GENERAL ASSEMBLY

INTRO TO DATA SCIENCE
LECTURE 2: MACHINE LEARNING

WHAT IS MACHINE LEARNING?

“Machine learning, a branch of artificial intelligence, is about the construction and study of systems that can learn from data.” (source: http://en.wikipedia.org/wiki/Machine_learning)

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  Machine Learning Pioneer
  Samuel checkers playing program

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- *“The automatic discovery of regularities in data through the use of computer algorithms, and with the use of these regularities to take actions such as classifying the data into different categories”*

  Christopher Bishop
  Distinguished Scientist Microsoft Research
  Head of Machine Learning, Cambridge, UK

QUESTION

WHAT IS MACHINE LEARNING USED FOR?

Pattern Recognition

Prediction

Search Engines

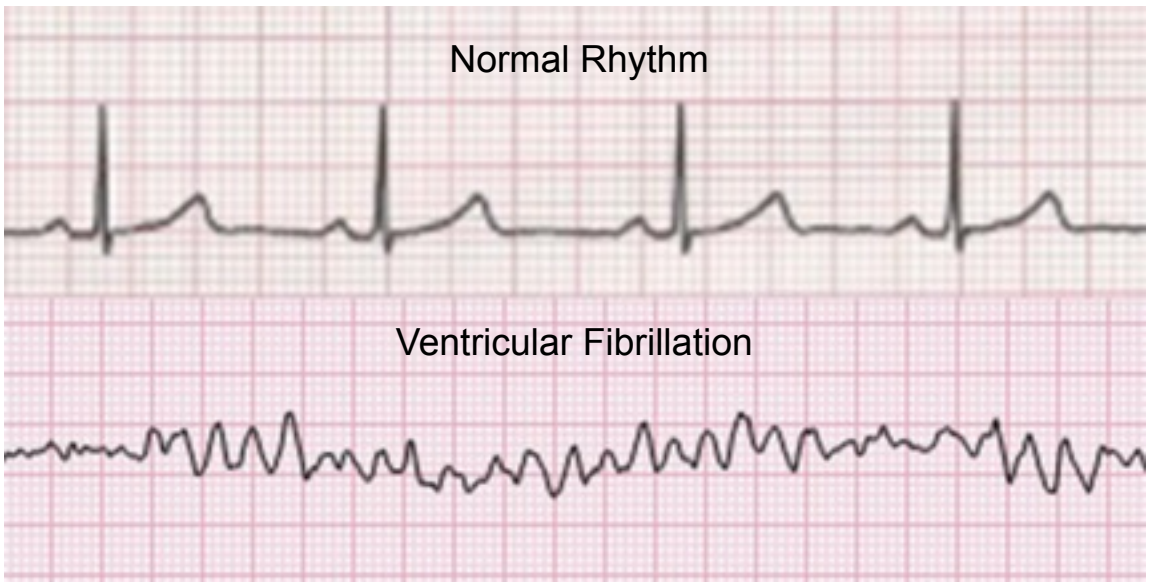
Diagnostics

Bioinformatics

Machine Translation

Summarization

EXAMPLE: DIAGNOSTICS & TREATMENT - ML THAT SAVES LIVES?



Johns Hopkins University School of Medicine estimates 522 lives are saved annually

- Finding patterns in (large) data sets
- Scaling out human decision making

- Algorithms vary in their ability to generalize over patterns
- Possibility of under/over-generalizing
- Limited by available data

MACHINE LEARNING ALGORITHMS

1. Supervised

2. Unsupervised

1. Supervised
   - Classification — Predict Class Membership
   - Regression — Predict Real Value
2. Unsupervised — Elucidate Structure

- Set of training data: x **– *"features or inputs"***
  - (also called regressors, covariates, independent variables, predictor measurements)
- Outcome measurements: y **– *"targets or outputs"***
  - (also called the dependent variable, the response)
- In ***regression***, *y* has real values - (54.9, 37.2, 24.6, …)
  - (e.g. house price, temperature)
- In ***classification***, *y* has finite values - (0, 1)
  - (e.g. survived/died, normal rhythm/fibrillation, cat/dog/horse)

On the basis of training data (consisting of m training examples)

(x_1, y_1)
(x_2, y_2)
(x_3, y_3)
:
(x_m, y_m)

we would like to:

- accurately predict unseen test cases
- understand which inputs affect the outcome, and how
- assess the quality of our predictions and inferences

- no target variable - just a set of features derived from the training data
- objective is less clear - find groups of features that behave similarly
- difficult to know how well you are doing
- can be useful as a pre-processing step for supervised learning

- spam filtering

- spam filtering
- character recognition

- spam filtering
- character recognition
- document clustering

- spam filtering
- character recognition
- document clustering
- fraud detection

- spam filtering
- character recognition
- document clustering
- fraud detection
- deciphering animal “speech”!