CS 412 Intro. to Data Mining

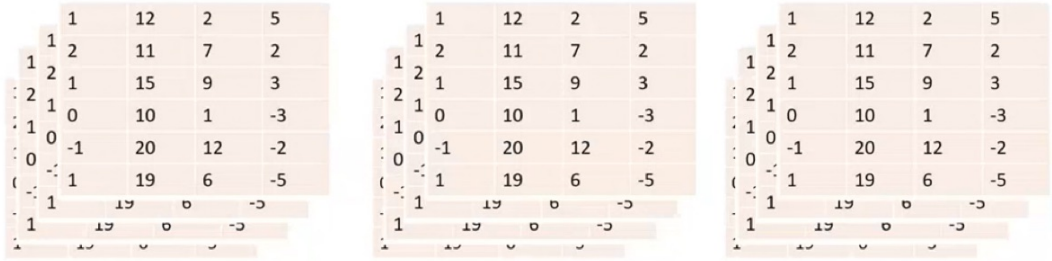
Chapter 2. Getting to Know Your Data

Jiawei Han, Computer Science, Univ. Illinois at Urbana-Champaign, 2017

Data

1	12	2	5
2	11	7	2
1	15	9	3
0	10	1	-3
-1	20	12	-2
1	19	6	-5

Data



4D = 3D เรียงต่อกัน

Data

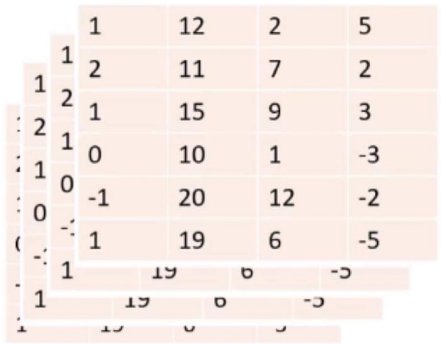
1
2
1
0
-1
1

1D = กว้างหรือยาว

1	12	2	5
2	11	7	2
1	15	9	3
0	10	1	-3
-1	20	12	-2
1	19	6	-5

2D = กว้างและยาว

÷



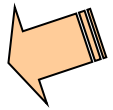
3D = 2D ซ้อนกัน

Data

	Attribute 1	Attribute 2	Attribute 3	Attribute 4
Record 1	1	12	2	5
Record 2	2	11	7	2
Record 3	1	15	9	3
Record 4	0	10	1	-3
Record 5	-1	20	12	-2
Record 6	1	19	6	-5

ถ้า Data มี Attribute เข้ากัน ข้อมูลก็จะเป็นชุดเดียวกัน

Chapter 2. Getting to Know Your Data

- Data Objects and Attribute Types 
- Basic Statistical Descriptions of Data
- Data Visualization
- Measuring Data Similarity and Dissimilarity
- Summary

Types of Data Sets: (1) Record Data

- Relational records
  - ตารางที่มีความสัมพันธ์กัน
  - Relational tables, highly structured
- Data matrix, e.g., numerical matrix, crosstabs

	China	England	France	Japan	USA	Total
Active Outdoors Crochet Glove		12.00	4.00	1.00	240.00	257.00
Active Outdoors Lycra Glove		10.00	6.00		323.00	339.00
InFlux Crochet Glove	3.00	6.00	8.00		132.00	149.00
InFlux Lycra Glove		2.00			143.00	145.00
Triumph Pro Helmet	3.00	1.00	7.00		333.00	344.00
Triumph Vertigo Helmet		3.00	22.00		474.00	499.00
Xtreme Adult Helmet	8.00	8.00	7.00	2.00	251.00	276.00
Xtreme Youth Helmet		1.00			76.00	77.00
Total	14.00	43.00	54.00	3.00	1,972.00	2,086.00

Person:

Pers_ID	Surname	First_Name	City
0	Miller	Paul	London
1	Ortega	Alvaro	Valencia
2	Huber	Urs	Zurich
3	Blanc	Gaston	Paris
4	Bertolini	Fabrizio	Rom

no relation

ตารางเชื่อมต่อกัน

Car:

