Statistical Learning and Data Mining
CS 363D/ SSC 358

Lecture: Introduction

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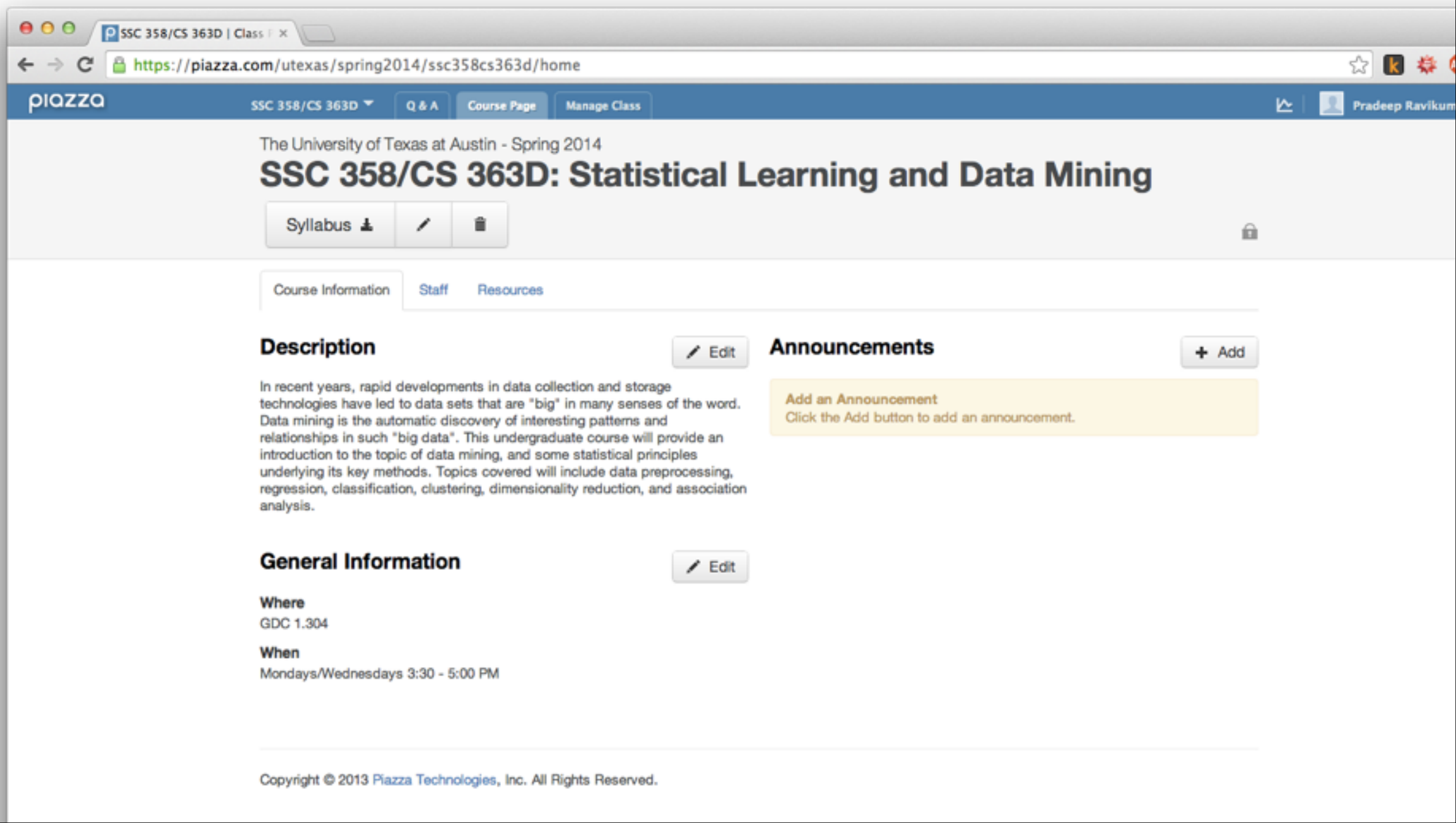
What is this course about (in 1 minute)

