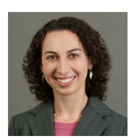
Machine Learning for Big Data (CSE 547 / STAT 548)

(Or how to do really kickass research in the age of big data)

Course Staff

Instructor:

- Emily Fox



TAs:

- Alden Timme
- Chad Young

CONTENT

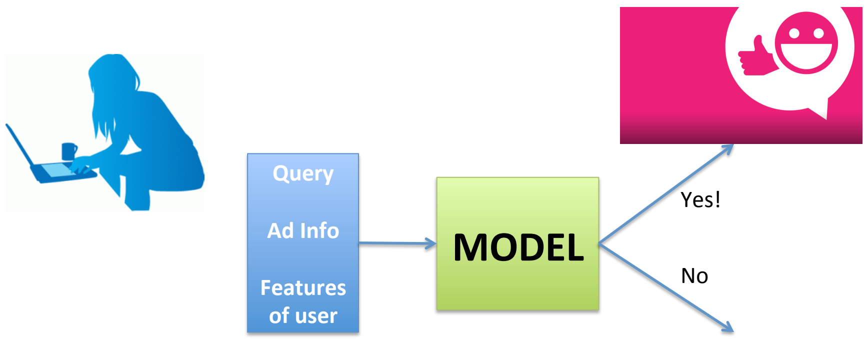
What is the course about?

Course Structure

- 5 "case studies"
  - Estimating Click Probabilities
  - Document Retrieval
  - fMRI Prediction
  - Collaborative Filtering
  - Document Mixed Membership Modeling
- Not comprehensive, but a sample of tasks and associated solution methods
- Methods broadly applicable beyond these case studies

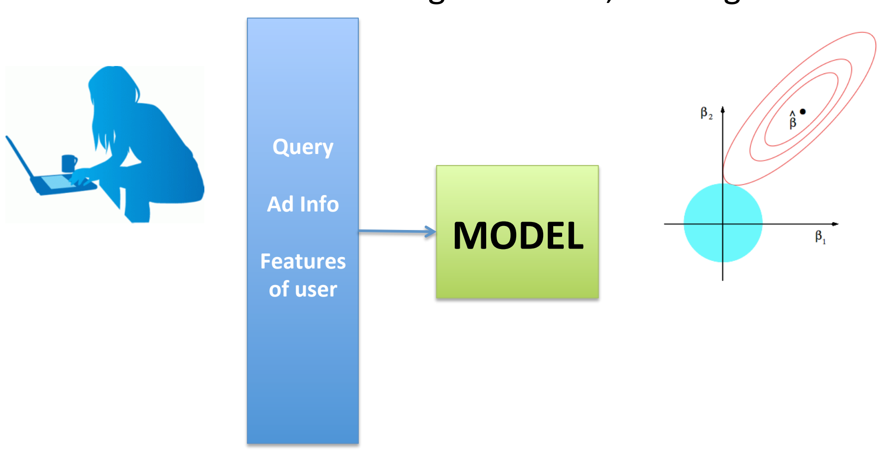
1. Estimating Click Probabilities

- **Goal:** Predict whether a person clicks on an ad
- **Basic method:** logistic regression, online learning



1. Estimating Click Probabilities

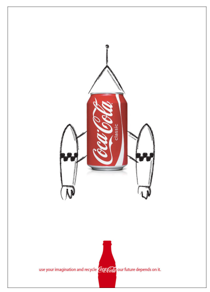
- **Challenge I:** Overfitting, high-dimensional feature space
- **Advanced method:** L2 regularization, hashing



1. Estimating Click Probabilities

- **Challenge II:** Dimension of feature space changes
  - New word, new user attribute, etc.
- **Advanced method:** sketching, hashing





