CS 445/545
Machine Learning
Spring, 2017

See syllabus at
http://web.cecs.pdx.edu/~mm/MachineLearningSpring2017/

Lecture slides will be posted on this website before each class.
What is machine learning?

- Textbook definitions of “machine learning”:
  - Detecting patterns and regularities with a good and generalizable approximation (“model” or “hypothesis”)
  - Execution of a computer program to optimize the parameters of the model using training data or past experience.
Training Examples: Class 1

Test example: Class = ?

Training Examples: Class 2
Training Examples: Class 1

Training Examples: Class 2

Test example: Class = ?
Training Examples: Class 1

Test example: Class = ?

Training Examples: Class 2
Training Examples: Class 1

Training Examples: Class 2

Test example: Class = ?
Training Examples: Class 1

Test example: Class = ?

Training Examples: Class 2
Types of machine learning tasks

• Classification
  – Output is one of a number of classes (e.g., ‘A’)

• Regression
  – Output is a real value (e.g., ‘$35/share’)

Types of Machine Learning Methods

• **Supervised**
  - provide explicit training examples with correct answers
    • e.g. neural networks with back-propagation

• **Unsupervised**
  - no feedback information is provided
    • e.g., unsupervised clustering based on similarity

• **“Semi-supervised”**
  - some feedback information is provided but it is not detailed
    • e.g., only a fraction of examples are labeled
    • e.g., reinforcement learning: reinforcement single is single-valued assessment of current state
Relation between “artificial intelligence” and “machine learning”?
Key Ingredients for Any Machine Learning Method

- **Features (or “attributes”)**
- Underlying **Representation** for “hypothesis”, “model”, or “target function”
- **Hypothesis space**
- **Learning method**
- **Data:**
  - **Training data**
    - Used to train the model
  - **Validation (or Development) data**
    - Used to select model hyperparameters, to determine when to stop training, or to alter training method
  - **Test data**
    - Used to evaluate trained model
- **Evaluation method**
Constructing Features
Wassup mm, how are you?!
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Benton Gothic is Light
**ChunkFive is Dramatic**
Helvetica is Neutral
Notation for Instances and Features

Instance: \( \mathbf{x} \) (boldface \( \Rightarrow \) vector)

Set of \( M \) instances:
\[
\{ \mathbf{x}^1, \mathbf{x}^2, ..., \mathbf{x}^M \}
\]

Instance as feature vector, with \( N \) features:
\[
\mathbf{x} = (x_1, x_2, ..., x_N)
\]

Instance as a point in an \( N \)-dimensional space:
Assumption of all ML methods:

**Inductive learning hypothesis:**

Any hypothesis that approximates target concept well over sufficiently large set of training examples will also approximate the concept well over other examples outside of the training set.

**Difference between “induction” and “deduction”?**
Goals of this course

• Broad survey of modern ML methods

• Learn by hands-on experience

• Good preparation to go further in the field, with more advanced courses or self-learning
Class Syllabus

http://web.cecs.pdx.edu/~mm/MachineLearningSpring2017/
Homework Collaboration

• Discussion is encouraged

• Actual code / experiments / writeup must be done entirely by you
Don’t forget to ask questions!
“To do” handout
Pre-Test

- 10 minutes
- Doesn’t count for grade
- Just for me to find out what math I need to review in class
- And for you to find out what math you need to review outside of class
Email me (mm@pdx.edu) if you are on the waiting list and would still like to join the class.