Tour Version

Data Mining

Weak 1
Introduction

INTRODUCTION TO DATA MINING

MOTIVATION ABOUT DATA MINING

• Vast amounts of data are collected daily

• knowledge mining from data

• Extraction of interesting (non-trivial, implicit, previously unknown and potentially useful) patterns or knowledge from huge amount of data

العالم ملئ بالبيانات اللى بتتجمع كل يوم,, البيانات محملة بالمعرفة, بس محتاجين طريقة للبحث داخل البيانات دى عشان اقدر استخلص اللى يهمنى جوه البيانات وهو المعرفة اللى مستخبية أو مضمونة جوه الكم الهائل ده,, عشان كده العلم ده موجود و بيخدم جميع المجالات المختلفة

حاجتنا الى المعرفة فى المجالات هى المحرك لاستخدام هذا العلم

DATA MINING TERMS AND NAMES

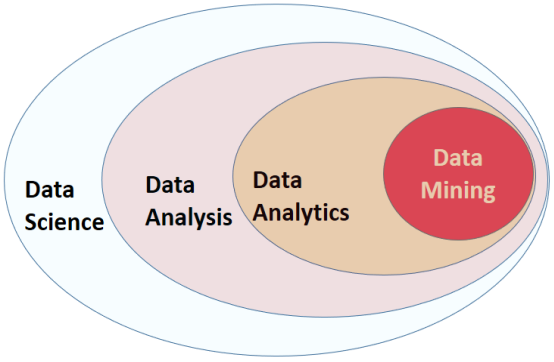
Data Mining = Knowledge mining from data = Knowledge Extraction = Data/Pattern Analysis = Data Archaeology = Data Dredging = Knowledge Discovery from Data (KDD)

KNOWLEDGE DISCOVERY PROCESS

مجموعة من العمليات المتابعة اللى بنعملها عشان نستخرج المعرفة

- Data Cleaning: remove noise and inconsistent data
- Data Integration: multiple sources combined
- Data Selection: data relevant to analysis task => البيانات اللى مرغوب دراستها
- Data Transformation: احول البيانات لشكل أقدر أتعامل معاه داخل الالجوريزم
- Data Mining: استخدام الجوريزم معين عشان أطلع ال pattern اللى بدور عليه
- Pattern Evaluation: اقيم اد ايه هو مناسب لاتخاذ القرارات
- Knowledge Representation: أعرضه بشكل مفهوم للمستخدم

NOT DATA MINING VS DATA MINING



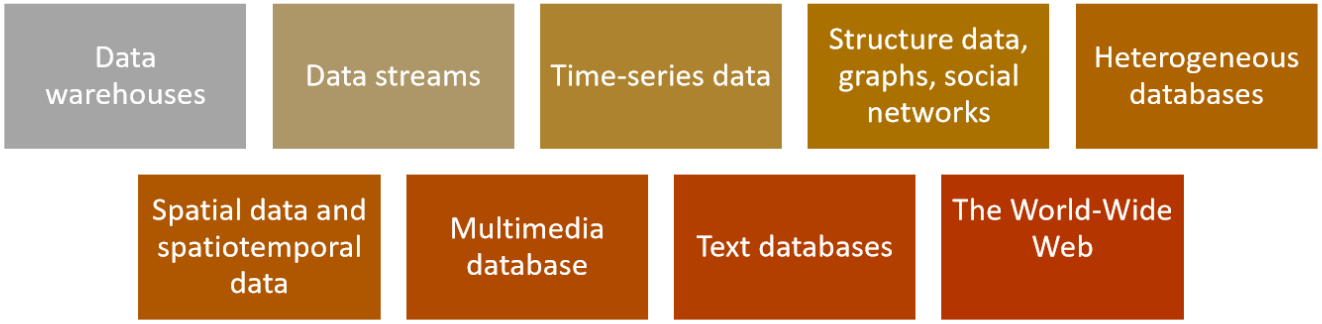
أوعى تفكر ان حضرتك لو بحثت على النت على طبخة مثلا يبقى ده داتا مينينج ,, ابسلوتلى

~~Searching for cooking on Google~~ vs. Grouping similar cuisines French, Italian, Arabian …

~~Looking up spa resorts~~ vs. More relevant Spa for curing certain diseases

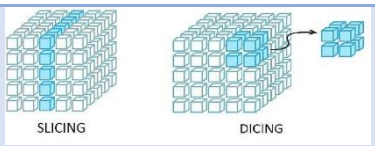
Data Mining is NOT about ~~searching in a Data~~, but more about Implicit meaningful

WHAT KINDS OF DATA CAN BE MINED?



