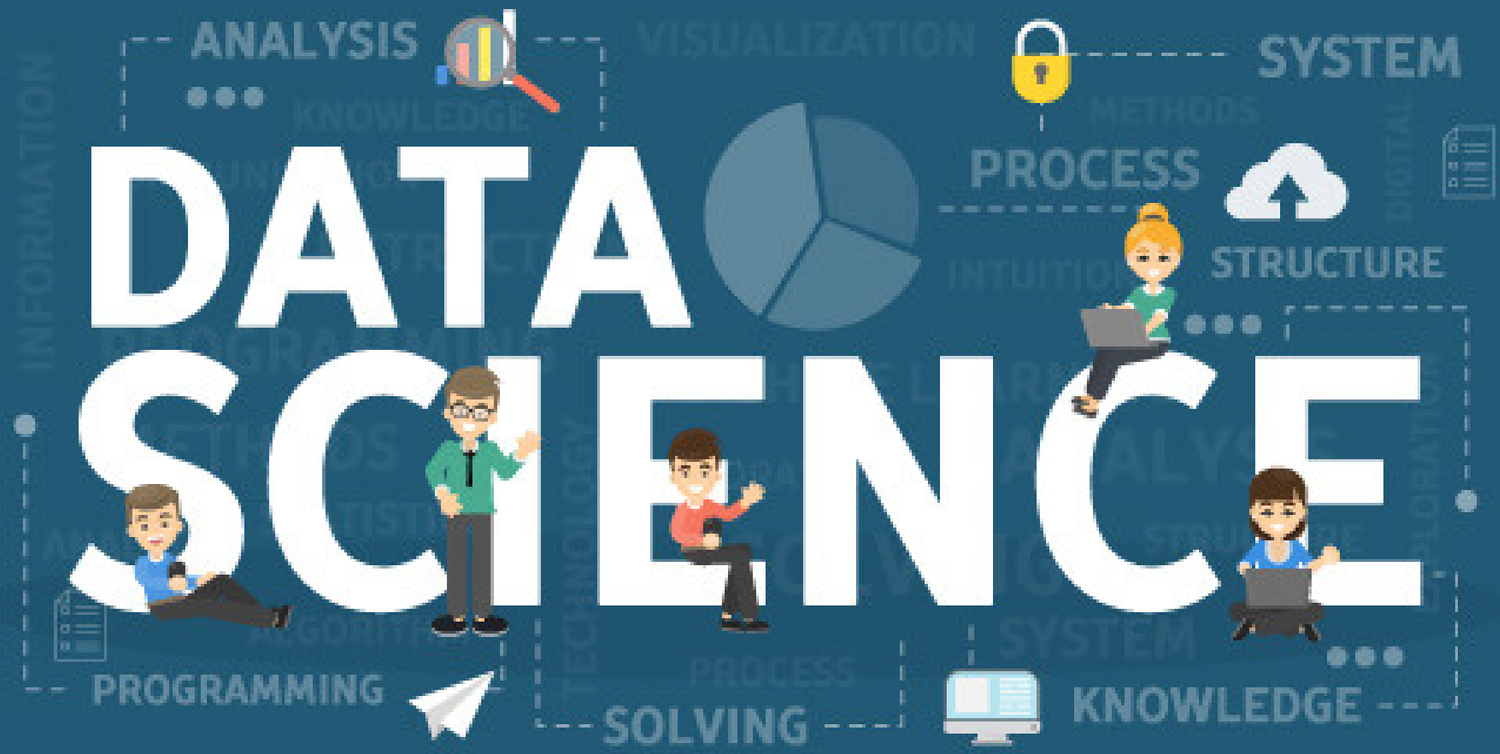
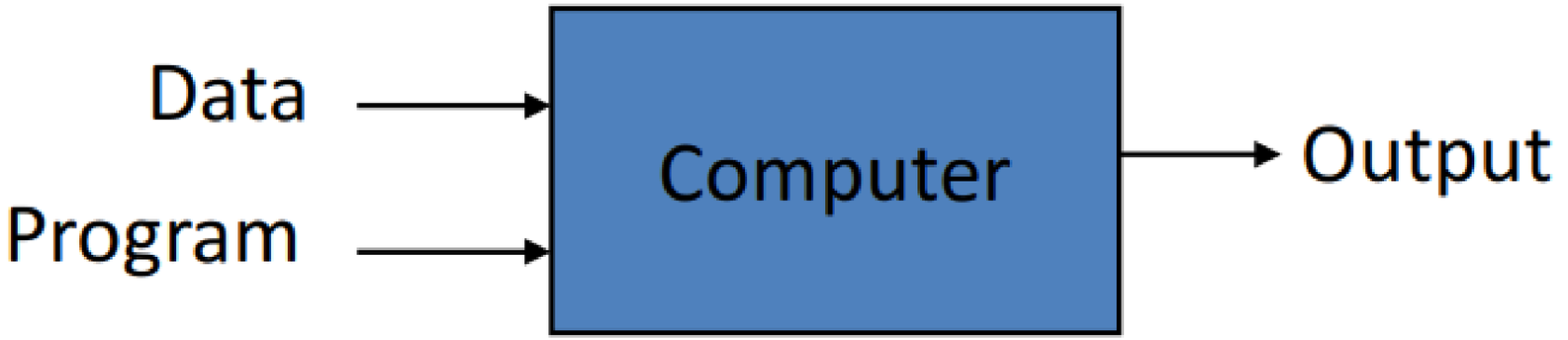
INTRODUCTION TO DATA SCIENCE



