Machine Learning - Introduction

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Motivation

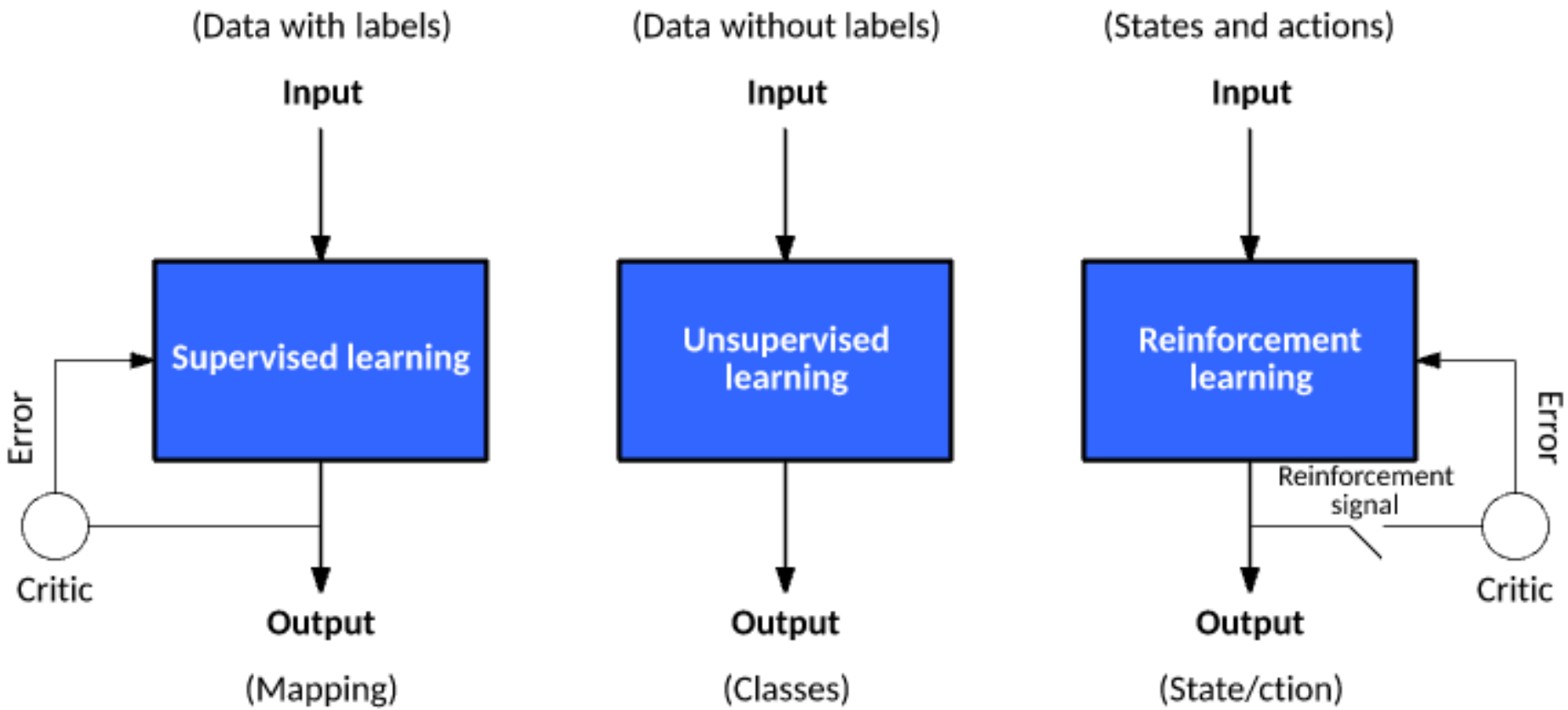
- AI goal: replace human programming with "self-programming" (= predict appropriate behavior based on experience)
- The example: infants
  - language skills
  - motor skills
  - other behaviors
- Usual dichotomy:
  - Algorithmic/heuristic "tricks"
  - Simulate human behavior (infant brain)

