Machine Learning of Sensory Signals

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✤ Roland Priemer (1991). Introductory Signal Processing

Anything that conveys information about attributes or behavior of underlying phenomenon

ECG Signal

Microsoft stock

Music Signal

Wikimedia

Established 1911

What are signals

✤ Roland Priemer (1991). Introductory Signal Processing

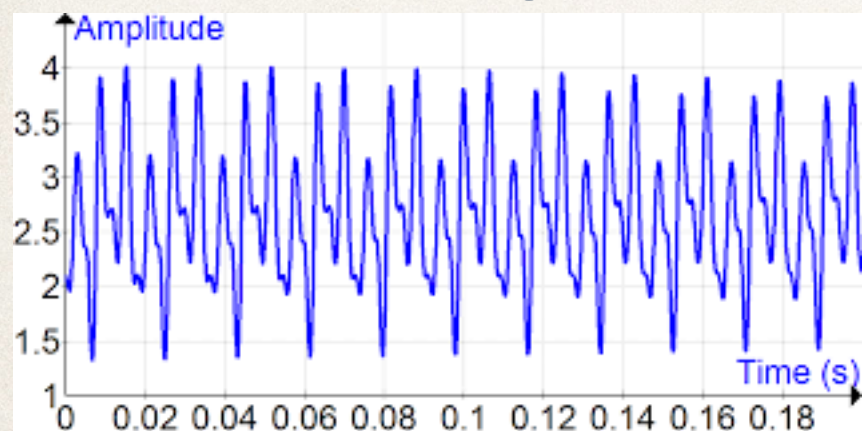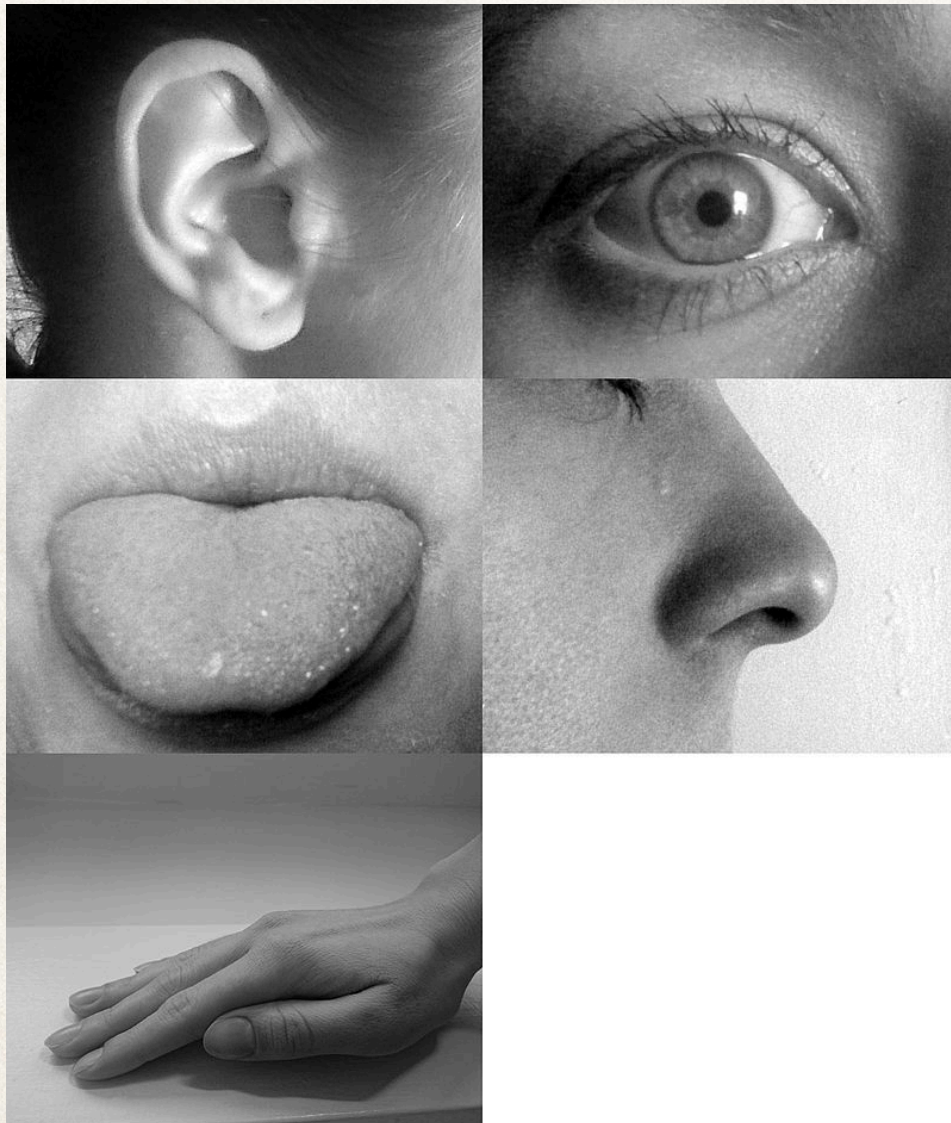 Anything that conveys information about attributes or behavior of underlying phenomenon

