What is Machine Learning? (4)



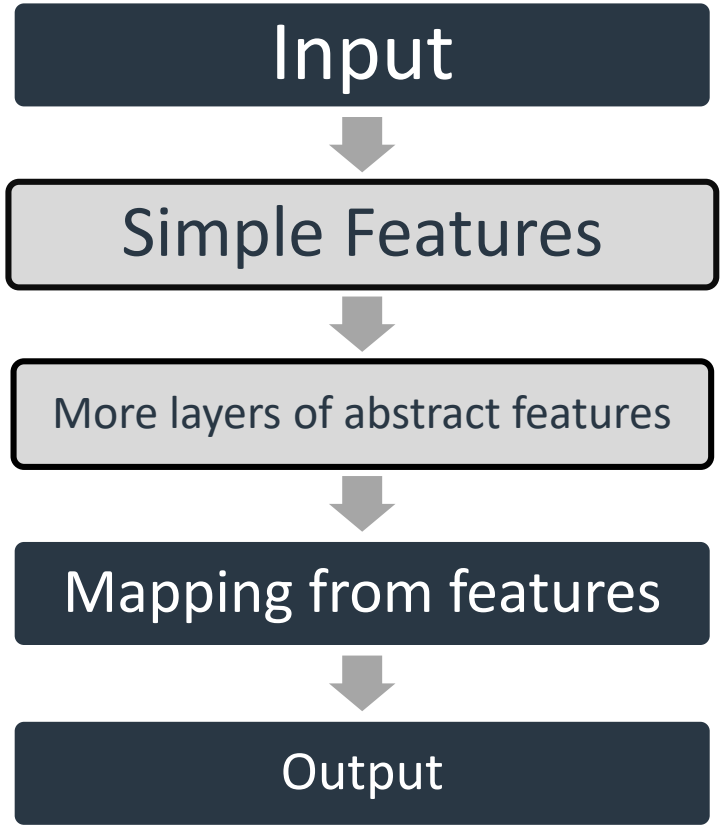
Representation Learning



What is Machine Learning? (5)



Representantion with Deep Learning



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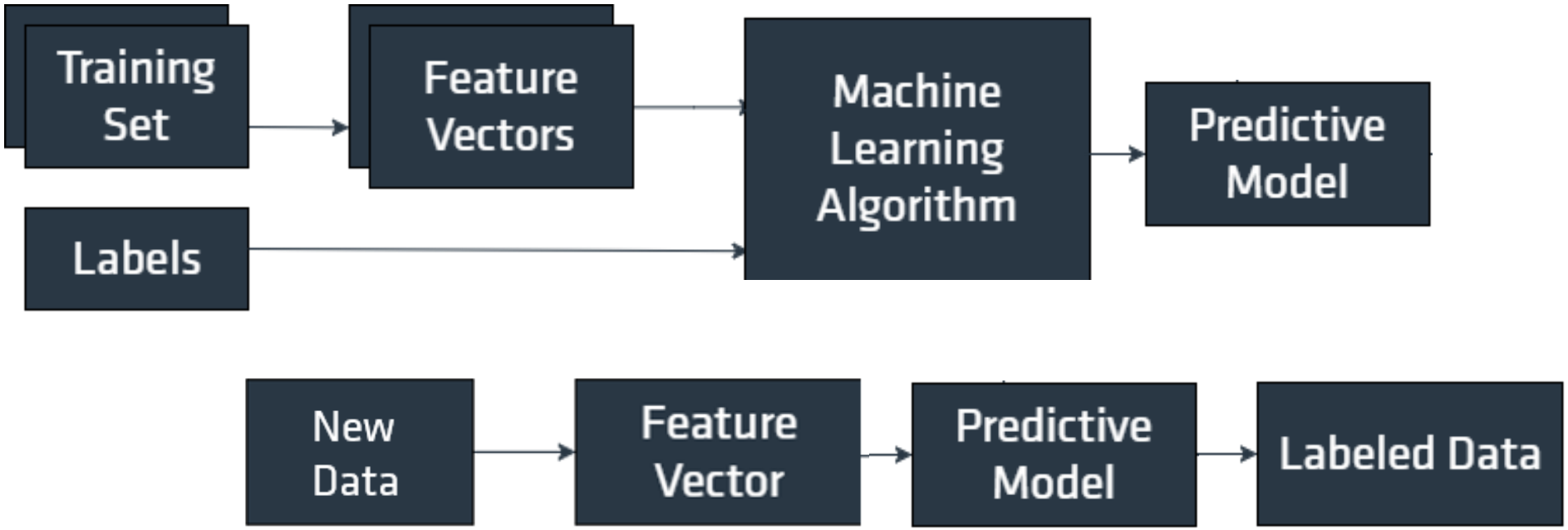
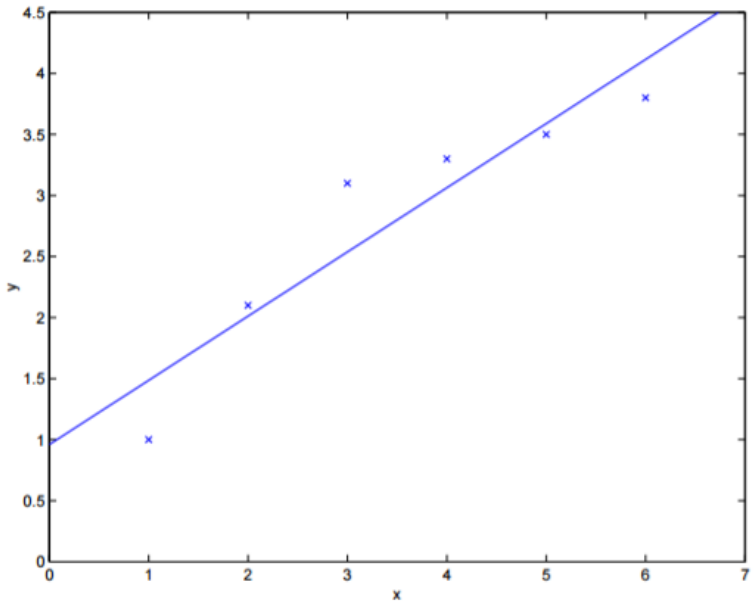
Supervised Learning (1)

