

Module – II: Intelligent Reasoning Systems

Components of intelligent System:

Hardware

- **Processor:** The central processing unit (CPU)
- **Memory:** The hard disk and other memory
- **Display devices:** Monitors and projectors
- **Input devices:** The keyboard and mouse
- **Sensing devices:** Sensors and scanners

Software

- **Machine learning (ML) algorithms:** Make predictions and decisions based on data analysis
- **Neural networks:** Model and solve complex tasks
- **Fuzzy logic:** Handles uncertainty in decision-making

Data

- **Sensors:** Collect data from the environment
- **Cameras:** Collect data from the environment
- **Internet:** Collect data from various sources

Learning

- **ML techniques:** Allow systems to adapt and improve their performance
- **Feedback and improvement:** Allow systems to learn from experience

Miscellaneous components

- **Algorithms:** Process and analyze data
- **Automation:** Reduces the need for human intervention
- **User interface (UI):** Allows an external agent to communicate with the system

Knowledge Based System

A knowledge-based system (KBS) is a program that captures and uses knowledge from a variety of sources. A KBS assists with solving problems, particularly complex issues, by artificial intelligence. These systems are primarily used to support human decision making, learning, and other activities.

A knowledge-based system is a major area of artificial intelligence. These systems can make decisions based on the data and information that resides in their database. In addition, they can comprehend the context of the data being processed.

A knowledge-based system is comprised of a knowledge base and an interface engine. The knowledge base functions as the knowledge repository, while the interface engine functions as the search engine. Learning is a key element to a knowledge-based system, and learning simulation improves the system over time. Knowledge-based systems are categorized as expert systems, intelligent tutoring systems, hypertext manipulations systems, CASE-based systems, and databases having an intelligent user interface.

Knowledge-Based Systems and Artificial Intelligence

While these systems are a subcategory of artificial intelligence, traditional knowledge-based systems are different in certain ways from AI. In some ways, AI is organized in a top-down, know everything system to capture and utilize statistical pattern detection methods, big data, deep learning, and data-mining. Examples of AI include approaches that involve neural network systems, which are a category of deep learning technology concentrated on pattern recognition and signal processing.

In contrast to conventional computer-based information systems, a KBS has several advantages. They provide excellent documentation while handling large quantities of unstructured data in an intelligent way. A KBS helps improve decision making and enables users to work at greater levels of expertise,

productivity, and consistency. In addition, a KBS is useful when expertise is not available, or when information must be stored effectively for future use. It also provides a common platform for integrating knowledge on a large scale. Finally, a KBS is capable of generating new knowledge by using the stored data.

The architecture of a knowledge-based system is its inference engine and knowledge base. The knowledge base holds a collection of data, and the inference engine can deduce insights from the data stored in the knowledge base.

Knowledge-based systems work across a number of applications. For instance, in the medical field, a KBS can help doctors more accurately diagnose diseases. These [systems are called clinical decision-support systems in the health industry](#). A KBS can also be used in areas as diverse as industrial equipment fault diagnosis, avalanche path analysis, and cash management.

Types of Knowledge-based Systems

Here's a list of the types of knowledge-based systems, based on the resources provided:

1. **Expert Systems:** Simulate human expertise in a specific domain for decision-making.
2. **Case-Based Systems:** Solve new problems based on solutions to past cases.
3. **Rule-Based Systems:** Use "if-then" rules for decision-making.
4. **Blackboard Systems:** Integrate data from multiple sources to solve problems.
5. **Classification Systems:** Categorize data into predefined groups.
6. **Intelligent Tutoring Systems:** Provide personalized learning support.
7. **Medical Diagnosis Systems:** Assist in diagnosing patients based on input data.

Advantages of Knowledge-based Systems

Enhanced Decision-Making: KBS leverages expert-level knowledge, improving accuracy in decision-making by providing reliable, data-driven insights. This reduces reliance on human intuition or guesswork.

Efficiency Improvement: By automating complex processes, such as diagnostics or planning, KBS minimizes manual effort, streamlining workflows, and reducing time spent on problem-solving.

Knowledge Preservation: Captures and stores the expertise of skilled individuals, ensuring critical knowledge is retained within the system even if the experts leave or retire. This creates a lasting knowledge repository.

Consistency: Since KBS operates using predefined rules and logic, it applies the same processes uniformly across various scenarios, ensuring consistent output. This reduces variability that may arise from human judgment, leading to more reliable results.

Scalability: They can handle large amounts of data or numerous simultaneous requests without degrading performance. This allows organizations to scale their operations without needing proportionate increases in human resources.

What is a knowledge-based system?

Knowledge-based systems are a crucial part of knowledge representation within AI.

A Knowledge-Based System (KBS) is a computer program that leverages a centralized information repository—a knowledge base—to support decision-making. A form of [artificial intelligence \(AI\)](#), KBSes are designed to [capture knowledge from human experts and use it to](#) inform decisions and help solve problems, much as a team of human experts might do.

