School of Computing
UNIVERSITY OF GEORGIA

CSCI 4380/6380 DATA MINING

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School of Computing
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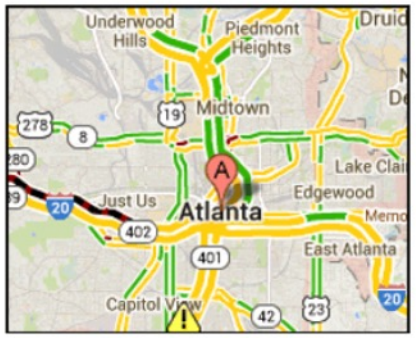
Introduction to Data Mining

Why Data Mining

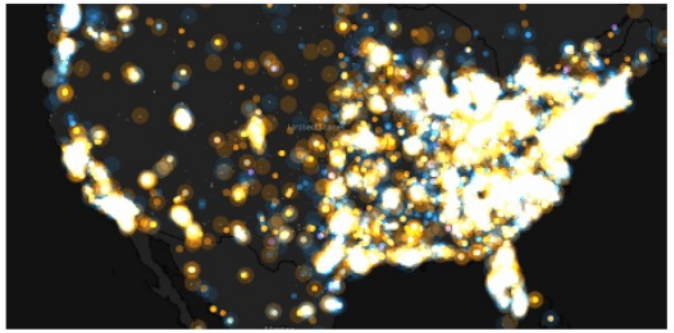
Cyber Security

E-Commerce

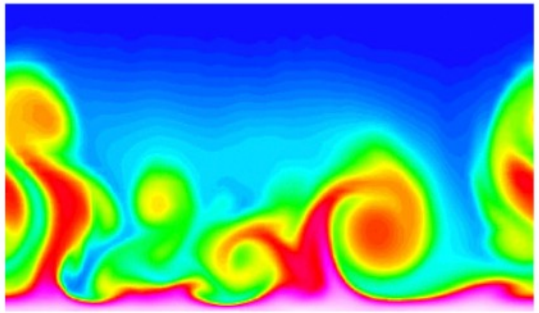
Sensor Networks



Traffic Patterns



Social Networking: Twitter



Computational Simulations

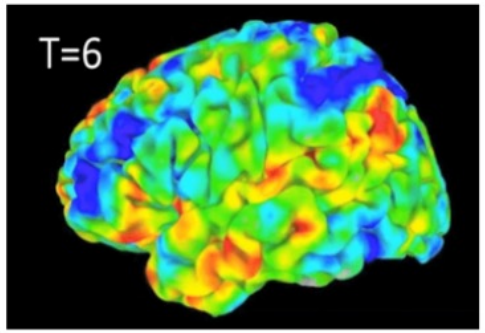
Why Data Mining

- Commercial Viewpoint

  - Lots of data is being collected and warehoused.
  - Computers have become cheaper and more powerful.
  - Competitive pressure is strong.

