

13 TREASURE HUNT



STICK TO THE RULES, AI!

Have you followed all the rules from the knowledge base and found the treasure? AI systems can also follow certain rules and draw conclusions from them. These systems are called **knowledge-based AI systems**.

In contrast to data-based AI systems, which derive correlations from available data, knowledge-based AI systems use a knowledge base. The knowledge base is a collection of information that describes how our world works and what relationships and connections exist. A knowledge base normally only relates to a specific context (also known as a domain), e.g. 'animal species', 'weather' or 'treasure hunt in the sea' as in this box. This restriction is necessary because it is not possible to summarise all knowledge in the world in one large set of rules. A **knowledge base, i.e. a set of rules** will like the one you used in the box, is compiled and created by humans (knowledge engineers) or derived from databases. Compared to data-based AI systems, this process is, of course, much more complex: first of all, it requires people who have an immense amount of knowledge on a specific topic or area and then this knowledge must also be written down in a way that is understandable and unambiguous for the AI system.

The knowledge in the knowledge base is represented in statements (facts) and logical relationships (rules). Different statements are linked using so-called logical operators. This sounds very complex, although we encounter such sentences every day. For example, we know that if it rains, the road gets wet. We can represent this for an AI system as follows:

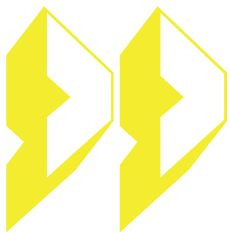
<i>It rains.</i>	→	<i>The street gets wet.</i>
<i>It snows.</i>	→	<i>It is winter.</i>
<i>It is winter.</i>	→	<i>You can go skiing.</i>





This sounds very simple to us at first, but **an AI system does not know these relationships until we record them in the knowledge base.**

The knowledge base is analysed by an **inference engine**. . What does this machine do? It **searches the knowledge base for logical connections** with the information that we enter into the AI system. For example, we enter the information into the inference engine that it is snowing. Based on the logical connections that we have previously stored in the system, the inference engine can now conclude that it must be winter. It also concludes from this statement that you can go skiing. This is the statement that the AI system returns to us.



What does this have to do with the treasure hunt in the box?

The rules you have used represent your knowledge base. For example, it contains the facts and rules:

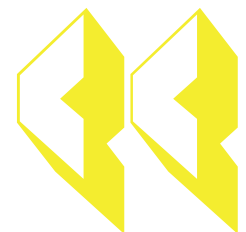
There are exactly two swirls.

There is a hazard in the field. → *There is no treasure in the field.*

There is a swirl in the field. → *There is a strong current in all fields vertically and horizontally from the swirl.*

You take on the role of the inference engine and evaluate the statements in order to get a result. You may have noticed that the inference engine is independent of the knowledge base. After all, both you and your classmate can evaluate the knowledge base and you could also evaluate other rules without any problems. This makes it easier to maintain the AI system.

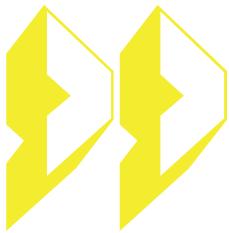
Nevertheless, **creating and maintaining a knowledge base involves a lot of effort, as everything has to be written down manually.** However, this has the advantage that you get a **true statement**: Only true statements are included in a knowledge base and correlations are presented that apply one hundred per cent. Data-based AI systems analyse very large amounts of data and determine correlations between the data. These correlations are probably valid because they are mapped in the available data, but they are not certain.





In contrast to knowledge-based systems, a data-based AI system cannot therefore draw 100% conclusions, but can only make very probable statements.

There is always some uncertainty, which is why these AI systems can also be wrong. This is not the case with knowledge-based AI systems, as they only draw their conclusions from the knowledge base built on logical statements. However, this also means that uncertain statements or incomplete information cannot be presented, which is why knowledge-based and data-based AI systems are often used together for efficient deployment. In addition, one usually limits oneself to a specific set of facts in order to minimise the effort required to create the knowledge base. The AI system is therefore an expert in a specific area, which is why it is also referred to as an expert system.



And what is the difference between a knowledge-based AI system and a search engine?

The search engine only returns the information from its 'knowledge base' [all the information on the internet] that contains our search term. It cannot interpret or extract any further information from the search term. In contrast, the knowledge-based AI system runs through an entire chain of 'linked' information starting from the search term and can thus generate new knowledge.



The 'Watson' AI system beats human contestants in the quiz show 'Jeopardy!'

A particularly impressive example of an expert system is the **Software „Watson“ from IBM**. Watson's knowledge base contains the entire online encyclopaedia Wikipedia. When a query is received, the software analyses this knowledge base in order to answer it. It can even respond to spoken language, which is why the software competed against and defeated two human opponents on the TV show 'Jeopardy!' in 2011.





SOURCES

Ertel, Wolfgang (2025): Introduction to Artificial Intelligence .
Springer Fachmedien Wiesbaden, doi: 10.1007/978-3-658-43102-0.

Video „Watson and the Jeopardy! Challenge“
<https://www.youtube.com/watch?v=P18EdAKuCIU>

