Introduction to Web Mining
What is Web Mining?

Discovering useful information from the World-Wide Web and its usage patterns
Web Mining v. Data Mining

- **Structure (or lack of it)**
  - Textual information and linkage structure

- **Scale**
  - Data generated per day is comparable to largest conventional data warehouses

- **Speed**
  - Often need to react to evolving usage patterns in real-time (e.g., merchandising)
Web Mining topics

- Web graph analysis
- Power Laws and The Long Tail
- Structured data extraction
- Web advertising
- Systems Issues
Web Mining topics

- Web graph analysis
- Power Laws and The Long Tail
- Structured data extraction
- Web advertising
- Systems Issues
Size of the Web

- **Number of pages**
  - Technically, infinite
  - Much duplication (30-40%)
  - Best estimate of “unique” static HTML pages comes from search engine claims
    - Google = 8 billion(?), Yahoo = 20 billion
Netcraft survey

The web as a graph

- Pages = nodes, hyperlinks = edges
  - Ignore content
  - Directed graph

- High linkage
  - 10-20 links/page on average
  - Power-law degree distribution
Structure of Web graph

- Let’s take a closer look at structure
  - Broder et al (2000) studied a crawl of 200M pages and other smaller crawls
  - Bow-tie structure
    - Not a “small world”
Bow-tie Structure

Source: Broder et al, 2000
What can the graph tell us?

- Distinguish “important” pages from unimportant ones
  - Page rank
- Discover communities of related pages
  - Hubs and Authorities
- Detect web spam
  - Trust rank
Web Mining topics

- Web graph analysis
- Power Laws and The Long Tail
- Structured data extraction
- Web advertising
- Systems Issues
Power-law degree distribution

Source: Broder et al, 2000
Power-laws galore

- Structure
  - In-degrees
  - Out-degrees
  - Number of pages per site

- Usage patterns
  - Number of visitors
  - Popularity e.g., products, movies, music
The Long Tail

Source: Chris Anderson (2004)
The Long Tail

- Shelf space is a scarce commodity for traditional retailers
  - Also: TV networks, movie theaters, ...
- The web enables near-zero-cost dissemination of information about products
- More choice necessitates better filters
  - Recommendation engines (e.g., Amazon)
  - How Into Thin Air made Touching the Void a bestseller
Web Mining topics

- Web graph analysis
- **Power Laws and The Long Tail**
- Structured data extraction
- Web advertising
- Systems Issues
Extracting Structured Data

Software Implementation Consultant / Engineer
Kaidara Software (Los Altos, CA)
Kaidara Software (www.kaidara.com) provides software solutions that enable firms to effectively harness the experience and know-how within an organization to reduce the cost of delivering superior customer service. We are looking for a Software Implementation Consultant / Engineer to add to our...
2 days and 3 hours ago from Monster

Software Engineer
ESP Enviromental Software (Mountain View, CA)
... server-side data updates and various data manipulation tools. You'll participate in the design and development of Internet/Intranet application software to deliver the next generation of our products line that allows our customers to engage in business-to-business, e-commerce and global...
2 days and 19 hours ago from Dice

http://www.simplyhired.com
Extracting structured data

http://www.fatlens.com
Web Mining topics

- Web graph analysis
- Power Laws and The Long Tail
- **Structured data extraction**
- Web advertising
- Systems Issues
Searching the Web

The Web — Content aggregators — Content consumers
Ads vs. search results

GEICO Car Insurance. Get an auto insurance quote and save today...
GEICO auto insurance, online car insurance quote, motorcycle insurance quote, online insurance sales and service from a leading insurance company.
www.geico.com/ - 21k - Sep 22, 2005 - Cached - Similar pages

Geico, Google Settle Trademark Dispute
The case was resolved out of court, so advertisers are still left without legal guidance on use of trademarks within ads or as keywords.

Google and GEICO settle AdWords dispute | The Register
Google and car insurance firm GEICO have settled a trademark dispute over ... Car insurance firm GEICO sued both Google and Yahoo subsidiary Overture in ...
www.theregister.co.uk/2005/09/09/google_geico_settlement/ - 21k - Cached - Similar pages

GEICO v. Google
... involving a lawsuit filed by Government Employees Insurance Company (GEICO). GEICO has filed suit against two major Internet search engine operators, ...
www.consumeraffairs.com/news04/geico_google.html - 19k - Cached - Similar pages

Sponsored Links

Great Car Insurance Rates
Simplify Buying insurance at Safeco
See Your Rate with an Instant Quote
www.Safeco.com

Free Insurance Quotes
Fill out one simple form to get multiple quotes from local agents.
www.HometownQuotes.com

5 Free Quotes, 1 Form.
Get 5 Free Quotes In Minutes!
You Have Nothing To Lose. It's Free
sayyesoftware.com/Insurance
Missouri
Ads vs. search results

- Search advertising is the revenue model
  - Multi-billion-dollar industry
  - Advertisers pay for clicks on their ads

- Interesting problems
  - What ads to show for a search?
  - If I’m an advertiser, which search terms should I bid on and how much to bid?
Sidebar: What’s in a name?

- Geico sued Google, contending that it owned the trademark “Geico”
  - Thus, ads for the keyword geico couldn’t be sold to others
- Court Ruling: search engines can sell keywords including trademarks
- No court ruling yet: whether the ad itself can use the trademarked word(s)
Web Mining topics

- Web graph analysis
- Power Laws and The Long Tail
- Structured data extraction
- Web advertising
- Systems Issues
Systems architecture

- CPU
- Memory
- Disk

Machine Learning, Statistics

“Classical” Data Mining
Very Large-Scale Data Mining

Cluster of commodity nodes
Systems Issues

- Web data sets can be very large
  - Tens to hundreds of terabytes
- Cannot mine on a single server!
  - Need large farms of servers
- How to organize hardware/software to mine multi-terabyte data sets
  - Without breaking the bank!
Web Mining topics

- Web graph analysis
- Power Laws and The Long Tail
- Structured data extraction
- Web advertising
- Systems Issues
Project

- Lots of interesting project ideas
  - If you can’t think of one please come discuss with us

- Infrastructure
  - Google
  - Amazon EC2

- Data
  - Netflix
  - Google
  - WebBase
  - TREC
The World-Wide Web

Our modern-day Library of Alexandria

The Web