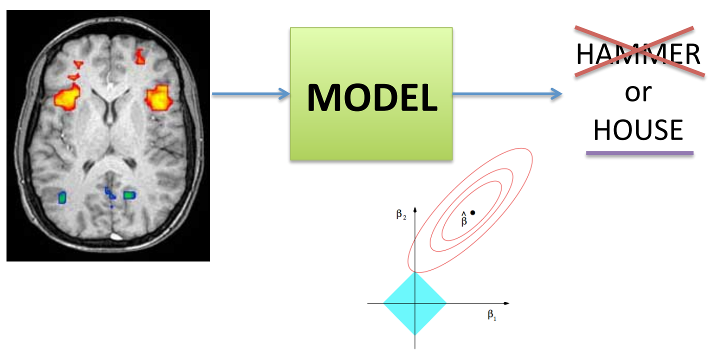

2. Document Retrieval

- **Goal:** Retrieve documents of interest
- **Methods:** fast K-NN, k-means, mixture models, Hadoop



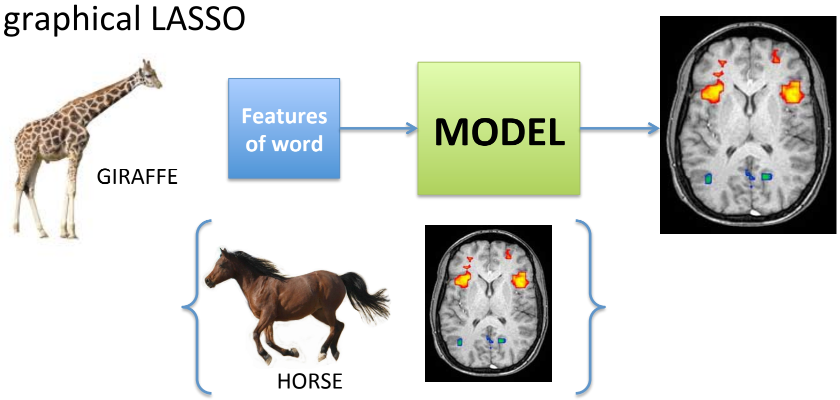
3. fMRI Prediction

- **Goal:** Predict word probability from fMRI image
- **Challenge:** p >> n (feature dimension >> sample size)
- **Methods:** L1 regularization (LASSO), parallel learning



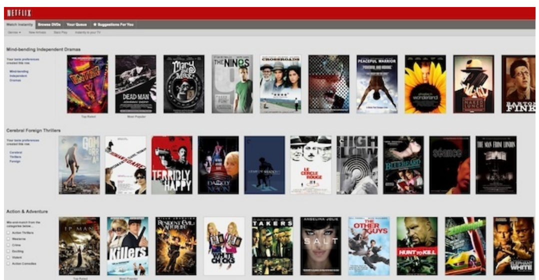
3. fMRI Prediction

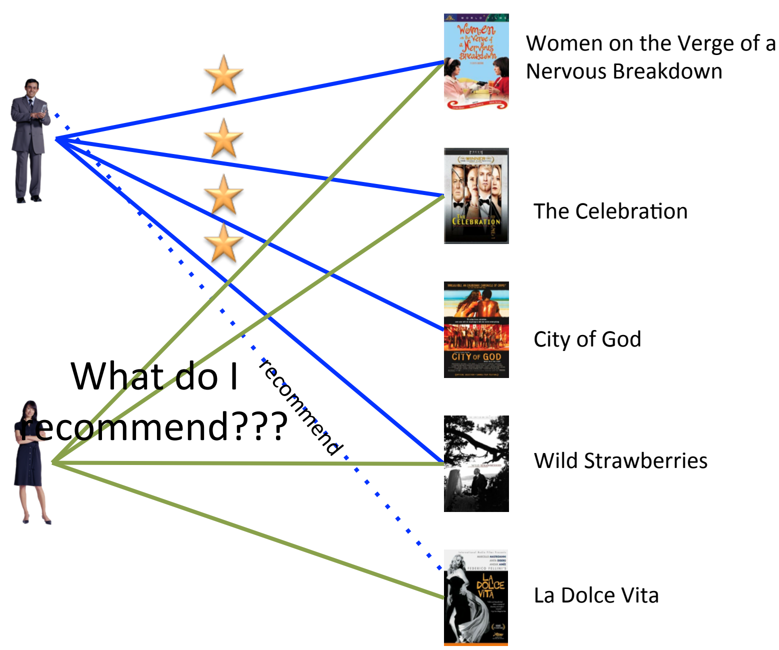
- **Goal:** Predict fMRI image for given stimulus
- **Challenge:** zero shot learning (generalization)
- **Methods:** features of words, Mechanical Turk, graphical LASSO



