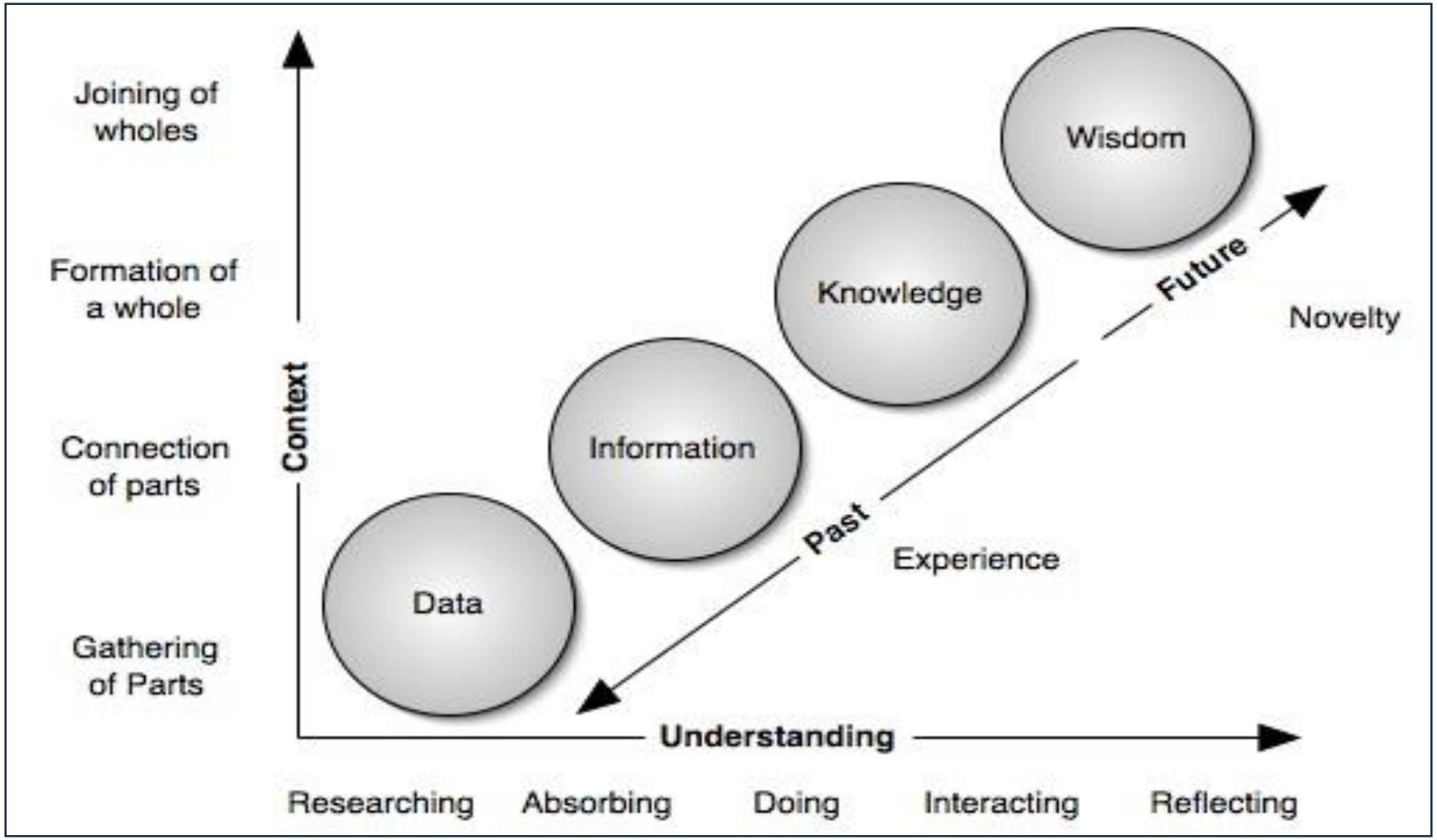
Agenda

- **Housekeeping**
- **Lecture 1 :**
  - **Intro to data Mining**
  - **Intro to Probability**
- **R down loads**