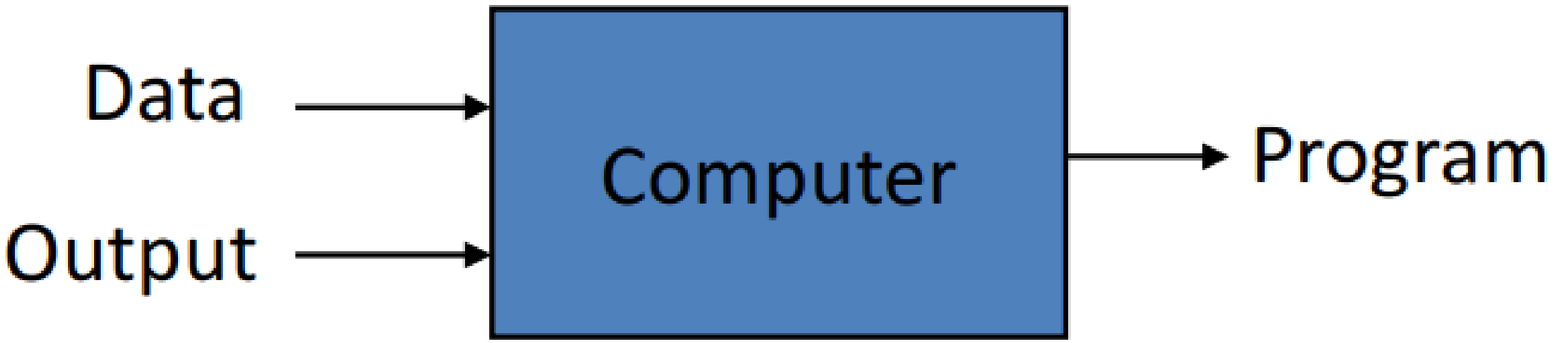
Introduction to Machine Learning

“Learning is any process by which a system improves performance from experience.”
- Herbert Simon