✤ Common signals - (mapping from one domain to another)

  ✤ function of time (e.g. speech, music, ECG, financial data etc)

  ✤ function of space (e.g. images)

  ✤ joint function of time and space (eg. video signals)

What are sensory signals

✤ Sensory signals

A sense is a physiological capacity of organisms that provides data for perception.

✤ Living organisms have multitude of sensations.

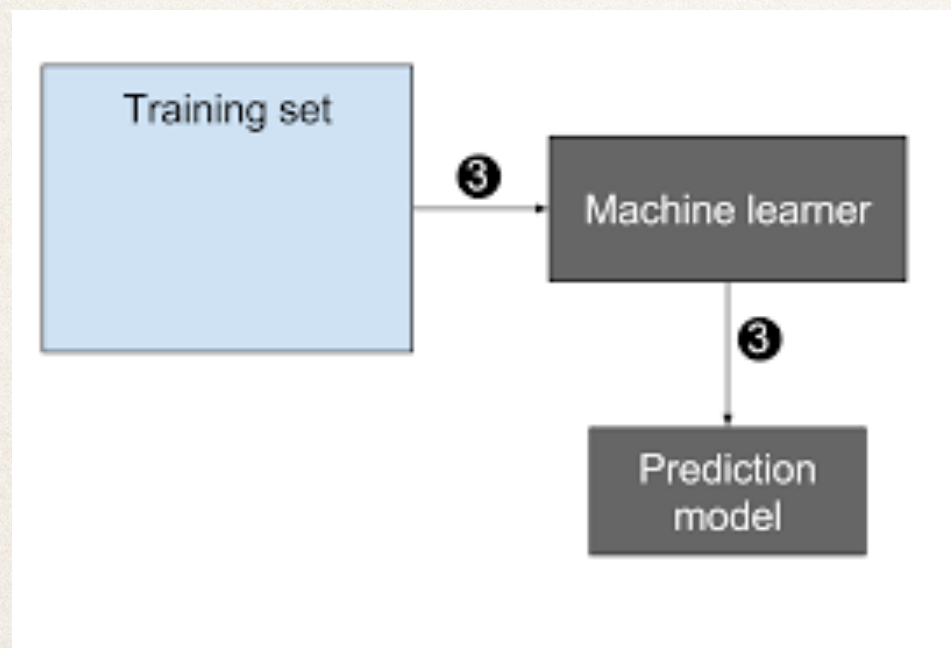✤ Humans have the most complex perception system for these sensory signals.

Wikimedia

What is learning

✤ Learning

Act of acquiring new/reinforcing existing knowledge, behavior, skills

✤ Human learning starts even before birth.
  ✤ Fundamental to the existence and evolution.

✤ Machine learning
  ✤ Branch of artificial intelligence
  ✤ Attempts to use data to learn models that can predict/classify.

Wikimedia

MLSS

- ❖ Objectives

  - ❖ Automatic discovery of patterns.

  - ❖ Motivated by human capabilities to process real world signals.

  - ❖ Mimicking/Extending/Replacing human functions.

  - ❖ Branch of artificial intelligence.

  - ❖ Classification and Regression.

❖ Domain Identification - Blog v/s Chat ?

"I tried these Butterscotch Muffins today
and they turned out so good. I had half
the pack of butterscotch chips that I
bought long back so wanted to use it up."

