

4.1: Introduction to Data and Databases

You've already learned about the first two components of information systems: hardware and software. However, these alone do not make a computer useful. Imagine turning on your computer and typing up a document, but being unable to save it. Or opening your music app, only to find no music available to play. Or opening a web browser, but finding no web pages to browse.

To gain a competitive advantage, companies have two methods of control: increasing efficiency through cost savings or increasing profits by providing new solutions that meet customer needs. To increase efficiency, companies need to allow employees to share relevant data. This facilitates timely decision-making and standardizes the process of submitting time cards for payroll. To meet customer demands, marketing, and manufacturing must have access to real-time inventory levels. To understand customer preferences and buying patterns, companies must keep track of trends and collect data on what customers are buying, when, and how. To achieve these goals, companies must standardize their processes, store data in a common location accessible to appropriate personnel, and collect customer data for analysis.

Businesses need to gather data and information on their procedures, staff, clientele, suppliers, and other relevant data and organize it to maximize efficiency and effectiveness across all employee levels. Without data, hardware and software are not very useful! This chapter will discuss data, the third component of an information system, and how it is organized. Data collection and utilization are crucial to the business models of many modern companies, enabling real-time decision-making and a competitive edge.

? Use Case Example 4.1.1

Uber wants to:

1. Predict which areas are of high demand to direct more drivers to those areas
2. Analyze average pickup times to improve processes
3. Adjust surge pricing dynamically based on demand
4. Plan a campaign to recruit drivers
5. Build an Artificial Intelligence model to forecast future demands

What data should Uber collect?

Answer

Uber can collect the following data from the Uber app used by customers and drivers.

- Number of active drivers
- Driver locations
- Request locations and times
- Historical request patterns

After gathering the necessary data, Uber can thoroughly analyze and combine it to detect trends and acquire valuable information that can help enhance customer satisfaction, increase driver productivity, adjust the pricing accordingly, and introduce new services.

Data, Information, Knowledge, and Wisdom

In everyday life, we use these terms interchangeably. However, to organize data effectively, we need to clearly differentiate these four terms: data, information, knowledge, and wisdom and how they relate to each other.

Figure 4.1.1 shows four circles; each is larger, encompassing the previous one, labeled from the innermost to the outermost circle: data, information, knowledge, and wisdom. Wisdom sits at the top, enclosing the other foundation of knowledge, information, and raw data. Each layer provides more meaning and capability.

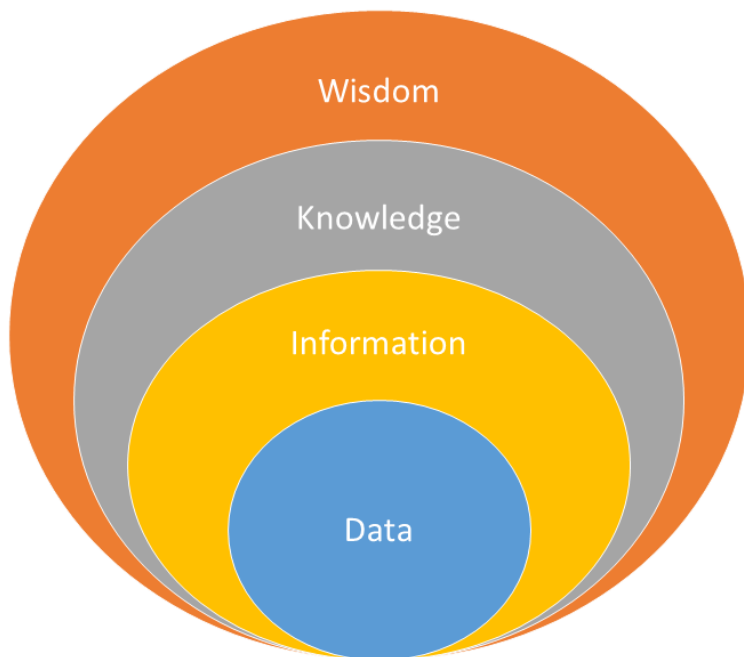


Figure 4.1.1: From Data to Wisdom. Image by Ly-Huong Pham, is licensed under [CC BY](#)

Data consists of discrete facts and observations that are not disputable facts. Data leads to information when it is organized in a meaningful way that give more context. Information leads to knowledge when there is a recognized pattern, a cause and effect, or insights from prior experience. Knowledge leads to wisdom when a person exercises good judgment, foresight, and balanced perspective when making a decision.

