Logistics

- Schedules
- Shirts
- Room keys
- Lunch
- Presentations
Thanks To...

Microsoft Research
University of Washington, CSE
Kay Beck-Benton
Why?

Education + Crowdsourcing
Educational Goals

• Increasing Access: MOOCs
  – Need
  – Cost
  – Technology

• Improved Quality
  – Materials
  – Response time
  – Personalization
Crowdsourcing Challenges

• How to crowdsource.....?
  – Image labeling, nutritional analysis of meal photo
  – Peer grading
  – Hints & explanations
  – Creation of new...
    • Problems
    • Examples
    • Animations
    • Etc...
Crowdsourcing Challenges

• Intelligent tutoring systems meet

• Big data analytics
  – Student modeling
  – Real-time A/B testing for (micro) curricular changes
  – Personalization & engagement
    15% Udacity; 8% MIT; 12-28% Coursera
Crowdsourcing Challenges

Workflow design & control

Course = very complex workflow
Crowdsourcing Challenges

• Novel form of crowd

• Motivation?
Motivation / Incentives

- Money

[Logos for Amazon Mechanical Turk, VWorker, oDesk, and MobileWorks]
Motivation / Incentives

• Money

• Altruism, Esteem & Community

Customer Reviews

3,314 Reviews

5 star: (2,578)
4 star: (416)
3 star: (179)
2 star: (66)
1 star: (75)

Average Customer Rating: 🌟🌟🌟🌟🌟 (3,314 customers)

Most Helpful Customer Reviews

515 of 581 people found the following review helpful:

🌟🌟🌟🌟🌟 A stunning and thoroughly satisfying experience.

By T. Burger (Chicago) - See all my reviews

Top 100 Reviewer  Real Name  VINE™ Voice
Motivation / Incentives

- Money
- Altruism, Esteem & Community
- Entertainment

The ESP Game

foldit

duolingo
Motivation / Incentives

- Money
- Altruism, Esteem & Community
- Entertainment
- Self-Interest
Motivation / Incentives

- Money
- Altruism, Esteem & Community
- Entertainment
- Self-Interest
- Education
Crowds of ...?

- Students
  - Peer grading
- Graduates
  - Forum monitoring
- Teachers
Machine Reading & Education

- Classify pages (syllabus, problem set...)
- Identify topics, prerequisites, hierarchy
- Extract content...

- Create a educational resource to drive traffic
Topic: Expectation Maximization
Baum-Welch Algorithm is an instance of Expectation Maximization, used in natural language processing.

(extracted from Wikipedia)
In **statistics**, an **expectation–maximization (EM) algorithm** is an **iterative method** for finding **maximum likelihood** or **maximum a posteriori** (MAP) estimates of **parameters** in **statistical models**, where the model depends on unobserved **latent variables**. The EM iteration alternates between performing an expectation (E) step, which computes the expectation ...

**EM** is an **iterative optimization** method to estimate some unknown parameters $T$, given measurement data $U$. However, we are not given some “hidden” **nuisance variables** $J$, which need to be integrated out. In particular, we want to maximize the **posterior probability** of the parameters $T$ given the data $U$, marginalizing over $J$ ...

The **EM algorithm** is used to approximate a **probability function** (p.f. or p.d.f.). **EM** is typically used to compute **maximum likelihood** estimates given incomplete samples. Let $X$ be the set of hidden variables, $Y$ the set of observable variables, ...
Topic: Expectation Maximization

Overview

Topic Map
Prerequisites
Summary
Learn
Videos
Slides
Tutorials
Courses

Test

Problem sets
Autograded

Discuss

Q&A
Comments

General Idea

- Start by devising a noisy channel
- Any model that predicts the corpus observations via some hidden structure (tags, parses, ...)
- Initially guess the parameters of the model
- Educated guess is best, but random can work

Expectation step: Use current parameters (and observations) to reconstruct hidden structure
Maximization step: Use that hidden structure (and observations) to reestimate parameters

Overview

Objective

- Expectation Maximization (EM) is perhaps most often used and mostly half-understood algorithm for unsupervised learning.
  - It is very intuitive
  - Many people use it as a solution to apply the algorithm in different problem domains
  - I will present a proof of the EM Theorem that explains why the algorithm works.
  - Hopefully this will help applying EM robustness is not obvious

Expectation Maximization

- First introduced in 1977
- Lots of mathematical derivations
- Problem: given a set of data (data is incomplete or having missing values)
- Goal: assume the set of data come from a underlying distribution, we need to guess the most likely (maximum likelihood) parameters of that model.