Traditional Programming



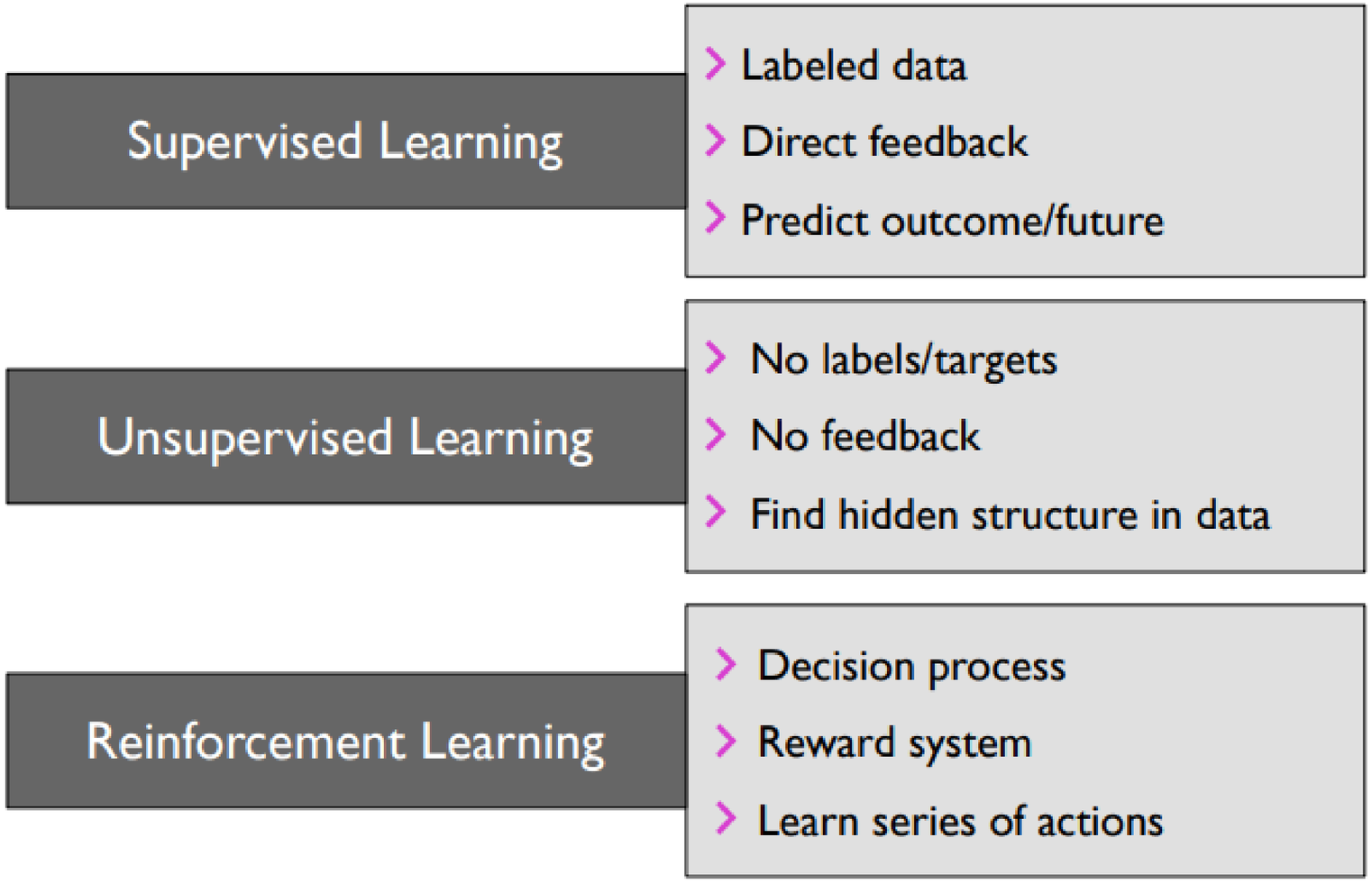
Machine Learning

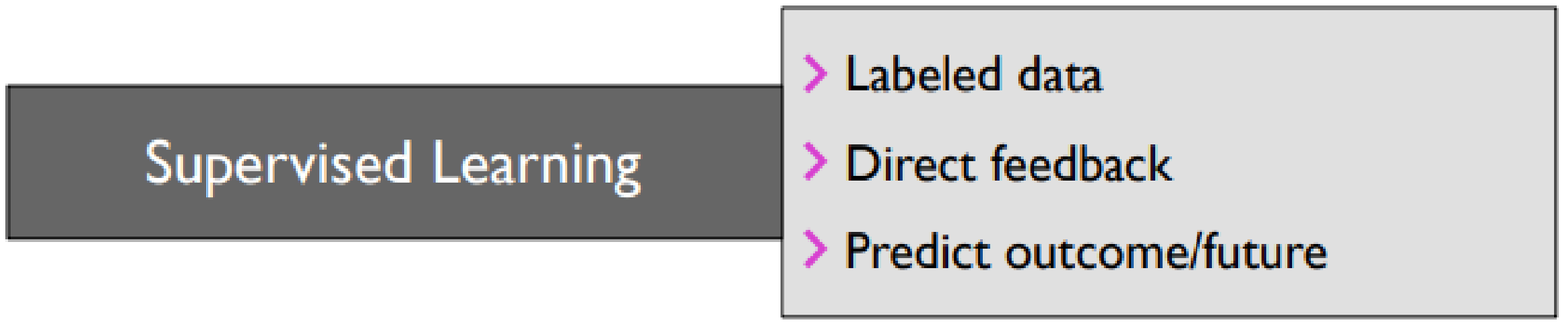


Some Applications of Machine Learning

- Email spam detection
- Face detection and matching (e.g., iPhone X)
- Web search (e.g., DuckDuckGo, Bing, Google)
- Sports predictions
- Stock predictions
- Smart assistants (Apple Siri, Amazon Alexa, ...)
- Product recommendations (e.g., Netflix, Amazon)
- Self-driving cars (e.g., Uber, Tesla)
- Sentiment analysis