Car_ID	Model	Year	Value	Pers_ID
101	Bentley	1973	100000	0
102	Rolls Royce	1965	330000	0
103	Peugeot	1993	500	3
104	Ferrari	2005	150000	4
105	Renault	1998	2000	3
106	Renault	2001	7000	3
107	Smart	1999	2000	2

- Transaction data

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

คำ / ข้อความ

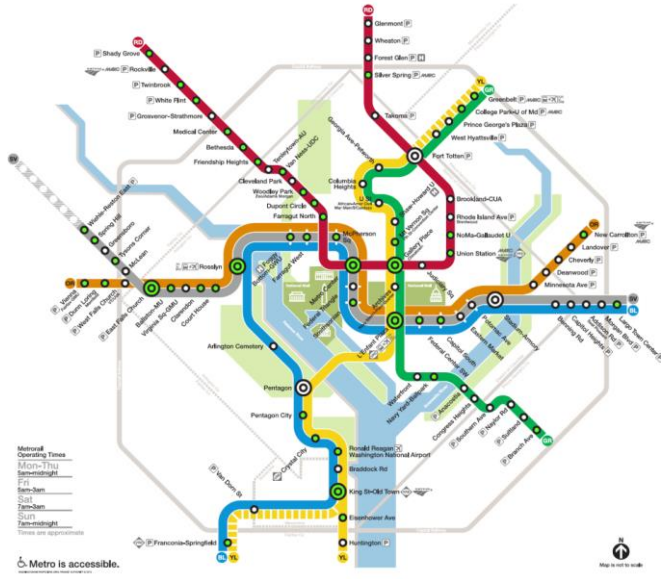
	team	coach	play	ball	score	game	win	lost	timeout	season
Document 1	3	0	5	0	2	6	0	2	0	2
Document 2	0	7	0	2	1	0	0	3	0	0
Document 3	0	1	0	0	1	2	2	0	3	0

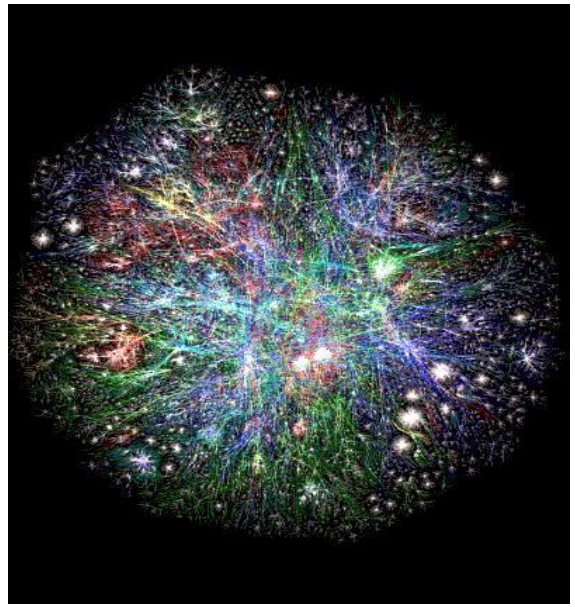
แปลงข้อมูลให้เป็นตัวเลข

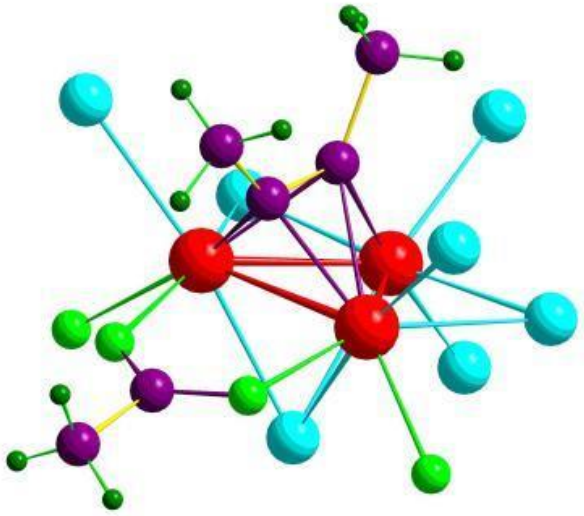
- Document data: Term-frequency vector (matrix) of text documents

