Machine Learning

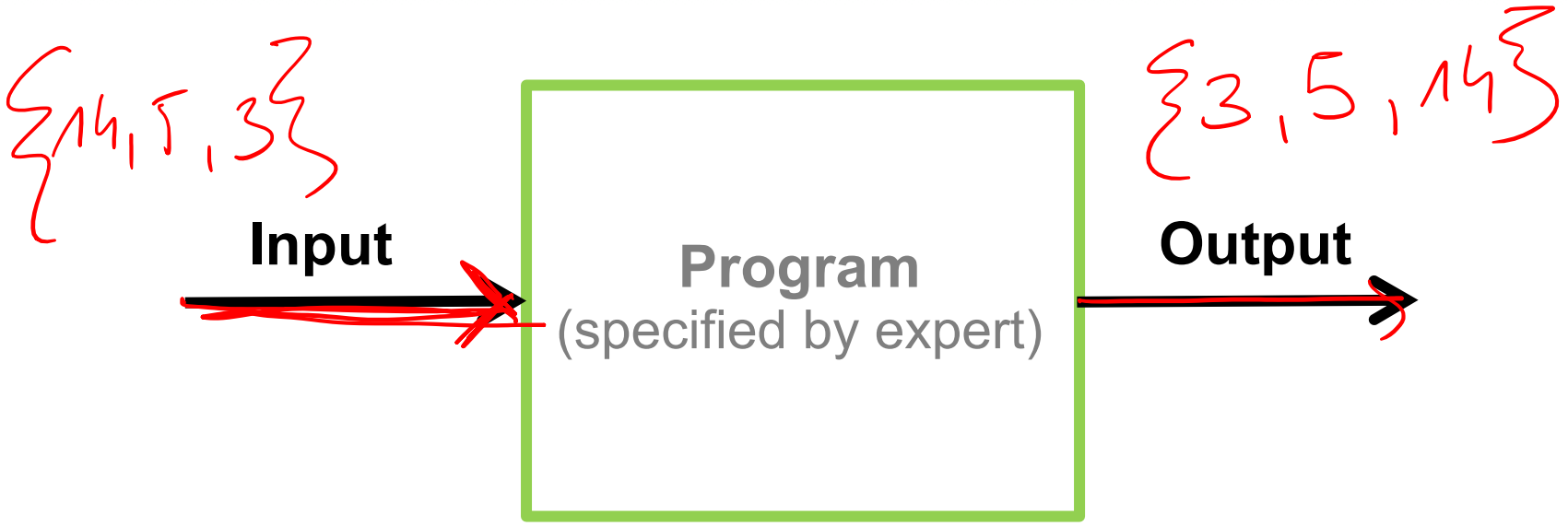
Heni Ben Amor, Ph.D.
Assistant Professor
Arizona State University

