Machine Learning for Big Data (CSE 599)

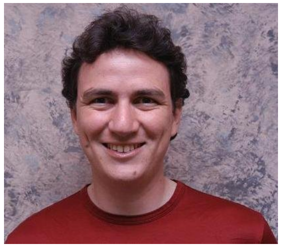
Statistics for Big Data (STAT 592)

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

Course Staff

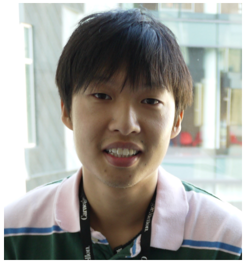
Instructors:

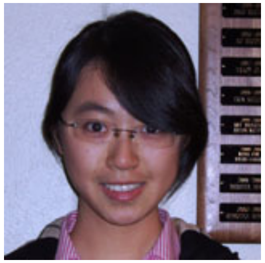
- Emily Fox (Stat)
- Carlos Guestrin (CSE)



TAs:

- Jay Gu (CSE)
- Linda Li (Stat)





CONTENT

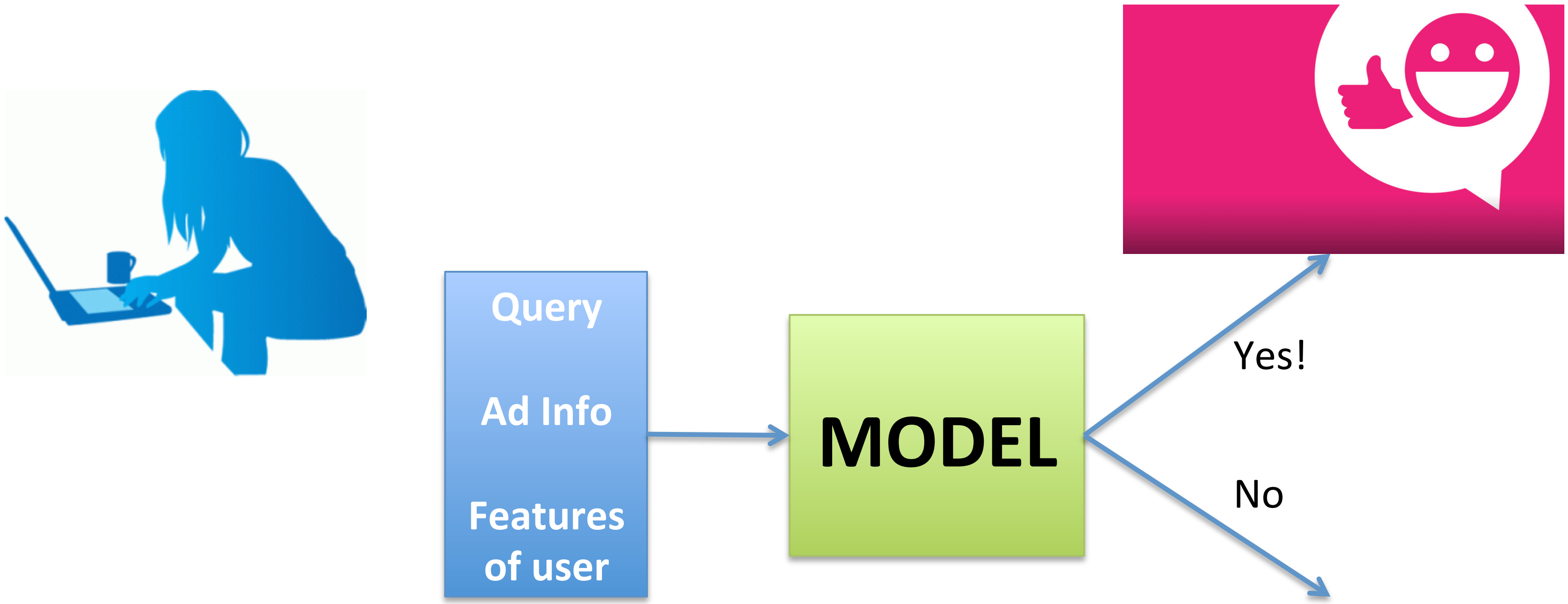
What is the course about?