"Supervised learning is the machine learning task of inferring a function from labeled training data."



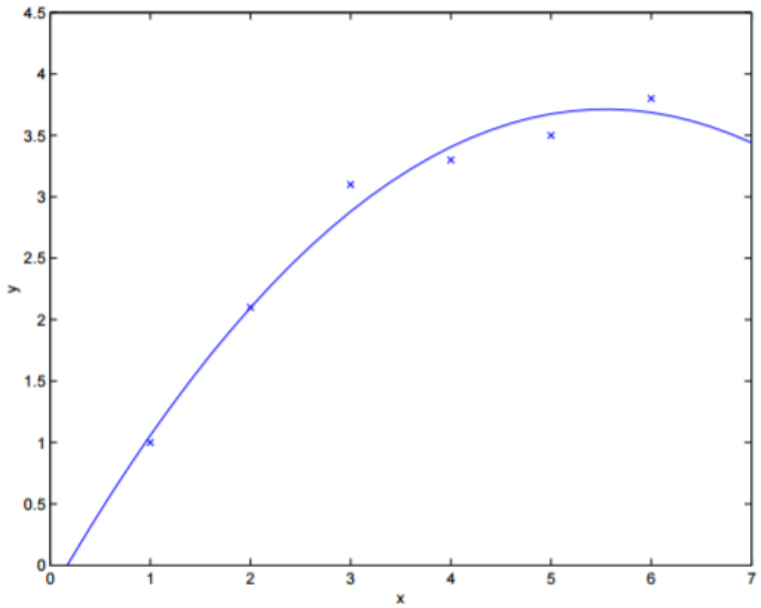
Supervised Learning (2)