- Warehouse: منطة لتجميع كمية كبيرة من قواعد البيانات
- Spatial => x,y,z , spatiotemporal = spatial + Time
- Heterogeneous => قواعد بيانات متنوعة ,, يعنى الداتا بتيجى من سكول و نو سكول و هكذا

عرفنا ايه اشكال البيانات اللى منكم نشتغل عليها بس لسه ماعرفناش ايه أنواع الباترن اللى منكم تطلعلنا من العمليات و ازاى منكم تفدنا ؟؟؟

Patterns	How can it help
CHARACTERIZATION AND DISCRIMINATION	Characterization => slicing and dicing the data to understand what it is all about. Discrimination => identifying splitting conditions to partition the data into independent bins. 
ASSOCIATION / CORRELATION ANALYSIS	بشوف اذا كان فيه ترابط مابين الاعمدة وبعضها و ازاى بتأثر على بعضها يا سلب يا ايجاب يا اما No Hypotheses => Independent Attributes
CLASSIFICATION	و ده نوع من الباترن اللى بيحتاج مودل يدرب البيانات عشان بعد كده يخمن لو جاله داتا بعد كده ياخدله القرار Supervised Learning => Machine Learning Algorithms
CLUSTER ANALYSIS	ده مش محتاج داتا يتدرب عليها ده Unsupervised learning
OUTLIER ANALYSIS	بيشوف ايه البيانات اللى معدية الحدود الطبيعية و منكم تكون مفيدة مثلا فى المجال الطبى للكشف عن الأمراض

TERMINOLOGY

Mining Tasks

Descriptive Tasks

- Characterize properties of the data in a target data set.
- e.g., (classification, regression, anomalies/outliers detection)
- بتستخدم مجموعة من المتغيرات عشان تتنبأ بالمتغيرات الأخرى

Predictive Tasks

- Perform induction on the current data to make predictions.
- (e.g., clustering, association rule discovery, sequential pattern discovery)
- الهدف منه انه يطلعلى باترن يقدر يفهمه المستخدم زى لو جالك بيانات شكلها 1و2و3 خدلها القرار ده

Technologies

Applications

هيفدنى فى ايه الداتا مينينج ؟

Data Objects

- Data sets are made up of data objects.
- Also referred as samples, examples, instances, data points.
- e.g. customers, students, patients, books.
- Data objects are typically described by attributes

Entity of A DB like Table, Json file, CSV

Attributes

- A data field, representing a characteristic or feature of a data object.
- attribute, dimension, feature, and variable are often used interchangeably
- A customer object can include, for example, customer ID, name, and address.
- Observed values for a given attribute are known as observations.

CATEGORIAL DATA
QUALITATIVE

Nominal Attributes {B , A , C}

- The values of a nominal attribute are symbols or names of things
- do not have any meaningful order
- e.g. hair color, marital status, occupation

Binary Attributes {A , C}

- a nominal attribute with only two categories or states: 0 or 1
- symmetric if both of its states carry the same weight (e.g. gender)
- Asymmetric like HIV result of medical test, The +ve and -ve values are not in the same weight
- هى هياها النومينال بس ماليهاش الا قيمتين بس

Ordinal Attributes (A, B, C)

- an attribute with possible values that have a meaningful order or ranking among them
- e.g. professional rank, grade, customer satisfaction
- Central tendency can be the mode or the median **But the Mean Cannot be Defined (Why?)**

NUMERICAL DATA
QUANTITATIVE

Interval-Scaled

- measured on a scale of equal-size units.
- does not have a true zero-point.
- e.g. temperature, neither 0C nor 0F indicates “no temperature.”

Ratio-Scaled

- a numeric attribute with an inherent zero-point
- e.g. years of experience

Statistical Descriptions of Data

For data **preprocessing** to be successful, it is **essential** to have an **overall picture** of your data.

- Measuring Central Tendency => Mean , Median , Mode, MidRange
- Measuring the Dispersion of Data => Ranges, Quartiles, five number summaries, SD, Variance
- Basic Graphs => Histogram, Scatter Plots

Measuring Central Tendency

Mean

- Simple Mean = $\bar{x} = \frac{\sum_{i=1}^{N} x_i}{N} = \frac{x_1 + x_2 + \cdots + x_N}{N}$
- Weighted mean = $\bar{x} = \frac{\sum_{i=1}^{N} w_i x_i}{\sum_{i=1}^{N} w_i} = \frac{w_1 x_1 + w_2 x_2 + \cdots + w_N x_N}{w_1 + w_2 + \cdots + w_N}$.

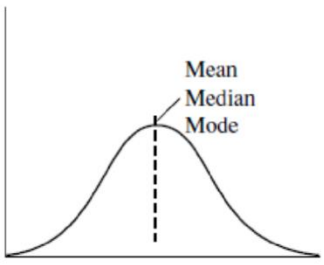
- A major problem with the mean is its **sensitivity to extreme** (e.g., outlier) values.
- we can instead use the trimmed mean, which is the mean obtained after **chopping off** values at the high and low extremes.