Types of Data Sets: (2) Graphs (กราฟ) and Networks

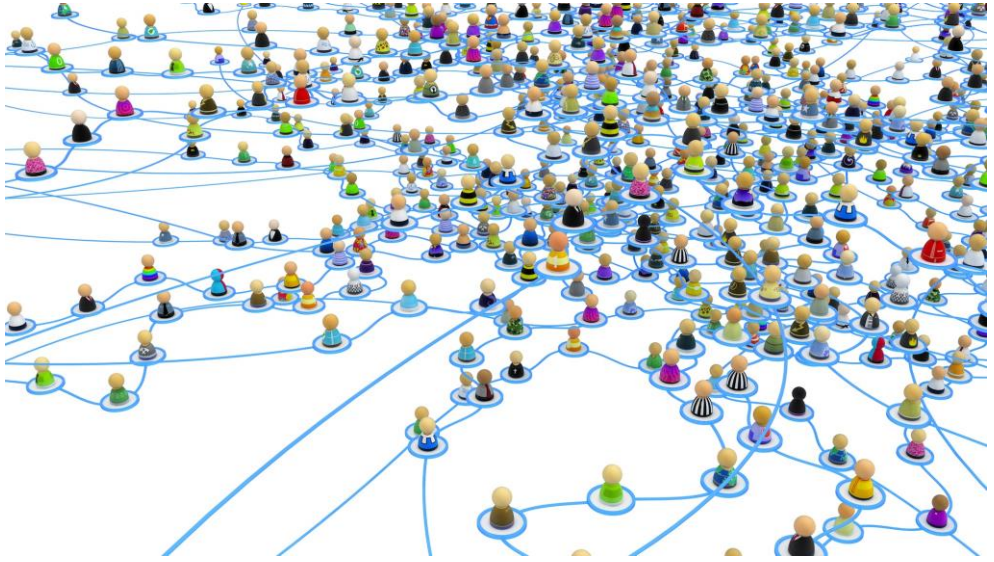
- Transportation network
- World Wide Web