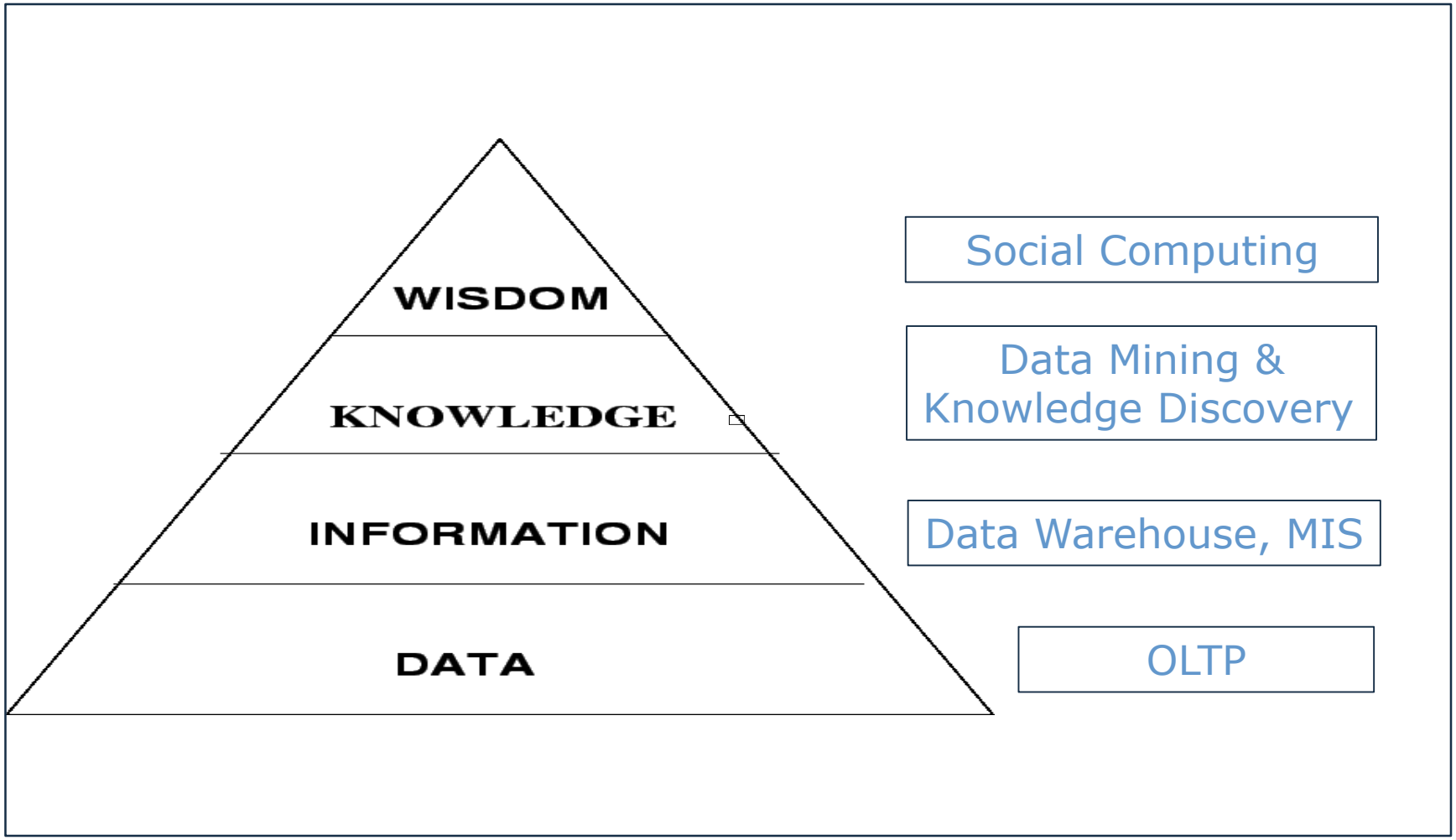
Definitions

- Data
  - Representations of Facts
- Information
  - Data with “Relevance and Importance”
  - Data that changes the probability of a relevant outcome.
- Knowledge
  - Ability to use information to act (or not), in order to achieve objectives.
- Wisdom
  - Ability to synthesize information and knowledge, to create a framework for optimal actions.