"Hey, it's Geoff from yesterday. How's it going?
Hi there. Don't wanna bother you long, but
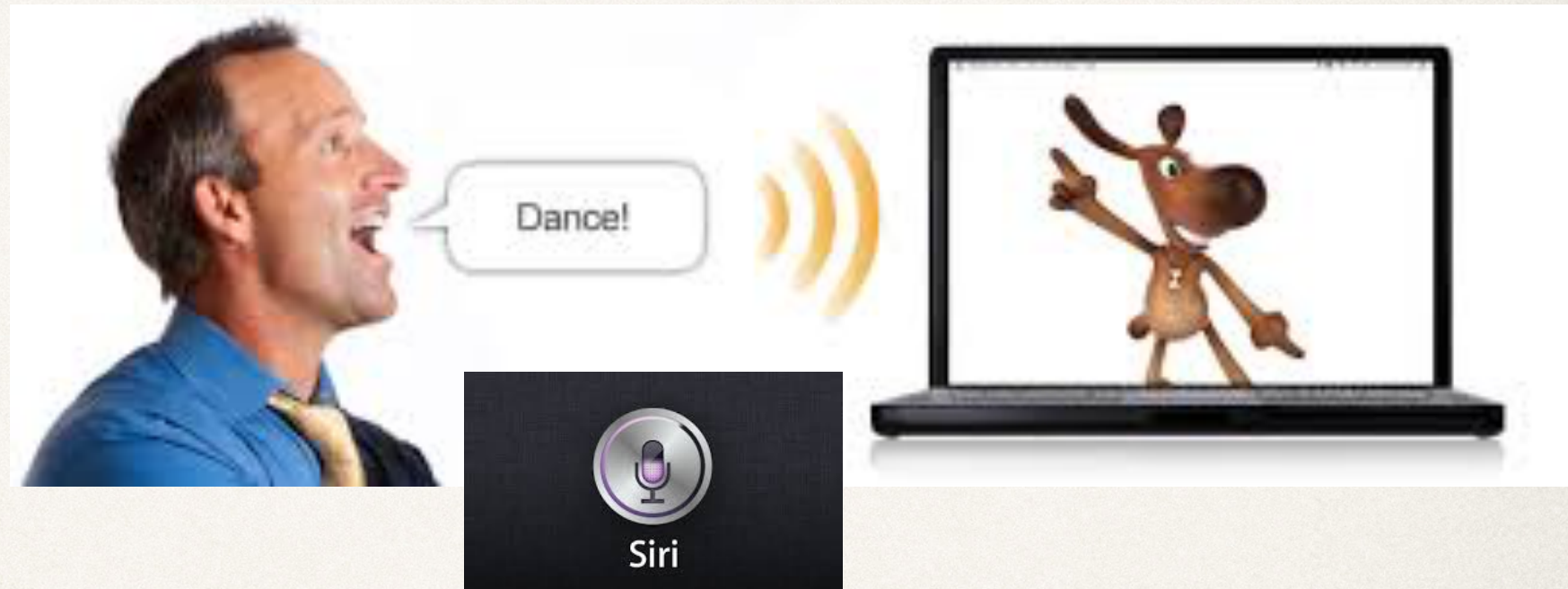you saw this video?"

❖ Did a Human or Machine write this ?

"A shallow magnitude 4.7 earthquake was reported Monday morning five miles from Westwood, California, according to the U.S. Geological Survey. The temblor occurred at 6:25 AM, Pacific time at a depth of 5.0 miles."

"Kitty couldn't fall asleep for a long time. Her nerves were strained as two tight strings, and even a glass of hot wine, that Vronsky made her drink, did not help her. Lying in bed she kept going over and over that monstrous scene at the meadow."

Established 1911

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MLSS - Examples

Speech Recognition

Sound Synthesis   http://news.mit.edu/2016/artificial-intelligence-produces-realistic-sounds-0613

