Data Mining Concepts and Techniques

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Data Mining
Concepts and Techniques

What Is Data Mining?

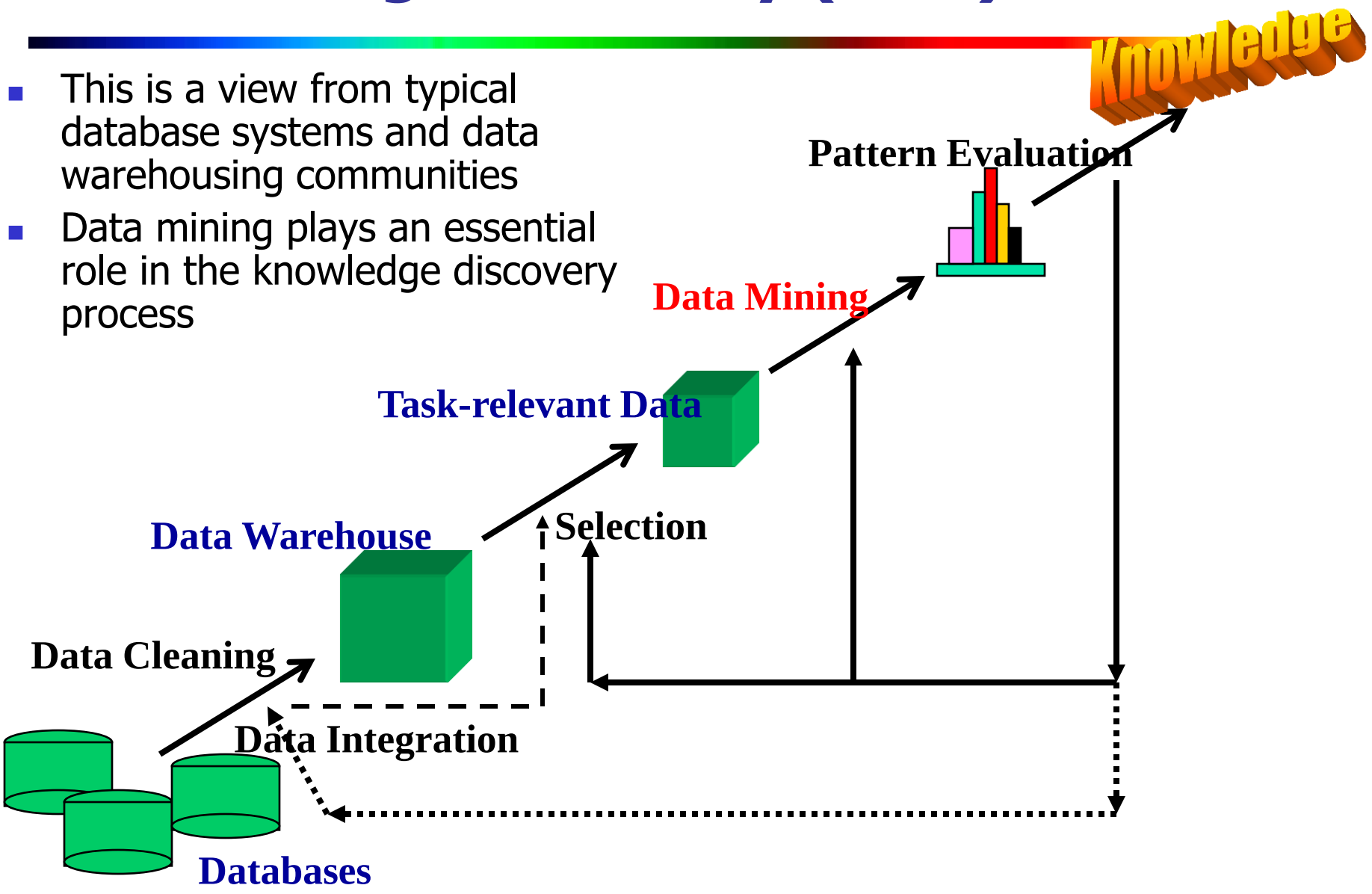
- Data mining (knowledge discovery from data)
  - Extraction of interesting (non-trivial, implicit, previously unknown and potentially useful) patterns or knowledge from huge amount of data
  - Data mining: a misnomer?
- Alternative names
  - Knowledge discovery (mining) in databases (KDD), knowledge extraction, data/pattern analysis, data archeology, data dredging, information harvesting, business intelligence, etc.
- Watch out: Is everything "data mining"?
  - Simple search and query processing
  - (Deductive) expert systems

Why Data Mining?

