Announcement

1. HW#2 due Next Tuesday, OCT 23

2. Computer Lab Hour (if you know Microsoft Access, You may not attend)
   Date Time: Oct 17 and 18: 08:00 - 09:30 PM
   Location: Baskin Engineering Building Room 109
   Instructor: TAs.

   * Due to space limit: you should arrange Date and time (All class are same)
Review

Operational Excellence, Customer Intimacy
Enterprise Application

Business System
Competitive Advantages

Operational excellence

Goods production
Distributions

Enterprise System

SCPS
SCES

Supply Chain Management System

Customer Relationship Management System

Challenges posed by enterprise applications

T, O, BP changes
P, I, Sw. Costs of S/W
Data Standardization

New cross-functional services
Platforms

Keeping good Customers

PRM
ERM

Otis
Cisco Cases

Enterprise suites
Open & on-demand sol(Cloud)
Mobile; Web 2.0 capabilities
Complementary
Nature of Data Processing

Data Warehousing, OLAP and Data Mining:

what and why (now)?
A business Enterprise wants to know...

Which are our lowest/highest margin customers?

Who are my customers and what products are they buying?

Which customers are most likely to go to the competition?

What impact will new products/services have on revenue and margins?

What kinds of product have the biggest impact on revenue?

What is the most effective distribution channel?

source  IIT Bombay
Data, Data everywhere yet ...  

**We have Enough Data..., But..**  

- I can’t find the data I need  
  - data is scattered over the network  
  - many versions, subtle differences

- I can’t get the data I need  
  - need an expert to get the data

- I can’t understand the data I found  
  - available data poorly documented

- I can’t use the data I found  
  - results are unexpected  
  - data needs to be transformed from one form to other

**source**  
IIT Bombay
What is a Data Warehouse?

A single, complete and consistent store of data obtained from a variety of different sources made available to end users in a way they can understand and use in a business context.

[Barry Devlin]
What is Data Warehousing?

A process of transforming data into information and making it available to users in a timely enough manner to make a difference

[Forrester Research, April 1996]

source: IIT Bombay
Evolution

• 60’s: Batch reports
  – hard to find and analyze information
  – inflexible and expensive, reprogram every new request

• 70’s: Terminal-based DSS and EIS (executive information systems)
  – still inflexible, not integrated with desktop tools

• 80’s: Desktop data access and analysis tools
  – query tools, spreadsheets, GUIs
  – easier to use, but only access operational databases

• 90’s: Data warehousing with integrated OLAP engines and tools

source  IIT Bombay
Warehouses are Very Large Databases

Source: META Group, Inc.

Respondents

Initial
Projected 2Q96

Source: IIT Bombay
<table>
<thead>
<tr>
<th>$n$</th>
<th>$10^{3n}$</th>
<th>American name</th>
<th>European name</th>
<th>SI prefix</th>
<th>Greek-based name (proposed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>$10^9$</td>
<td>billion</td>
<td>milliard</td>
<td>giga-</td>
<td>gillion</td>
</tr>
<tr>
<td>4</td>
<td>$10^{12}$</td>
<td>trillion</td>
<td>billion</td>
<td>tera-</td>
<td>tetrillion</td>
</tr>
<tr>
<td>5</td>
<td>$10^{15}$</td>
<td>quadrillion</td>
<td>billiard</td>
<td>peta-</td>
<td>pentillion</td>
</tr>
<tr>
<td>6</td>
<td>$10^{18}$</td>
<td>quintillion</td>
<td>trillion</td>
<td>exa-</td>
<td>hexillion</td>
</tr>
<tr>
<td>7</td>
<td>$10^{21}$</td>
<td>sextillion</td>
<td>trilliard</td>
<td>zetta-</td>
<td>heptillion</td>
</tr>
<tr>
<td>8</td>
<td>$10^{24}$</td>
<td>septillion</td>
<td>quadrillion</td>
<td>yotta-</td>
<td>oktillion</td>
</tr>
</tbody>
</table>
The names *googol* and *googolplex* were invented by Edward Kasner's nephew, Milton Sirotta, and introduced in Kasner and Newman's 1940 book, *Mathematics and the Imagination*,[12] in the following passage:

