# Knowledgebase Systems
Introduction

Knowledge Progression

❑ **Data** is viewed as a collection of *disconnected facts*.

❑ **Information** emerges when *relationships among facts* are established and understood; Provides answers to *"who", "what", "where", and "when".*

❑ **Knowledge** emerges when *relationships among patterns* are identified and understood; Provides answers as *"how"*

❑**Wisdom (Experience)** understanding, uncovers the *principles of relationships that describe patterns*. Provides answers as *"why"*. determine what facts of knowledge are applicable at a specific situation.

➢ **Example** : It is raining.

➢ **Example :** The temperature dropped 15 degrees and then it started raining.

➢ **Example :** If the humidity is very high and the temperature drops substantially, then atmospheres is unlikely to hold the moisture, so it rains.

➢ **Example** : Encompasses understanding of all the interactions that happen between raining, evaporation, air currents, temperature gradients and changes.

Knowledge

▶ **Knowledge** is a progression that starts with *data* which is of limited utility.

❑ By organizing or analyzing the data, we understand what the data means,

▶ and this becomes *information*.

❑ The interpretation or evaluation of information yield *knowledge*.

❑ An understanding of the principles embodied within the knowledge
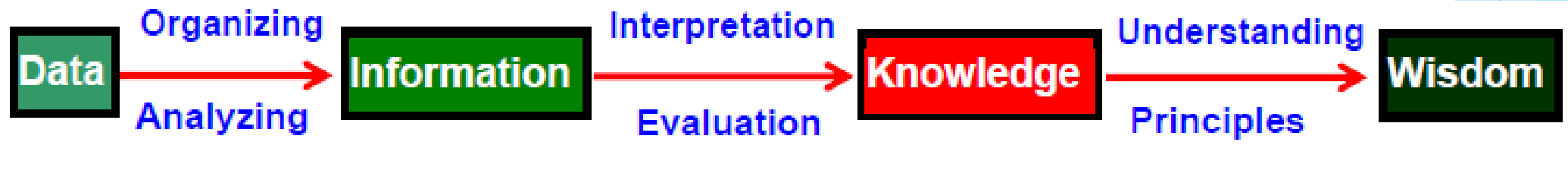
Convergence from data to intelligence
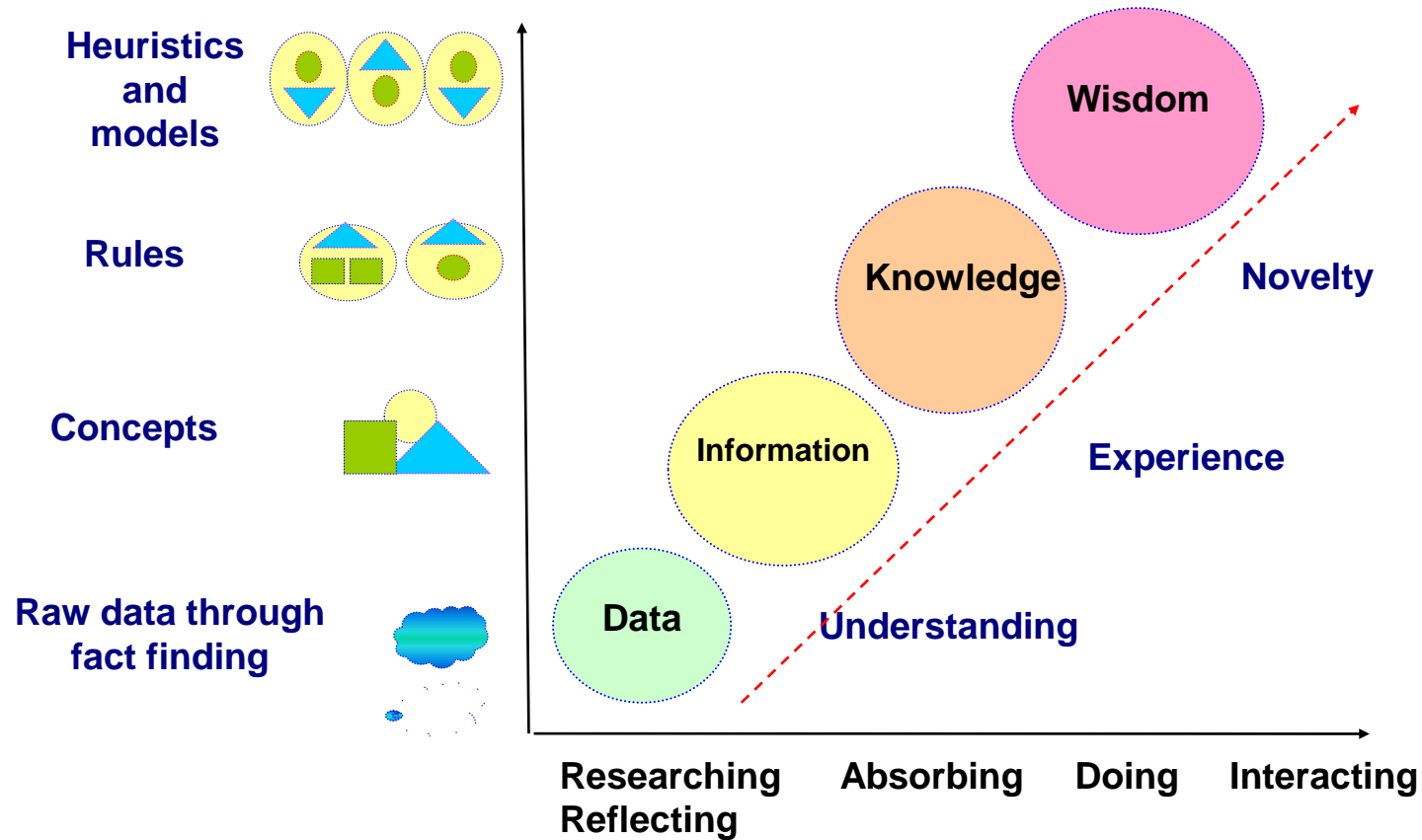
Knowledge Categories