What are Data, Information, Knowledge, & Wisdom?



Support Systems In a Typical Organization



Evolution of Technology

- **1960s**
  - **Data collection, database creation, IMS and network DBMS**
- **1970s:**
  - **Relational data model, relational DBMS implementation**
- **1980s:**
  - **RDBMS, advanced data models (extended-relational, OO, deductive, etc.)**
  - **Application-oriented DBMS (spatial, scientific, engineering, etc.)**
- **1990s:**
  - **Data mining, data warehousing, multimedia databases, and Web databases**
- **2000s**
  - **Stream data management and mining**
  - **Data mining with a variety of applications**
  - **Web technology and global information systems**

Data Explosion Problem ("Big" Data)

- Yahoo generates mountains of data daily.
- NASA Earth Observing System (EOS) is projected to generate 50GB of image data hourly.
- Wal-Mart built an 11-Tbyte database of customer transactions (on 700M unique store/item product combinations, 2,900 stores, 52 weeks/year).
- 3.6 Zettabytes (ZB = 10^21 bytes) of data were consumed by individuals in the U.S. in 2008.

How much is 3.6 zettabytes? **If we printed 3.6 zettabytes of text in books, and stacked them as tightly as possible across the United States including Alaska, the pile would be 7 feet high**

Data Explosion Problem ("Big" Data)

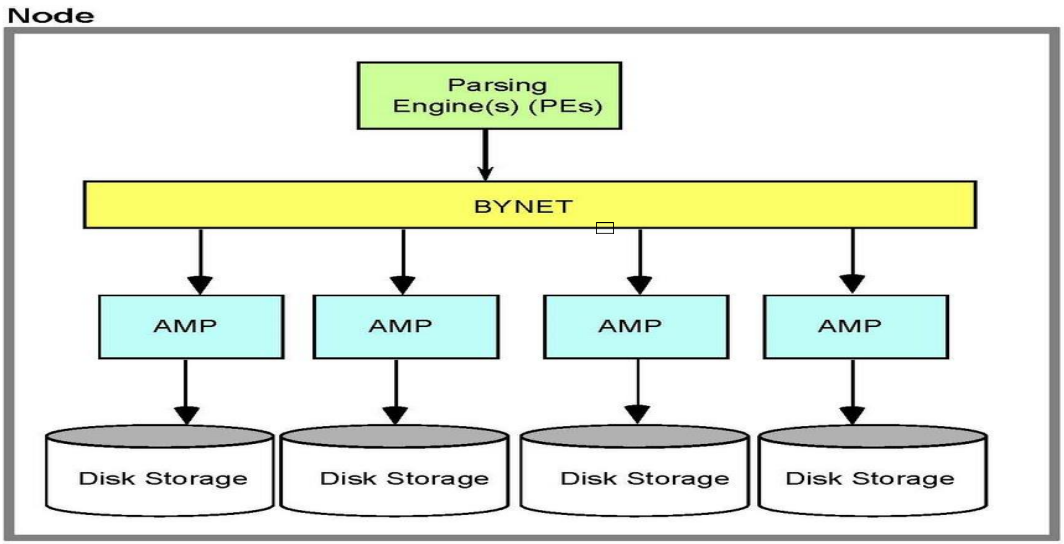
The AT&T Network Handles:

- 2.7 Zetabytes of data exist in the digital universe today.[1]
- 235 Terabytes of data has been collected by the U.S. Library of Congress in April 2011.
- The Obama administration is investing $200 million in big data research projects.[2]
- IDC Estimates that by 2020,business transactions on the internet- business-to-business and business-to-consumer – will reach 450 billion per day.[3]
- Facebook stores, accesses, and analyzes 30+ Petabytes of user generated data.[4]
- [1] MarTech – Big Data Brings Marketing Big Numbers, [2, 4,] Wikibon – Taming Big Data, [3] Wikibon – The Rapid Growth in Unstructured Data Research