Categories of ML

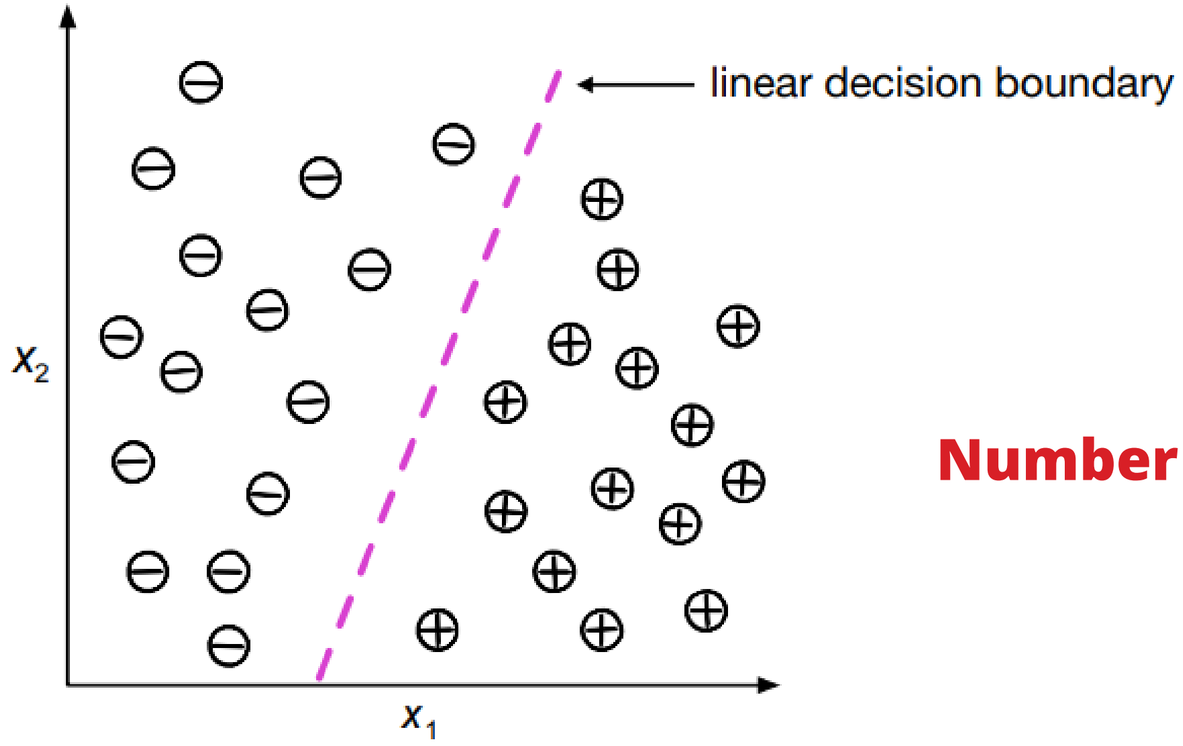



Supervised Learning
Labeled data
Direct feedback
Predict outcome/future

Loves the German bakeries in Sydney. Together with my imported honey it feels like home	Positive
@VivaLaLauren Mine is broken too! I miss my sidekick	Negative
Finished fixing my twitter...I had to unfollow and follow everyone again	Negative
@DinahLady I too, liked the movie! I want to buy the DVD when it comes out	Positive
@frugaldougal So sad to hear about @OscarTheCat	Negative
@Mofette briliant! May the fourth be with you #starwarsday #starwars	Positive
Good morning thespians a bright and sunny day in UK, Spring at last	Positive
@DowneyisDOWNEY Me neither! My laptop's new, has dvd burning/ripping software but I just can't copy the files somehow!	Negative