Knowledge is categorized into two major types:

Tacit : informal type of knowledge.

Explicit: Formal type of knowledge.

Tacit

▶ Knowledge gained from personal experience that is more difficult to express.

▶ Exists within a human being.

▶ Is gained from personal experience and context.

▶ The most difficult to write down, articulate, or present.

▶ Difficult to communicate or share.

▶ Hard to steal or copy.

▶ Drawn from experiences and actions.

Knowledge Categories

Knowledge is categorized into two major types:

Tacit : informal type of knowledge.

Explicit: Formal type of knowledge.

Explicit

- Knowledge that is easy to articulate, write down, and share.
- Exists outside a human being.
- The most basic form of knowledge and is easy to pass along because it's written down and accessible.
- When data is processed, organized, structured, and interpreted, the result is explicit knowledge.
- Is easily articulated, recorded, communicated.
- Easy to steal or copy.
- Drawn from procedure, process and concepts.

Knowledge Types

| Procedural knowledge	Declarative knowledge
◇ Knowledge about *"how to do something"*; e.g., to determine if Peter or Robert is older, first find their ages.	◇ Knowledge about *"that something is true or false"*. e.g., A car has four tyres; Peter is older than Robert;
◇ Focuses on tasks that must be performed to reach a particular objective or goal.	◇ Refers to representations of objects and events; knowledge about facts and relationships;
◇ Examples *:* procedures, rules, strategies, agendas, models.	◇ Example *:* concepts, objects, facts, propositions, assertions, semantic nets, logic and descriptive models.