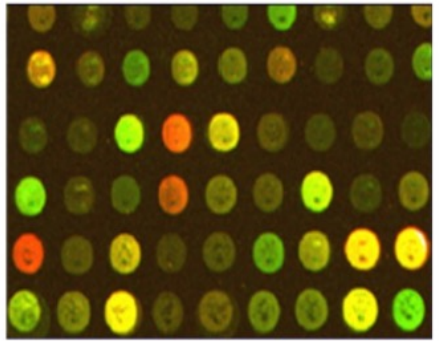
Why Data Mining

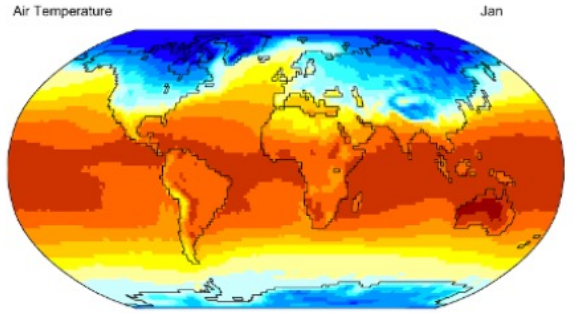
- Scientific Viewpoint



fMRI Data from Brain


Sky Survey Data


Gene Expression Data



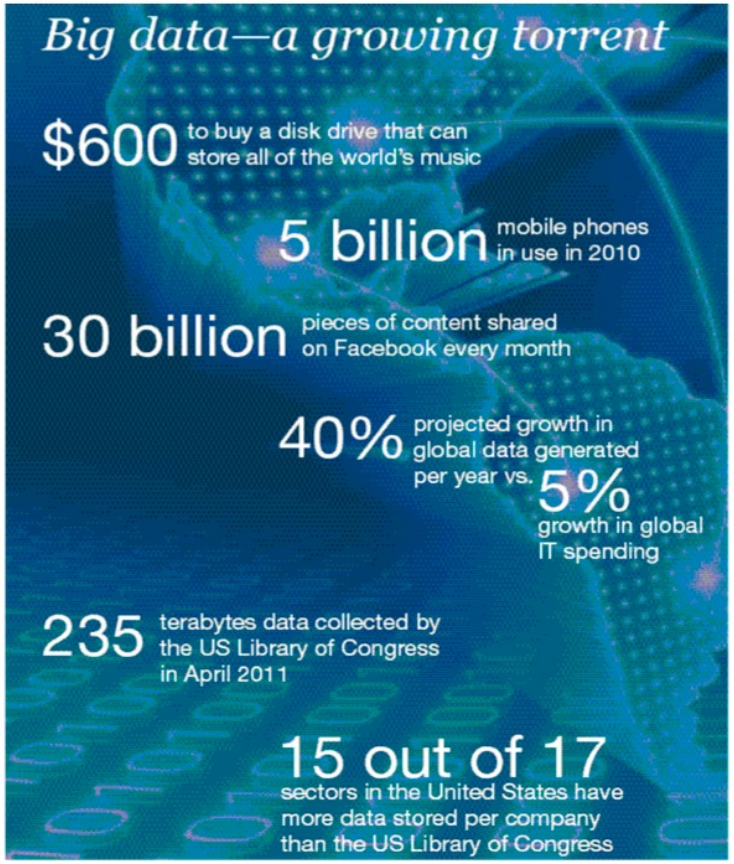
Surface Temperature of Earth

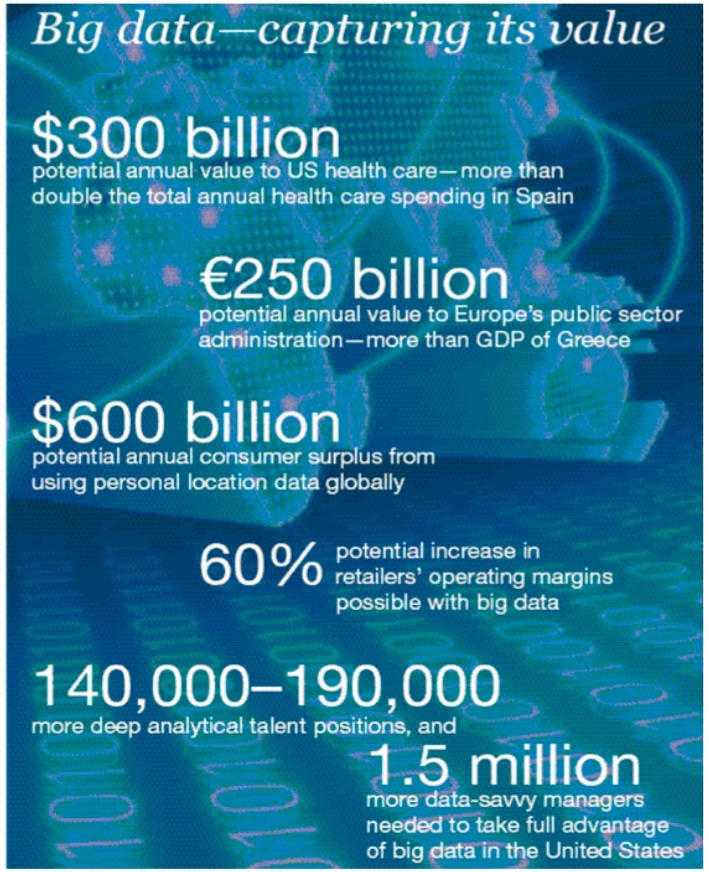
Data collected and stored at enormous scale and speed

- fMRI for patients.
- Telescopes scanning the skies
- High-throughput biological data
- Scientific simulations

Why Data Mining

- Great opportunities to improve productivity.
- Great opportunities to solve society's major problems.





Why Data Mining

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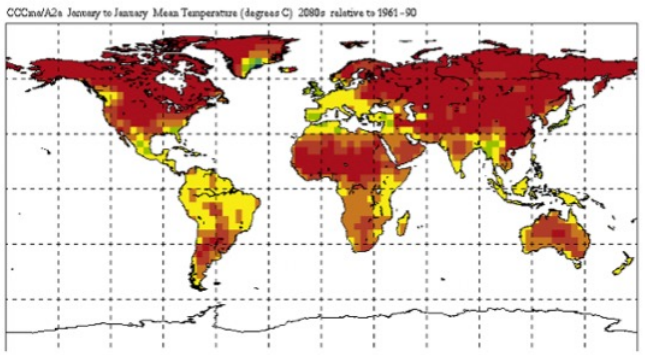
- Great opportunities to solve society's major problems.