- “Big Data”
- Data Mining, Statistical Learning
- Pre-reqs: Basic knowledge of **linear algebra**, **probability**, **programming**, data structures, and algorithms
  - We will review {linear algebra, probability} fundamentals at appropriate junctures

Class Webpage

- https://piazza.com/utexas/spring2014/ssc358cs363d/



Class Discussion

- https://piazza.com/utexas/spring2014/ssc358cs363d/
- Piazza: a discussion board, where you can ask questions (anonymously if need be)
  - Any question has a single wiki-editable student answer; students can (and should) collectively add to this answer. I or TA will edit if need be, certify.
  - Statistics reg. the most helpful people will be visible; be a good citizen! :-)
  - Comment on or ask further questions about a post, by starting a followup discussion
  - Can format equations into your posts/questions/answers
  - Any small question, please add it to the class Piazza site

Textbooks and Materials

- Introduction to Data Mining. P. Tan, M. Steinbach, V. Kumar, Addison Wesley, 2006.
    - Textbook URL: http://www-users.cs.umn.edu/~kumar/dmbook/index.php
- Misc. materials will be posted on Piazza

Grading Policy

- 5 Homeworks: 25%
- 1 Midterm: 16%; 1 Final: 24%
- Final Project: 30%
- Class Attendance and Participation: 5%

Grading Policy: Homeworks

- Five Homeworks (25%)
  - Due beginning of class on the due date
  - Two “free” late days: use it all on one homework, or on two different homeworks
  - Homework will be worth 50% if one day late, and 0% if it is two or more days late. It is required to submit all homeworks even if after two days.

Grading Policy: Project

- Final Project (30 %)
  - a. Initial Project Milestone (5%) ; due Apr 02.
  - b. Final Project Presentation (25%) ; due May 02.
  - The list of candidate projects will be provided once the class gets underway. You have to work individually on your class project.

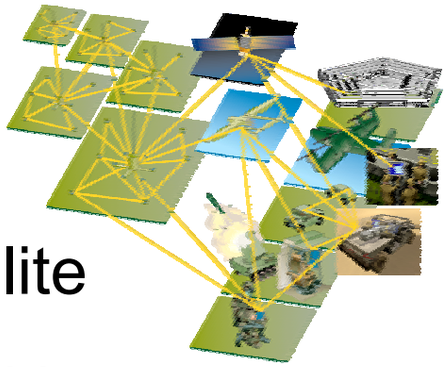
Why Data Mining: Commercial Viewpoint

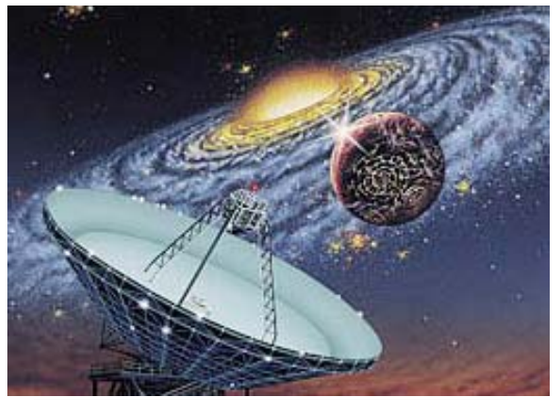
- Lots of data is being collected and warehoused
  - Web data, e-commerce
  - purchases at department/ grocery stores
  - Bank/Credit Card transactions

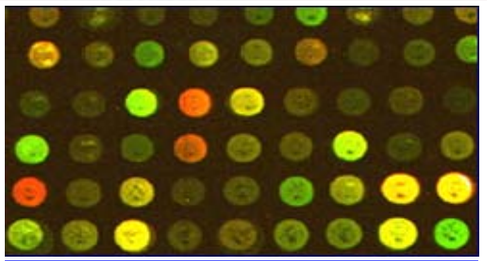
- Computers have become cheaper and more powerful
- Competitive Pressure is Strong
  - Provide better, customized services for an *edge* (e.g. in Customer Relationship Management)