Relationship among types of knowledge
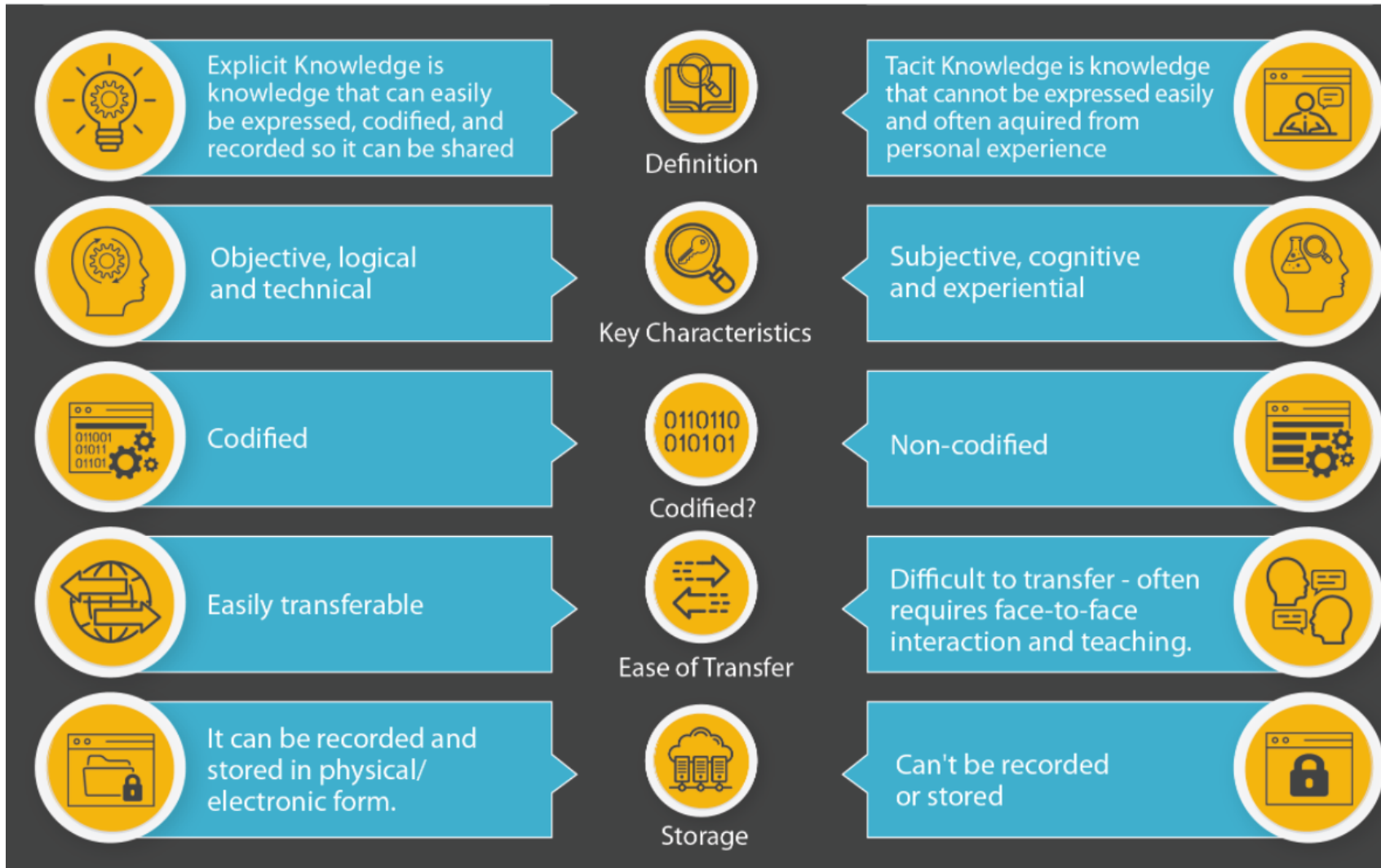
Relationship among