Supervised Learning: Classification

BINARY CLASSIFICATION EXAMPLE WITH TWO FEATURES



Number of classes are known

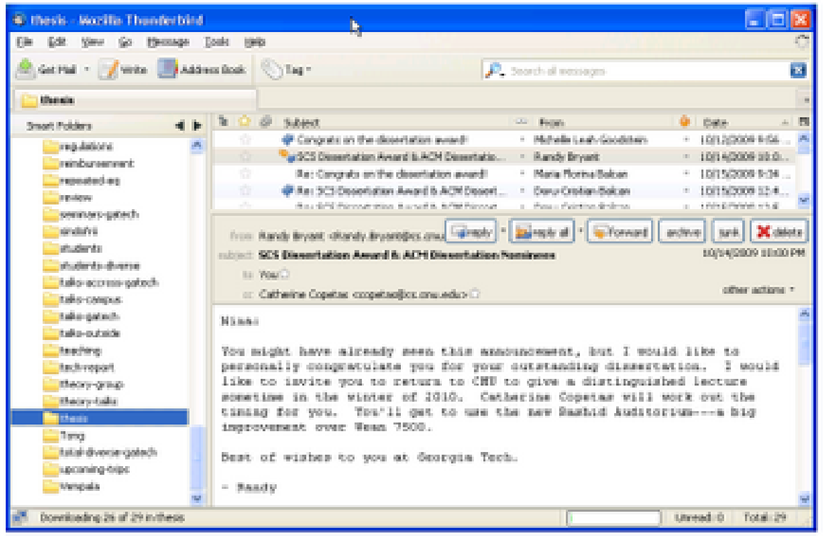
Example: Spam Detection

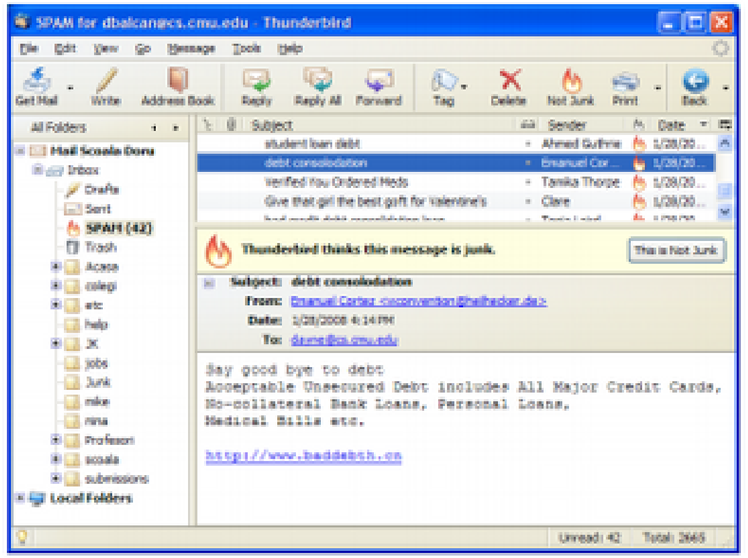
Decide which emails are spam and which are important.

Supervised classification

Not spam

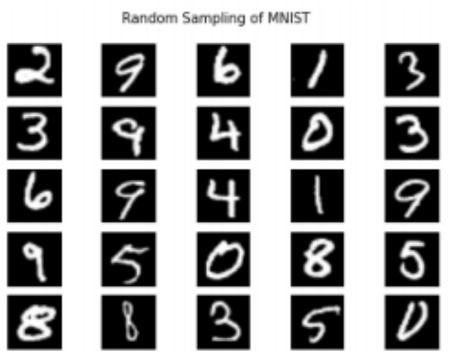
spam





Example: Image classification

- Handwritten digit recognition (convert hand-written digits to characters 0..9)