What is Involved

Data → Signal Processing/ Analysis → Feature representations
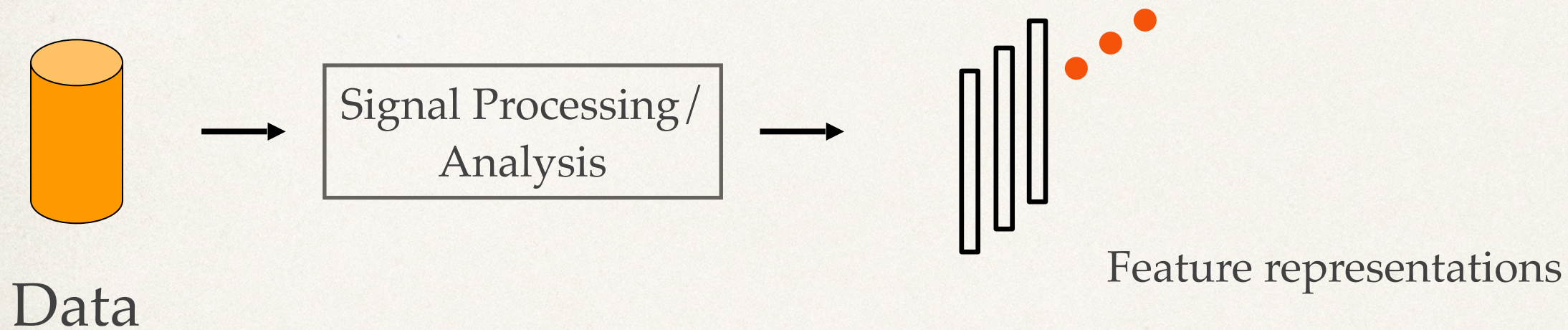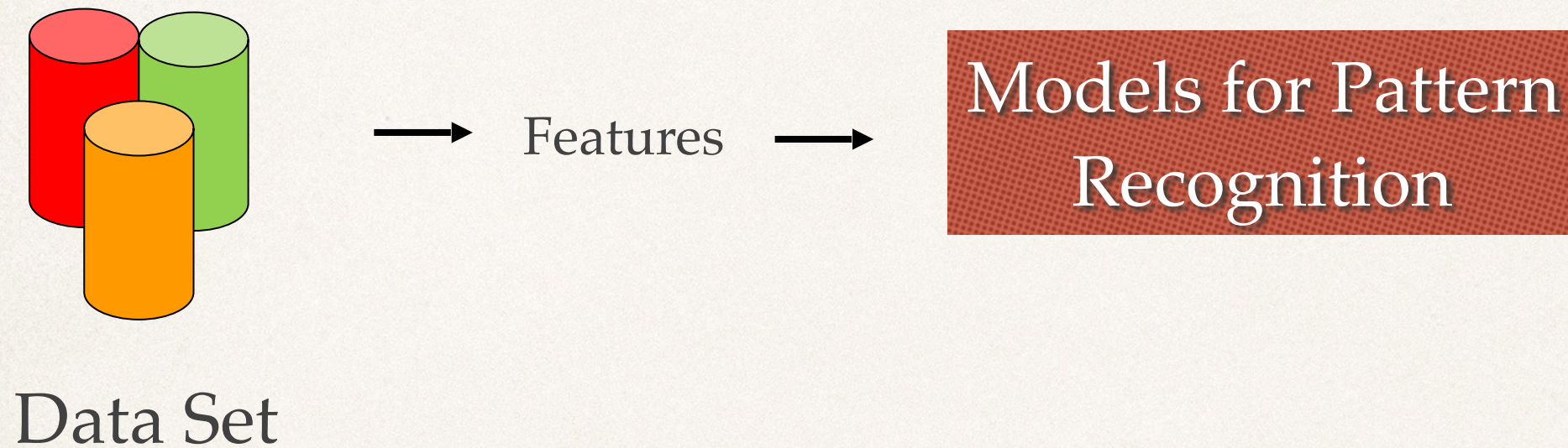
- ❖ Feature Extraction from Text, Speech, Image/Video signals.

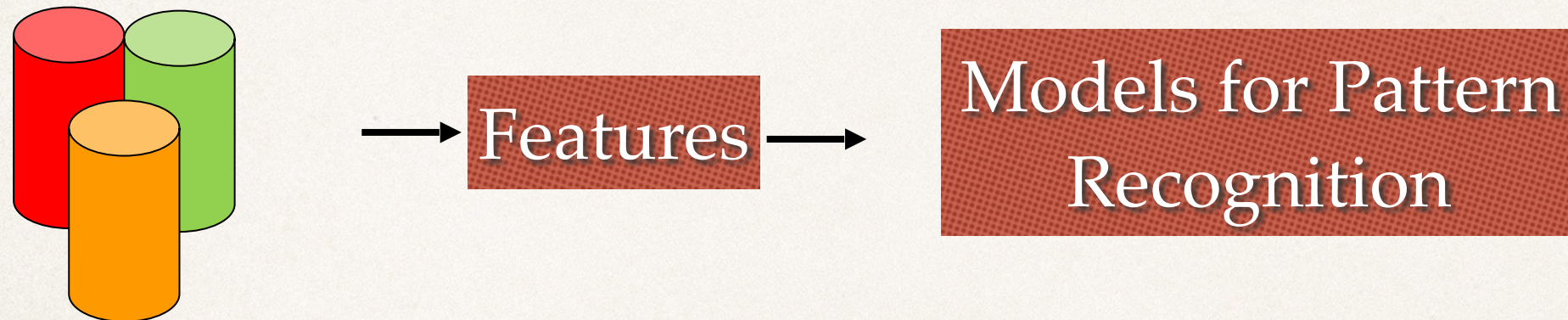- ❖ Dealing with noise and unwanted redundancies.

- ❖ Bio-inspired processing.

What is Involved

Data Set → Features → Models for Pattern Recognition

- ❖ Modeling the generation of data

  - ❖ Gaussian, Mixture Gaussian, Hidden Markov Models etc.

- ❖ Modeling the separation of data

  - ❖ Support Vector Machines, Deep Neural Networks etc.

What is Involved

Data Set → Features → Models for Pattern Recognition

Data Set

❖ Between features and pattern recognition

 ❖ Feature selection, dimensionality reduction, adaptation.

 ❖ Representation learning.

- ❖ Basics of Machine Learning

- ❖ Support Vector Machines for Classification

- ❖ Neural networks

- ❖ Deep learning methodologies