Course Structure

- 4 “case studies”
  - Estimating Click Probabilities
  - Document Retrieval
  - fMRI Prediction
  - Collaborative Filtering
- 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



Query

Ad Info

Features of user

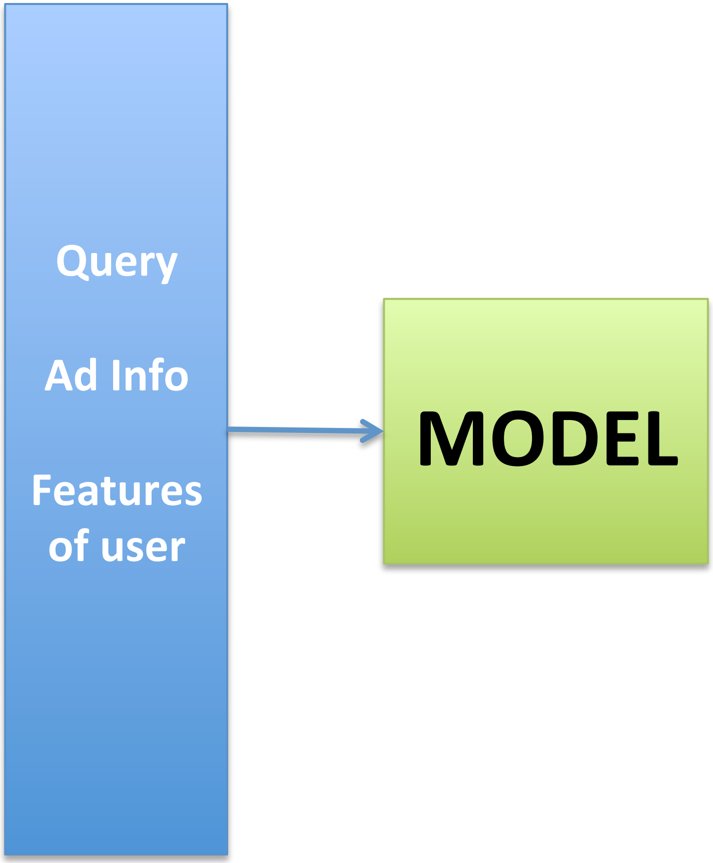
MODEL

Yes!

No

1. Estimating Click Probabilities

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

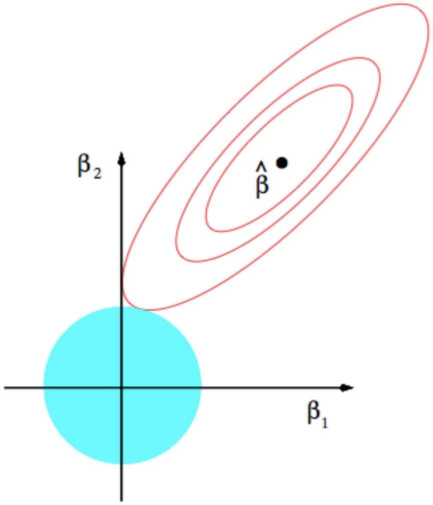


Query

Ad Info

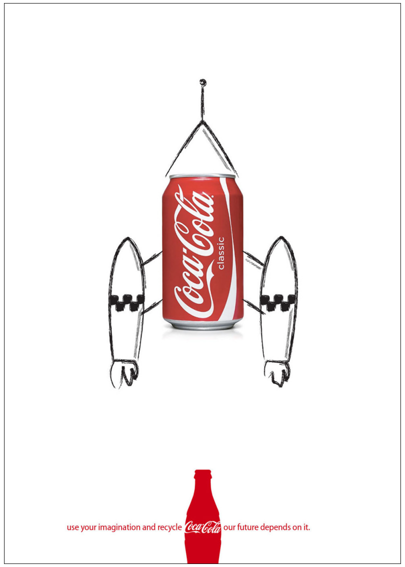
Features of user

MODEL



1. Estimating Click Probabilities

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


Coca-Cola classic
use your imagination and recycle Coca-Cola our future depends on it.