Improving health care and reducing costs

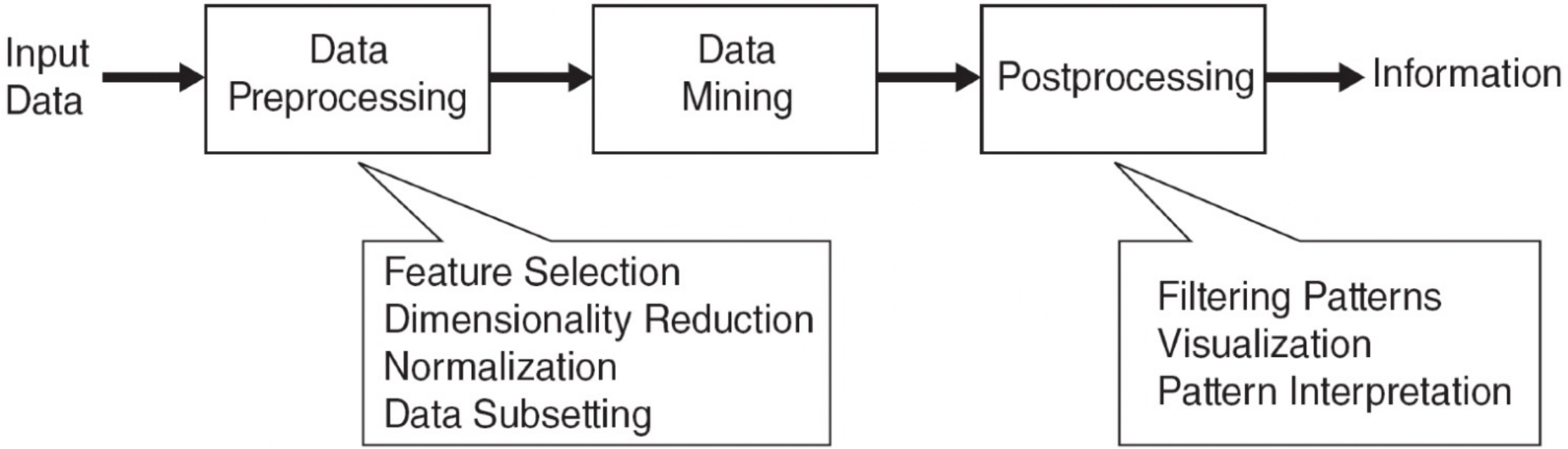


Predicting the impact of climate change

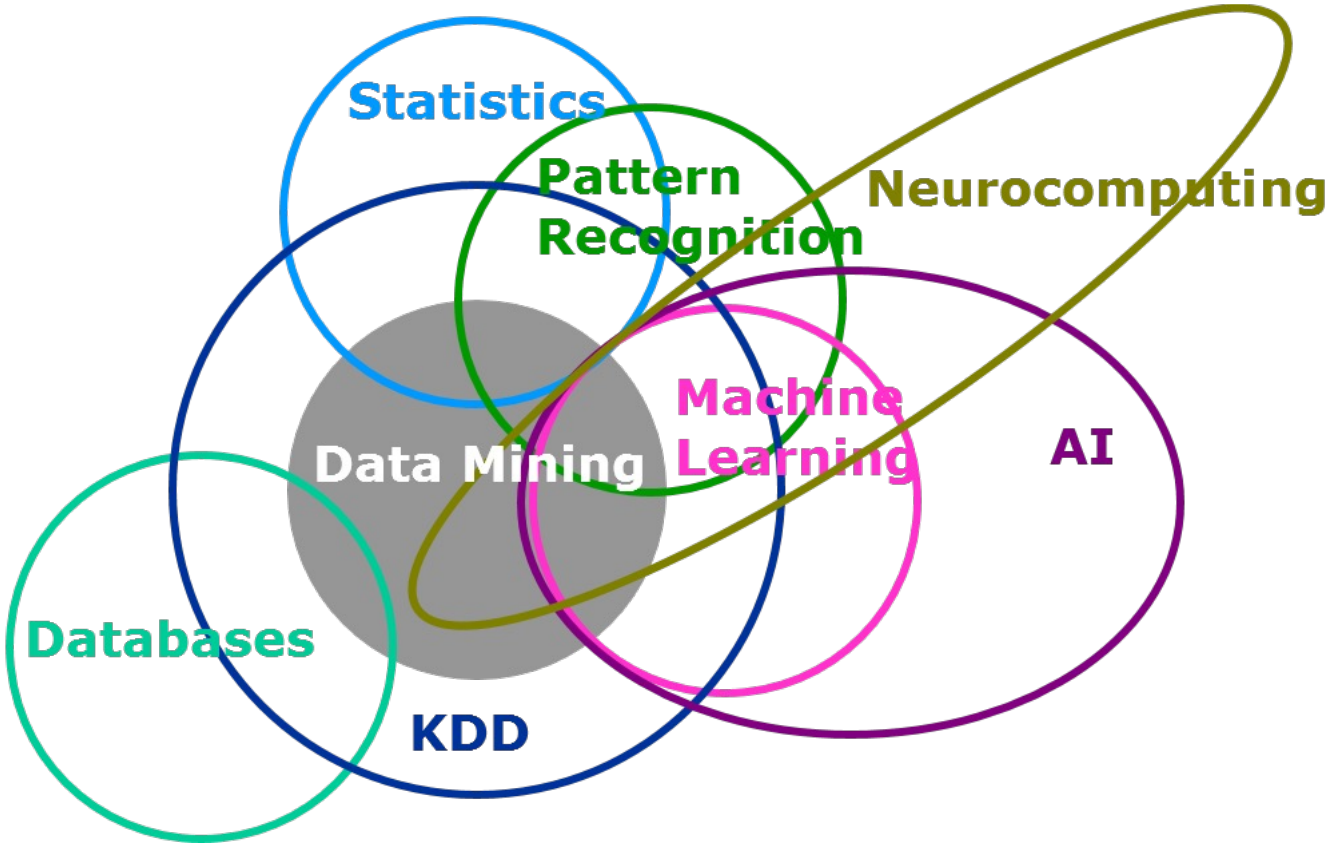
Finding alternative/ green energy sources

Reducing hunger and poverty by increasing agriculture production

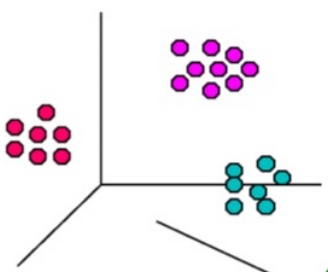
Data Mining Process



Data Mining vs Other Concepts



Data Mining



Clustering

Data

Tid	Refund	Marital Status	Taxable Income	Cheat
1	Yes	Single	125K	No
2	No	Married	100K	No
3	No	Single	70K	No
4	Yes	Married	120K	No
5	No	Divorced	95K	Yes
6	No	Married	60K	No
7	Yes	Divorced	220K	No
8	No	Single	85K	Yes
9	No	Married	75K	No
10	No	Single	90K	Yes
11	No	Married	60K	No
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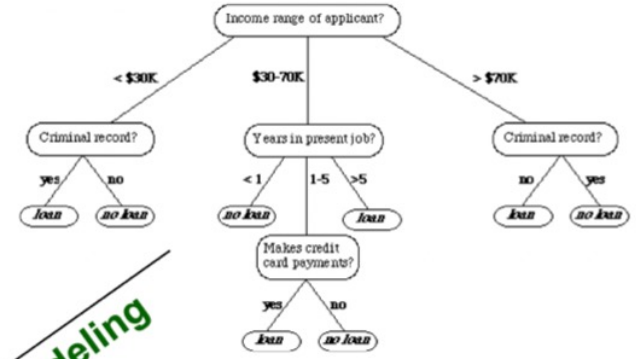
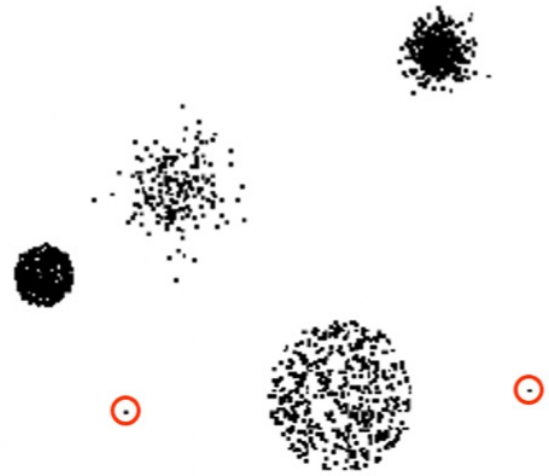
14	No	Married	75K	No
15	No	Single	90K	Yes