How to Get Information Out of "Big" Data

New Data Warehouse Architectures

Major Components of a Teradata System



How to Get Knowledge Out of "Big" Data

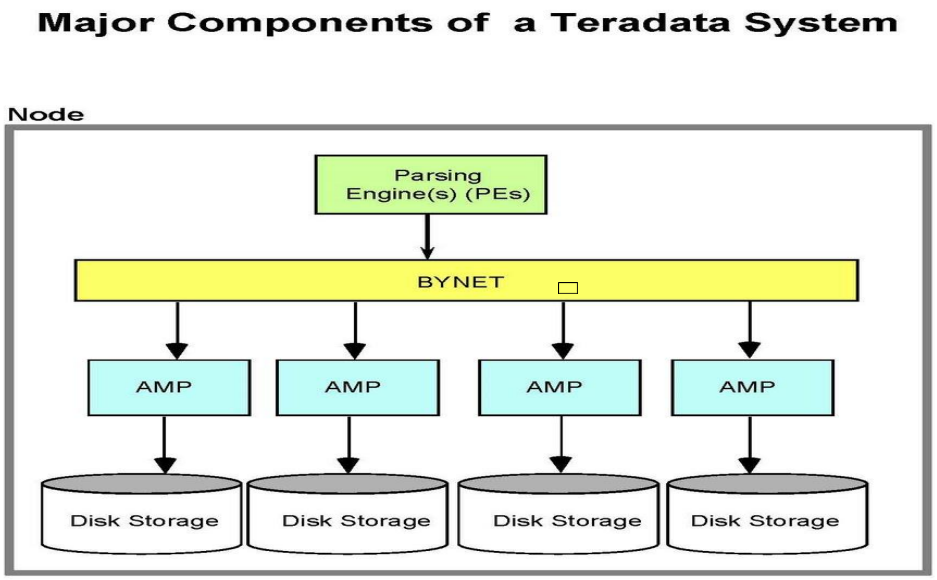
There is a need for a new generation of techniques with the ability to *intelligently and automatically* assist humans in analyzing 'mountains' of data for nuggets of useful knowledge (and not just information).

This has led to an emerging field:

Data Mining & Knowledge Discovery (DM & KD)

How to Get Knowledge Out of "Big" Data

Equip the Data Warehouse with Intelligent Algorithms



What is Data Mining & Knowledge Discovery ?

DM & KD Mean Different Things to Different Professionals

- Management: Potentially money making tools
- Computer Scientists: A new Knowledge Discovery breakthrough - NOT STATISTICS
- Statisticians: Not statistically, significantly, new - A computerized statistician
- Electrical Engineers: Another application of Information Theory and Entropy
- Neuroscientists: Neurocomputer - a computer model of the human brain
- Mathematicians: Some weighted average of a bunch of numbers

Data Mining & Knowledge Discovery

- Underlying Disciplines

  Biology, Neurology, Psychology, Statistics, Computer Science, Engineering

- Artificial Intelligence (AI)

  Integrates the "Underlying Disciplines" for solving various types of problems

- Techniques

  – Symbolic: *Rules Based Systems (RBS)*, *Case-Based Reasoning (CBR)*, *Fuzzy Logic (FL)*

  – Connectionist: *Artificial Neural Networks (ANN)*

  – Inductive (ML): *C4.5*, *CART*

  – Evolutionary: *Genetic Algorithms (GA)*

What is Data Mining & Knowledge Discovery?

The non-trivial ***process*** of identifying ***valid***, ***novel***, potentially ***useful***, and ultimately ***understandable*** patterns in data.