4. Collaborative Filtering

- **Goal:** Find movies of interest to a user based on movies watched by the user and others
- **Methods:** matrix factorization, latent factor models, GraphLab



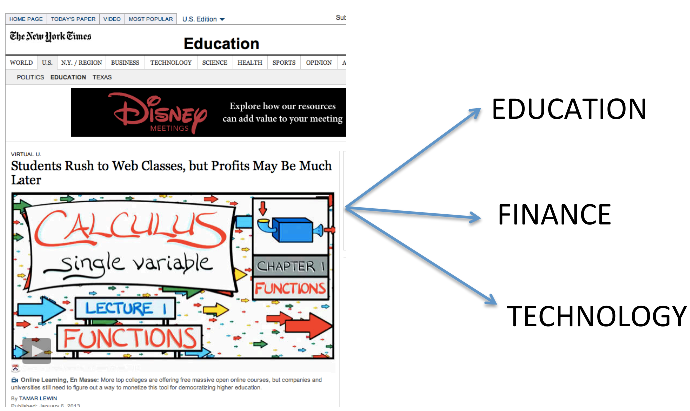


4. Collaborative Filtering

- **Challenge:** Cold-start problem (new movie or user)
- **Methods:** use features of movie/user

5. Document Mixed Membership

- **Challenge:** Document may belong to multiple clusters
- **Methods:** mixed membership models (e.g., LDA), distributed Gibbs, stochastic variational inference



Scalability

- Throughout case studies, introduce notions of parallel learning and distributed computations

Assumed Background

Official Prereq (strict): CSE 546 or STAT 535

Specific topics:
- Linear and logistic regression, ridge regression, LASSO
- Basic optimization (e.g., gradient descent, SGD)
- Perceptron algorithm
- K-NN, k-means, EM algorithm

Comfortable with:
- Java
- Probabilistic and statistical reasoning

Computational and mathematical maturity

LOGISTICS

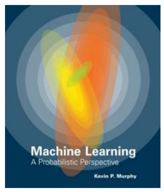
How is the course going to operate?

Website and Catalyst

- Course website: http://www.cs.washington.edu/education/courses/cse547/14wi/
- Catalyst:
  - Used for all discussions
  - Post all questions there (unless personal)
  - Homework collection

Reading

- No req'd textbook, but background reading in:



"Machine Learning: A Probabilistic Perspective"
Kevin P. Murphy

- Readings will be from papers linked to on course website
- Please do reading before lecture on topic

Homework

- 4 HWs, approx one for each case study
- Collaboration allowed, but write-ups and coding must be done individually
- On due date, due at beginning of class time
- Allowed 2 "late days" for entire quarter
- 3rd assignment must be completed individually
  → "Midterm"

Project

- Individual, or teams of two
- New work, but can be connected to research
- Schedule:
  - Proposal (1 page) – January 28
  - Progress report (3 pages) – February 20
  - Poster presentation –
    Friday, March 14, 2:30-4:30pm
  - Final report (8 pages, NIPS format) – March 18

Grading

- HWs 1, 2, 4 (15% each)
- HW 3 (20%) – midterm exam
- Final project (35%)

Support/Resources

- Office Hours
  - TAs: M 10-12, T 1-2, W 3-4… Location TBA
  - Emily: Th 11-12 in CSE 346
- Recitations
  - Optional tutorial/example-based sections will be held weekly on Mondays from 5:30-6:30pm
  - Location TBA

Conclusion

- I like Big Data and I cannot lie

[INSERT SONG HERE]

Or, let's just carry on with the first lecture…