Predictive Modeling

Association Rules

Anomaly Detection



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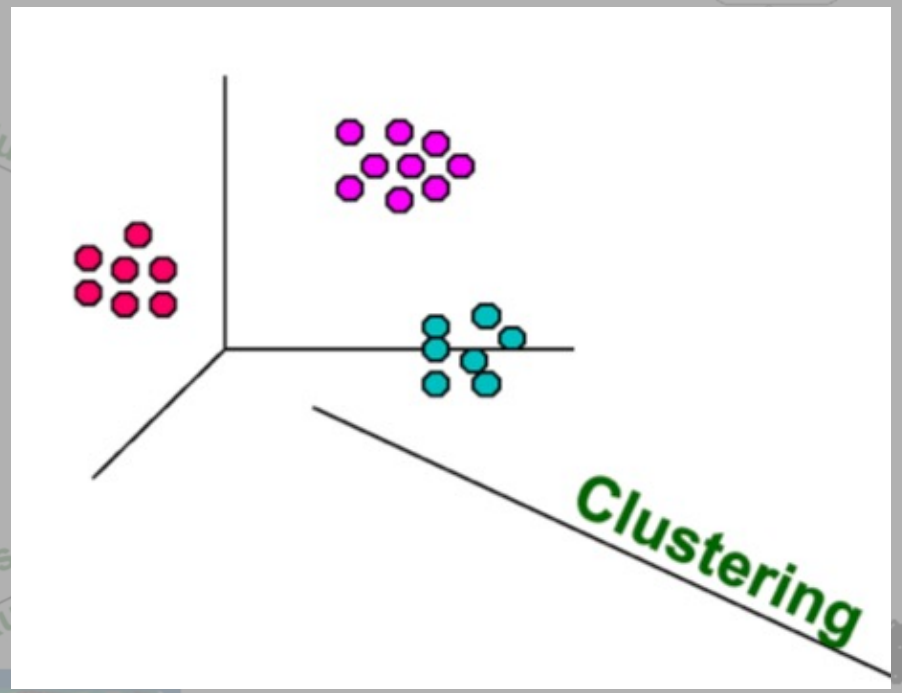

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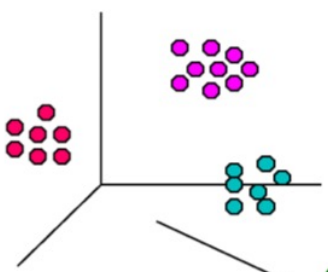

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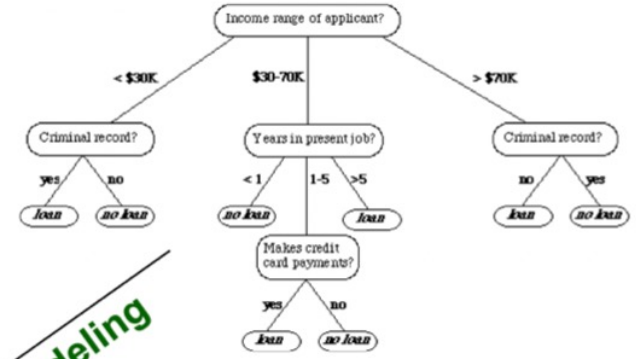

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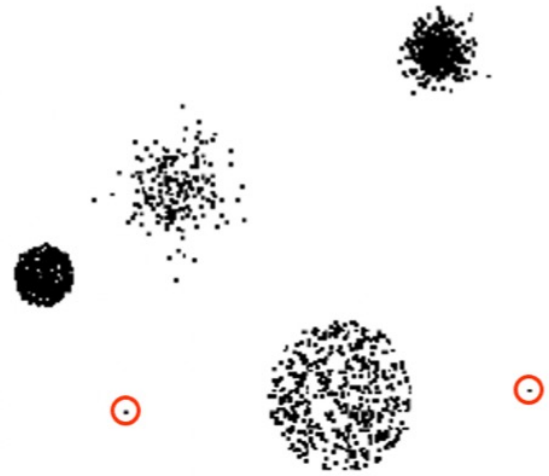