types of knowledge
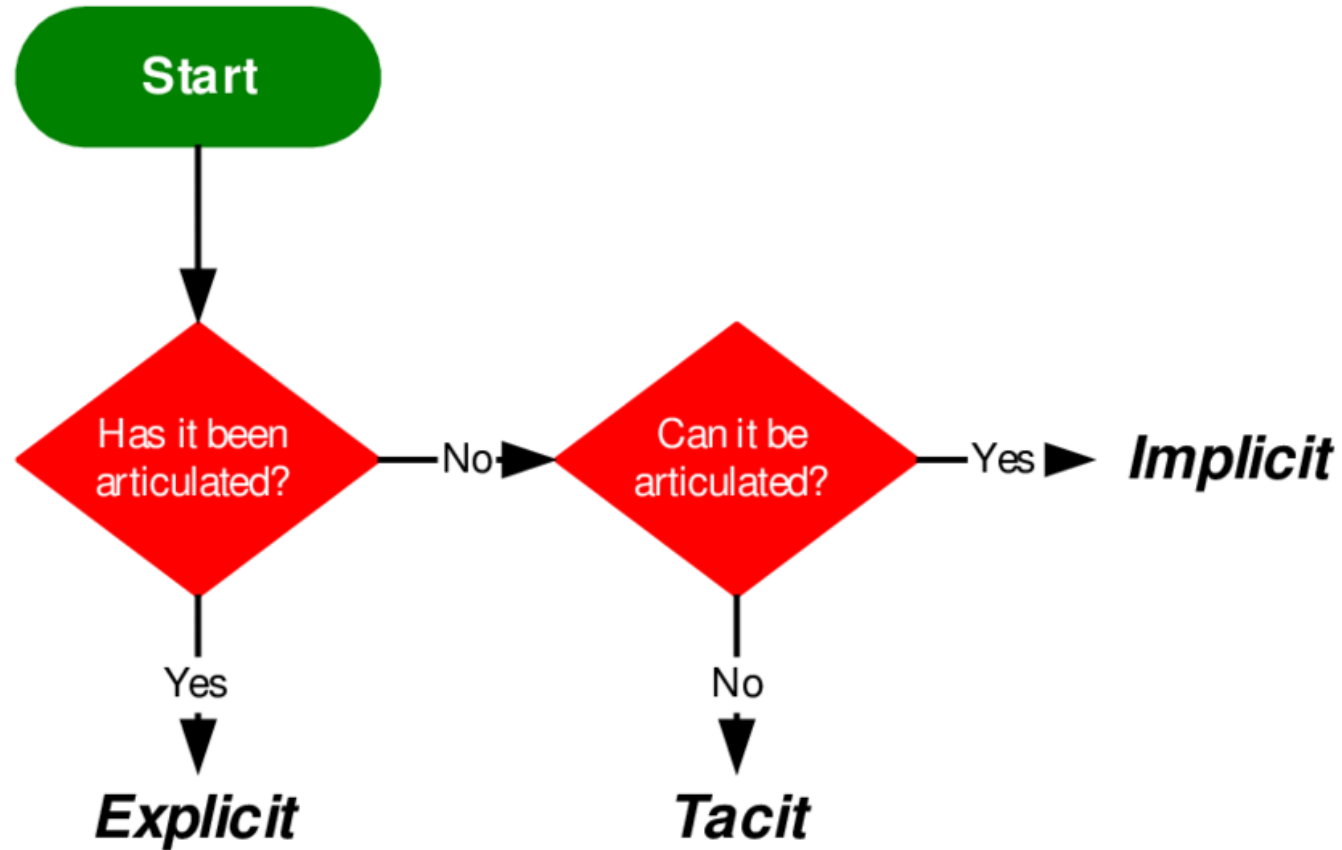
What is Knowledge based system?