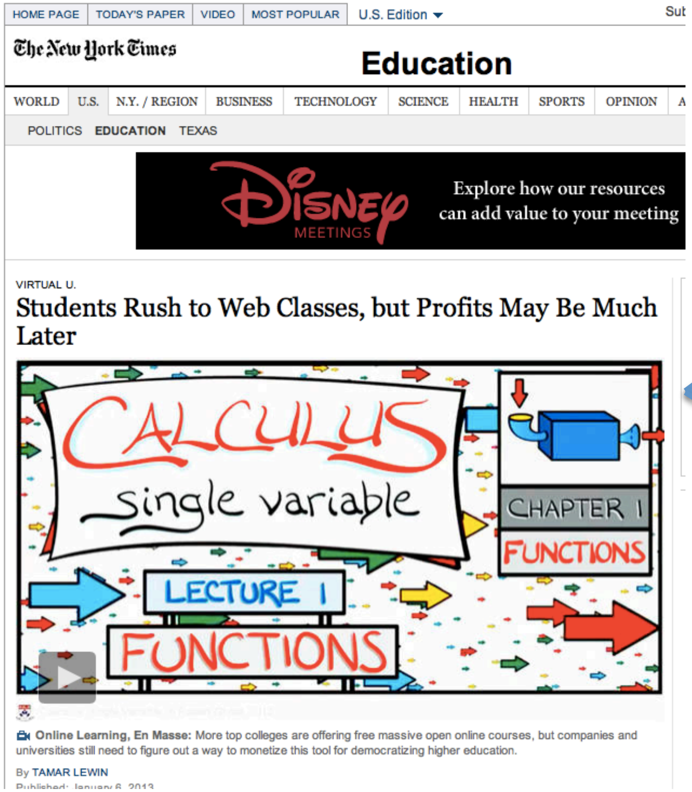
2. Document Retrieval

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

Abbott Reveals Views on Trial
5 FLYERS BAIL OUT OVER PACIFIC---2 SAVED

2. Document Retrieval

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



HOME PAGE | TODAY'S PAPER | VIDEO | MOST POPULAR | U.S. Edition ▾ Sut

The New York Times

Education

WORLD | U.S. | N.Y. / REGION | BUSINESS | TECHNOLOGY | SCIENCE | HEALTH | SPORTS | OPINION | A

POLITICS **EDUCATION** TEXAS

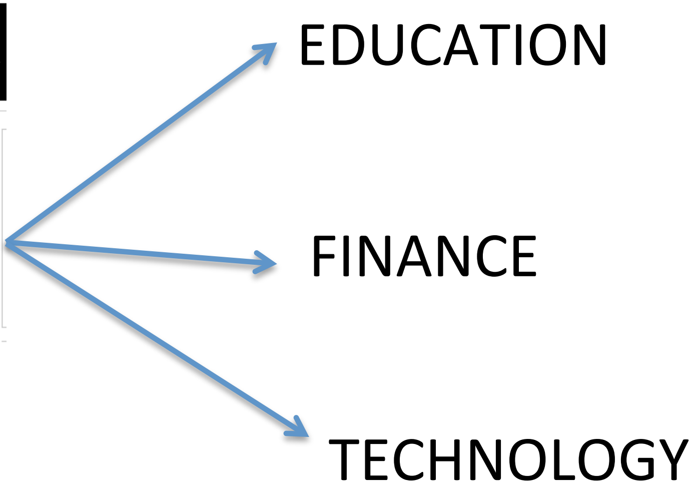
VIRTUAL U.