-- ***Fayad, Shapiro, Smyth (1996)***

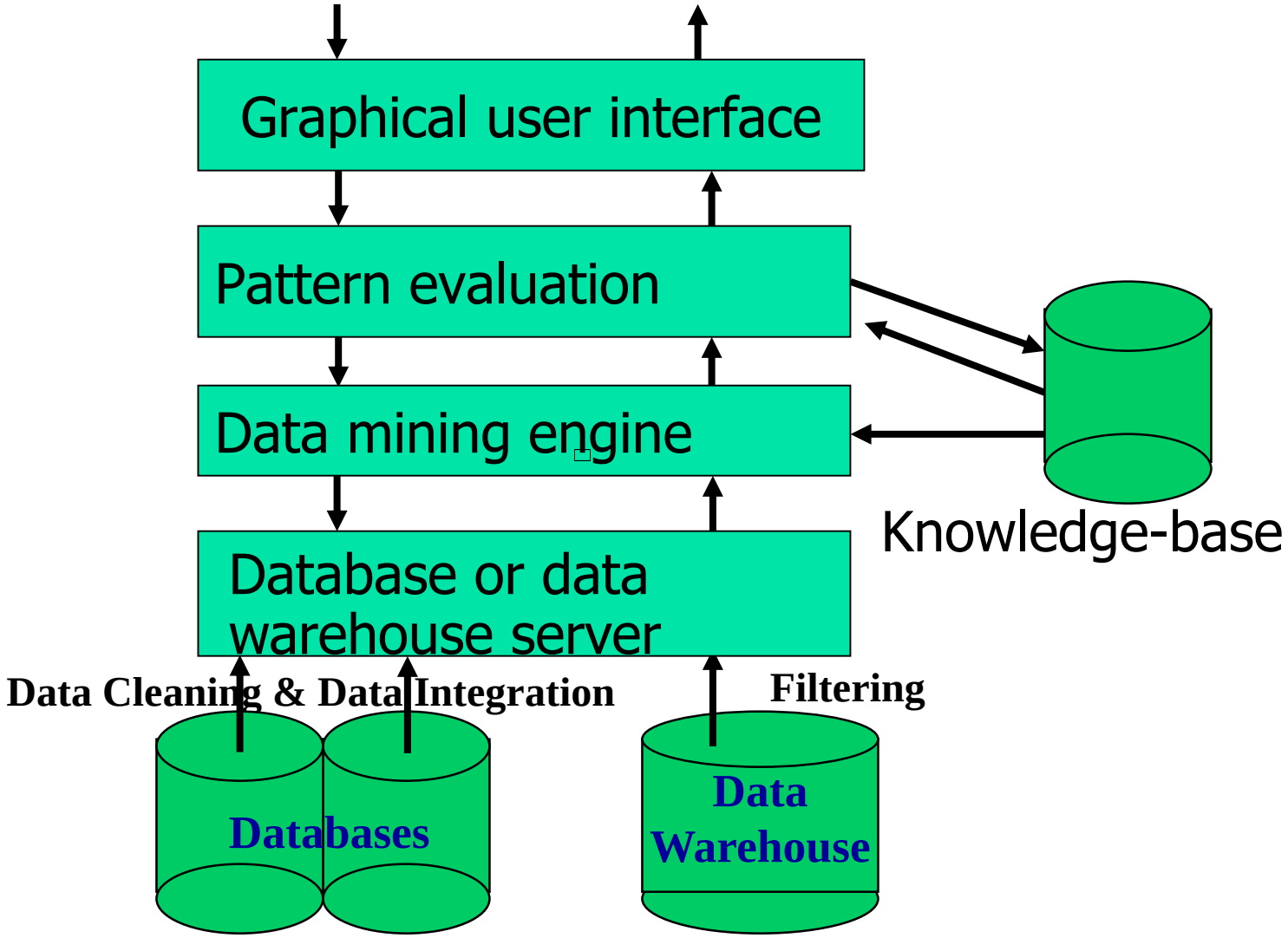
- ***process:*** knowledge discovery is iterative, as you uncover "nuggets" in the data, you learn to ask better questions
- ***valid:*** generalize to the future
- ***novel:*** not something we already know
- ***useful:*** actionable, can be used for a task
- ***understandable:*** process leads to human insight

What is Data Mining & Knowledge Discovery ?

The New York Times:

Data mining has entered a golden age, whether being used to set ad prices, find new drugs more quickly or fine-tune financial models. Companies as diverse as Google, Pfizer, Merck, Bank of America, the InterContinental Hotels Group and Shell use it.

Architecture: Typical Data Mining System



DM & KD Process: End-to-End Solution

- Pose a Profound Question
- Identify Relevant Data
- Access the Data
- Clean the Data
- Transform & Integrate the Data
- Mine/Discover Knowledge
- Make Intelligent Decisions