▶ A KBS is a computer program that uses artificial intelligence to solve problems within a specialized domain that ordinarily requires human expertise.

▶ KBS is a more general than expert system.

▶ KBSs use explicit representations of knowledge in the form of words and symbols.

▶ These representations make the knowledge more easily and understood by a human than the numerically derived implicit models in computational intelligence.

▶ It is also called Cognitive System.

Tasks of KBS

▶ **Diagnosis:** to identify a problem given a set of symptoms.

▶ **Interpretation:** to provide an understanding of a situation from available information.

▶ **Prediction:** to predict a future state from a set of data or observations.

▶ **Design:** to develop configurations that satisfy constraints of a design problem.

▶ **Planning:** both short- and long-term planning in areas like project management, product development or financial planning.

Tasks of KBS

▶ **Monitoring:** to check performance exceptions. e.g., KBS monitors radar data and estimates the position of the space shuttle.

▶ **Control:** to collect and evaluate evidence and form opinions on the evidence. e.g., control patient's treatment.

▶ **Instruction:** to train students and correct their performance. e.g., give medical students experience diagnosing illness.

▶ **Debugging:** To identify and prescribe remedies for malfunctions. E.g., identify errors in an ATM network and ways to correct the errors.
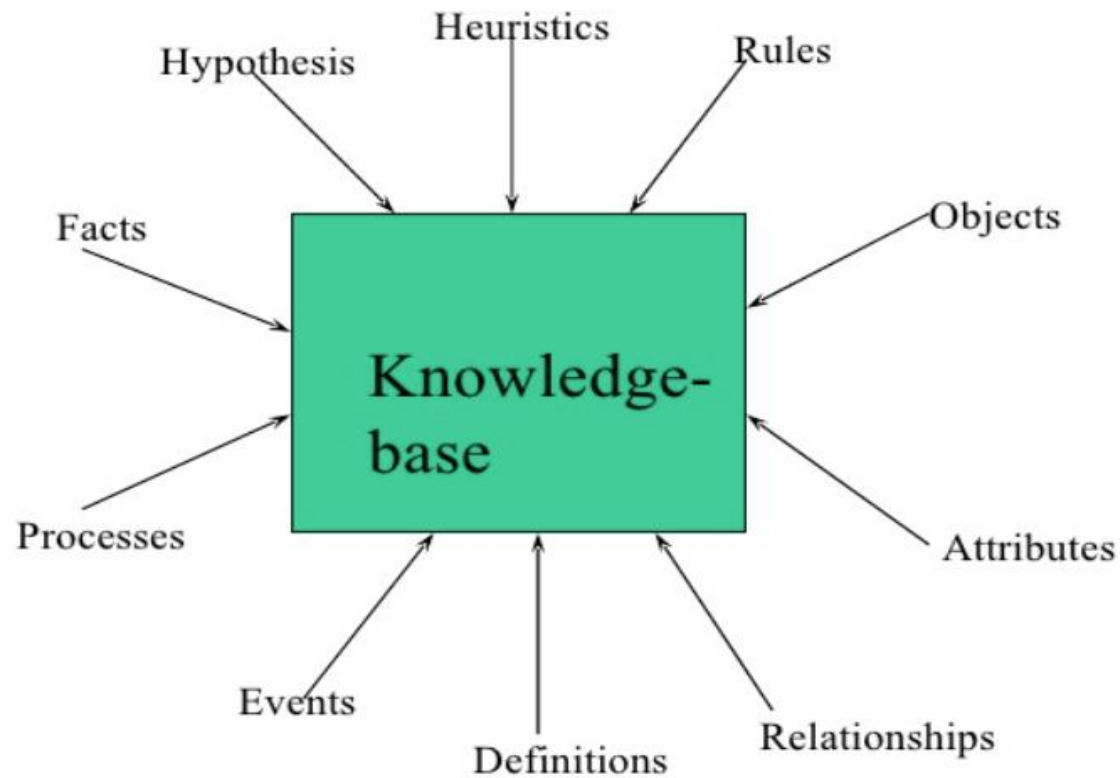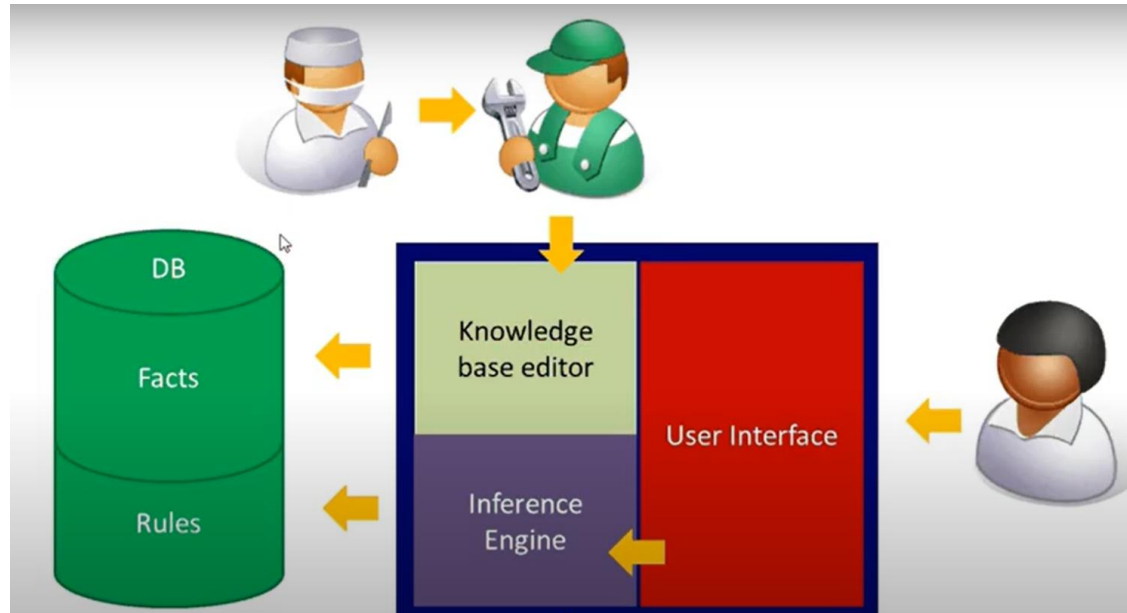
Components of KBS
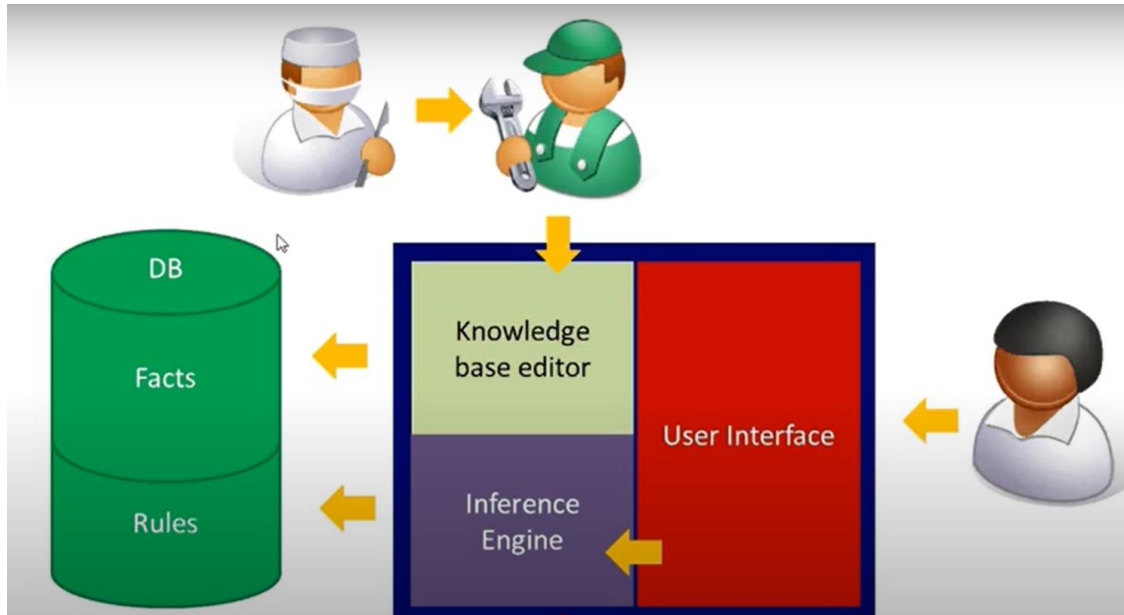
Knowledgebase:
➤ Contains essential information about the problem domain.
➤ Often represented as facts and rules.