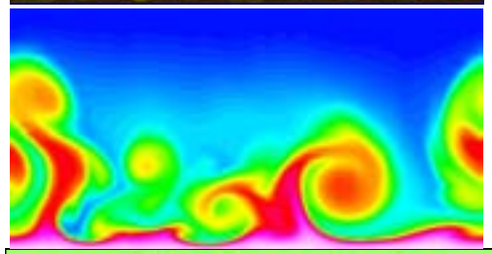
Why Data Mining: Scientific Viewpoint

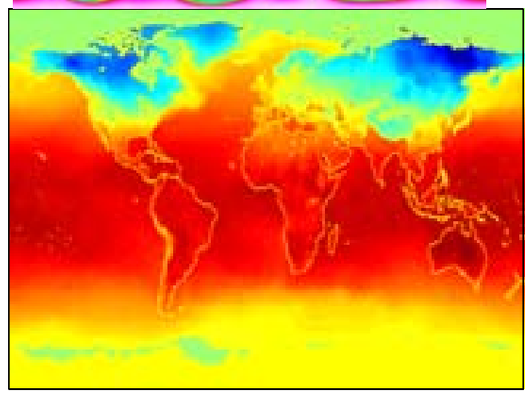
- Data collected and stored at enormous speeds (GB/hour)
  - remote sensors on a satellite
  - telescopes scanning the skies
  - microarrays generating gene expression data
  - scientific simulations generating terabytes of data
- Traditional techniques infeasible for raw data
- Data mining may help scientists
  - in classifying and segmenting data
  - in Hypothesis Formation