1st order approximation



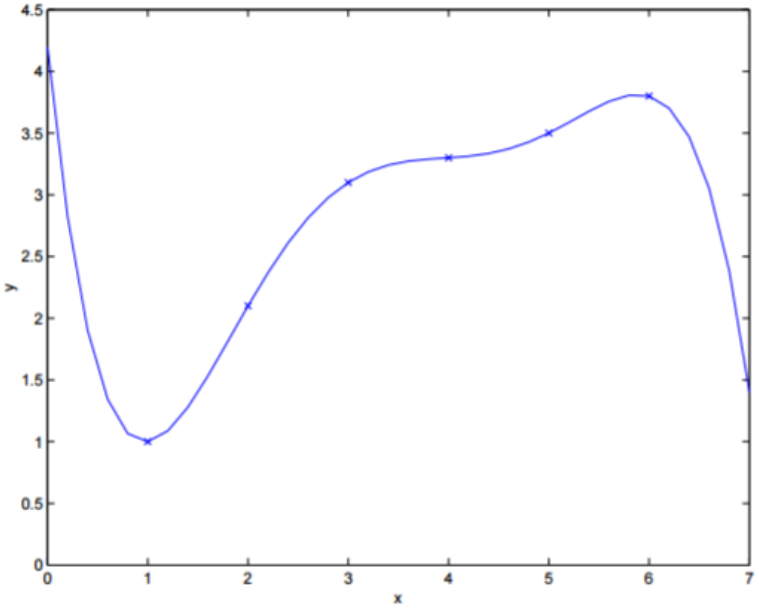
Underfitted

2nd order approximation



Good fit

5th order approximation

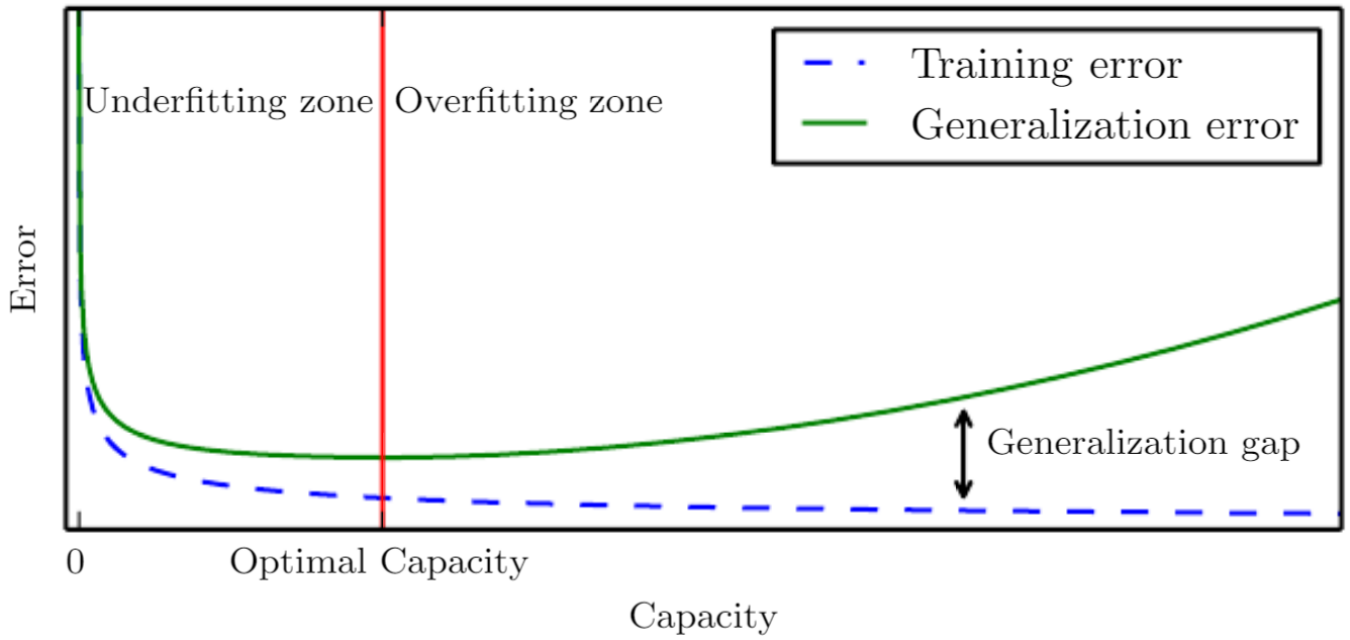


Overfitted

From “CS229 Lecture Notes” by Andrew Ng

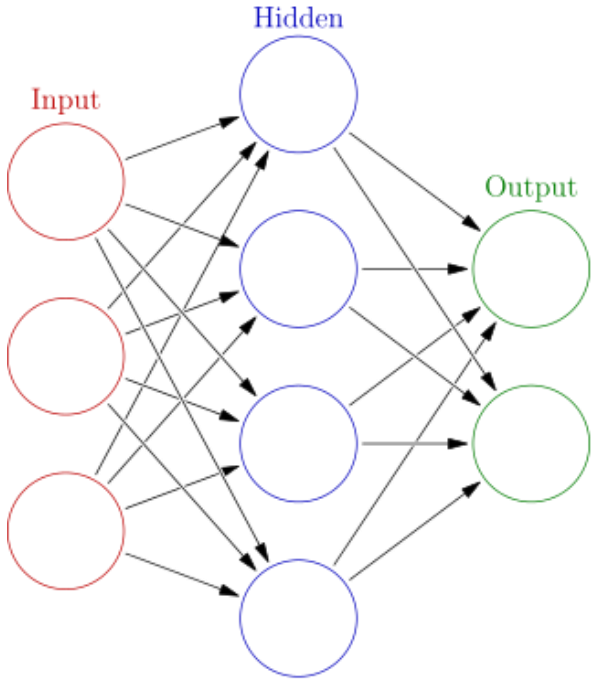
Supervised Learning (3)

- Overfitting is the great villain of supervised learning.
- Detected and actively avoided using a validation and test set.