<table>
<thead>
<tr>
<th>Value</th>
<th>Name</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10^{100}$</td>
<td>Googol</td>
<td>Kasner and Newman, dictionaries (see above)</td>
</tr>
<tr>
<td>$10^{\text{googol}} = 10^{10^{100}}$</td>
<td>Googolplex</td>
<td>Kasner and Newman, dictionaries (see above)</td>
</tr>
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</table>
Very Large Data Bases

- **Tera**bytes -- $10^{12}$ bytes: Walmart -- 24 Terabytes
- **Peta**bytes -- $10^{15}$ bytes: Geographic Information Systems
- **Exa**bytes -- $10^{18}$ bytes: National Medical Records
- **Zetta**bytes -- $10^{21}$ bytes: Weather images
- **Zotta**bytes -- $10^{24}$ bytes: Intelligence Agency Videos

source IIT Bombay
Explorers, Farmers and Tourists

**Explorers:** Seek out the unknown and previously unsuspected rewards hiding in the detailed data

**Farmers:** Harvest information from known access paths

**Tourists:** Browse information harvested by farmers

source: IIT Bombay
Motivation:
“Necessity is the Mother of Invention”

• **Data explosion problem**
  – Automated data collection tools and mature database technology lead to tremendous amounts of data stored in databases, data warehouses and other information repositories

• **We are drowning in data, but starving for knowledge!**

• **Solution: Data warehousing and data mining**
  – Data warehousing and on-line analytical processing
  – Extraction of interesting knowledge (rules, regularities, patterns, constraints) from data in large databases
Why Mine Data? Commercial Viewpoint

- Lots of data is being collected and warehoused
  - Web data, e-commerce
  - Purchases at department/grocery stores
  - Bank/Credit Card transactions

- Computers have become cheaper and more powerful

- Competitive Pressure is Strong
  - Provide better, customized services for an *edge* (e.g., in Customer Relationship Management)
What Is Data Mining?

• Data mining (knowledge discovery in databases):
  – Extraction of interesting (non-trivial, implicit, previously unknown and potentially useful) information or patterns from data in large databases

• Alternative names and their “inside stories”:
  – Data mining: a misnomer? Academic usage
  – Knowledge discovery(mining) in databases (KDD), knowledge extraction, data/pattern analysis, data archeology, business intelligence, etc.
### Examples: What is (not) Data Mining?

<table>
<thead>
<tr>
<th>What is not Data Mining?</th>
<th>What is Data Mining?</th>
</tr>
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<tbody>
<tr>
<td>- Look up phone number in phone directory</td>
<td>- Certain names are more prevalent in certain US locations (O’Brien, O’Rurke, O’Reilly... in Boston area)</td>
</tr>
<tr>
<td>- Query a Web search engine for information about “Amazon”</td>
<td>- Group together similar documents returned by search engine according to their context (e.g. Amazon rainforest, Amazon.com,)</td>
</tr>
</tbody>
</table>
Data Mining Tasks

• Prediction Tasks
  – Use some variables to predict unknown or future values of other variables
• Description Tasks
  – Find human-interpretable patterns that describe the data.

Common data mining tasks
  – Classification [Predictive]
  – Clustering [Descriptive]
  – Association Rule Discovery [Descriptive]
  – Sequential Pattern Discovery [Descriptive]
  – Regression [Predictive]
  – Deviation Detection [Predictive]
Clustering: Application

- **Market Segmentation:**
  - Goal: subdivide a market into distinct subsets of customers where any subset may conceivably be selected as a market target to be reached with a distinct marketing mix.
  - Approach:
    - Collect different attributes of customers based on their geographical and lifestyle related information.
    - Find clusters of similar customers.
    - Measure the clustering quality by observing buying patterns of customers in same cluster vs. those from different clusters.
Data Mining vs. Statistical Analysis

**Statistical Analysis:**
- Ill-suited for Nominal and Structured Data Types
- Completely data driven - incorporation of domain knowledge not possible
- Interpretation of results is difficult and daunting
- Requires expert user guidance