- The Explosive Growth of Data: from terabytes to petabytes
  - Data collection and data availability
    - Automated data collection tools, database systems, Web, computerized society
  - Major sources of abundant data
    - Business: Web, e-commerce, transactions, stocks, …
    - Science: Remote sensing, bioinformatics, scientific simulation, …
    - Society and everyone: news, digital cameras, YouTube
- We are drowning in data, but starving for knowledge!
- "Necessity is the mother of invention"—Data mining—Automated analysis of massive data sets

Knowledge Discovery (KDD) Process

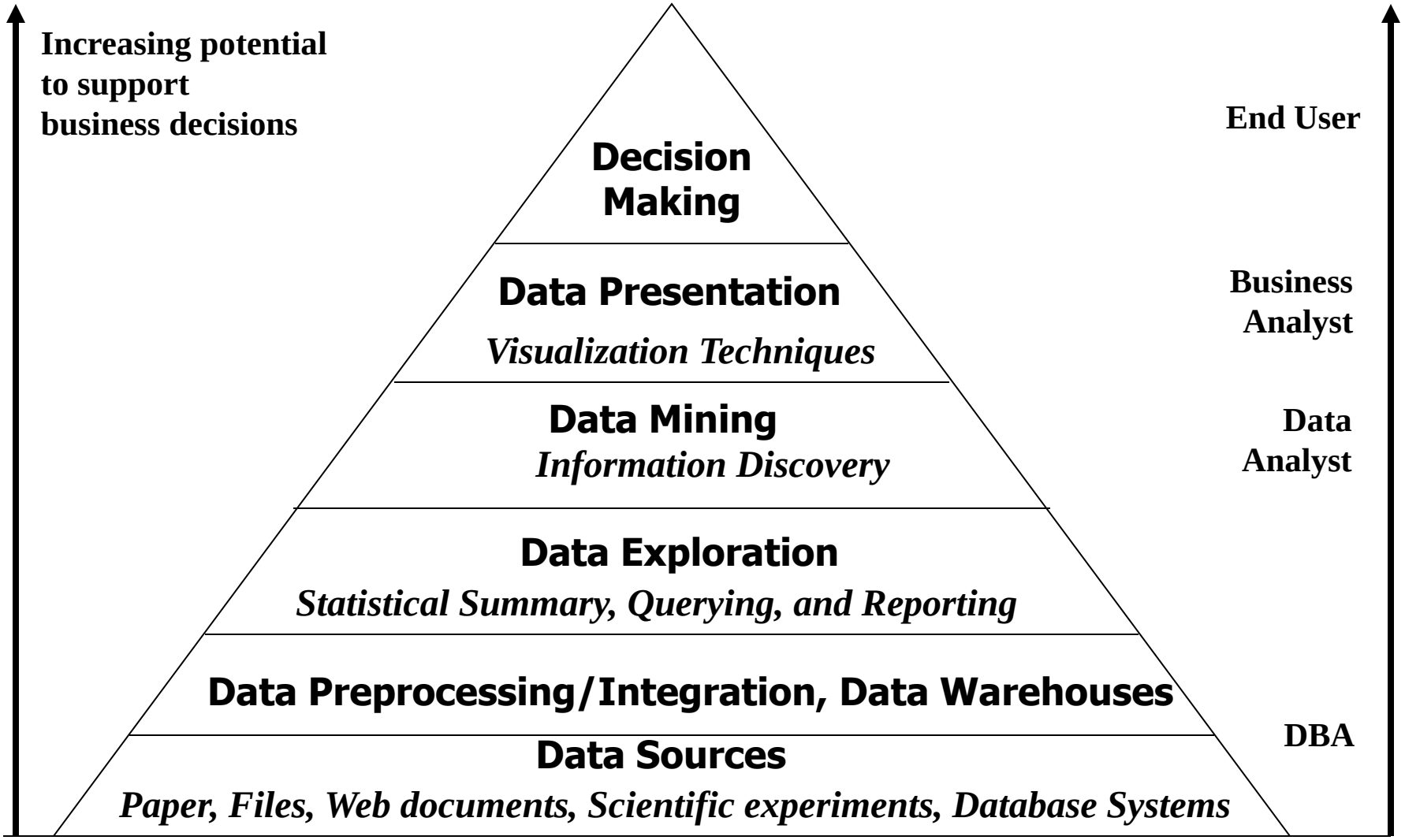
- This is a view from typical database systems and data warehousing communities
- Data mining plays an essential role in the knowledge discovery process



Example: A Web Mining Framework

- Web mining usually involves
  - Data cleaning
  - Data integration from multiple sources
  - Warehousing the data
  - Data cube construction
  - Data selection for data mining
  - Data mining
  - Presentation of the mining results
  - Patterns and knowledge to be used or stored into knowledge-base