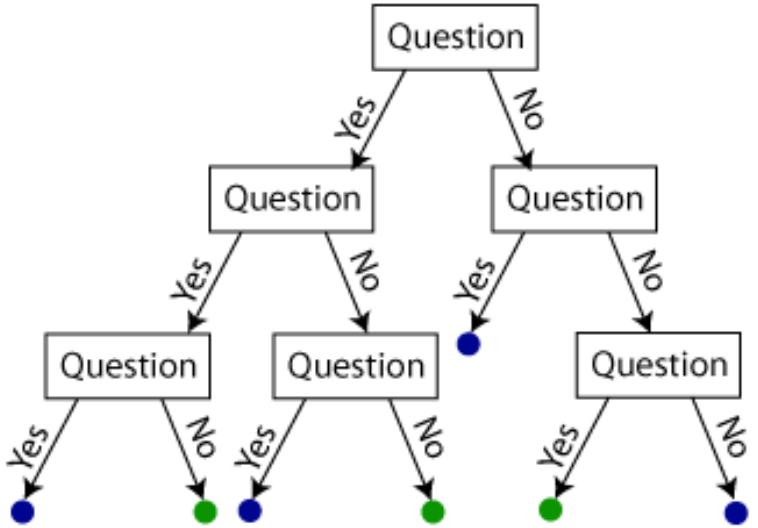
From “Deep Learning” by Goodfellow, Bengio et al., MIT Press

Supervised Learning (4)



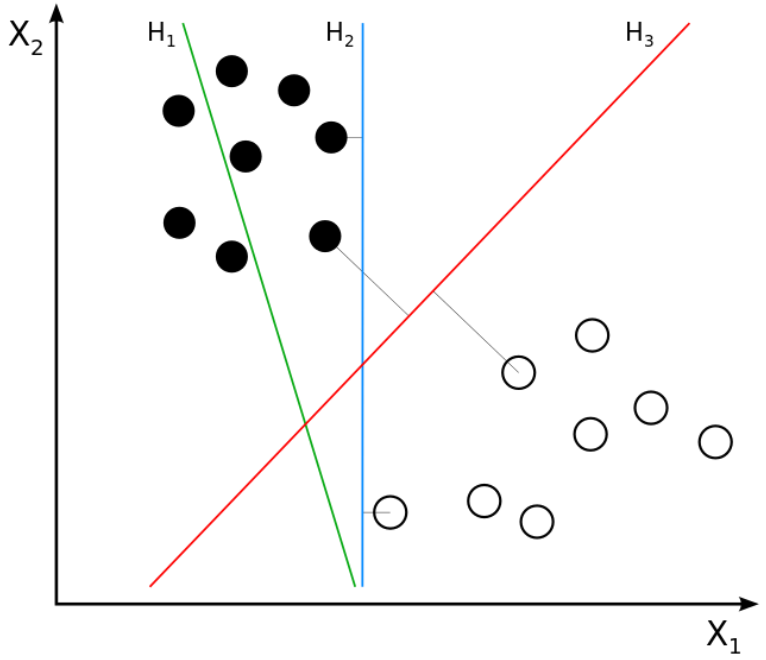
From wikipedia.org

Artificial Neural Network



From shapeofdata.wordpress.com

Decision Trees



From wikipedia.org

Support Vector Machines

$$p(C_k \mid \mathbf{x}) = \frac{p(C_k)\, p(\mathbf{x} \mid C_k)}{p(\mathbf{x})}$$