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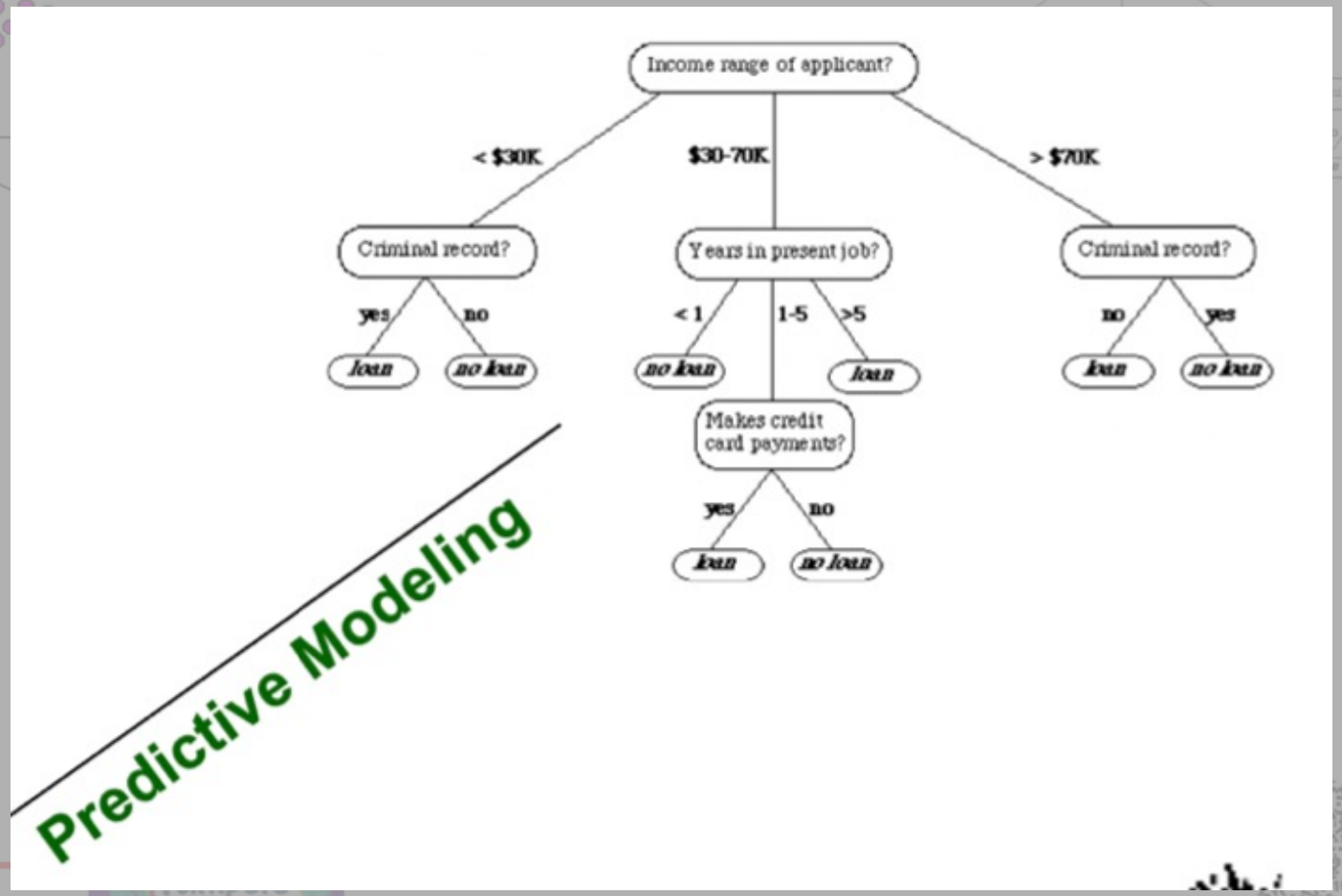
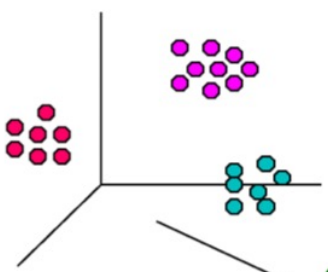

Income range of applicant?
< $30K
$30-70K
> $70K
Criminal record?
Years in present job?
Criminal record?
yes
no
< 1
1-5
>5
no
yes
loan
no loan
no loan
loan
loan
no loan
Makes credit card payments?
yes
no
loan
no loan
Predictive Modeling

Data Mining



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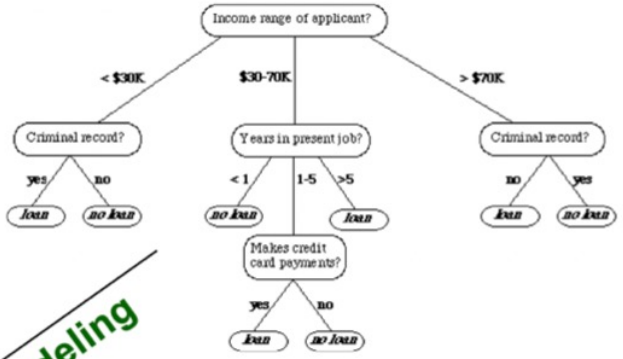

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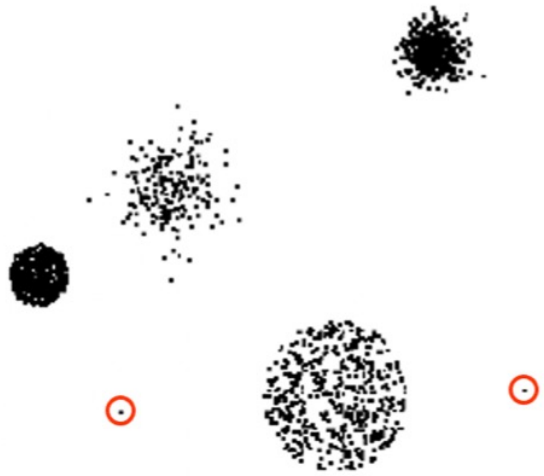

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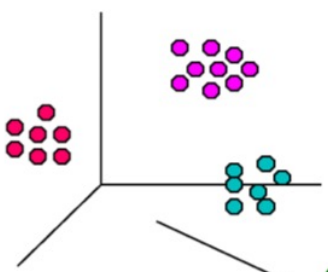

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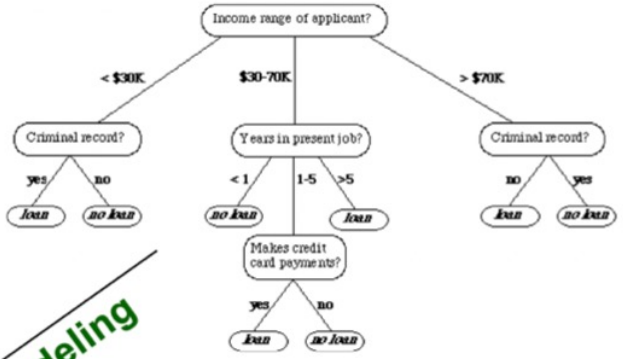

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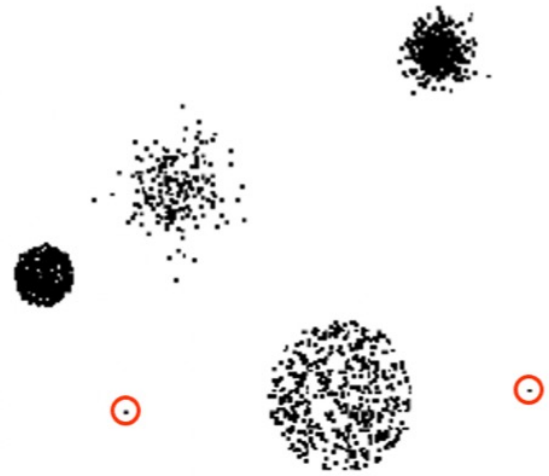

