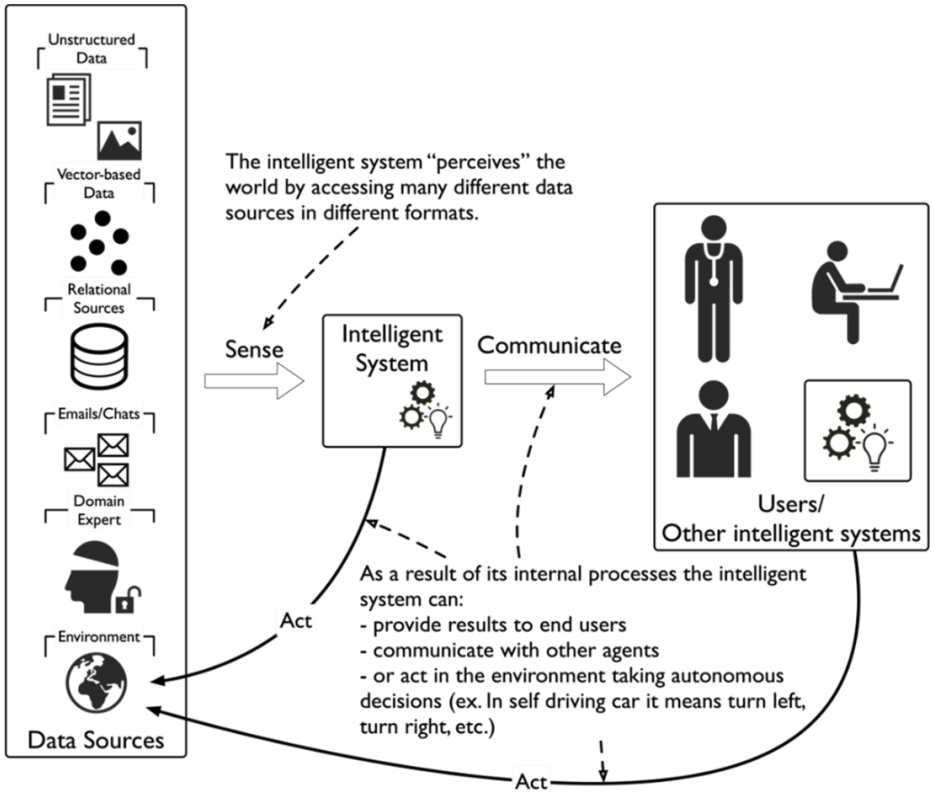
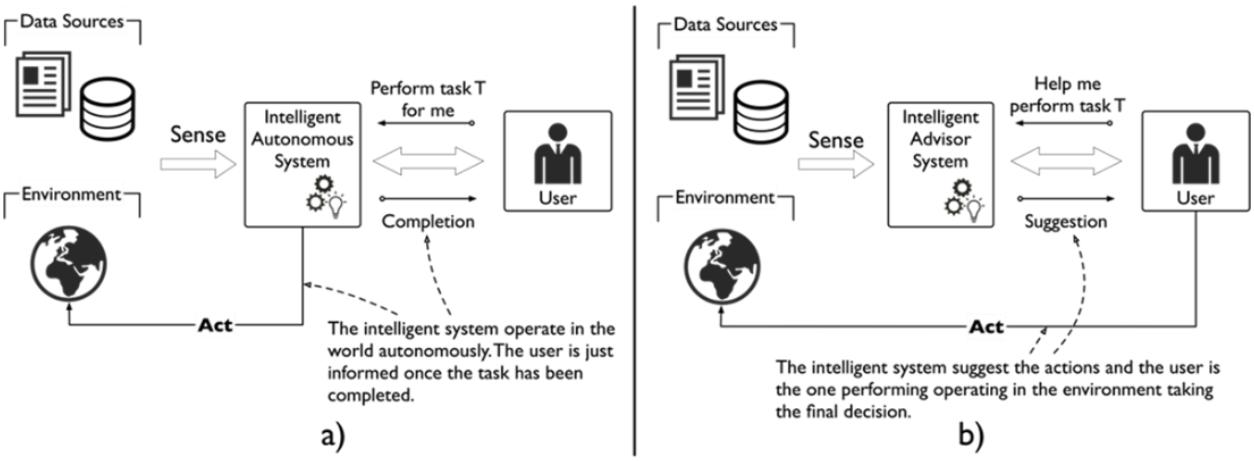
Intelligent systems connect users to artificial intelligence (AI) and machine learning (ML) to achieve meaningful objectives. An intelligent system is one in which intelligence evolves and improves over time, particularly when it improves by watching how users interact with the system.