Bayes Classifier

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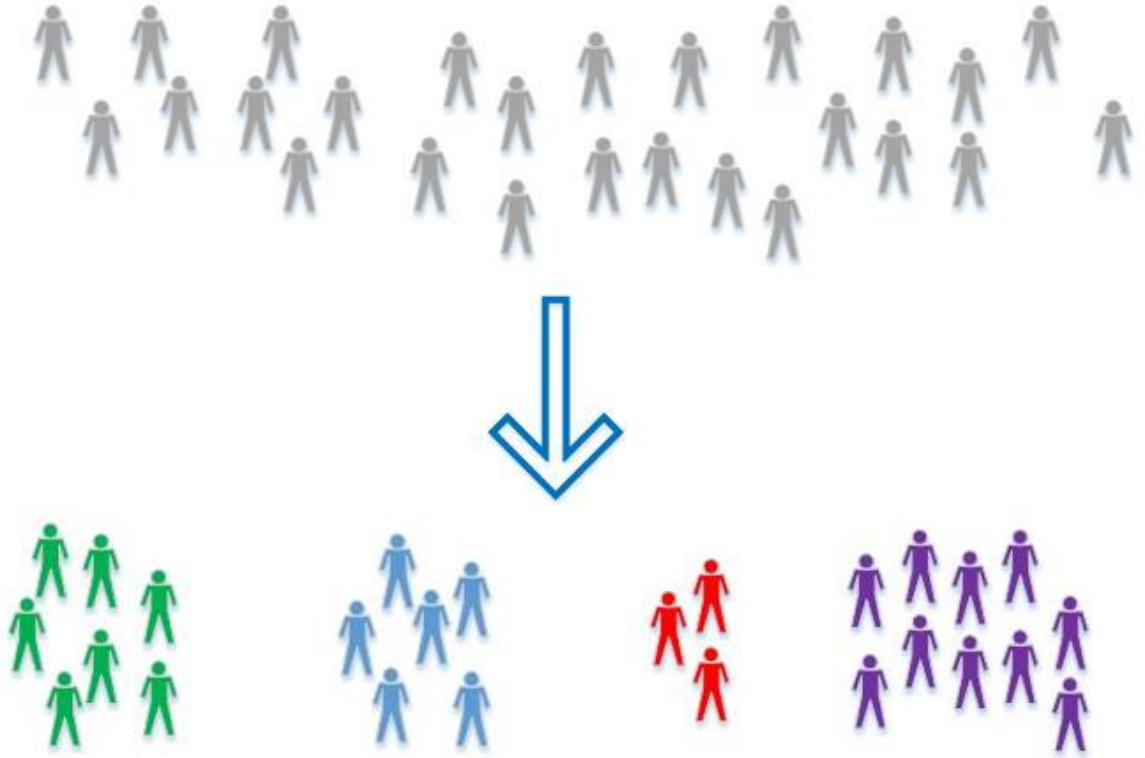
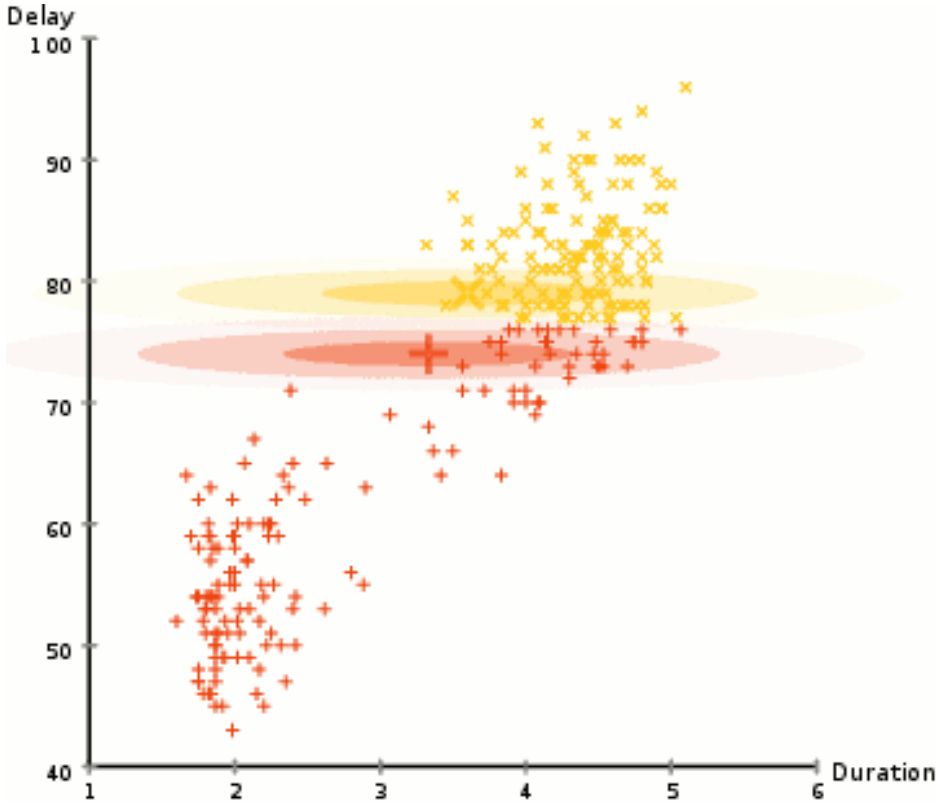
Unsupervised Learning (1)

- Unsupervised Learning is the task of inferring a function to describe hidden structures from “unlabeled” data.