KBSes are designed to simulate the decision-making abilities of a human expert within a specific domain. These expert systems rely on a reasoning system to derive new knowledge, making them a valuable tool for solving complex problems across a wide range of applications, from [software development](#) to healthcare to finance to industrial design.

In this article, we'll cover the [basics](#) of knowledge-based systems: their essential components, their benefits and challenges, how to ensure their health and quality, and what the future might hold for knowledge-based systems

Exploring the depths of knowledge-based systems

Knowledge-based systems are a crucial part of knowledge representation within AI.

Knowledge representation refers to the creation of structures, processes, and models that represent information in a format the AI can use to help solve complex problems. One example is a production rule system: a precondition or “if” statement and an action or “then” statement.

Components of a knowledge-based system

Two main components make up a KBS: the **knowledge base** and the **inference engine**.

The knowledge base

A knowledge base is a centralized repository of data specific to a given field. This could be anything from medical data to hardware specifications to your company's internal wiki. The knowledge base works in tandem with the inference engine, providing the raw data that the inference engine uses to draw conclusions and make recommendations.

The inference engine

Much like a search engine, the inference engine processes and locates data based on your requests. It employs a reasoning system to draw conclusions from the data provided and make decisions based on if-then rules, logic programming, or constraint handling rules. The inference engine applies logical reasoning to your knowledge base to expose new insights.

Why a strong user interface is important

For knowledge-based systems to succeed, [they require a good user interface](#). It's important to keep user requirements in mind if you want people to *use* your knowledge-based system, which of course you do. The user interface should make it easy for people to capture, preserve, update, and share knowledge without interrupting their established workflows. (For more tips on how to integrate AI tools into your technical workflows, [read this article](#).)

Benefits of knowledge-based systems

Knowledge-based systems deliver obvious benefits, from better data-driven decision-making to greater efficiency and faster upskilling. When drawing from a healthy knowledge base, KBSes can:

- Serve as expert systems, to help guide expert decision-making when human experts aren't available
- Create efficient documentation that users can access quickly and easily
- Reveal new insights from existing data, including unstructured and big data
- Organize data by analyzing and classifying information in different formats
- Handle large volumes of both structured and unstructured data

Challenges of knowledge-based systems

KBSes also come with challenges. They can be difficult to maintain, in need of continuous updating as business and technical processes evolve. They require a huge amount of high-quality data. New users often require training to understand how the system works, how to maintain it, and how to take full advantage of its capabilities. Anomalies like [circular dependencies](#) and repetitive rules can crop up in some systems. But the biggest challenge is that a knowledge-based system is only as good as the knowledge base that feeds it.

Ensure the health of your knowledge base

In spite of its name, generative AI (AI that can generate text, code, or even images and music) can't create something from nothing. If your knowledge base isn't healthy—if the information

it contains is incomplete, inaccurate, out-of-date, or devoid of context—your KBS won't perform to a high level.

Garbage in, garbage out

The old computing adage about "[garbage in, garbage out](#)" applies to knowledge-based systems, too. Your KBS is dependent on the training data you provide, so if that data is low-quality, the AI can start "hallucinating": suggesting incorrect, incomplete, or misleading answers that can cause headaches for your team. When this happens, employees' trust in the knowledge platform starts to erode. When trust erodes, fewer people contribute to the growth and upkeep of your knowledge base, and its information grows even more stale. It's a vicious cycle you can avoid by giving your KBS what it needs to support your decision-making.

Your knowledge base should be:

- Accurate and trustworthy, with answers vetted by knowledgeable users
- Easy to update and refresh as new information emerges
- Capable of capturing the context in which questions are asked and answered
- Continuously improving and self-sustaining

The role of knowledge management

It's essential to have a [knowledge management \(KM\)](#) approach that enables discussion and collaboration, since this allows you to improve the quality of your knowledge base by evaluating the KBS's responses and refining the structure of your queries to yield better answers. This pattern of interaction—humans applying their judgment to the quality and accuracy of the AI-generated output—will help you get even better results from your KBS over time.

Keep in mind that your framework for knowledge management should line up with how your employees already search for and find answers. Users should be able to capture knowledge, discover answers to their questions, and learn from domain experts without disrupting their existing workflows.

The future of knowledge-based systems

As AI continues to evolve, knowledge-based systems will become more capable, with the potential to entirely reshape how we work.

In a marketing context, KBSes won't just analyze static data; they'll unpack the nuances of customer behavior. They'll pick up on the sentiments behind social media posts, interpret the tone of online reviews, and predict customer trends before they gain mainstream momentum.

In sales, these systems will evolve to understand complex sales dynamics and buyer psychology. They'll analyze historical sales data, market trends, competitor strategies, and individual buying behaviors to create comprehensive sales strategies.

In customer service, KBSes will become sophisticated, empathetic virtual customer service agents who understand not only the customer's issue, but the feelings and context behind it. They'll be capable of perceiving frustration, confusion, or urgency and respond accordingly, just as a human would.