**Data Mining:**
- Large Data sets
- Efficiency of Algorithms is important
- Scalability of Algorithms is important
- Real World Data
- Lots of Missing Values
- Pre-existing data - not user generated
- Data not static - prone to updates
- Efficient methods for data retrieval available for use
Data Mining vs. DBMS

• Example DBMS Reports
  – Last months sales for each service type
  – Sales per service grouped by customer sex or age bracket
  – List of customers who lapsed their policy

• Questions answered using Data Mining
  – What characteristics do customers that lapse their policy have in common and how do they differ from customers who renew their policy?
  – Which motor insurance policy holders would be potential customers for my House Content Insurance policy?
Data Mining and Data Warehousing

- **Data Warehouse**: a centralized data repository which can be queried for business benefit.
- **Data Warehousing makes it possible to**
  - extract archived operational data
  - overcome inconsistencies between different legacy data formats
  - integrate data throughout an enterprise, regardless of location, format, or communication requirements
  - incorporate additional or expert information
- **OLAP: On-line Analytical Processing**
- **Multi-Dimensional Data Model (Data Cube)**
- **Operations**:
  - Roll-up
  - Drill-down
  - Slice and dice
  - Rotate
Data Mining: Confluence of Multiple Disciplines

- Database Technology
- Statistics
- Machine Learning
- Information Science
- Visualization
- Other Disciplines

Source: IIT Bombay
Data Mining: A KDD Process

- Data mining: the core of knowledge discovery process.
## DBMS, OLAP, and Data Mining

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</table>

*source: Temple University*
What does Data Mining Do?

- Explores Your Data
- Finds Patterns
- Performs Predictions

<table>
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<th>Query, Reporting, Analysis</th>
<th>Data Mining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why</td>
<td></td>
</tr>
<tr>
<td>What</td>
<td>How</td>
</tr>
</tbody>
</table>
Data Mining and Business Intelligence

Increasing potential to support business decisions

Making Decisions

Data Presentation
*Visualization Techniques*

Data Mining
*Information Discovery*

Data Exploration
*Statistical Analysis, Querying and Reporting*

Data Warehouses / Data Marts
*OLAP, MDA*

Data Sources
*Paper, Files, Information Providers, Database Systems, OLTP*

End User

Business Analyst

Data Analyst

DBA

source  IIT Bombay
Example of DBMS, OLAP and Data Mining: Weather Data

<table>
<thead>
<tr>
<th>Day</th>
<th>outlook</th>
<th>temperature</th>
<th>humidity</th>
<th>windy</th>
<th>play</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>sunny</td>
<td>85</td>
<td>85</td>
<td>false</td>
<td>no</td>
</tr>
<tr>
<td>2</td>
<td>sunny</td>
<td>80</td>
<td>90</td>
<td>true</td>
<td>no</td>
</tr>
<tr>
<td>3</td>
<td>overcast</td>
<td>83</td>
<td>86</td>
<td>false</td>
<td>yes</td>
</tr>
<tr>
<td>4</td>
<td>rainy</td>
<td>70</td>
<td>96</td>
<td>false</td>
<td>yes</td>
</tr>
<tr>
<td>5</td>
<td>rainy</td>
<td>68</td>
<td>80</td>
<td>false</td>
<td>yes</td>
</tr>
<tr>
<td>6</td>
<td>rainy</td>
<td>65</td>
<td>70</td>
<td>true</td>
<td>no</td>
</tr>
<tr>
<td>7</td>
<td>overcast</td>
<td>64</td>
<td>65</td>
<td>true</td>
<td>yes</td>
</tr>
<tr>
<td>8</td>
<td>sunny</td>
<td>72</td>
<td>95</td>
<td>false</td>
<td>no</td>
</tr>
<tr>
<td>9</td>
<td>sunny</td>
<td>69</td>
<td>70</td>
<td>false</td>
<td>yes</td>
</tr>
<tr>
<td>10</td>
<td>rainy</td>
<td>75</td>
<td>80</td>
<td>false</td>
<td>yes</td>
</tr>
<tr>
<td>11</td>
<td>sunny</td>
<td>75</td>
<td>70</td>
<td>true</td>
<td>yes</td>
</tr>
<tr>
<td>12</td>
<td>overcast</td>
<td>72</td>
<td>90</td>
<td>true</td>
<td>yes</td>
</tr>
<tr>
<td>13</td>
<td>overcast</td>
<td>81</td>
<td>75</td>
<td>false</td>
<td>yes</td>
</tr>
<tr>
<td>14</td>
<td>rainy</td>
<td>71</td>
<td>91</td>
<td>true</td>
<td>no</td>
</tr>
</tbody>
</table>
Example of DBMS, OLAP and Data Mining: Weather Data