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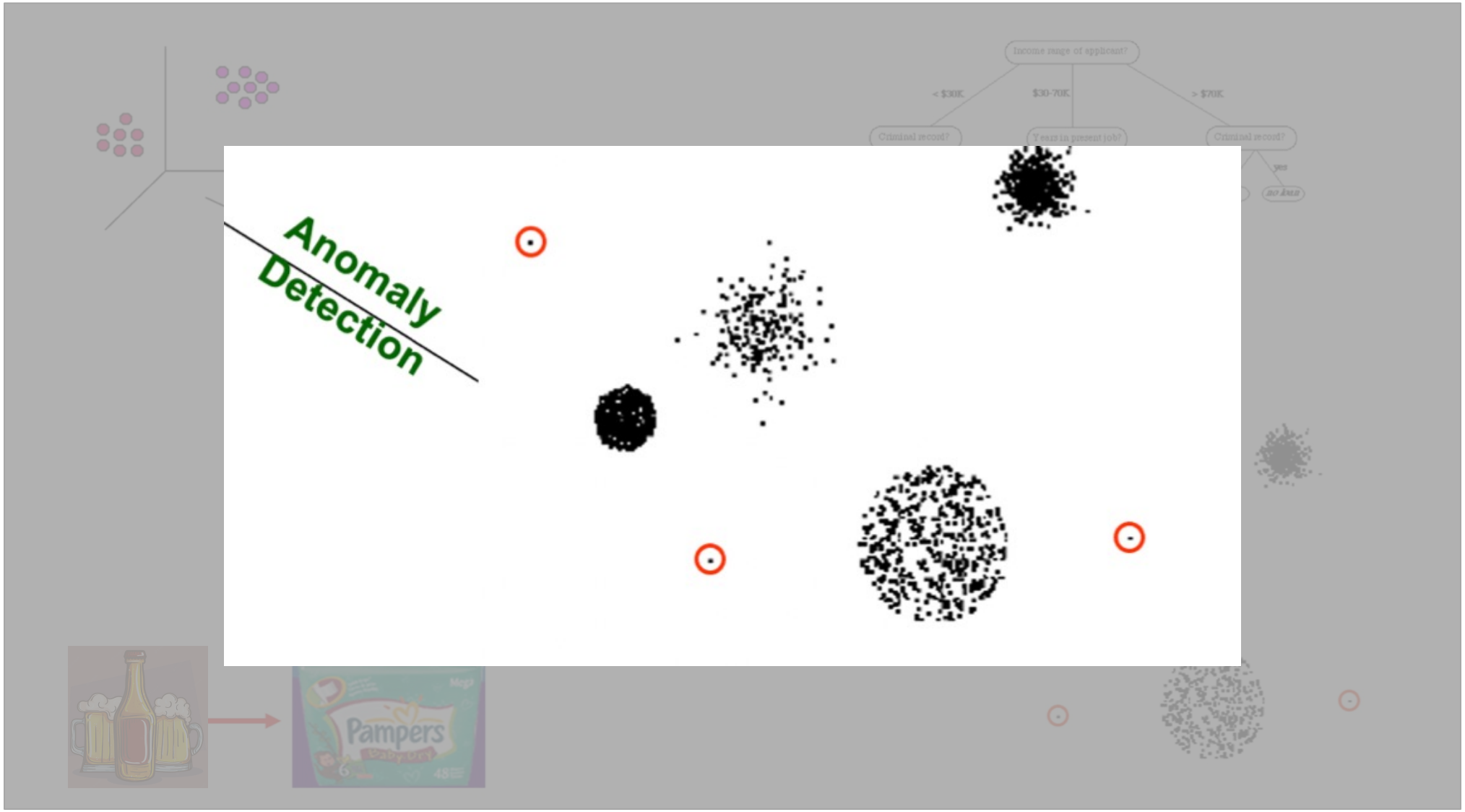
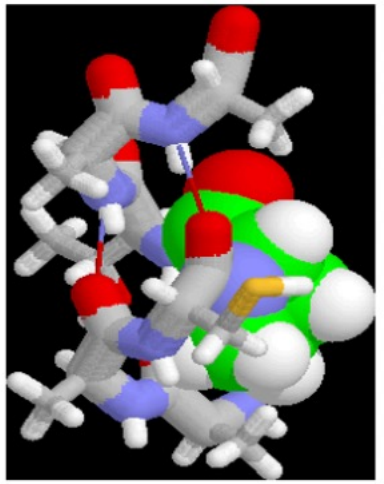


