What VIPs are Saying about Machine Learning

“A breakthrough in machine learning would be worth ten Microsofts”
— Bill Gates

“Machine learning is the next Internet”
— Tony Tether (DARPA director)

“Machine learning is the hot new thing”
— John Hennessy (Stanford president)

“Web rankings today are mostly a matter of machine learning”
— Prabhakar Raghavan (Google VP)

“Machine learning is going to result in a real revolution”
— Greg Papadopoulos (Sun CTO)

“Machine learning is today’s discontinuity”
— Jerry Yang (Yahoo founder)
What is Learning?

- Predicting the future, given the past
- Generalizing to new scenarios
- Getting better with practice
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- Getting better with practice

To measure how well an algorithm has learned, we give it a test (sound familiar?).
Examples

- Categorizing documents (e.g., “is this email spam?”)
- Labeling images (e.g., “who’s in this picture?”)
- Predicting the future: weather, finance, medical outcomes
- Collect sensor data, predict values everywhere (e.g., energy use in a building)
- Recommending products (e.g., movies and books)
- Decision-making in the face of uncertainty (e.g., self-driving cars)
- Given an instance, find similar ones (e.g., images)
- Find structure or patterns in large datasets (e.g., clustering)
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Today

ML is required for . . .

▶ Video and image processing
▶ Speech and language processing
▶ Search engines
▶ Robot control
▶ Sensor networks
▶ Computational biology
▶ Medical and health analysis

When people say “AI” they almost always mean “ML.”

Trends: more data, faster processing and networks, new sensors and IO devices, demand for customization.

Software is becoming too complex to write by hand.
Is it Magic?
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More like *gardening*.

Growing successful plants (programs) requires:
- seeds (algorithms)
- nutrients (data)
- a gardener (ML expert)
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Gardens are somewhat predictable, but not entirely, and our scientific understanding is still improving!
Inductive, Supervised Machine Learning

- **Training:** a learning algorithm is given a set of example input-output pairs \((x, y)\) and produces a function \(f\); the goal is for \(f(x)\) to recover \(y\), for each example, and on future examples.

- **Testing:** we apply \(f\) to new test examples \((x, y)\) and measure how well \(f(x)\) matches \(y\).
Inputs and Output

- $x$ can be pretty much anything we can represent
  - To start, we’ll think of $x$ as a bundle of attribute-value pairs, e.g., $\phi(x) = v$.
- $y$ can be
  - a real value (regression)
  - a label (classification)
  - an ordering (ranking)
  - a vector (multivariate regression)
  - a sequence/tree/graph (structured prediction)
  - ...
Examples

▶ Predict rainfall in Seattle tomorrow.

▶ Is this email spam?
  From: 6cq0ybi1otqmtyidobfsrd2r8dwkhea@mx7.besthappydayes.com
  Subject: We Have Found Your Missing Money
  You are Owed Cash That You Don’t Know About Find Unclaimed Money

▶ What zip code is in this image?
  20 / 35
Examples

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- What zip code is in this image?

35460
Administrivia
Bookmark These

Course website: http://courses.cs.washington.edu/courses/cse446/17au/

Canvas: https://canvas.uw.edu/courses/1173938

Textbook: http://ciml.info
Noah (instructor):

- UW CSE professor since 2015, NIPS & ICML papers since 2008, professor since 2006, using ML since 1998
- Research interests: machine learning for structured problems in NLP, ML & NLP for social science

TAs: Kousuke, John, Deric, Patrick, Andrew, and Jane
Outline of CSE 446

- Problem formulations: classification, regression
- Techniques: decision trees, nearest neighbors, perceptron, linear models, probabilistic models, neural networks, kernel methods, clustering
- “Meta-techniques”: ensembles, expectation-maximization
- Understanding ML: limits of learning, practical issues, bias & fairness
- Recurring themes: (stochastic) gradient descent, bullshit detection
Project

- Teams of three
- Parts:
  1. Build and justify a new regression or binary classification dataset (due 10/17)
  2. Dataset review (part of A2) & class-wide selection (official datasets announced 11/3)
  3. Implement ML algorithms and compete in a bakeoff on ~5 datasets (due 12/5)
- Don’t wait! Part 1 is already available on the course website.
Grading

- Assignments (five, 11% each)
- Project (30%)
- Final exam (15%)
Grading

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  - Some pencil and paper, mostly programming
  - Graded mostly on attempt, not correctness
  - Five late days; no credit for late work after they are used up.
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- Final exam (15%) tentatively Wed. Dec. 13, 8:30–10:20 am
“Can I Take This Class?”

▶ Short answer: yes (if you can get past the wait list), but be warned.

▶ Official prerequisites (and linear algebra) are strongly advised.
  ▶ Be forthcoming with your potential teammates!

▶ We assume you’re a strong programmer and comfortable with math.

▶ We will move fast; lectures will focus on concepts and mathematics, quizzes are for review and implementation discussions.

▶ “Sink or swim.”

I’ve been told to give The Link on Friday.
Quiz section meetings start tomorrow. **Bring your laptop!**

Read: Daume (2017, ch. 1)

Academic integrity statement: on the course web page; upload your signed scan through Canvas.

Form groups and register them on Canvas (People → Groups → Project Groups)