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Introduction to Machine Learning

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What is Machine Learning?

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

Arthur Samuel, IBM 1959

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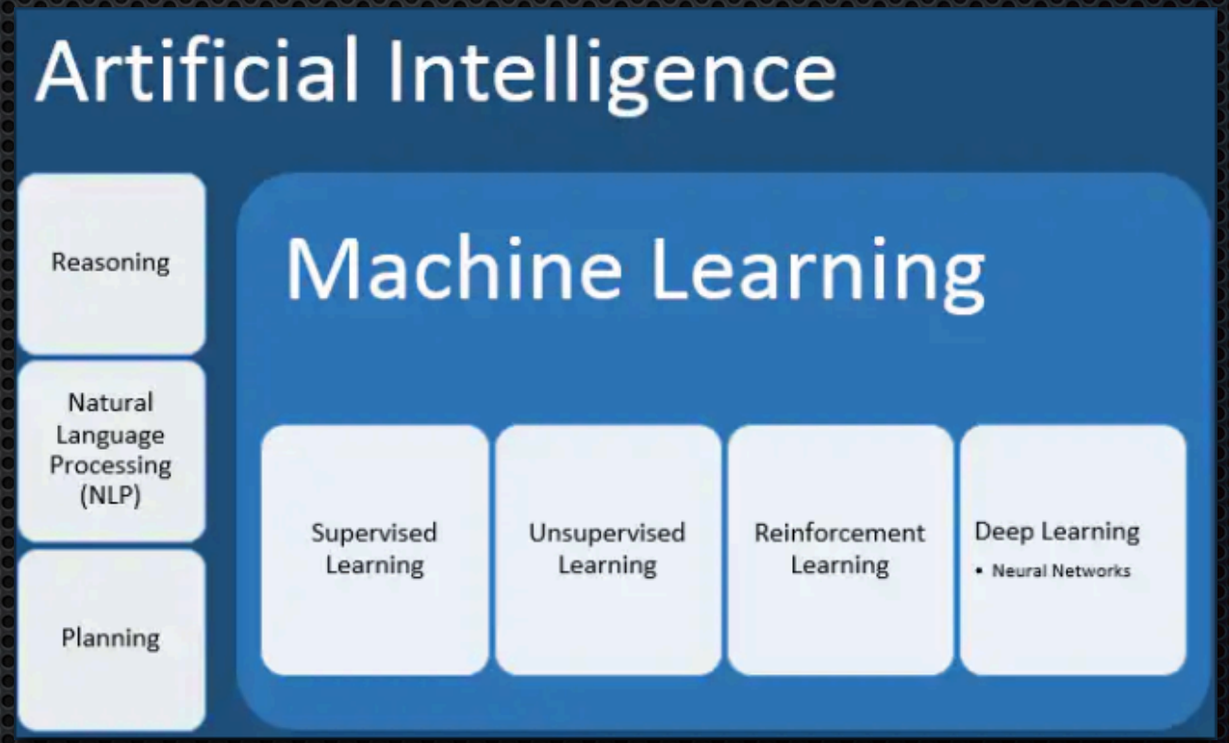
The Machine Learning Process

- Clean your data
- Select a proper algorithm for building a prediction model
- Train your model to understand your data
- Evaluate your model
- Parameter tuning
- Deploy model

Approaches to Machine Learning [1]

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning
- Deep Learning



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Supervised Learning Techniques

- Classification - the process of predicting discrete class labels or categories; using labeled data
- Regression - the process of predicting continuous values
- Anomaly Detection - the process of discovering abnormal and unusual cases

Unsupervised Learning Techniques

- Clustering - finds patterns and groupings from unlabeled data
- Dimension Reduction - reduce redundant data
- Density Estimation - mostly used to explore the data to find some structure within it
- Market Basket Analysis - based on the theory that customers of certain items are more likely to purchase another group of items

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Major Machine Learning Techniques

- Regression/Estimation — predicting continuous values
- Classification — predicting the item class/category of a case
- Clustering — grouping of data points or objects that are similar
- Associations — used for finding frequent co-occurring items/events
- Anomaly Detection — discovering abnormal and unusual cases
- Sequence Mining — predicting next events
- Dimension Reduction — reducing the size of data
- Recommendation Systems — associating people's preferences and recommending items

Real-World Applications

- Infectious disease researchers searching for the cause of a mysterious polio-like illness (AFM -Acute Flaccid Myelitis) that is paralyzing children [2]
- Converting complex media and raw data into useful information, such as automatic speech and handwriting transcription, and automatic face recognition [3]
- Serve as a cost and time-saving tool when compared with manual classification of public health expenditures. [4]
- Brain tumors are often classified by visual assessment of tumor cells, yet such diagnosis can vary depending on the observer. Machine-based learning approaches are being developed to aid the diagnosis of clinical samples and classifying brain tumors [5]

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References

1. IBM. (n.d.) Retrieved from https://www.ibm.com/analytics/machine-learning

2. Reardon, S. (2018). Machine learning hunts for cause of paralyzing illness. *Nature*, 564(7735), 170.

3. Camastra, F., & Vinciarelli, Alessandro. (2008). Machine learning for audio, image and video analysis theory and applications (Springer computer science). London: Springer.

4. Brady, E., Leider, J., Resnick, B., Alfonso, Y., & Bishai, D. (2017). Machine-Learning Algorithms to Code Public Health Spending Accounts. *Public Health Reports*, 132(3), 350-356.

5. Wong, D., & Yip, S. (2018). Machine learning classifies cancer. *Nature*, 555(7697), 446-447.

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