- Molecular Structures



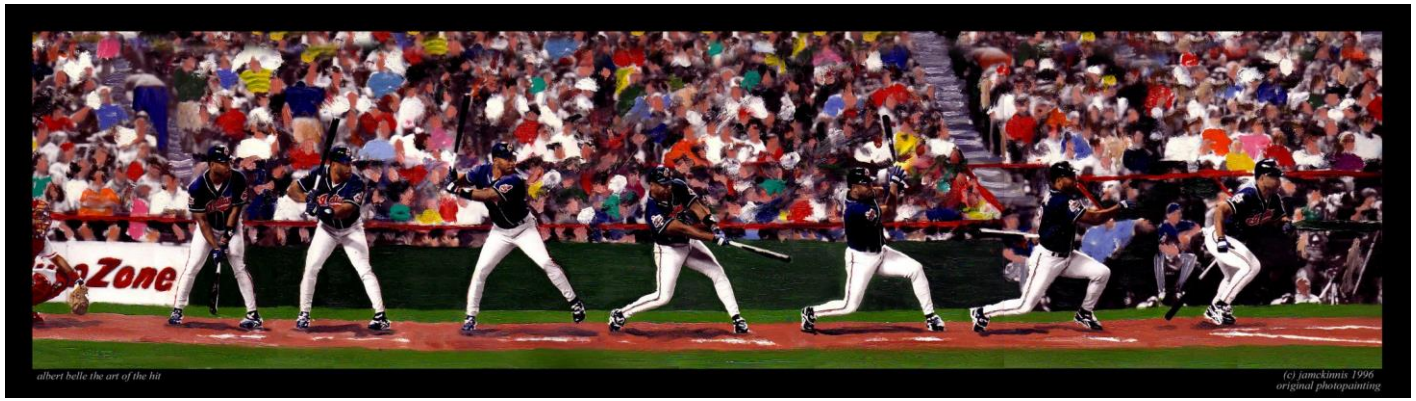
- Social or information networks

ข้อมูลมีเวลาเกี่ยวข้อง Ex : หุ้น

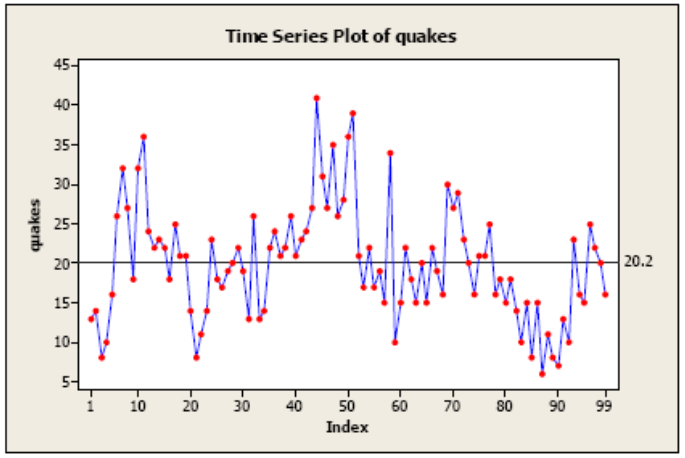
Types of Data Sets: (3) Ordered Data

ข้อมูลวิดีโอที่มีเวลาเข้ามาเกี่ยวข้อง, นำภูมาฝึกนาๆ กัน

- Video data: sequence of images

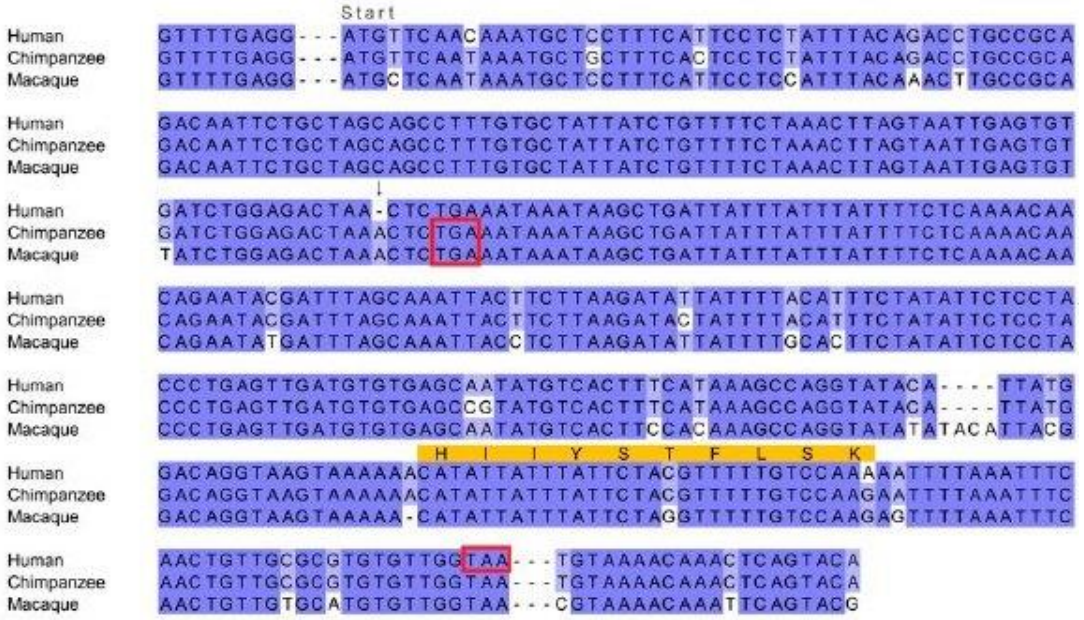


- Temporal data: time-series



- Sequential Data: transaction sequences

- Genetic sequence data

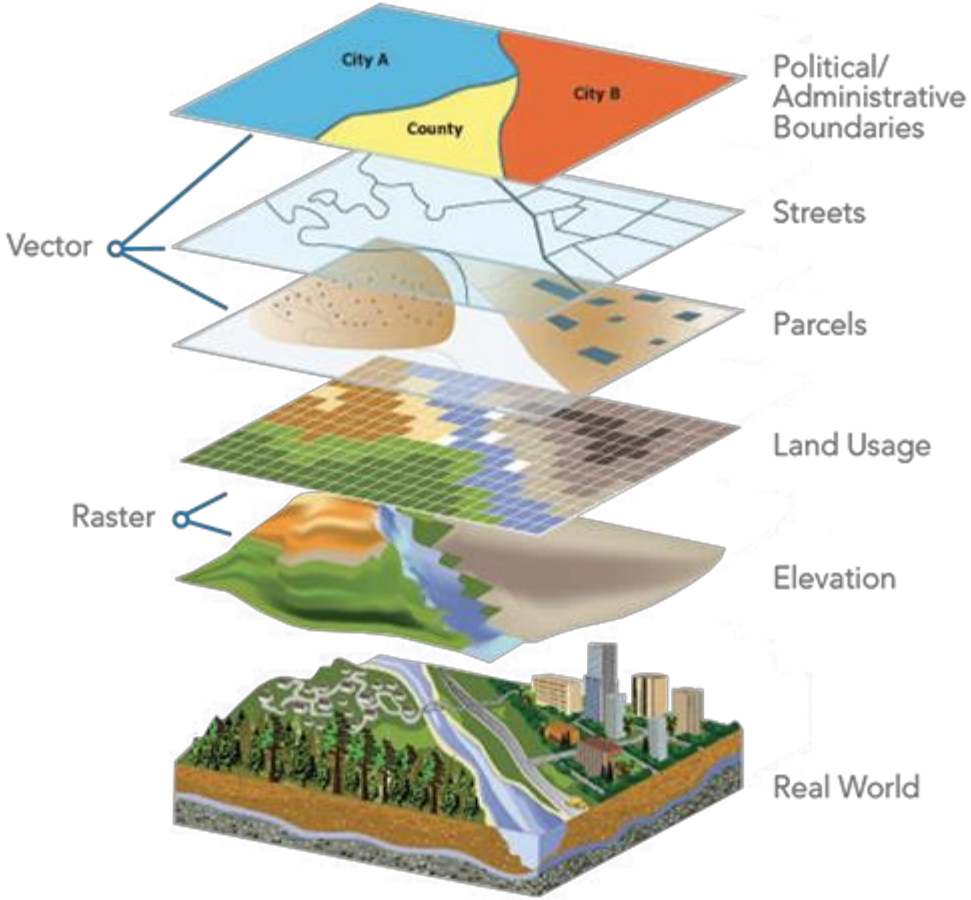


ข้อมูลเชิงพื้นที่ (มีค่าพิกัดและขนาด x,y)

Types of Data Sets: (4) Spatial, image and multimedia Data

- Spatial data: maps

ข้อมูลเชิงพื้นที่



- Image data:

ข้อมูลเชิงรูปภาพ

- Video data: Spatio-temporal

Important Characteristics of Structured Data

- Dimensionality มีกี่ Dimension
  - Curse of dimensionality
- Sparsity สนใจเฉพาะตรงที่มีข้อมูล ค่าข้อมูลเป็น 0 เยอะก็ไม่ต้องสนใจ
  - Only presence counts
- Resolution เก็บข้อมูลกี่ปี
  - Patterns depend on the scale
- Distribution จัดค่ากลาง กลาง / มืด
  - Centrality and dispersion

Data Objects

- Data sets are made up of data objects กลุ่มของข้อมูลที่ประกอบด้วยหลายๆ ข้อมูล
- A **data object** represents an entity ข้อมูลแต่ละตัวจะมี entity
- Examples:
  - sales database: customers, store items, sales
  - medical database: patients, treatments
  - university database: students, professors, courses
- Also called *samples , examples, instances, data points, objects, tuples*
- Data objects are described by **attributes** ข้อมูลจะถูกอธิบายด้วย attributes
- Database rows → data objects; columns → attributes