ML and Systems

- Data flow in ML systems
- Data complexity
- ML system evaluation

Data flow in ML systems

- Supervised Learning
  - Classification
  - Regression
- Unsupervised Learning
  - Clustering
  - Association
- Reinforcement Learning



https://docs.paperspace.com/machine-learning/wiki/supervised-unsupervised-and-reinforcement-learning

Data complexity

- Numerical Data
  - Continuous
  - Discrete
- Ordinal Data
- Categorical Data
- Fancy Data

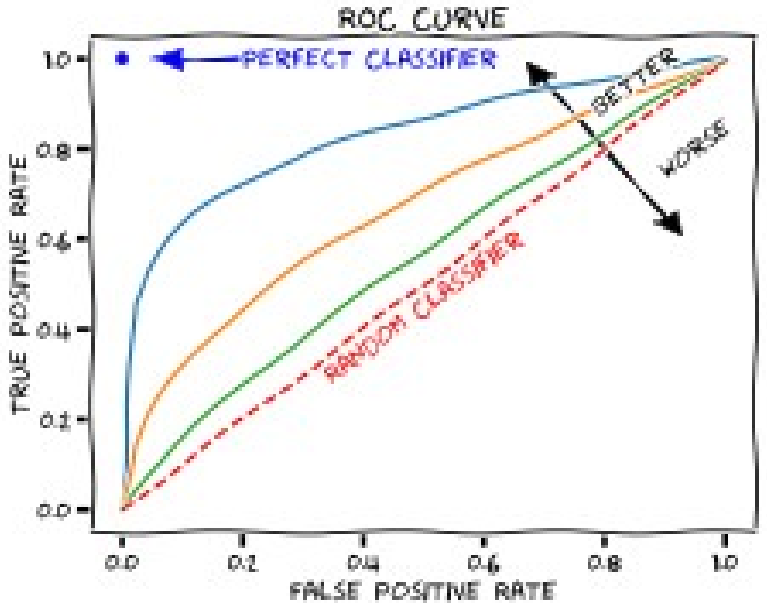
ML System Evaluation

- Binary Classifications:
  - True Positive
  - False Positive
  - True Negative
  - False Negative

Some Binary Classification Metrics

- Accuracy = correct predictions / all predictions
- Recall = true positives / (true positives + false negatives)
- Precision = true positives / (true positives + false positives)

- Receiver Operating Characteristic (ROC) curve



https://upload.wikimedia.org/wikipedia/commons/thumb/3/36/Roc-draft-xkcd-style.svg/375px-Roc-draft-xkcd-style.svg.png

More Binary Classification Metrics

- Confusion Matrix

Confusion Matrix

	Actually Positive (1)	Actually Negative (0)
Predicted Positive (1)	True Positives (TPs)	False Positives (FPs)
Predicted Negative (0)	False Negatives (FNs)	True Negatives (TNs)

- F1 Score

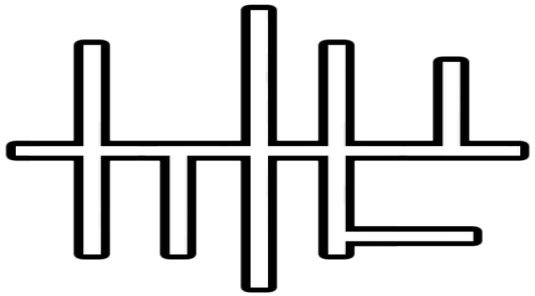
$$\text{F1 Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}}$$

https://glassboxmedicine.files.wordpress.com/2019/02/confusion-matrix.png

More Classification Metrics

- Prediction “Loss”

Inputs



Outputs +
Prediction Error Term

(Image: Wikimedia Commons)

Typically various norms, e.g. L0, L1, L2