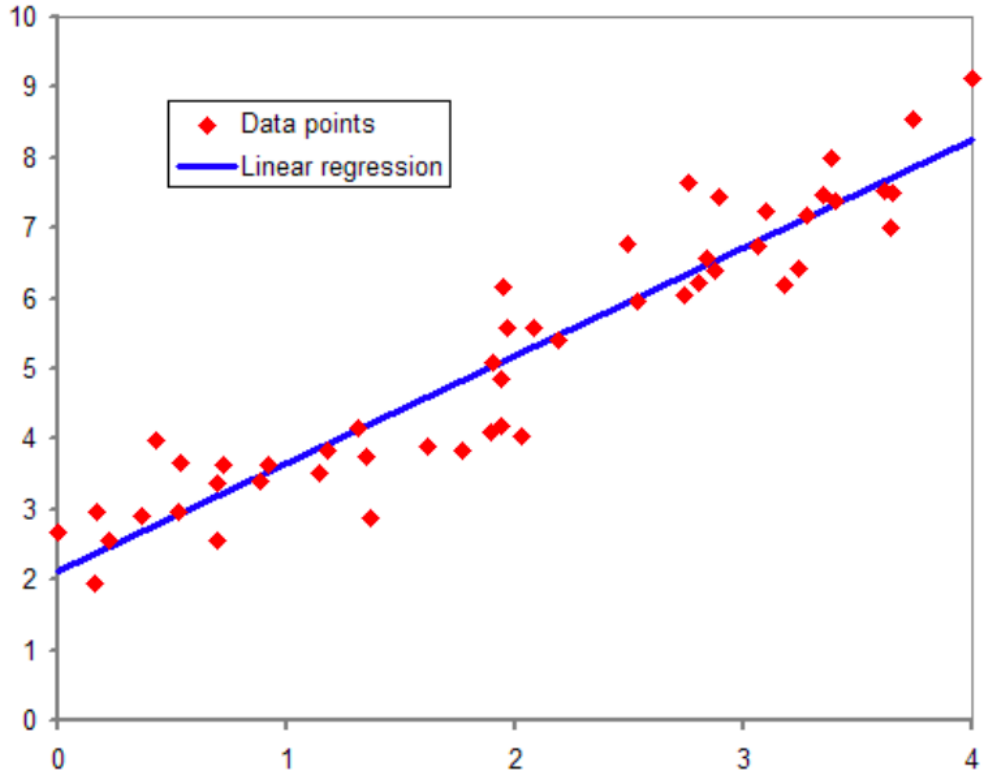
Introduction - Classification

- Classifying credit card transactions as legitimate or fraudulent.
- Classifying land covers (water bodies, urban areas, forests, etc.) using satellite data.
- Identifying intruders in the cyberspace.
- Predicting tumor cells as benign or malignant.
- Classifying secondary structures of protein as alpha-helix, beta-sheet, or random coil.



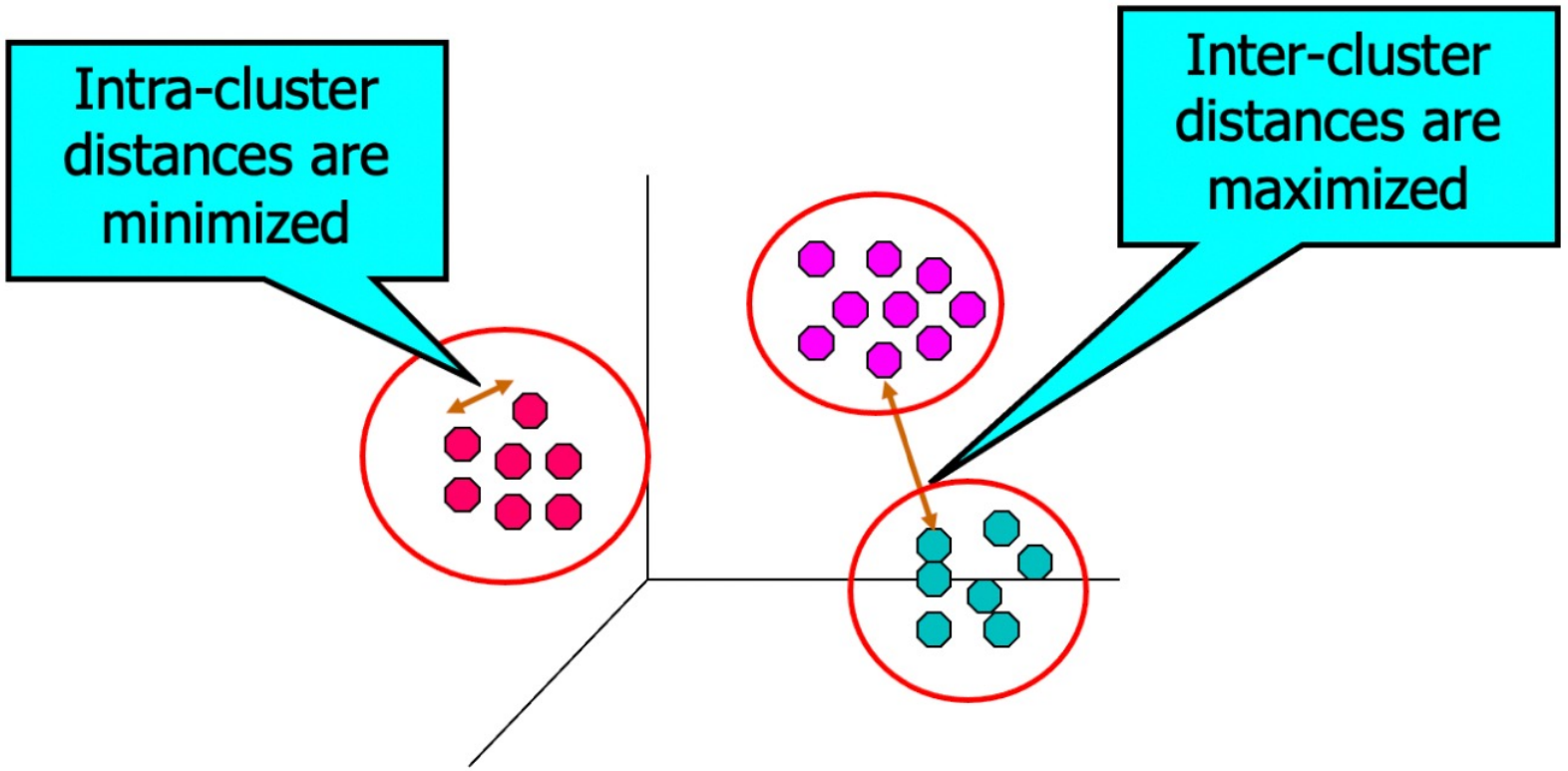
Introduction - Regression

- Predict a value of a given continuous valued variable based on the values of other variables, assuming a linear or nonlinear model of dependency.



Introduction - Clustering

- Finding groups of objects such that the objects in a group will be similar (or related) to one another and different from (or unrelated to) the objects in other groups



Introduction - Clustering

- Understanding
  - Custom profiling for targeted marketing
  - Group related documents for browsing
  - Group genes and proteins that have similar functionality
  - Group stocks with similar price fluctuations
- Summarization
  - Reduce the size of large data sets

Introduction - Association Rule Discovery

- Given a set of records each of which contain some number of items from a given collection, produce dependency rules which will predict occurrence of an item based on occurrences of other items.