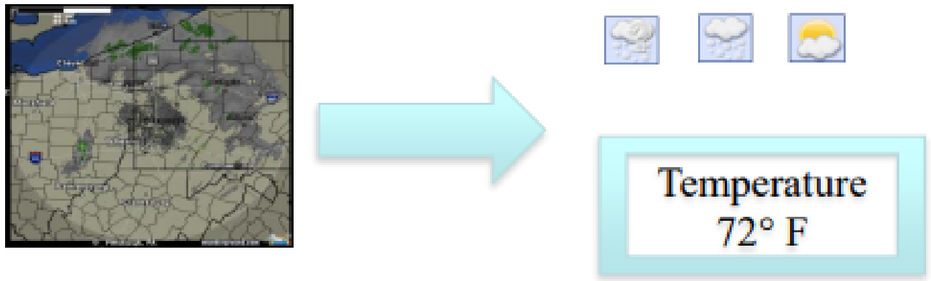
- Face Detection and Recognition

Supervised Learning: Regression

Stock market

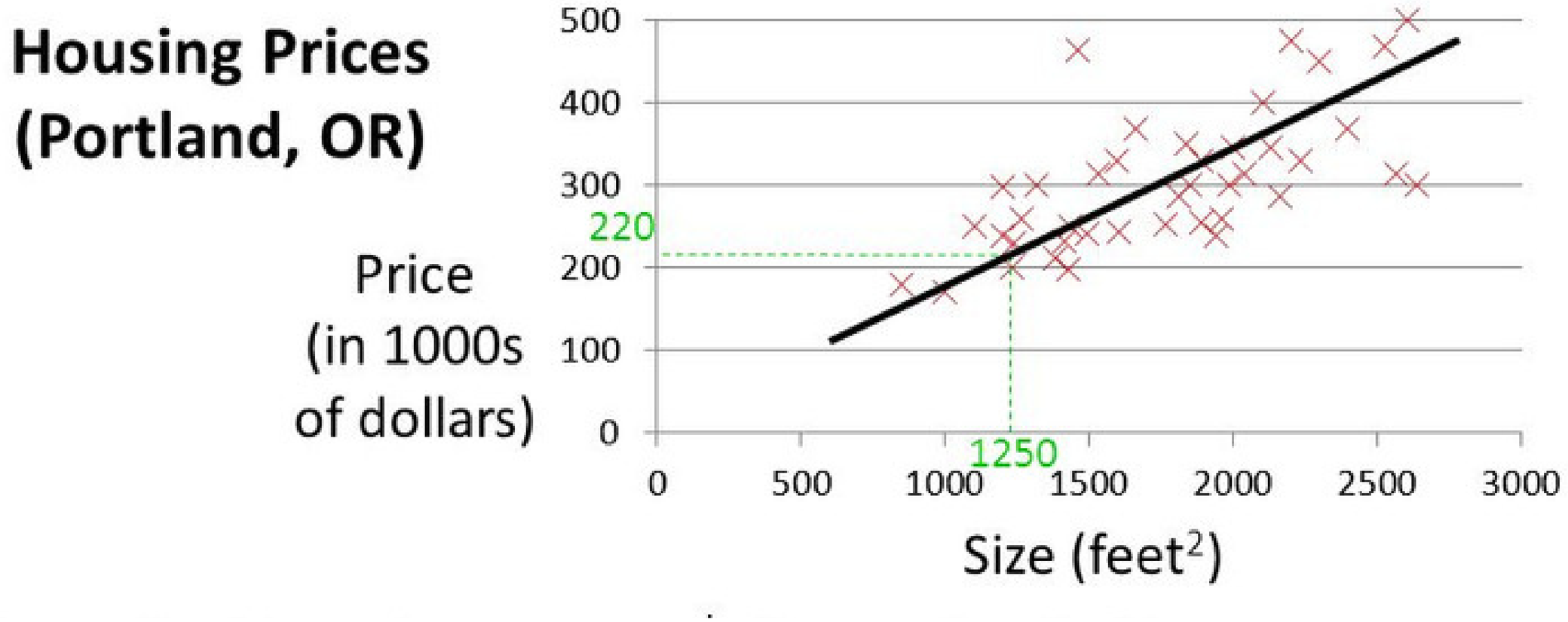
Weather prediction

Number of classes are unknown.
You may know the range



Predict the temperature at any given location

Example: House Price Prediction