- By querying a DBMS containing the above table we may answer questions like:
  - What was the temperature in the sunny days? \{85, 80, 72, 69, 75\}
  - Which days the humidity was less than 75? \{6, 7, 9, 11\}
  - Which days the temperature was greater than 70? \{1, 2, 3, 8, 10, 11, 12, 13, 14\}
  - Which days the temperature was greater than 70 and the humidity was less than 75? The intersection of the above two: \{11\}
Example of DBMS, OLAP and Data Mining: Weather Data

OLAP:

• Using OLAP we can create a Multidimensional Model of our data (Data Cube).

• For example using the dimensions: time, outlook and play we can create the following model.

<table>
<thead>
<tr>
<th></th>
<th>sunny</th>
<th>rainy</th>
<th>overcast</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 / 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 1</td>
<td>0 / 2</td>
<td>2 / 1</td>
<td>2 / 0</td>
</tr>
<tr>
<td>Week 2</td>
<td>2 / 1</td>
<td>1 / 1</td>
<td>2 / 0</td>
</tr>
</tbody>
</table>
Example of DBMS, OLAP and Data Mining: Weather Data

Data Mining:

• Using the ID3 algorithm we can produce the following decision tree:

  • outlook = sunny
    – humidity = high: no
    – humidity = normal: yes
  • outlook = overcast: yes
  • outlook = rainy
    – windy = true: no
    – windy = false: yes
Major Issues in Data Warehousing and Mining

- **Mining methodology and user interaction**
  - Mining different kinds of knowledge in databases
  - Interactive mining of knowledge at multiple levels of abstraction
  - Incorporation of background knowledge
  - Data mining query languages and ad-hoc data mining
  - Expression and visualization of data mining results
  - Handling noise and incomplete data
  - Pattern evaluation: the interestingness problem

- **Performance and scalability**
  - Efficiency and scalability of data mining algorithms
  - Parallel, distributed and incremental mining methods

*source* Temple University
Major Issues in Data Warehousing and Mining

• **Issues relating to the diversity of data types**
  – Handling relational and complex types of data
  – Mining information from heterogeneous databases and global information systems (WWW)

• **Issues related to applications and social impacts**
  – Application of discovered knowledge
    • Domain-specific data mining tools
    • Intelligent query answering
    • Process control and decision making
  – Integration of the discovered knowledge with existing knowledge: A knowledge fusion problem
  – Protection of data security, integrity, and privacy
Chapter 4;

e-Commerce, Digital Markets, Digital Goods
Learning Objectives

The unique features of e-Commerce, Digital goods
- e-Commerce Business and Revenue Models
- e-Commerce, Market Transformations
- e-Commerce, Business Transactions
- m-Commerce in Business, m-Commerce Applications
- Building an e-Commerce Web site
e-Business, Digital Markets

- e-Commerce
  - Goods, Services
  - e-Business Systems
  - IT Systems
- e-Business Models
  - e-Revenue Models
- e-Business Entrants
- e-Business Challenges
  - New Directions
Nexus Games: E-Commerce Goes Social
Nexus Games: E-Commerce Goes Social

Problem: Building a business model that serves the emerging market for social networking sites.

Solutions: Sell games that are social experiences. Online users can access full games for free but must pay for any “virtual items” to enhance game play.

