جامـــــعة المـــــستـقبـل
AL MUSTAQBAL UNIVERSITY

كلية العـــــــلوم
قـســـــــم علوم الذكاء الاصطناعي

LECTURE: (4)

Subject: Data-Information-Knowledge (DIK Hierarchy)
Level: First
Lecturer: Dr. Hussein Al-Zaidy

Data Information Knowledge

The terms “data,” “information,” and “knowledge” are often used interchangeably. However, it’s important to recognize that these terms hold distinct meanings. One might wonder, “Why be so precise about terminology? What difference does it make?” Well, a clear understanding of these terms is essential for effective knowledge management within an organization. Once we establish precise definitions for these concepts and understand their relationships, we can grasp their implications and their significance in organizational processes.

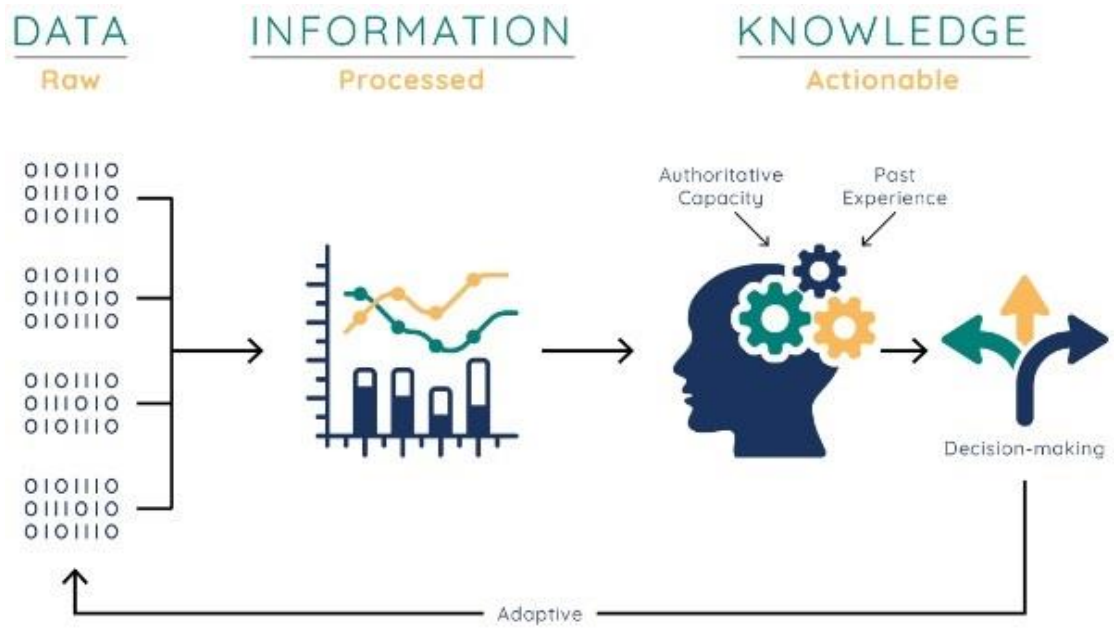
Accordingly, we need to distinguish between the data, information, and knowledge.

Data: are the raw alphanumeric values obtained through different acquisition methods. Data in their simplest form consist of raw alphanumeric values.

Information: is created when data are processed, organized, or structured to provide context and meaning. Information is essentially processed data.

Knowledge: is what we know. Knowledge is unique to each individual and is the accumulation of past experience and insight that shapes the lens by which we interpret, and assign meaning to, information. For knowledge to result in action, an individual must have the authority and capacity to make and implement a decision. Knowledge (and authority) are needed to produce actionable information that can lead to impact.

The flow and characteristics of these terms are illustrated in next figure and Table.



Data	Information	Knowledge
Is objective	Should be objective	Is subjective
Has no meaning	Has a meaning	Has meaning for a specific purpose
Is unprocessed	Is processed	Is processed and understood
Is quantifiable, there can be data overload	Is quantifiable, there can be information overload	Is not quantifiable, there is no knowledge overload

If we talk about the sequence of operations, the following figure shows the sequence of these terms:

Finally, the next example indicates how is the data becomes information, and then to be knowledge.

Example

Looking at the examples given for **data**:

- 3, 6, 9, 12
- cat, dog, gerbil, rabbit, cockatoo
- 161.2, 175.3, 166.4, 164.7, 169.3

Only when we assign a context or meaning does the data become **information**. It all becomes meaningful when we are told:

- 3, 6, 9 and 12 are the first four answers in the 3 x table
- cat, dog, gerbil, rabbit, cockatoo is a list of household pets
- 161.2, 175.3, 166.4, 164.7, 169.3 are the heights of the five tallest 15-year-old students in a class.