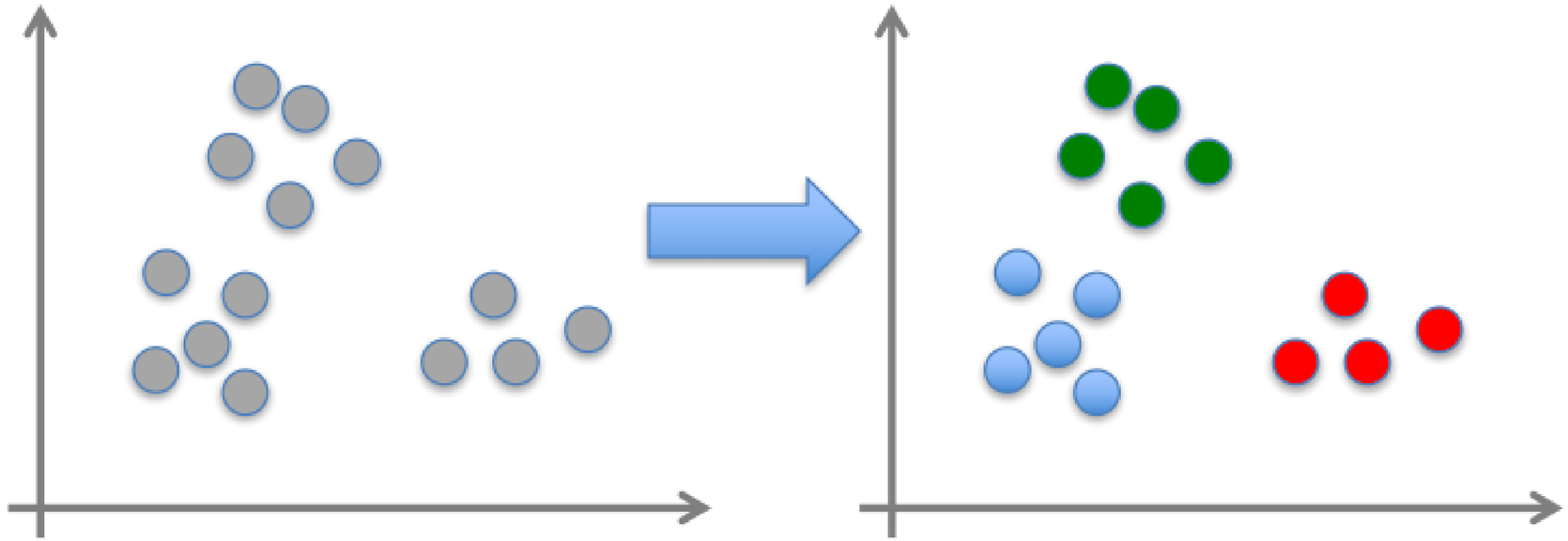


Unsupervised Learning

- No labels/targets
- No feedback
- Find hidden structure in data

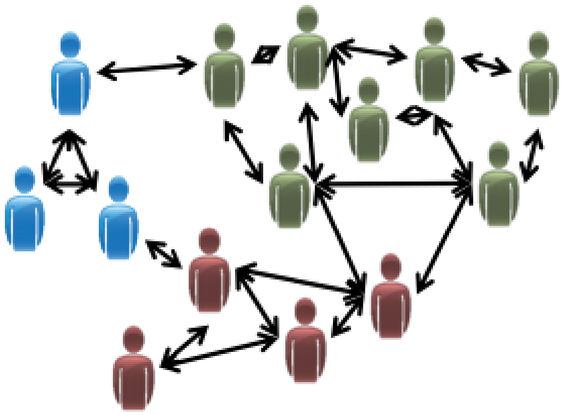
Unsupervised Learning

- Given x_1, x_2, …, x_n (without labels)
- Output hidden structure behind the x's
  - E.g., clustering