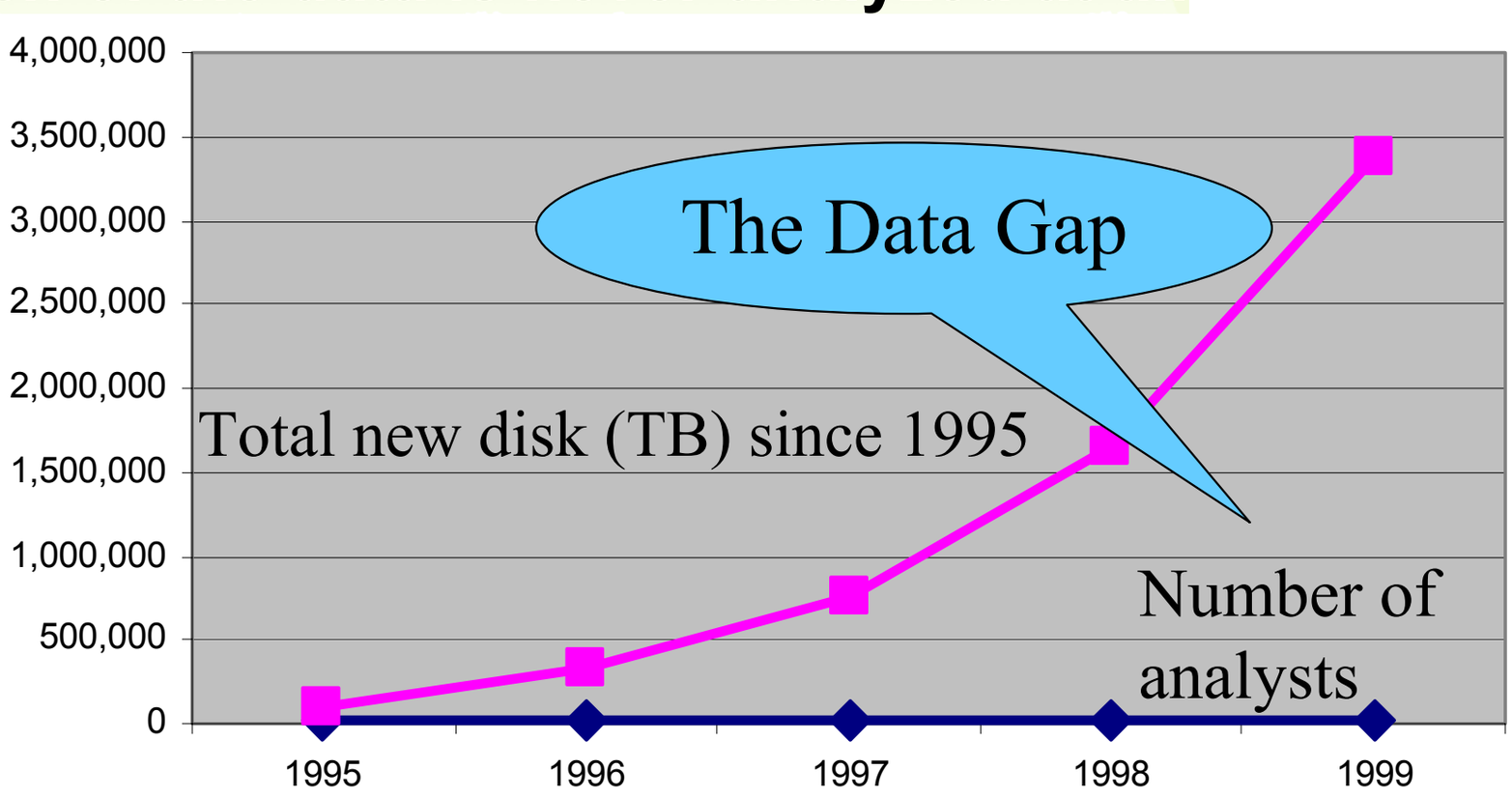






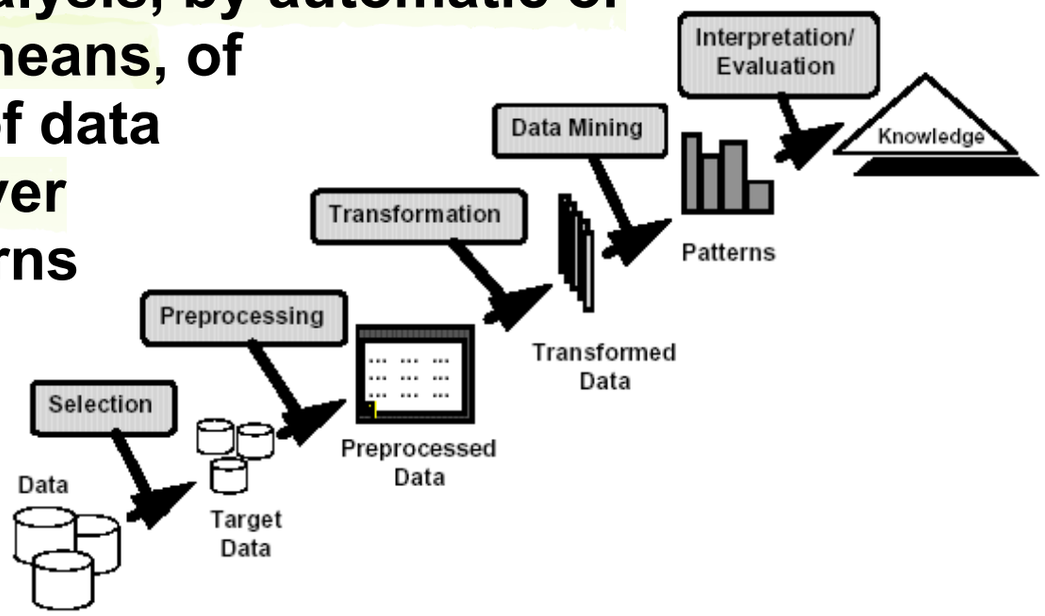
Why Data Mining: Automation Viewpoint

- **There is often information "hidden" in the data that is not readily evident**
- **Human analysts may take weeks to discover useful information**
- **Much of the data is never analyzed at all**



What is Data Mining?