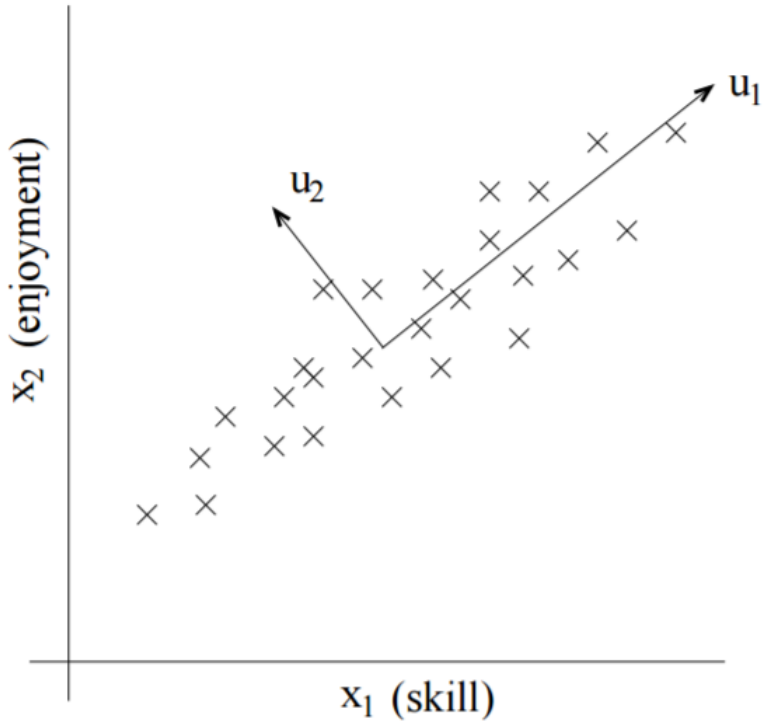
From insidebigdata.com

Unsupervised Learning (2)



From wikipedia.org

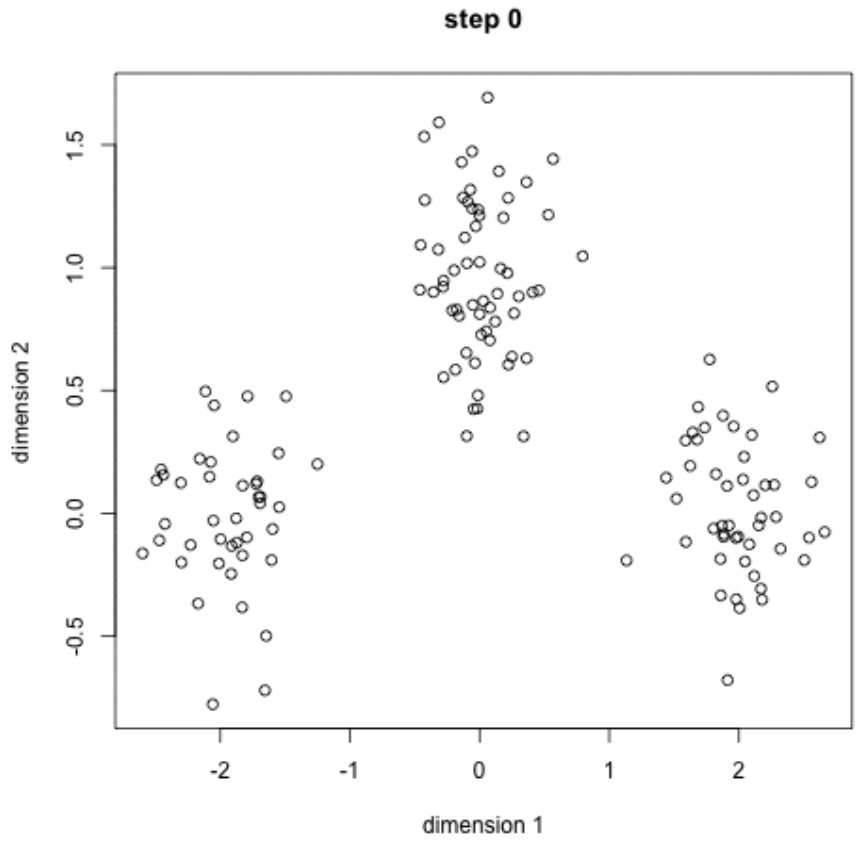
Expectation Maximization Algorithm



From "CS229 Lecture Notes" by Andrew Ng

Principal Component Analysis

Unsupervised Learning (3)



K-Means Clustering

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Reinforcement learning (1)

Policy: a = $\pi(s)$

Observation →  → Action

↑

Reward

Reinforcement learning (2)