Ira A. Fulton Schools of Engineering
Arizona State University

Machine Learning

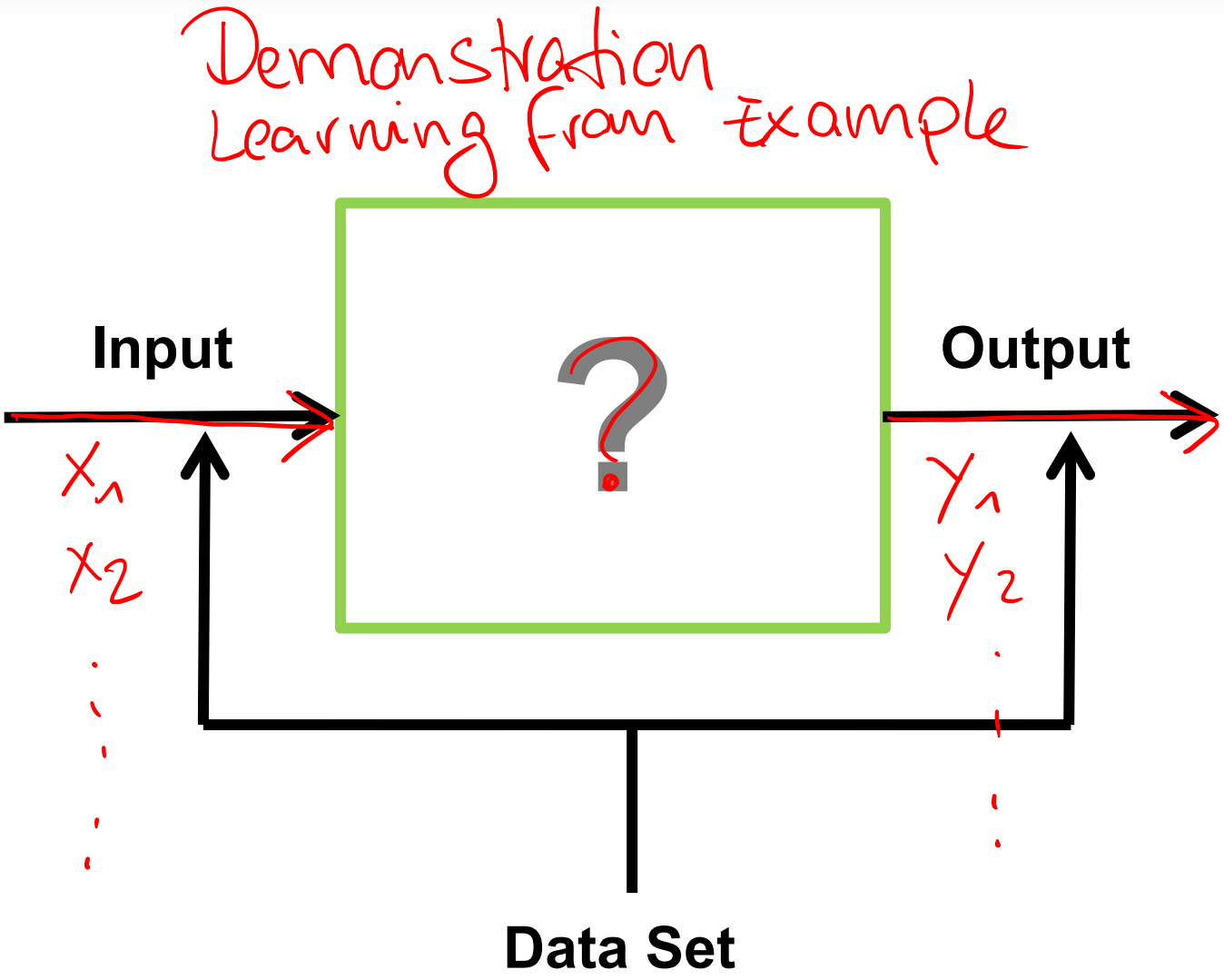
- Machine Learning (ML) has had many successes in recent years.
- May sound magical to an outsider
- ML is part of Artificial Intelligence.
- It focuses on learning structure and relationships in data in order to make a determination or prediction.
- Rules are automatically extracted from data rather than programmed by human.

Typical Programming Paradigm



- **However, many tasks are really difficult to implement by hand**
  - Computer Vision
  - Speech Recognition
  - Natural Language Processing

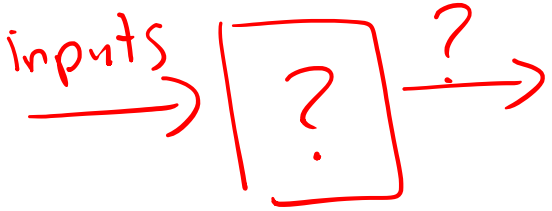
Machine Learning



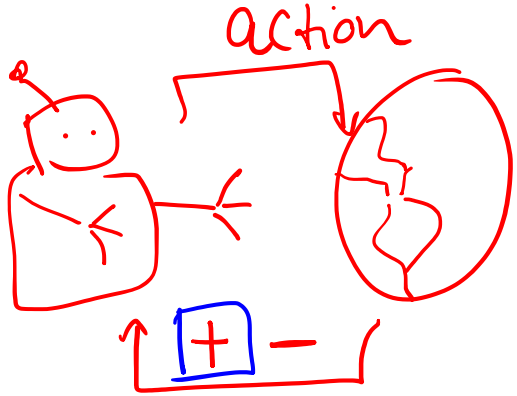
Types of Machine Learning

Supervised Learning

Unsupervised Learning



Reinforcement Learning



Functional vs. Probabilistic View

- Machine Learning common vantage points
- Learn function that maps inputs to outputs

$$f(input) \rightarrow outputs$$

- Another view would be probabilistic
- We calculate a conditional probability distribution given the inputs

$$p(outputs|input)$$

noise uncertainty

So What is Deep Learning?

- Deep Learning is a modern name of learning with artificial neural networks
- Inspired by biological neural networks
- Deep Learning = Neural Networks 3.0
- Very powerful technique widely used in industries
- We will dive deep into this topic

Example Applications

- **Medical classification:**
  - Reading multiple values from a lab result and making a determination
- **Anomaly Detection in Industry:**
  - Sorting out defected parts in a factory for quality assurance

Example Applications

- **Decision-making in Autonomous Driving:**
  - Steering a car autonomously and safely on the highway
- **Speech Recognition and Generation:**
  - Making Alexa understand you and answer your queries

Why Now?

- We have an abundance of data from sensors and the Internet
- Computation power has caught up, now ML models can run on your phone
- Some new theoretical tricks and insights have enabled substantial progress and breakthroughs
- More investment by major companies

Summary

- Introduced the basic idea behind ML
- Discussed probabilistic and functional view
- Highlighted some example applications
- Introduced common types of machine learning

Supervised Learning

Unsupervised Learning

Reinforcement Learning