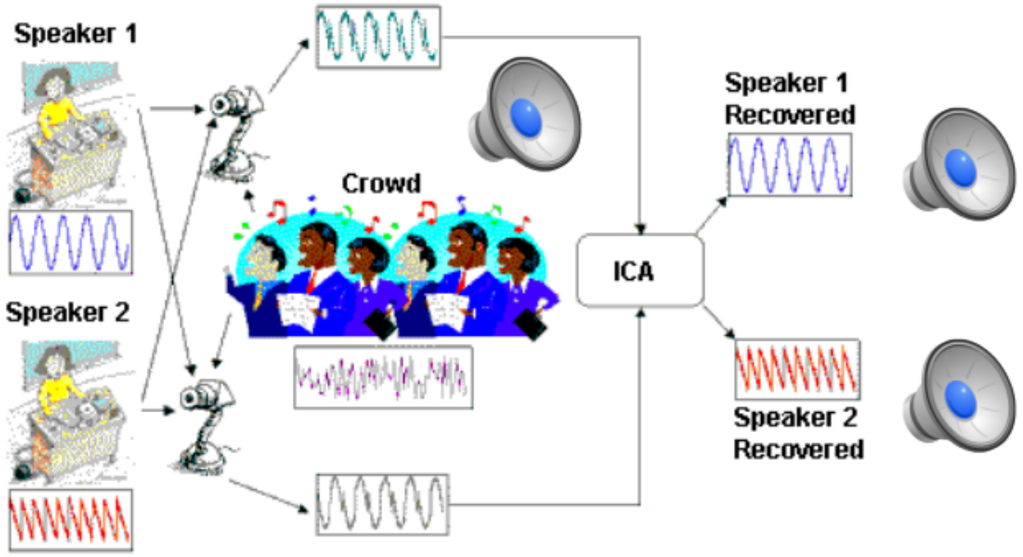


Unsupervised Learning: Examples

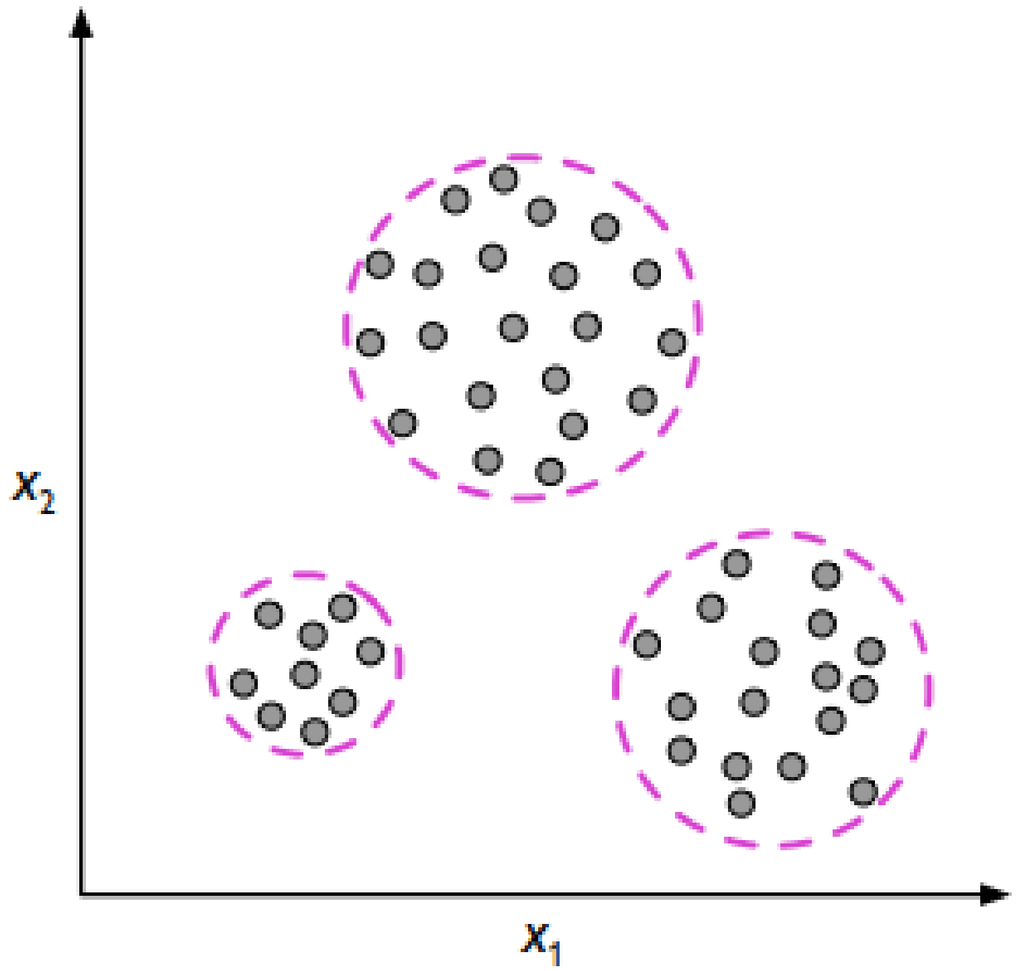
Market segmentation



Social network analysis



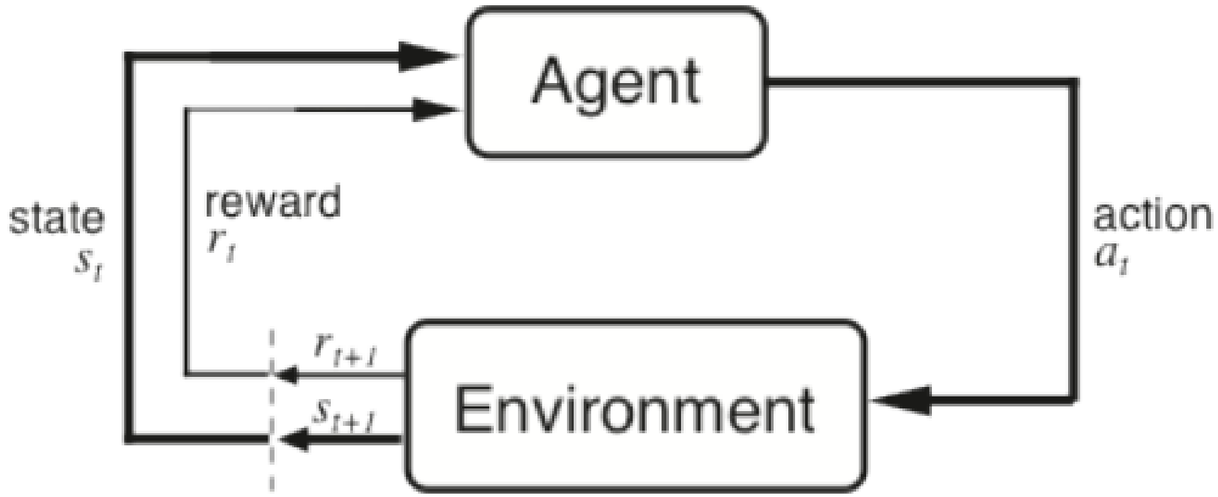
Unsupervised Learning: Clustering



Reinforcement Learning

Given a sequence of states and actions with (delayed) rewards, output a policy

– Policy is a mapping from states a actions that tells you what to do in a given state



Example: Mario Game