Prepaid cards used to purchase Nexon game items are second best-selling entertainment gift card at Target.

Nexon games all feature Forums where users can socialize, share tips.

Demonstrates digital technology’s role in generating new business models.
4FOOD: Burgers Go Social

**Problem** - Differentiate a burger restaurant’s services in crowded marketplace (Manhattan)

**Solution** – Utilize social networking and crowdsourcing for marketing and services
  - Ordering via iPad, online
  - Customers can create and name own sandwiches
  - Twitter, Facebook, Foursquare integration

**Illustrates:** Use of information systems to create new products and services

**Demonstrates:** Use of social networking technologies as marketing tool
Electronic Commerce and the Internet

• E-commerce
  • Use of the Internet and Web to transact business
  • Digitally enabled transactions

• History of e-commerce
  • Began in 1995 and grew exponentially; still growing at an annual rate of 16 percent
  • Rapid growth led to market bubble
  • While many companies failed, many survived with soaring revenues
  • E-commerce today the fastest growing form of retail trade in U.S., Europe, Asia
Retail e-commerce revenues grew 15–25 percent per year until the recession of 2008–2009, when they slowed measurably. In 2010, e-commerce revenues are growing again at an estimated 12 percent annually.
<table>
<thead>
<tr>
<th>Development</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google</td>
<td>Search engine used by more than 30 percent of the Internet population to find anything</td>
</tr>
<tr>
<td>Broadband</td>
<td>High-speed access used by more than 50 percent of Internet users, making it much more convenient to shop</td>
</tr>
<tr>
<td>eBay</td>
<td>Web site that introduced the masses to the power and benefits of e-commerce</td>
</tr>
<tr>
<td>Amazon</td>
<td>Pioneer of e-commerce that sets the standard for online transactions</td>
</tr>
<tr>
<td>Google AdWords</td>
<td>Today’s biggest online advertising vehicle that generates $6.8 billion per year for Google</td>
</tr>
<tr>
<td>Open standards</td>
<td>Standards such as HTML and XML that provide opportunities for everyone, not just a select few</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>Wireless technology that helped move e-commerce from desktops to mobile devices</td>
</tr>
<tr>
<td>User-generated content</td>
<td>Contributions to the online community by anyone and everyone via Web sites like YouTube</td>
</tr>
<tr>
<td>iTunes</td>
<td>Application that legitimized music distribution over the Internet</td>
</tr>
<tr>
<td>BlackBerry</td>
<td>Device that helped to create a new mobile business culture</td>
</tr>
</tbody>
</table>
FIGURE 8.2 • U.S. e-commerce revenues (billions of dollars)

The amount of revenue from online transactions is increasing at an exponential rate.

Note: Excludes Travel, Prescription Drugs & Auto

Source: Jupiter Internet Shopping Model, 5/01 (US only)
Turner Sports New Media Marries TV and the Internet

• Read the Interactive Session: Organizations and then discuss the following questions:

  • Describe the unique features of e-commerce technology illustrated in this case.

  • How does the Web enhance the TV businesses for the companies discussed in this case? How does it add value?

  • Why is NASCAR TrackPass a good example of Turner Sports New Media’s value to sports league sites?

  • Do you think Turner Sports New Media will continue to grow steadily? Why or why not?
Eight unique features of e-commerce technology

1. Ubiquity
2. Global reach
3. Universal standards
5. Richness Interactivity
6. Information density
7. Personalization/Customization:
8. Social technology
Ubiquity
Internet/Web technology available everywhere: work, home, etc., anytime.