If we now apply this information to gain further **knowledge** we could say that:

- 4, 8, 12 and 16 are the first four answers in the 4 x table (because the 3 x table starts at three and goes up in threes the 4 x table must start at four and go up in fours)
- The tallest student is 175.3cm.
- A lion is not a household pet as it is not in the list and it lives in the wild.

Deeper comparison

1. *Data*

Data are raw facts and figures with no fundamental meaning. Data plainly reports part of a situation without providing an interpretation. It is an unprocessed form of knowledge that doesn't convey value or significance. For data to have some useful meaning, it has to be organized, analyzed and interpreted. In the context of an organization, "data are most usefully described as structured records of transactions."

Data can be:

Quantitative: when data can be counted or measured like cost, weight, and volume.

Qualitative: when data describes things like name, color, and shape.

Here are a few examples of data:

- A spreadsheet containing sales figures.
- A database with customer information.
- Temperature readings from a weather station.
- GPS coordinates from a mobile device.

2. Information

On the other hand, information is processed data. It is organized, classified, structured and provides meaningful and useful context. In contrast to data, information has meaning. "Data becomes information when its creator adds meaning. We transform data into information by adding value in various ways." Here are several important processes that convert data to information:

I- Calculation: data are mathematically or statistically scrutinized.
II- Categorization: data are sorted into groups or classes.
III- Condensing: summarizing data to be more concise.
IV- Contextualizing: gathering data for a purpose.
V- Correcting: editing errors out from the data.

Some examples of information include:

- A sales report highlighting top-selling products.
- An article summarizing research findings.
- A graph showing the correlation between two variables.

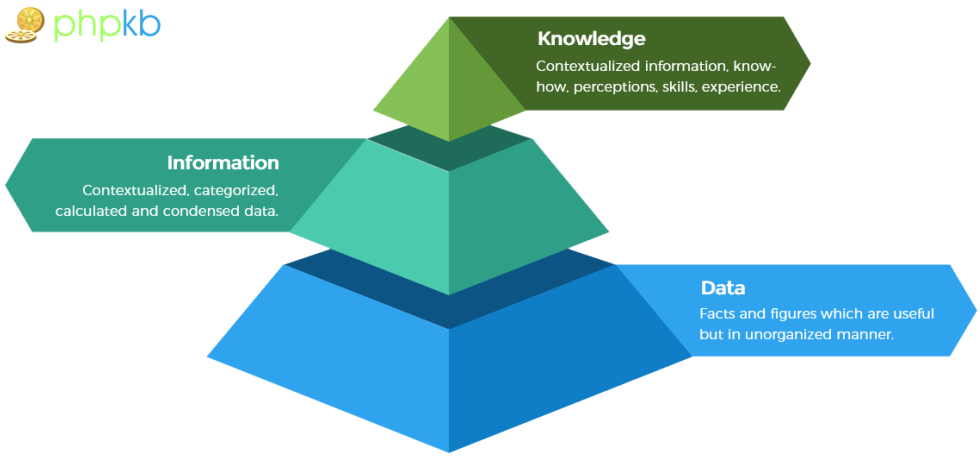
3. Knowledge

Davenport and Prusak proposed a working definition of knowledge framed in a practical sense of organizational knowledge that it is "broader, deeper and richer than data or information":

Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms.

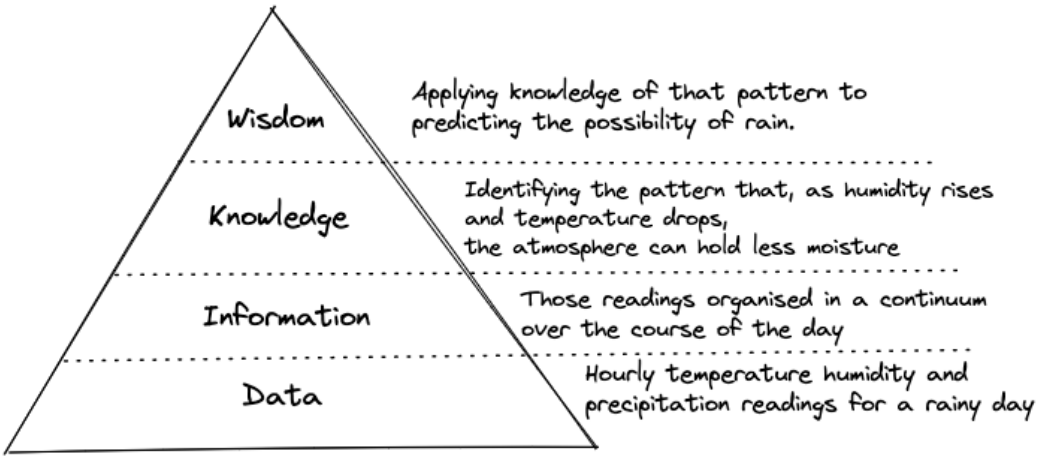
Examples of knowledge include:

- A doctor diagnosing and treating a patient based on their symptoms.
- A chef creating a new recipe by combining different ingredients and cooking techniques.
- A lawyer using legal precedents to argue a case in court.
- Customer support utilizing the company processes and procedures to answer a client question.



Another taxonomy

Another taxonomy represented by adding wisdom to the data, information and knowledge. The fourth and new item is the wisdom as shown in the nest figure.



The wisdom is defined as applying the knowledge of the pattern to predict a new possibility.

Data vs Information: Compare and Contrast

1. ***Context Matters***

Data: Typically lacks context. It represents mere facts, like ’10’, ‘blue’, or ‘A’.

Information: Has context and is meaningful. For instance, “The sky is blue today” is a piece of information derived from processing the data: ‘sky’ and ‘blue’.

2. ***The Role of Value***

Data: On its own, data might not have direct significance or value until processed.

Information: Possesses inherent value because it aids in decision-making, understanding, or knowledge derivation.

3. ***Purpose***

Data: Serves as the foundation or input for deriving information.

Information: Used for making decisions, insights, or forming knowledge.

4. ***How They’re Represented***

Data: Can be represented as numbers, symbols, or characters.

Information: Usually represented in a form that's interpretable by humans, such as reports, images, sounds, or explanations.

5. Dependency On Other Factors

Data: Independent.

Information: Derived from data.

6. Structure of Data and Information

Data: Often scattered and can be messy until organized.

Information: Structured and organized, making it easier to understand and interpret.

Data Management

- ⊕ Data Storage & Retrieval: Knowledge management software allows users to store and access large volumes of data in a structured and organized manner. It typically provides features such as databases, data warehouses, and search capabilities to ensure quick and easy retrieval of specific data.
- ⊕ Data Integration: Knowledge management software enables the integration of data from disparate sources. It can consolidate data from various systems or databases, providing a unified view of information for users.
- ⊕ Data Security: Knowledge management software often incorporates robust security measures to protect sensitive data - Encryption: Data can be encrypted to prevent unauthorized access and ensure confidentiality. Access Control: Users can be granted specific permissions and access levels to control who can view, modify, or delete data.

- Audit Trails: Knowledge management software may include audit trail functionality, allowing organizations to track and monitor data access and changes for compliance and security purposes.

Information Management

- Knowledge Base Creation: Knowledge management software enables the creation of a centralized knowledge base where information can be stored, organized, and shared. This helps teams access relevant information and ensures consistency and accuracy in information dissemination.
- Collaboration Tools: Knowledge management software often includes collaboration features such as document sharing, commenting, and version control. These tools facilitate teamwork and enable continuous collaboration on information, allowing teams to work together effectively.
- Knowledge Capture: Knowledge management software offers features for capturing, sharing and documenting tacit knowledge, which is the knowledge that resides in people's minds. This ensures that valuable knowledge is not lost when individuals leave an organization or retire.
- Search and Retrieval: With the vast amount of information available, knowledge management software offers robust search capabilities, allowing users to quickly find the information they need. This can save time and improve productivity.
- Knowledge Sharing and Distribution: Knowledge management software facilitates the sharing and distribution of information within an organization. It enables employees to easily share their expertise and best practices, leading to better decision-making and problem-solving.
- Metadata Management: Knowledge management software allows users to manage metadata associated with information. Metadata includes information such as the

author, date created, keywords, and tags, which helps in organizing and categorizing information effectively.