Students Rush to Web Classes, but Profits May Be Much Later

Online Learning, En Masse: More top colleges are offering free massive open online courses, but companies and universities still need to figure out a way to monetize this tool for democratizing higher education.

By TAMAR LEWIN

Published: January 6, 2013



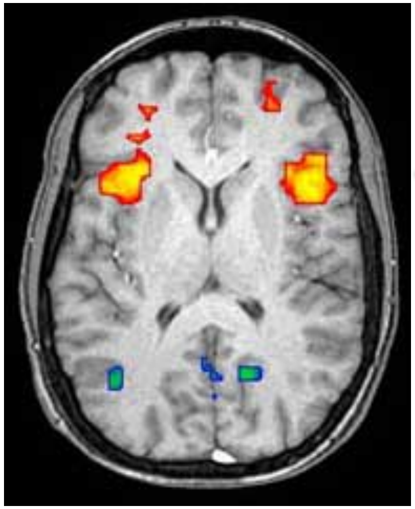
EDUCATION

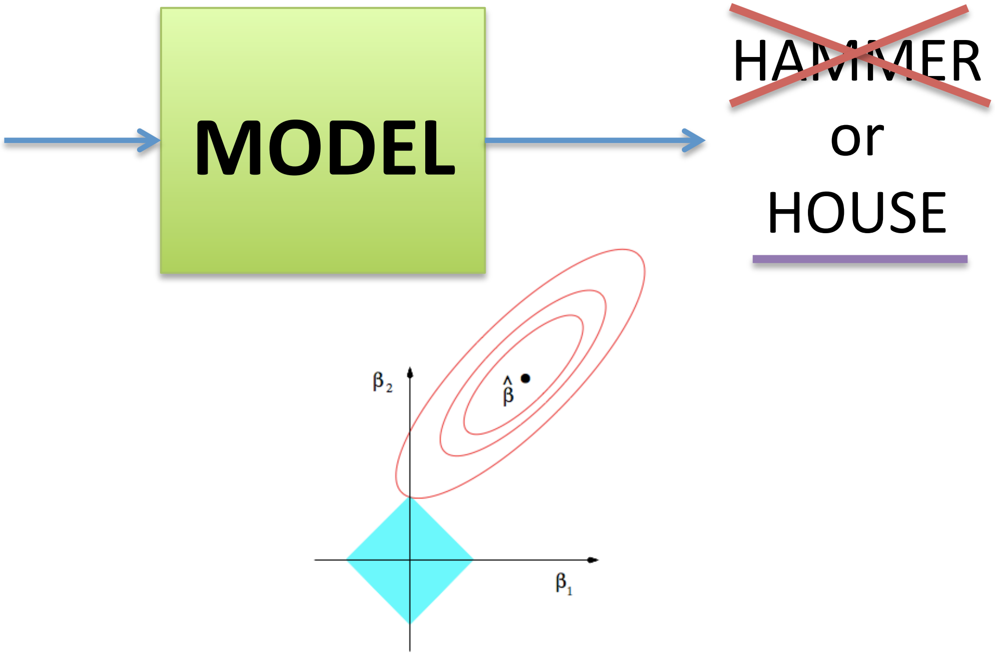
FINANCE

TECHNOLOGY

3. fMRI Prediction

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





MODEL

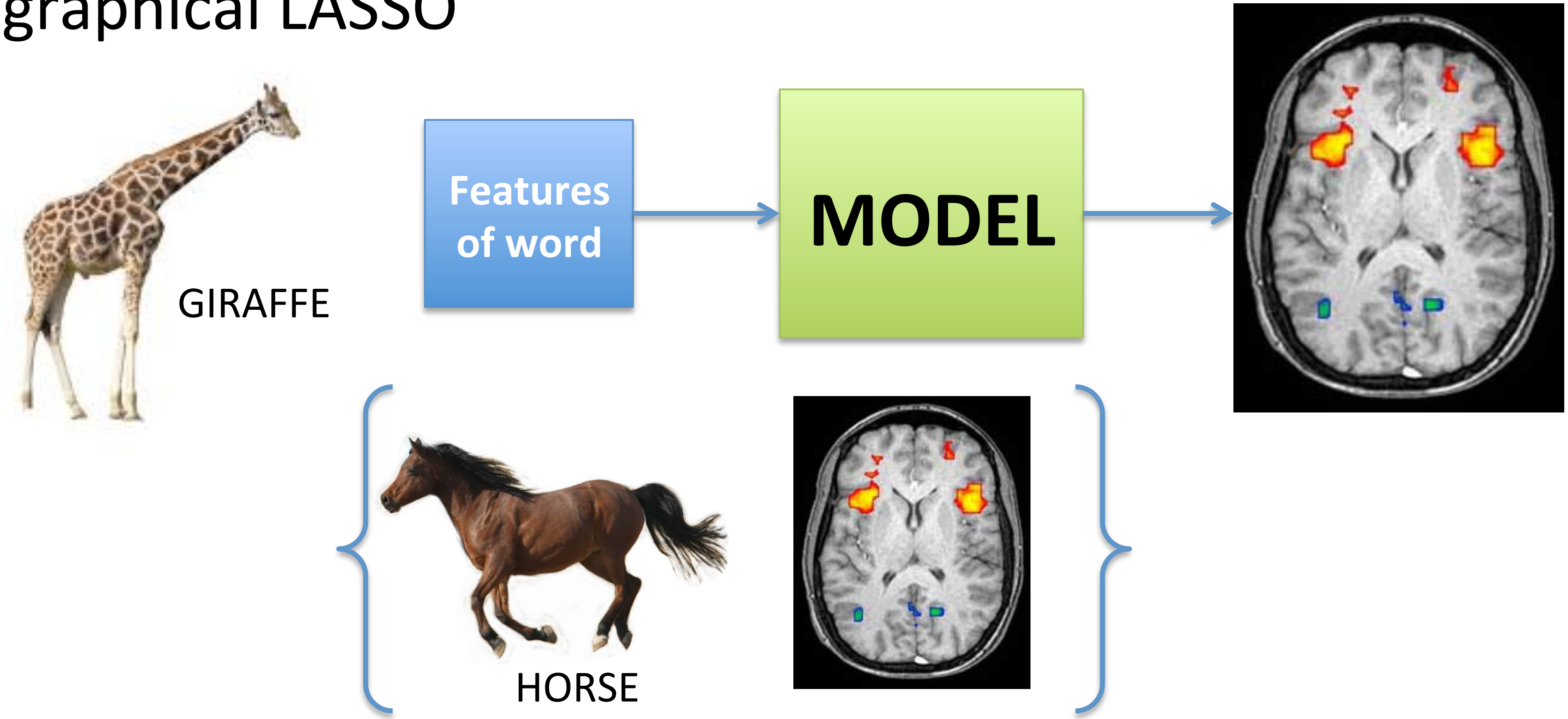
~~HAMMER~~

or

HOUSE

3. fMRI Prediction

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



GIRAFFE

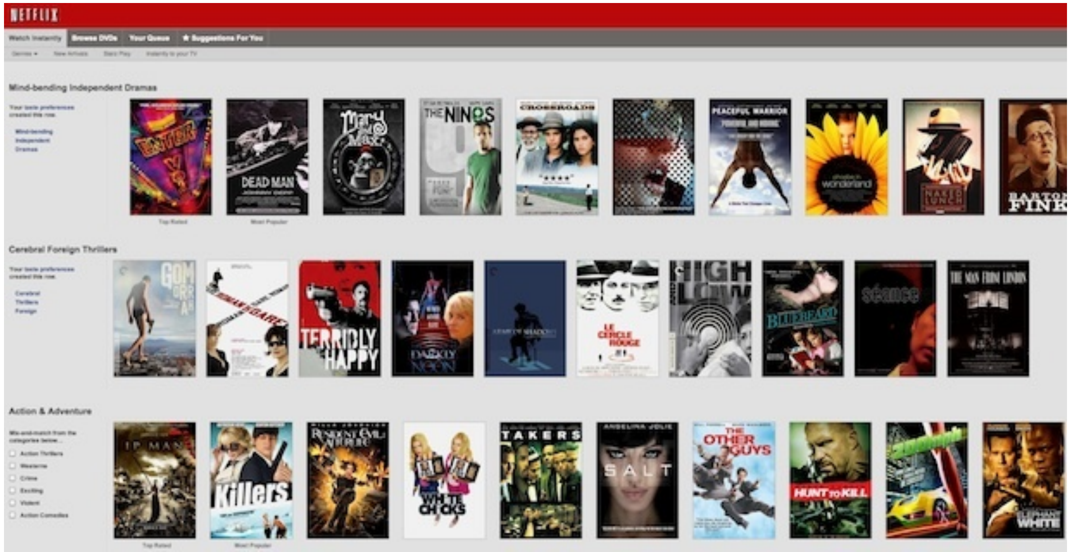