Median

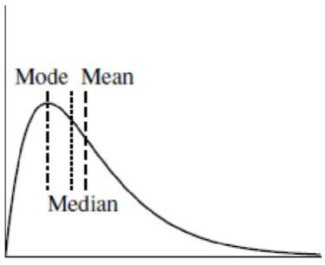
- the middle value in a set of ordered data values.
- It is the value that separates the higher half of a data set from the lower half.
- The median is **expensive to compute** when we have many observations

Mode & Mid Range

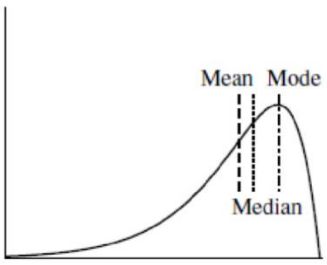
- the value that occurs most frequently in the set
- it can be determined for qualitative and quantitative attributes.
- Data sets with one, two, or three modes are respectively called unimodal, bimodal, and trimodal.
- Mid Range: is the average of the largest and smallest values in the set.



(a) Symmetric data



(b) Positively skewed data



(c) Negatively skewed data

Data in most real applications are not symmetric. They may instead be either positively skewed, where the mode occurs at a value that is smaller than the median or negatively skewed, where the mode occurs at a value greater than the median

$$\bar{x} = \frac{30+36+47+50+52+52+56+60+63+70+70+110}{12}$$

$$= \frac{696}{12} = 58.$$

Mean = 58,000

Median = $\frac{52+56}{2} = \frac{108}{2}$ =54,000

Mode = 52,000 and 70,000 – bimodal

Midrange= $\frac{30{,}000+110{,}000}{2}$ = 70,000

- Salary (in thousands of dollars), shown in increasing order: 30, 36, 47, 50, 52, 52, 56, 60, 63, 70, 70, 110

Measuring the Dispersion of Data

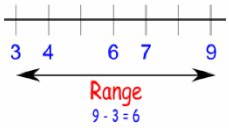
The dispersion or spread of numeric data is useful in identifying **outliers**.

Variance and Standard Deviation

- **low** standard deviation means that the data observations tend to be **very close** to the **mean**,
- **high** standard deviation indicates that the data are **spread out** over a large range of values

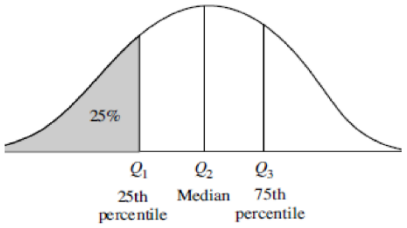
Range

- the difference between the largest (max()) and smallest (min()) values



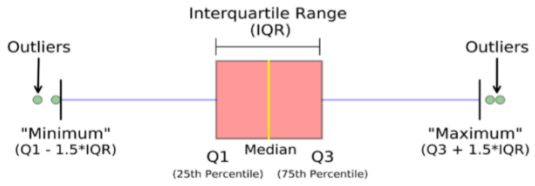
Quantiles

- are points taken at regular intervals of a data distribution, dividing it into equal size consecutive sets.
- For example ,3 quantiles shown to the Right.
- The distance between the first and third quartiles is **interquartile range (IQR)**



Five-Number Summary, Boxplots, and Outliers

- a standardized way of displaying the distribution of data based on a five numbers summary ("minimum", first quartile (Q1), median, third quartile (Q3), and "maximum").

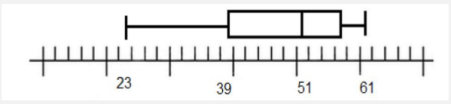


Example

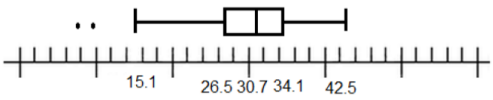
- Draw the boxplot for the following data sets
- Age: 23, 23, 27, 27, 39, 41, 47, 49, 50, 52, 54, 54, 56, 57, 58, 58, 60, 61
- %fat: 9.5, 26.5, 7.8, 17.8, 31.4, 25.9, 27.4, 27.2, 31.2, 34.6, 42.5, 28.8, 33.4, 30.2, 34.1, 32.9, 41.2, 35.7

First: order the data set if it is not ordered

- Age: 23, 23, 27, 27, 39, 41, 47, 49, 50, 52, 54, 54, 56, 57, 58, 58, 60, 61
- **%fat:** 7.8, 9.5, 17.8, 25.9, 26.5, 27.2, 27.4, 28.8, 30.2, 31.2, 31.4, 32.9, 33.4, 34.1, 34.6, 35.7, 41.2, 42.5



For Age
Q1=39, median= 51, Q3=57,
min=23, max=61
IQR= 57-39= 18 → 1.5 IQR= 27
newMin= 39-27= 12, newMax= 57+27= 84



For Fat
Q1=26.5, median= 30.7, Q3=34.1,
min=7.8, max=42.5
IQR= 34.1-26.5= 7.6, 1.5 IQR= 11.4
newMin= 26.5-11.4= 15.1, newMax= 34.1+11.4= 45.5

The Practical about this lecture:
https://github.com/AhmedKhalil777/DataScience.Learning/blob/master/Resources/Lectures_Contripution/Lecture1.contribution.ipynb