Effect:
Marketplace removed from temporal, geographic locations to become “market space”
Enhanced customer convenience and reduced shopping costs
Global reach

The technology reaches across national boundaries, around Earth

Effect:

Commerce enabled across cultural and national boundaries seamlessly and without modification. Marketspace includes, potentially, billions of consumers and millions of businesses worldwide.
Universal standards

One set of technology standards: Internet standards

Effect:

Disparate computer systems easily communicate with each other
Lower market entry costs—costs merchants must pay to bring goods to market
Lower consumers’ search costs—effort required to find suitable products
Richness

Supports video, audio, and text message

Effect:
Possible to deliver rich messages with text, audio, and video simultaneously to large numbers of people
Video, audio, and text marketing messages can be integrated into single marketing message and consumer experience
Interactivity
The technology works through interaction with the user

Effect:
Consumers engaged in dialog that dynamically adjusts experience to the individual
Consumer becomes co-participant in process of delivering goods to market
**Information density**

Large increases in information density—the total amount and quality of information available to all market participants

**Effect:**
- Greater price transparency
- Greater cost transparency
- Enables merchants to engage in price discrimination
Personalization/Customization

Technology permits modification of messages, goods

Effect

Personalized messages can be sent to individuals as well as groups
Products and services can be customized to individual preferences
Social technology
The technology promotes user content generation and social networking

Effect
New Internet social and business models enable user content creation and distribution, and support social networks
Key concepts in e-commerce

Digital markets reduce
  Information asymmetry
  Search costs
  Transaction costs
  Menu costs

Digital markets enable
  Price discrimination
  Dynamic pricing
  Disintermediation
The typical distribution channel has several intermediary layers, each of which adds to the final cost of a product, such as a sweater. Removing layers lowers the final cost to the consumer.
E-commerce business models

Portal
E-tailer
Content Provider
Transaction Broker
Market Creator
Service Provider
Community Provider
Key concepts in e-commerce

Digital goods
Goods that can be delivered over a digital network
E.g. Music tracks, video, software, newspapers, books
Cost of producing first unit almost entire cost of product:
Marginal cost of 2nd unit is about zero
Costs of delivery over the Internet very low
Marketing costs remain the same; pricing highly variable
Industries with digital goods are undergoing revolutionary changes (publishers, record labels, etc.)

Marginal cost: Cost for producing additional unit, 100 and one
• Internet business models
  • Pure-play models
  • Clicks-and-mortar models

• Social Network
  • Online meeting place
  • Social shopping sites
  • Can provide ways for corporate clients to target customers through banner ads and pop-up ads

• Online marketplace:
  • Provides a digital environment where buyers and sellers can meet, search for products, display products, and establish prices for those products
Summary of Class
Data Mining: A KDD Process

- Data mining: the core of knowledge discovery process.
# DBMS, OLAP, and Data Mining

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Data Mining and Business Intelligence

Increasing potential to support business decisions

- Making Decisions
- Data Presentation
  Visualization Techniques
- Data Mining
  Information Discovery
- Data Exploration
  Statistical Analysis, Querying and Reporting
- Data Warehouses / Data Marts
  OLAP, MDA
- Data Sources
  Paper, Files, Information Providers, Database Systems, OLTP

End User
Business Analyst
Data Analyst
DBA
Eight unique features of e-commerce technology

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2. Global reach
3. Universal standards
5. Richness Interactivity
6. Information density
7. Personalization/Customization:
8. Social technology
Key concepts in e-commerce

Digital markets reduce
Information asymmetry
Business cost

Digital markets enable
Dynamic pricing
Disintermediation
The typical distribution channel has several intermediary layers, each of which adds to the final cost of a product, such as a sweater. Removing layers lowers the final cost to the consumer.

**THE BENEFITS OF DISINTERMEDIATION TO THE CONSUMER**

<table>
<thead>
<tr>
<th>Cost per Sweater</th>
</tr>
</thead>
<tbody>
<tr>
<td>$48.50</td>
</tr>
<tr>
<td>$40.34</td>
</tr>
<tr>
<td>$20.45</td>
</tr>
</tbody>
</table>
E-commerce business models

Portal
E-tailer
Content Provider
Transaction Broker
Market Creator
Service Provider
Community Provider
Key concepts in e-commerce

**Digital goods**
Goods that can be delivered over a digital network
Cost of producing first unit almost entire cost of product: marginal cost of 2nd unit is about zero
• Internet business models
• Social Network
• Online marketplace:
  • Provides a digital environment where buyers and sellers can meet, search for products, display products, and establish prices for those products