Features of word

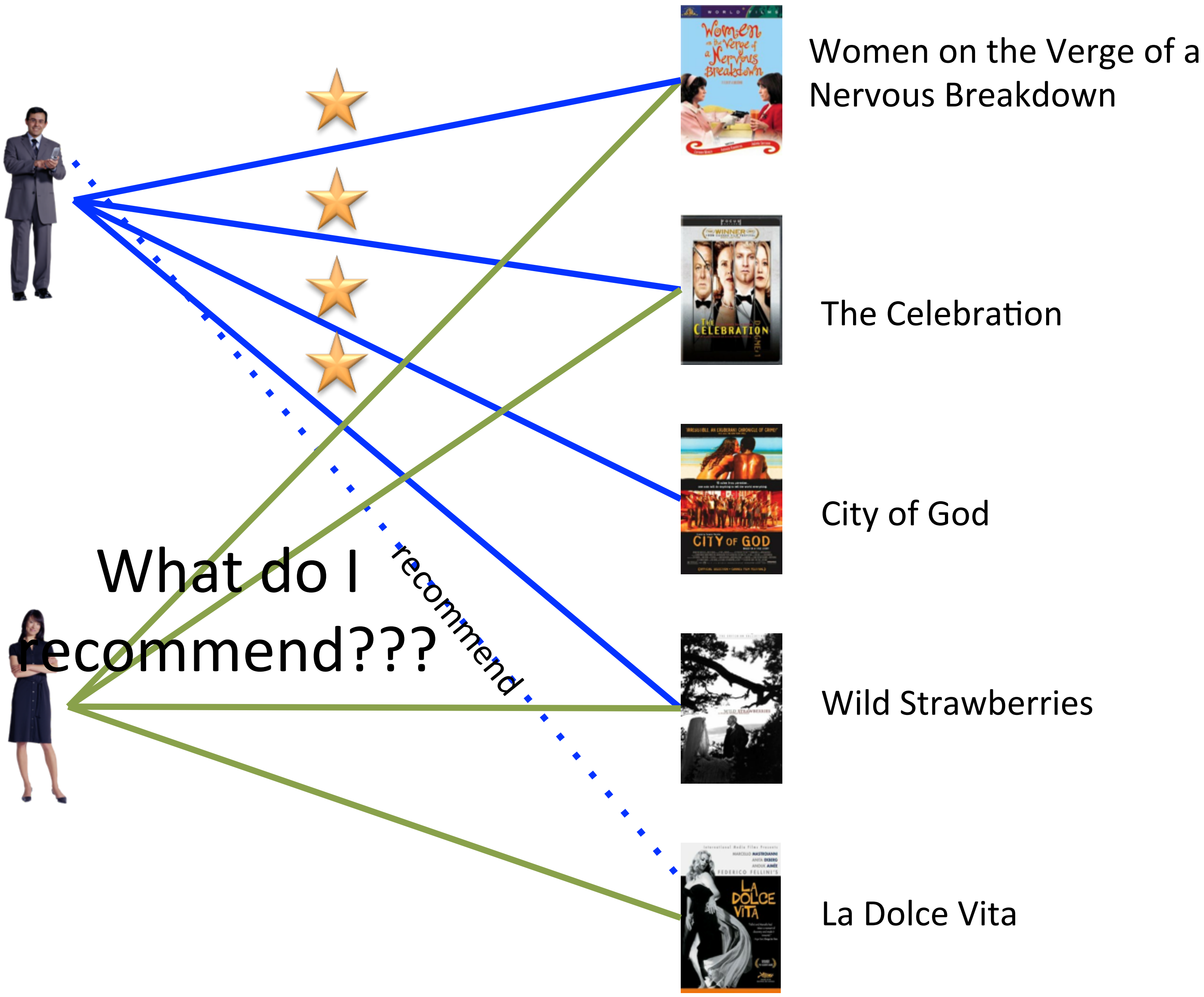
MODEL

HORSE

4. Collaborative Filtering

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





Women on the Verge of a Nervous Breakdown

The Celebration

City of God

Wild Strawberries

La Dolce Vita

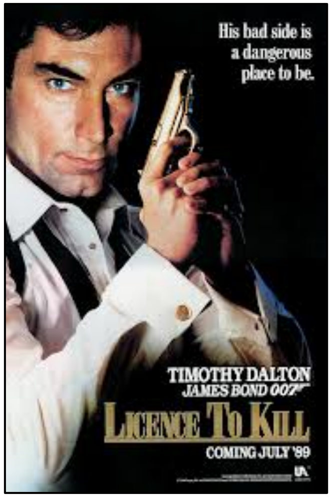
What do I recommend???

recommend

4. Collaborative Filtering

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

IN THEATERS



Scalability

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

Assumed Background

Comfortable with:

- Linear regression
- Basic optimization (e.g., gradient descent)
- EM algorithm
- Java

Have seen:

- Graphical models (as a representational tool)