Reward: Game Score

Policy: How to react to the visual input

Other examples: Algoritmic stock trading, control of cooling systems

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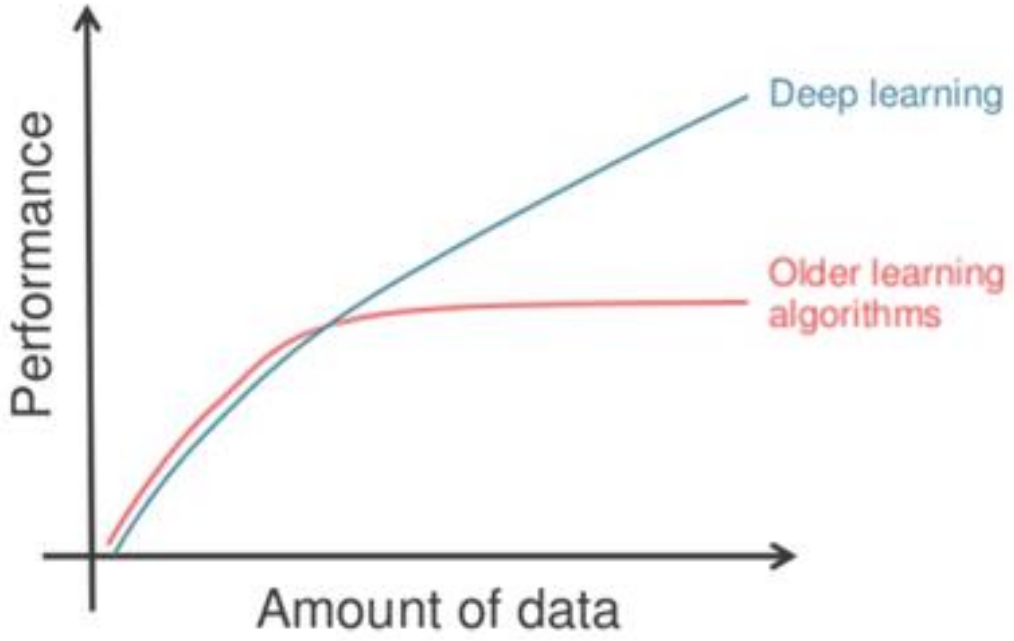
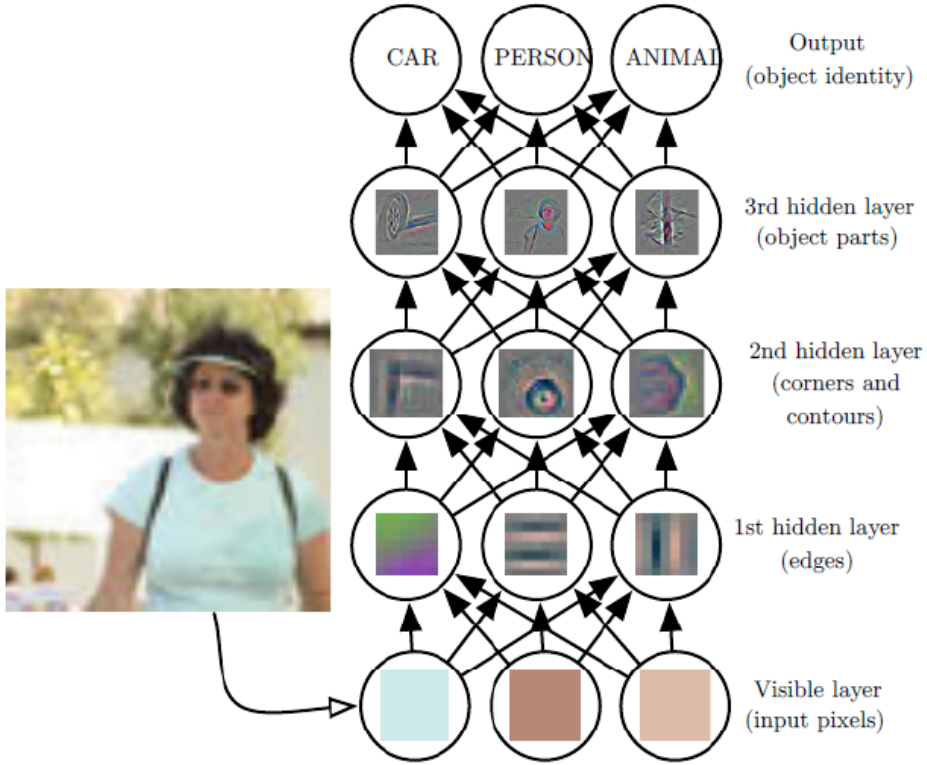
Deep Learning – Background (2)



“ Deep learning algorithms seek to exploit the unknown structure in the input distribution with higher-level learned features defined in terms of lower-level features ”