The two highest levels of data are quantitative or qualitative. To know which to use depends on the question to be answered and the available resources. Quantitative data is numeric, the result of a measurement, count, or some other mathematical calculation. A quantitative example would be how many 5th graders attended music camp this summer. Qualitative data consist of words, descriptions, and narratives. A qualitative example would be a camper wearing a red tee-shirt. A number can be considered qualitative as well. If I tell you my favorite number is 5, that is qualitative data because it is descriptive, not the result of a measurement or mathematical calculation.

When using qualitative data and quantitative data, we need to understand the context of its use. There are advantages and disadvantages to each. This table encapsulates the advantages and disadvantages when gathering data.

Qualitative Data

| Advantages | Disadvantages |
|--|---|
| <ul style="list-style-type: none"> • Can give a nuanced understanding of the perspectives and needs of program participants • Can help support or explain results indicated in quantitative analysis • Source of detailed or “rich” information that can be used to identify patterns of behavior | <ul style="list-style-type: none"> • May lend itself to working with smaller populations; may not be representative of larger demographics • Data analysis can be time-consuming • Analysis can be subjective; there is potential for evaluator bias in analysis and collection. |

Quantitative Data

| Advantages | Disadvantages |
|------------|---------------|
| | |

| Advantages | Disadvantages |
|---|---|
| <ul style="list-style-type: none">• Clear and specific• Accurate and reliable if properly analyzed• It can be easily communicated as graphs and charts• Many large datasets already exist that can be analyzed | <ul style="list-style-type: none">• Data collection methods provide respondents with a limited number of response options• Can require complex sampling procedures• May not accurately describe a complex situation• Some expertise with the statistical analysis required |

By itself, data is a collection of components waiting to be analyzed. To be useful, it needs to be given context. Users and designers create meaning by collecting, referencing, and organizing the data. Information typically involves manipulating raw data to indicate magnitude, trends, and patterns in the data for a purpose. Returning to the example above, if I told you that “15, 23, 14, and 85” are the numbers of students that had registered for an upcoming camp, that would be information. By adding the context – that the numbers represent the count of students registering for specific classes – I have added context to data which now is information. Information is data that has been analyzed, processed, structured, and avails itself to be useful.

Once we collect and understand the data, we put it into context, aggregate it, and analyze it. We then have information and can use it to make decisions for the individual and our organization. We can say that this consumption of information produces knowledge. Knowledge can be viewed as information that facilitates action. This knowledge can be used to make decisions, set policies, and spark innovation.

The final step up the information ladder is the step from knowledge (knowing a lot about a topic) to wisdom. Wisdom is experience coupled with understanding and insight. We can say that someone has wisdom when combining their knowledge and experience to produce a deeper understanding of a topic. It often takes many years to develop wisdom on a particular topic and requires patience and expertise.

✓ Use Case Example 4.1.1

Here's an example of the progression from data to wisdom in Alice's daily life context

Solution

Data:

- Alice's car makes loud grinding noise when brakes applied
- Checking account balance is \$125
- Alice's paycheck on Friday is \$500

Information:

- Brake pads likely need replacement from worn brake sound
- Low checking account balance currently

Knowledge:

- From experience, knows brake jobs cost ~\$300 at mechanic
- Paychecks come every 2 weeks so cashflow fluctuates

Wisdom:

- Waits to schedule brake replacement next Friday after paycheck
- Plans ahead for car maintenance by budgeting money each month
- Starts emergency fund for unexpected expenses

In this case, the discrete or raw facts like noises and balances become meaningful when organized as information. Alice used prior knowledge to interpret the costs of repairs. Wisdom was applied to make financial decisions, aligning short-term needs with long-term planning.

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