Quality in, quality out

Knowledge-based systems are a powerful AI tool. Thanks to their ability to leverage expert knowledge and their robust reasoning systems, KBSes can [help humans make critical decisions](#), weigh costs and rewards, and get up to speed quickly on a new topic. But for your KBS to deliver on its full potential, it needs a high-quality knowledge base to draw from.

Last updated



- ◆ knowledge base
 - ❖ contains essential information about the problem domain
 - ❖ often represented as facts and rules
- ◆ inference engine
 - ❖ mechanism to derive new knowledge from the knowledge base and the information provided by the user
 - ❖ often based on the use of rules
- ◆ user interface
 - ❖ interaction with end users
 - ❖ development and maintenance of the knowledge base

What Is a Knowledge-Based System? (With Types and Uses)

Written by

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Artificial intelligence (AI) allows you to use technology and machine learning processes to perform certain tasks automatically. This may be helpful for reducing the number of repetitive tasks you need to complete and improving efficiency. There are different ways to use AI in your career, and learning about some of the systems and what they can achieve may be beneficial. In this article, we define what a knowledge-based system is, list some types of these systems, discuss some of their uses and explain some of the benefits and challenges of using knowledge-based systems.

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What is a knowledge-based system?

A knowledge-based system (KBS) is a type of computer system that analyzes knowledge, data and other information from sources to generate new knowledge. It uses AI concepts to solve problems, which may be useful for assisting with human learning and making decisions. These systems often have built-in problem-solving capabilities that allow them to understand the context of the data that they review and process and make informed decisions based on the knowledge that they store. Knowledge-based systems typically have three components, which include:

- Knowledge base: A knowledge base is an established collection of information and resources. The system uses this as its repository for the knowledge it uses to make decisions.
- Interface engine: An interface engine processes data throughout the system. It acts similarly to a search engine within the system by locating relevant information based on the requests.
- User interface: The user interface is how the knowledge-based system appears to users on the computer. This allows users to interact with the system and submit requests.

Related: [Everything You Need To Know About a Knowledge Base](#)

Types of knowledge-based systems

Here are some types of knowledge-based systems:

Case-based systems

Case-based systems use case-based reasoning. This involves reviewing past knowledge of similar situations. Based on what it finds, the knowledge-based system provides solutions that were effective in those given situations. Related: [7 Types of Reasoning: Definitions and Examples](#)

Expert systems

Expert systems are one of the most common types of knowledge-based systems. These systems mimic human experts' decision-making processes, making them helpful for complex analyses, calculations and predictions. In addition to presenting solutions, they provide specific explanations for the problems they're solving. Related: [What Is an Information System? Definition and Uses](#)

Hypertext manipulation systems

Hypertext manipulation systems store knowledge by linking text to other texts and by using hypertext. Hypertext refers to a network of discrete blocks of information interconnected as a way to store data. This type of system allows you to access many types of data easily. Related: [What Is Network Segmentation? \(With Tips and Examples\)](#)

Intelligent tutoring systems

Intelligent tutoring systems are knowledge-based systems specifically designed to support learning. These systems provide users with personalized feedback and instructions based on their performance and inquiries. As such, they're often used in education, allowing students to learn more and have a personalized learning experience without direct intervention from a teacher. Related: [154 Tech Tools for Teaching](#)

Rule-based systems

Rule-based systems rely on human-made, hard-coded rules. It uses these rules to analyze and manipulate data to achieve specific outcomes. This may involve using IF-THEN rules, which establish that if a user makes a certain request, then the system delivers a certain outcome. Related: [What Is Artificial Intelligence Analytics? \(With 3 Types\)](#)

Uses of knowledge-based systems

Knowledge-based systems are useful for providing expertise to people who require it, especially when they're attempting to make decisions quickly. They can be helpful for providing recommendations for various industries, and their potential may continue to grow as technology evolves. Some examples of current uses for knowledge-based systems include:

Blackboard systems

A blackboard knowledge-based system allows users to collaborate to achieve a solution. Human experts can continuously input new information into the system, helping to create partial solutions as they investigate the final outcome. The system uses partial solutions to determine the appropriate answer to a problem. Related: [What Is Virtual Collaboration? Definition and Helpful Tips](#)

Classification systems

Classification systems analyze data and assign it to appropriate groups. This type of knowledge-based system allows you to determine what the classification status is for a section of data. It may be particularly useful for scientists, such as analyzing chemical components to determine the classification of particular chemical compounds.

Eligibility analysis systems

Eligibility analysis systems may include guided questions for a user. These are often rule-based systems because they typically allow users to continue to answer questions until one of their responses indicates they're not eligible for the service. This type of system may be useful for those looking to make their screening processes more efficient, such as government organizations or hiring professionals. Related: [10 Types of Artificial Intelligence Applications](#)

Medical diagnosis systems

Medical diagnosis systems help diagnose patients based on their symptoms in medical history. They may answer a series of questions or a medical professional may enter the information for them, and, based on their responses, the knowledge-based system identifies what condition they may be experiencing. Many of these systems also recommend treatment methods the patient may consider based on their responses and potential diagnosis. It's important to note the system alone is not an appropriate replacement for professional medical care.