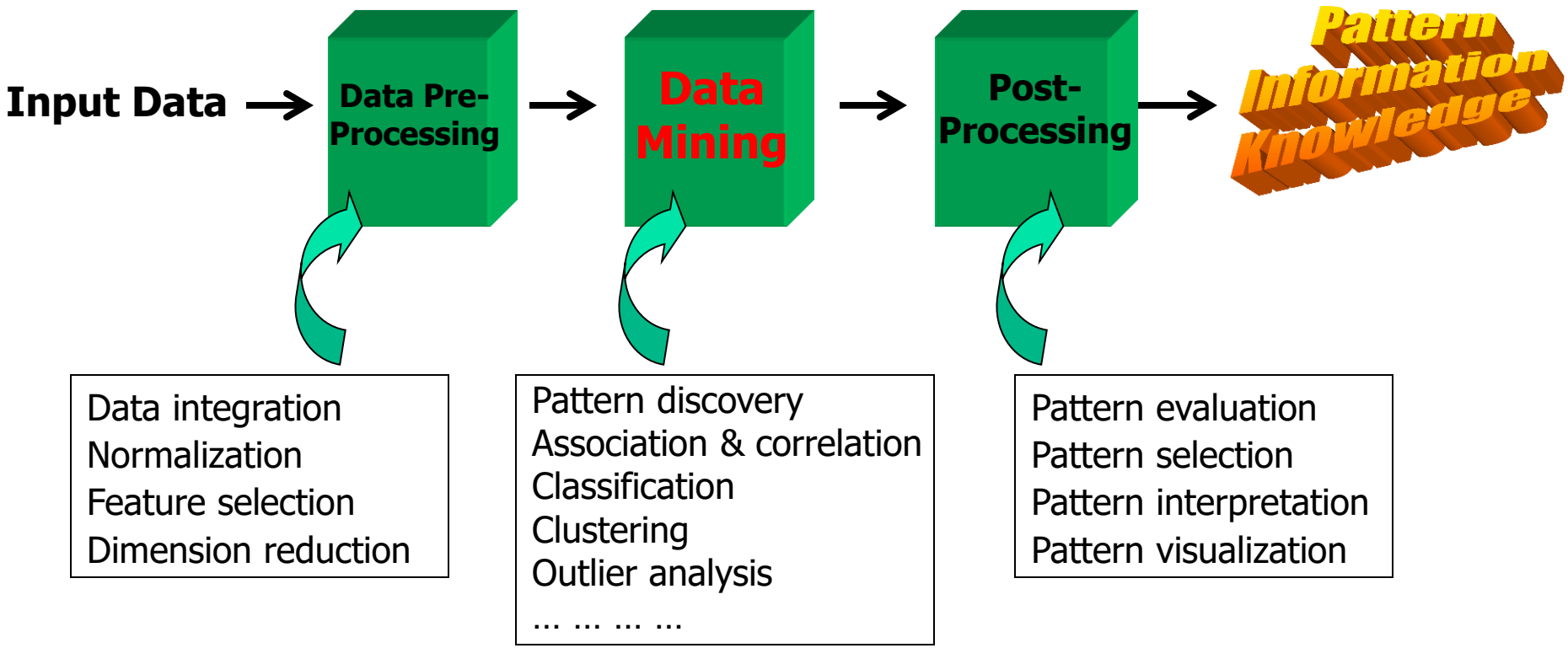
Data Mining in Business Intelligence



Example: Mining vs. Data Exploration

- Business intelligence view
  - Warehouse, data cube, reporting but not much mining
- Business objects vs. data mining tools
- Supply chain example: tools
- Data presentation
- Exploration

KDD Process: A Typical View from ML and Statistics



- This is a view from typical machine learning and statistics communities

Example: Medical Data Mining

- Health care & medical data mining – often adopted such a view in statistics and machine learning
- Preprocessing of the data (including feature extraction and dimension reduction)
- Classification or/and clustering processes
- Post-processing for presentation

Summary

- Data mining: discovering interesting patterns from large amounts of data
- A natural evolution of database technology, in great demand, with wide applications
- A KDD process includes data cleaning, data integration, data selection, transformation, data mining, pattern evaluation, and knowledge presentation
- Mining can be performed in a variety of information repositories
- Data mining functionalities: characterization, discrimination, association, classification, clustering, outlier and trend analysis, etc.

References

- PAKDD (1997), PKDD (1997), SIAM-Data Mining (2001), (IEEE) ICDM (2001), etc.
- Conferences: ACM-SIGKDD, IEEE-ICDM, SIAM-DM, PKDD, PAKDD, etc.
- Journal: Data Mining and Knowledge Discovery, KDD Explorations
- Conferences: ACM-SIGMOD, ACM-PODS, VLDB, IEEE-ICDE, EDBT, ICDT, DASFAA
- Journals: ACM-TODS, IEEE-TKDE, JIIS, J. ACM, etc.
- Conferences: Machine learning (ML), AAAI, IJCAI, COLT (Learning Theory), etc.
- Journals: Machine Learning, Artificial Intelligence, etc.
- Conferences: Joint Stat. Meeting, etc.
- Journals: Annals of statistics, etc.
- Conference proceedings: CHI, ACM-SIGGraph, etc.
- Journals: IEEE Trans. visualization and computer graphics, etc.