- Gibbs sampling

Computational and mathematical maturity

LOGISTICS

How is the course going to operate?

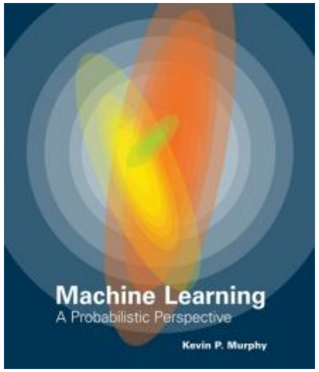
Website and Google Group

- Course website: http://www.cs.washington.edu/education/courses/cse599c1/13wi/

- Google Group:
  - Used for all discussions
  - Post all questions there (unless personal)
  - See website for sign-up details

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, one for each case study
- Collaboration allowed, but write-ups and coding must be done individually
- Submitted at beginning of class
- Allowed 2 “late days” for entire quarter
- 3rd assignment must be completed individually

Project

- Individual, or teams of two
- New work, but can be connected to research
- Schedule:
    - Proposal (1 page) – January 31
    - Progress report (3 pages) – February 21
    - Poster presentation – March 14
    - Final report (8 pages, NIPS format) – March 19

Grading

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

Support/Resources

- Office Hours
  - TAs: MW 4-5pm in CSE 216
    T 3-5pm in CSE 220
  - Emily: Th 12:45-1:45pm in Padelford B-305
  - Carlos: F 1:30-2:30pm in CSE 568
- Recitations
  - Optional tutorial/example-based sections will be held weekly on Thursdays from 5:30-7pm
  - MUE 153, to be confirmed

Conclusion

- I like Big Data and I cannot lie

[INSERT SONG HERE]

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