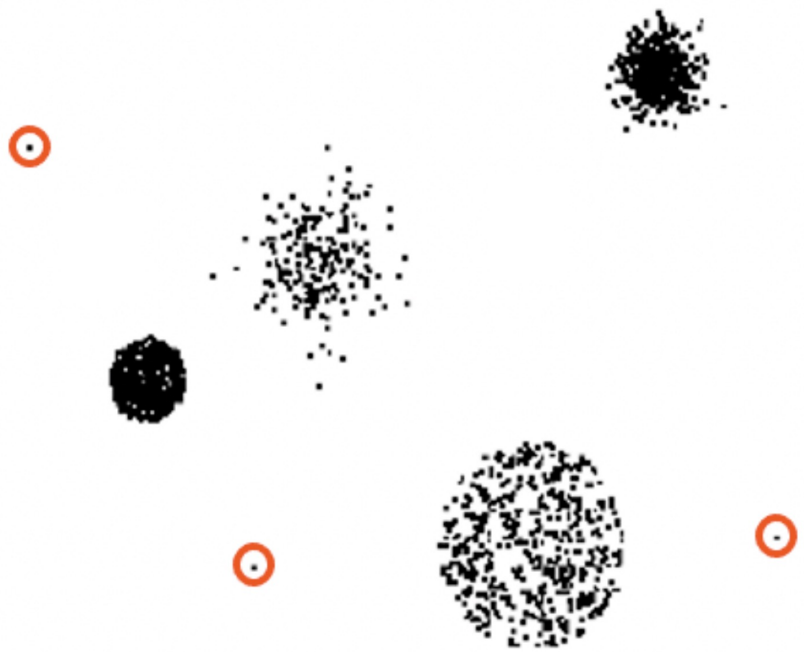
TID	*Items*
1	Bread, Coke, Milk
2	Beer, Bread
3	Beer, Coke, Diaper, Milk
4	Beer, Bread, Diaper, Milk
5	Coke, Diaper, Milk

Rules Discovered:
{Milk} --> {Coke}
{Diaper, Milk} --> {Beer}

- Implication means co-occurrence, not causality!

Introduction - Anomaly Detection/Outlier Detection

- Detect significant deviations from normal behavior.



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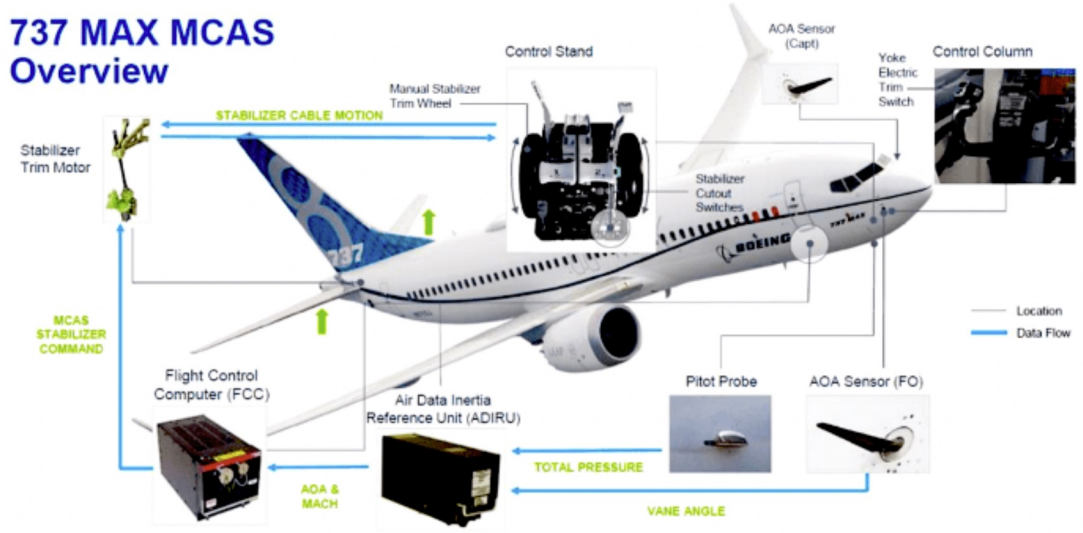

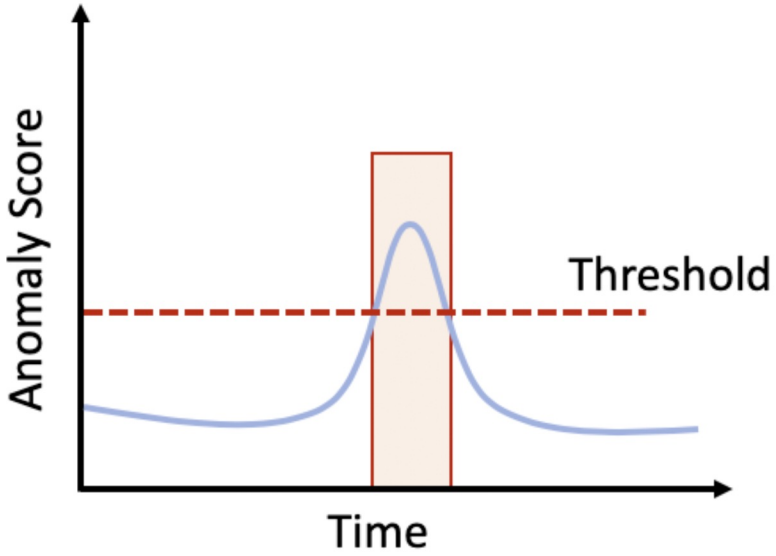

Motivating Challenges

- Scalability
- High Dimensionality
- Heterogeneous and Complex Data
- Data Ownership and Distribution
- Non-traditional Analysis
  - hypothesis generation and evaluation