Overview

- Expectation Maximization is a technique used to estimate probability densities under missing (unobserved) data
  - Density Estimation
  - Observed vs. Missing Data
  - EM

Notice an error?
Learn

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Overview

Topic: Expectation Maximization

Line Fitting: Write a function that fits a line to data. Note that Weiss describes a method for doing this using weighted least squares, which essentially only looks at error in the y direction. This fits the examples below, in which noise is added to ... 

The two local newspapers, the C-Gazette and the U-Gazette, publish $n$ articles everyday. The article length in the newspapers is distributed based on the Poisson distribution with parameter $\lambda$. To clarify, for a non-negative integer $x$ ... 

Consider data, $D = 2, 3, 1$, sampled from a two-dimensional (separable) distribution, $p(x_1, x_2) = px_1(x_1)px_2(x_2)$, with ...
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00-9:00 am</td>
<td>Breakfast (Owens A/B)</td>
</tr>
<tr>
<td>9:00-9:30 am</td>
<td>Opening Remarks (Dan Weld)</td>
</tr>
<tr>
<td>9:30-10:00 am</td>
<td>Jennifer Widom: From 100 Students to 100,000</td>
</tr>
<tr>
<td>10:00-10:30 am</td>
<td>Coffee break</td>
</tr>
<tr>
<td>10:30-11:30 am</td>
<td>Perspectives from Educational and Cognitive Psychology</td>
</tr>
<tr>
<td></td>
<td>- Michelene Chi: Two Approaches to Enhancing Online Learning: Dialogue Videos and Engagement Activities</td>
</tr>
<tr>
<td></td>
<td>- Ken Koedinger: Crowdsourcing Cognitive Models for Assessment, Tutoring, and In-Game Support</td>
</tr>
<tr>
<td>11:30 am-1:00 pm</td>
<td>Lunch (Owens B)</td>
</tr>
<tr>
<td>1:00-2:45 pm</td>
<td>Insights from Research on Intelligent Tutoring Systems</td>
</tr>
<tr>
<td></td>
<td>- Kurt Van Lehn: Toward socially intelligent tutoring systems: Of the crowd, for the crowd</td>
</tr>
<tr>
<td></td>
<td>- Sumit Gulwani: Intelligent Tutoring Systems: A Logical Perspective</td>
</tr>
<tr>
<td></td>
<td>- Emma Brunskill: Student Variability and Automated Instructional Policies</td>
</tr>
<tr>
<td>2:45-6:00 pm</td>
<td>Outside activities: hiking, biking, canoeing</td>
</tr>
<tr>
<td>6:15-7:30 pm</td>
<td>Dinner and discussions (Owens B)</td>
</tr>
<tr>
<td>7:30-8:30 pm</td>
<td>Luis von Ahn: DuoLingo: Learn a Language for Free while Helping to Translate the Web</td>
</tr>
</tbody>
</table>
Jennifer Widom

- Fletcher Jones Professor and Chair of CS at Stanford.
- Bachelor's from the Indiana University School of Music in 1982
- Ph.D. in CS from Cornell University in 1987.
- Research Staff at IBM Almaden for 6 years
- She is an ACM Fellow,
  - member of the National Acad Engr,
  - American Academy of Arts & Sciences;
  - Received ACM SIGMOD Edgar F. Codd Innovations Award in 2007
  - Guggenheim Fellow in 2000;
- Her research interests span many aspects of nontraditional data management, including crowdsourcing
- Taught one of the first MOOCs
  - 90k accounts, 25k work, 6500 successes