- **Many Definitions**
  - **Non-trivial extraction of implicit, previously unknown and potentially useful information from data**
  - **Exploration & analysis, by automatic or semi-automatic means, of large quantities of data in order to discover meaningful patterns**



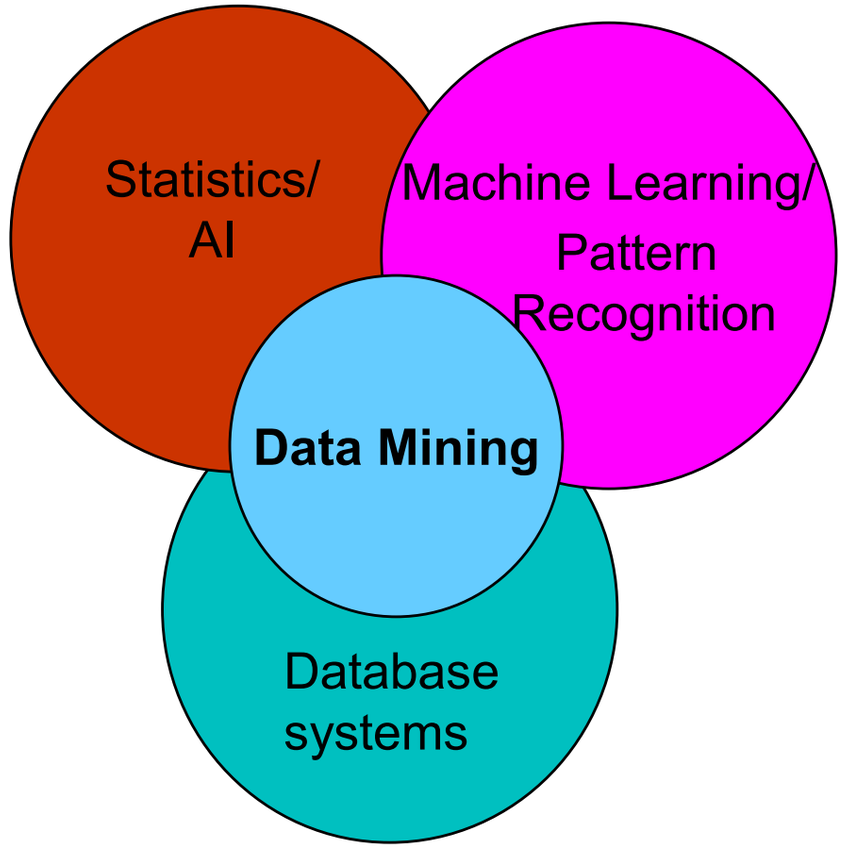
What is Data Mining?

- **What is not Data Mining?**
  - Look up phone number in phone directory
  - Query a Web search engine for information about "Amazon"

- **What is Data Mining?**
  - Certain names are more prevalent in certain US locations (O'Brien, O'Rurke, O'Reilly… in Boston area)
  - Group together similar documents returned by search engine according to their context (e.g. Amazon rainforest, Amazon.com,)

Origins of Data Mining

- **Draws ideas from machine learning/AI, pattern recognition, statistics, and database systems**
- **Traditional Techniques may be unsuitable due to**
  - **Enormity of data**
  - **High dimensionality of data**
  - **Heterogeneous, distributed nature of data**



Data Mining Tasks

- Prediction Methods
  - Use some variables to predict unknown or future values of other variables.

- Description Methods
  - Find human-interpretable patterns that describe the data.

Data Mining Tasks

- Classification [Predictive]
- Clustering [Descriptive]
- Association Rule Discovery [Descriptive]
- Regression [Predictive]
- Anomaly Detection [Predictive]
- SVD [Descriptive]