Attributes

คุณสมบัติ

- **Attribute (**or **dimensions, features, variables**)
  - A data field, representing a characteristic or feature of a data object.
  - *E.g., customer _ID, name, address*
- Types:
  - Nominal (e.g., red, blue) ชื่อของกลุ่มข้อมูลที่ ไม่ใช่ตัวเลข
  - Binary (e.g., {true, false}) ข้อมูลที่มี 2 ค่า
  - Ordinal (e.g., {freshman, sophomore, junior, senior}) ข้อมูลเรียงลำดับ
  - Numeric: quantitative ข้อมูลที่ +, -, x, ÷ แล้วมีความหมาย
    - Interval-scaled: 100°C is interval scales
    - Ratio-scaled: 100°K is ratio scaled since it is twice as high as 50 °K
- Q1: Is student ID a nominal, ordinal, or interval-scaled data?
- Q2: What about eye color? Or color in the color spectrum of physics? Numric

Attribute Types

ชนิด

- **Nominal:** categories, states, or "names of things"
  - *Hair_color* = {*auburn, black, blond, brown, grey, red, white*}
  - marital status, occupation, ID numbers, zip codes
- **Binary** มีแค่ 2 ค่าเลือก Ex : 0 คือ ๆ, ใช่ คือ ไม่
  - Nominal attribute with only 2 states (0 and 1)
  - Symmetric binary (สมมาตร): both outcomes equally important
    - e.g., gender
  - Asymmetric binary: outcomes not equally important. มี 2 ค่า แต่ความสำคัญไม่เท่ากัน
    - e.g., medical test (positive vs. negative)
    - Convention: assign 1 to most important outcome (e.g., HIV positive)
- **Ordinal** เรียงลำดับได้, รวมกันไม่ได้
  - Values have a meaningful order (ranking) but magnitude between successive values is not known
  - *Size* = {*small, medium, large*}, grades, army rankings

ข้อมูลที่เป็นตัวเลข เมื่อแท้/ไม่แท้

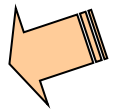
Numeric Attribute Types

- Quantity (integer or real-valued)
- **Interval**
  - Measured on a scale of **equal-sized units**
  - Values have order
    - E.g., *temperature in C˚or F˚, calendar dates*
  - No true zero-point
- **Ratio**
  - Inherent **zero-point**
  - We can speak of values as being an order of magnitude larger than the unit of measurement (10 K˚ is twice as high as 5 K˚).
    - e.g., *temperature in Kelvin, length, counts, monetary quantities*

Discrete vs. Continuous Attributes

- **Discrete Attribute**
  - Has only a finite or countably infinite set of values
    - E.g., zip codes, profession, or the set of words in a collection of documents
  - Sometimes, represented as integer variables
  - Note: Binary attributes are a special case of discrete attributes
- **Continuous Attribute**
  - Has real numbers as attribute values
    - E.g., temperature, height, or weight
  - Practically, real values can only be measured and represented using a finite number of digits
  - Continuous attributes are typically represented as floating-point variables

Chapter 2. Getting to Know Your Data

- Data Objects and Attribute Types
- Basic Statistical Descriptions of Data 
- Data Visualization
- Measuring Data Similarity and Dissimilarity
- Summary

Basic Statistical Descriptions of Data

- Motivation
  - To better understand the data: central tendency, variation and spread
- Data dispersion characteristics
  - Median, max, min, quantiles, outliers, variance, ...
- Numerical dimensions correspond to sorted intervals
  - Data dispersion:
    - Analyzed with multiple granularities of precision
  - Boxplot or quantile analysis on sorted intervals
- Dispersion analysis on computed measures
  - Folding measures into numerical dimensions
  - Boxplot or quantile analysis on the transformed cube