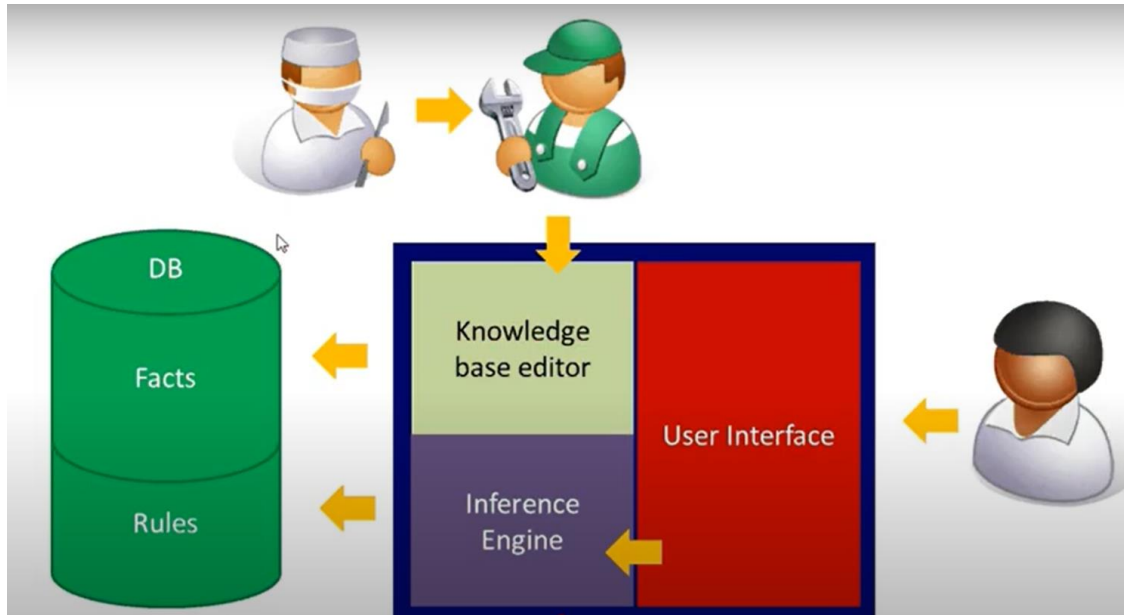# Kinds of knowledge in the knowledgebase