Yoshua Bengio

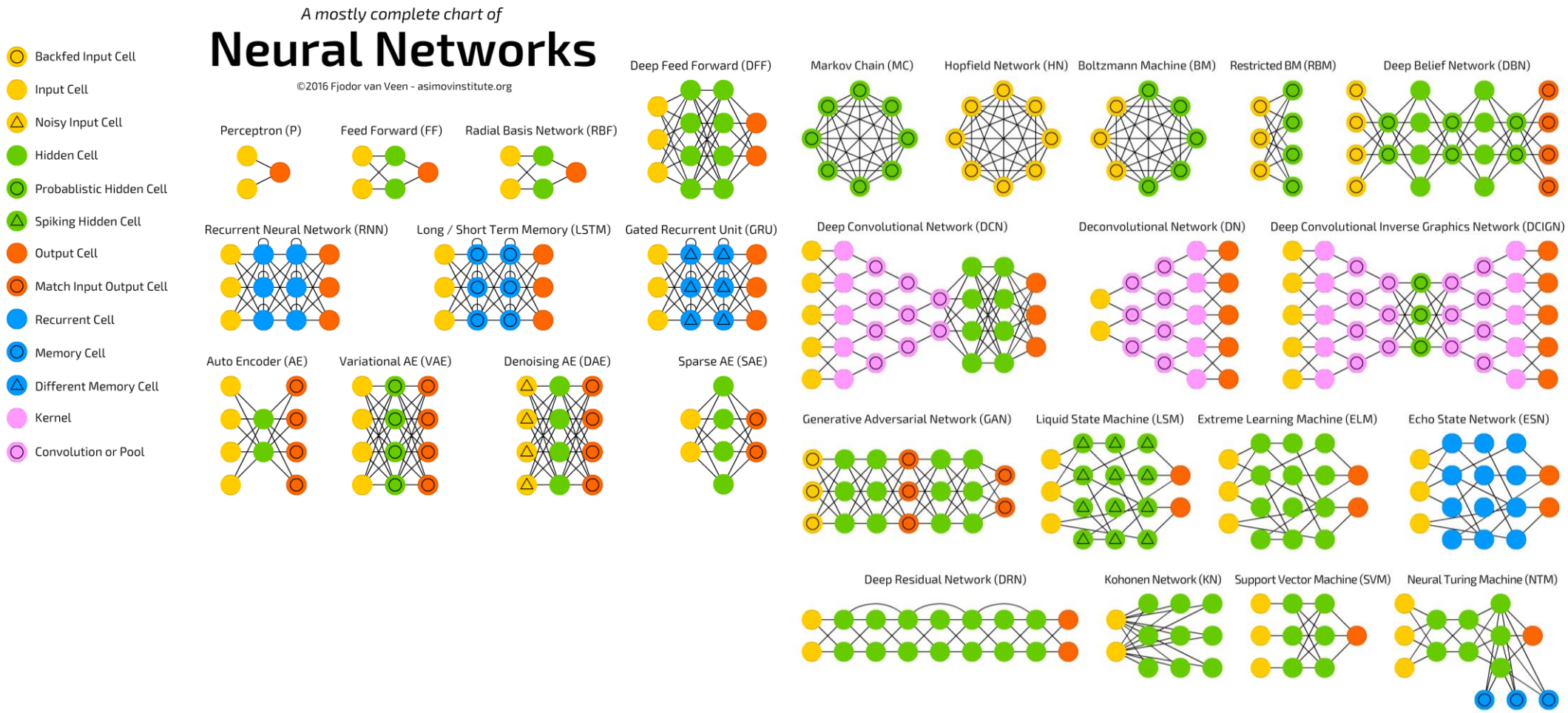
Deep Learning – Motivation (3)



From “Deep Learning” by Ian Goodfellow et al., MIT Press

Deep composition: Exponential gain in generalization

Deep Learning – Landscape (4)



Conclusions

1. **What is Machine Learning?**
   Machine learning gives meaning to data by finding a model

2. **Limitations**
   Important to generalize well to new data

3. **Supervised vs Unsupervised?**
   Supervised learning learns to relate input to a specified output and unsupervised learning finds patterns

4. **Learning with rewards?**
   Reinforcement learning adjusts its model based on external rewards

5. **Importance of Deep Learning?**
   Generalizes well to complex data

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About us

Mission: Teach machine learning to students who are interested but don't have a course on the topic

Motivation: Machine learning is becoming a transversal tool for understanding data and extracting knowledge

Events

Invited Speakers:

- Academy
- Industry

Workshops:

- Implementation / specific algorithms
- Case studies

Social:

- Hackathons
- Competitions

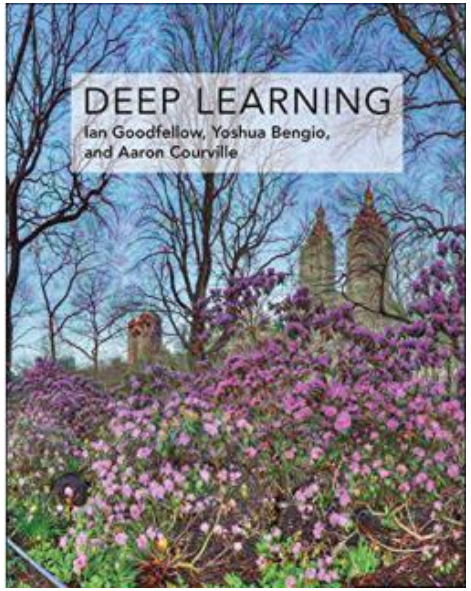
Upcoming events

Supervised Learning, Unsupervised Learning

Python/R for Machine Learning


Further Reading

- **Deep Learning** by Ian Goodfellow and Yoshua Bengio, MIT Press, 2016



- Lecture Notes by Andrew Ng, CS229, Stanford University

Questions?

Feedback?