Explicit, Implicit, and Tacit Knowledge

Explicit Knowledge

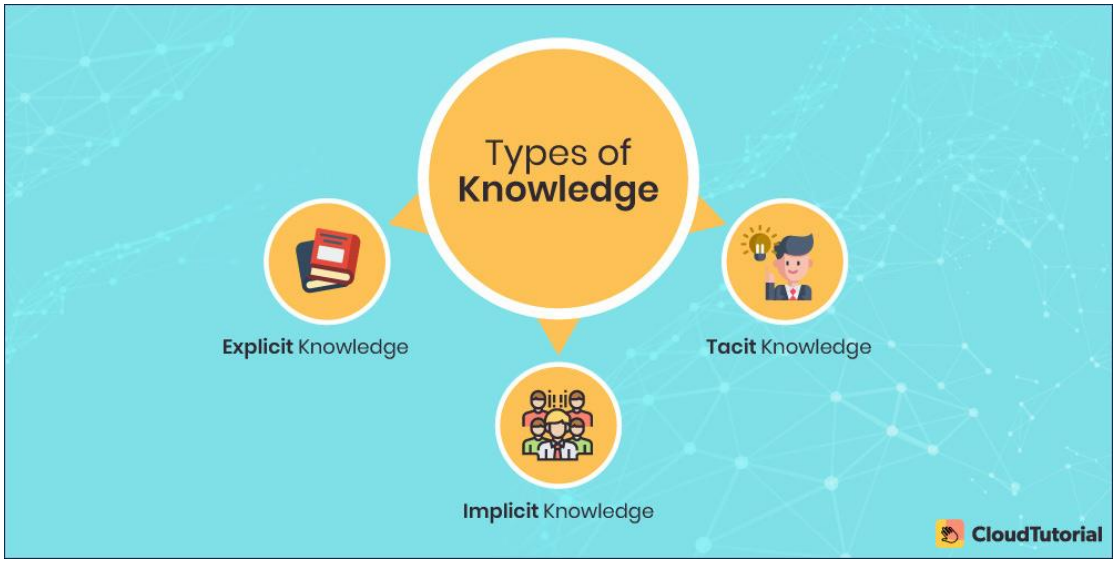
Explicit knowledge is knowledge that is easily expressed, communicated and captured in text documents, diagrams, illustrations, and product specifications among other things. Examples of explicit knowledge includes scientific formulas, computer programs, industry standards, and company best practices. It is "formal and systematic knowledge".

Implicit Knowledge

On the other hand, implicit knowledge is displayed knowledge that can be captured. A simple example would be someone performing a task and how they execute that task is a display of implicit knowledge. Identifying and capturing that implicit knowledge can turn it into explicit knowledge that can be used across similar tasks.

Tacit Knowledge

Tacit knowledge is less tangible and more difficult to articulate and transfer. It is knowledge in the form of individual skills, wisdom, experience and ideas. Unlike explicit knowledge, tacit knowledge is usually passed on through exhaustive exposure to and continuous practice with the person of knowledge. Everyday life examples include language and intuition – knowledge that is harder to systematize or automate.



Knowledge management

Knowledge management frameworks include:

- Recognizing Knowledge Needs: thinking about knowledge assets at your organization, and the ways they are actually used for your operation.
- Identifying Knowledge Resources: finding where your knowledge comes from, for instance individual skill and experience, project-driven information, procedural knowledge, internal processes, market research findings, customer feedback, and community knowledge.
- Gathering Disparate Knowledge: deciding on the best KM tools to collect scattered or siloed information, which includes actively asking employees about their routine processes and including everyone in the knowledge management process.
- Storing and Refining Knowledge: how knowledge is held, but also assessing what knowledge is actually worth keeping. Examples are centralized knowledge management tools, company wiki, learning management system (LMS), customer relationship management (CRM) system, and community forum.

- Retrieval and Distribution of Knowledge: how employees or customers can get the knowledge you've gathered. Examples are training programs, messaging apps (Slack, MS Teams), content management systems (CMS), webinars, intranets, and supporting software.

Practical Use of Knowing the Terms

Why did we have to go in depth with all the different terminologies? It all comes down to effectively identifying what to capture, share and transfer within your company. Understanding what data, information, knowledge and the types of knowledge are is fundamental to driving your organization's success.

Recognizing the precise definitions of data, information, and knowledge, as well as the types of knowledge (explicit, implicit, tacit, declarative, and procedural), has practical implications for organizations. It enables them to make informed decisions about what to capture, share, and transfer.

By distinguishing between data, information, and knowledge, organizations can streamline their processes and workflows. For instance, data can be efficiently collected and transformed into meaningful information, and this information can then serve as the basis for knowledge creation and sharing.

Moreover, understanding the types of knowledge empowers organizations to identify areas where explicit knowledge can be documented, making it accessible to all employees. It also sheds light on the importance of recognizing and leveraging implicit and tacit knowledge held by experienced personnel, ultimately leading to improved decision-making and problem-solving.