Components of KBS

Inference engine:
➢ Mechanism to derive answers and new knowledge from the knowledgebase and the information provided by the user.
➢ The brain of the KBS.
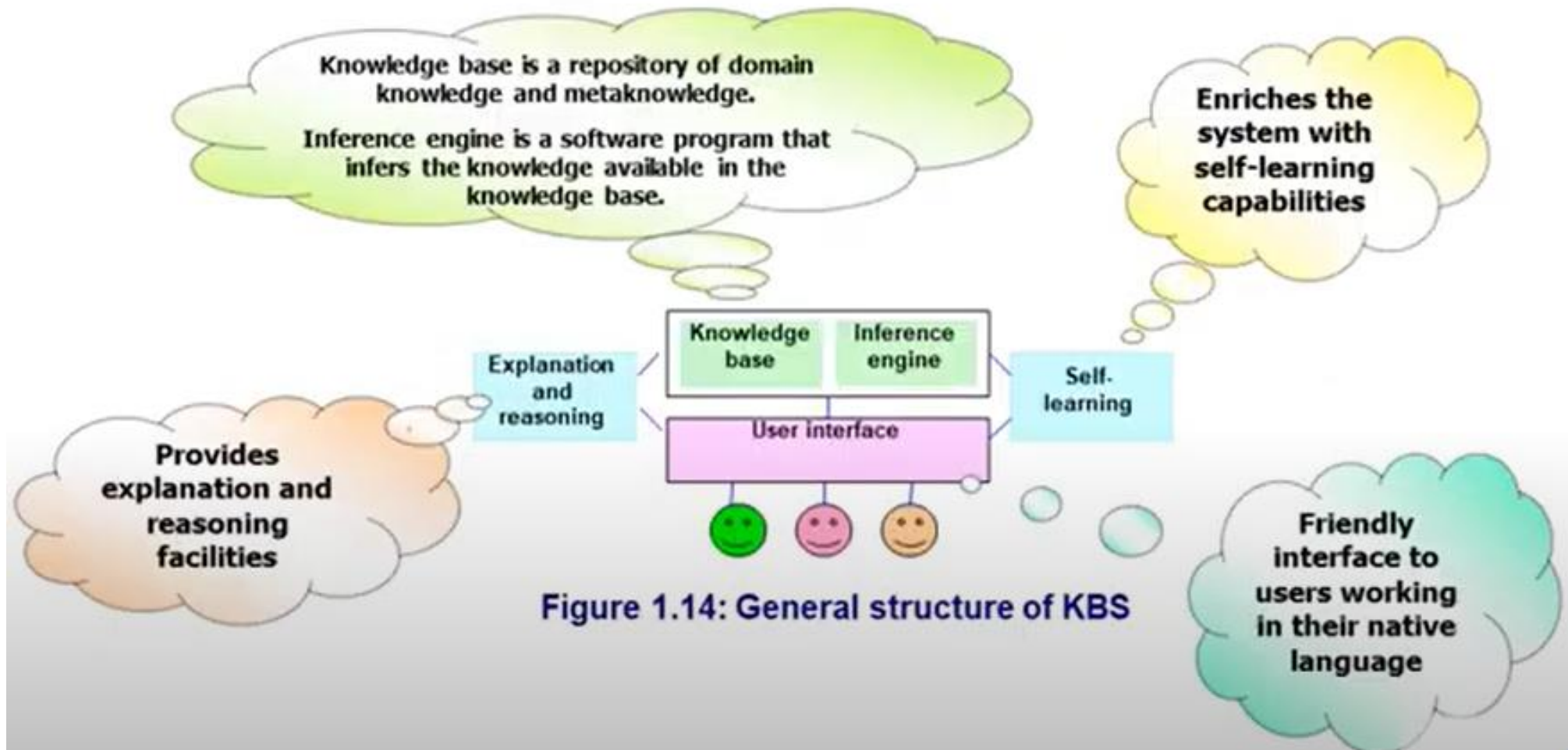➢ Often based on the use of rules.

Components of KBS

User interface:
➤ Interact with end users.
➤ Development and maintain of the knowledgebase.

Components of KBS

Knowledge base is a repository of domain knowledge and metaknowledge.

Inference engine is a software program that infers the knowledge available in the knowledge base.

Enriches the system with self-learning capabilities

Provides explanation and reasoning facilities

Explanation and reasoning

Knowledge base

Inference engine

Self-learning

User interface

Friendly interface to users working in their native language

Figure 1.14: General structure of KBS

General Concepts of KBS

knowledge acquisition: (knowledge elicitation)

– transfer of knowledge from humans to computers

– sometimes knowledge can be acquired directly from the environment (machine learning)

Knowledge representation: storing and processing knowledge in computers .

Inference: mechanism that allows the generation of new conclusions from existing knowledge in a computer

Explanation: illustrates to the user how and why a particular solution was generated.

Reasoning: is the ability of consciously making sense of things, establishing and verifying facts, applying logic, and changing or justifying practices, institutions, and beliefs based on new or existing information.

Learning: denotes changes in the system that enable the system to do the same task more effectively the next time.

Limitations of KBS

- Need to identify the tricks used by the expert.
- What if the knowledge engineer doesn't ask the right question?
- What if there is some unexpected data not accounted for?
- What if the knowledge changes?

Topics in KBS

- ✓ **Knowledge Representation**
  - Logic
  - Semantic Network
  - Frames
  - Production Rule
  - Case based reasoning

- ✓ **Reasoning and Inference**
  - Predicate Logic, Inference Methods
  - Reasoning with Uncertainty
  - Probability, Bayesian Decision Making
- ✓ **Rule-Based Systems (Expert System)**
  - Forward& backward chaining
  - Fuzzy Rule-Based Systems (Fuzzy Theory)