This definition emphasizes a number of crucial elements that show our idea of an intelligent system and how we approach its construction in this book. The primary role that the user is assigned comes first. The primary objective is to assist users in completing challenging activities, either by acting on their behalf or by making suggestions. The ability to gain knowledge from user engagement comes in second. The system must build, utilize, and keep up a knowledge base that should change over time, utilizing user interactions in addition to fresh or updated data sources.

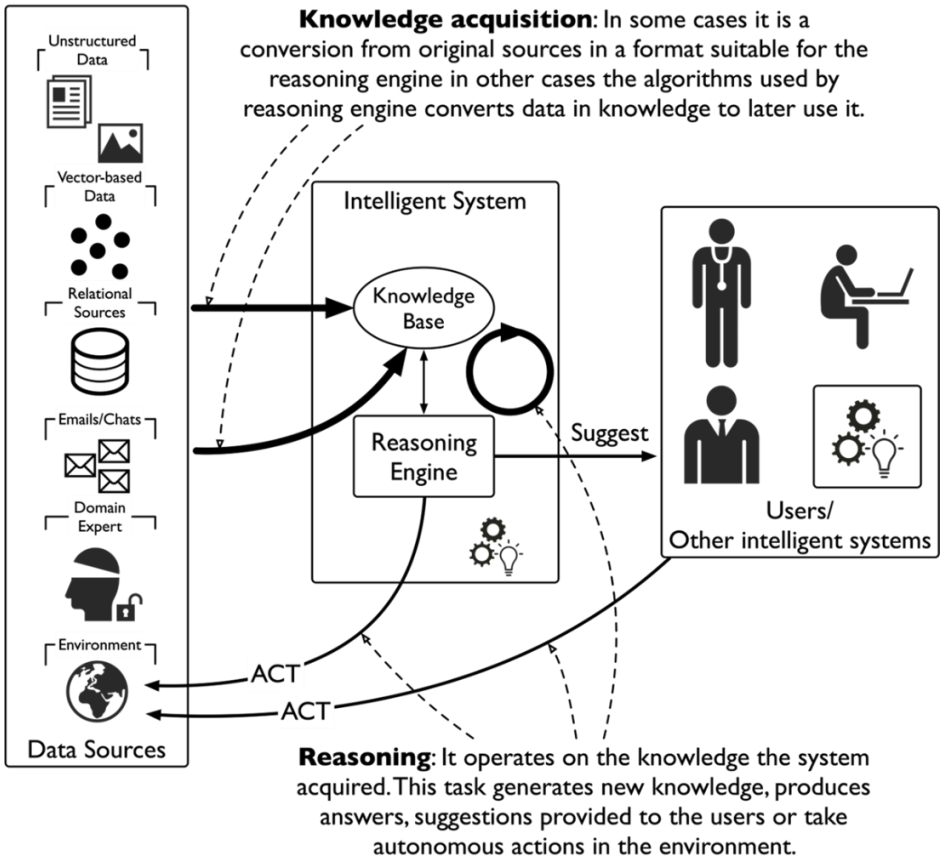


The difference between two types of intelligent systems is based on whether they support users or act on their behalf. In his comprehensive taxonomy of intelligent systems, Martin Molina distinguishes between intelligent adviser systems and intelligent autonomous systems. The user is replaced by the machine in an intelligent autonomous system. This group includes self-driving cars. The user is assisted in acting in the world by an intelligent advisor system. The user is ultimately in charge of deciding what to do in this situation, and the system's job is to assist by offering helpful information to make selections easier.

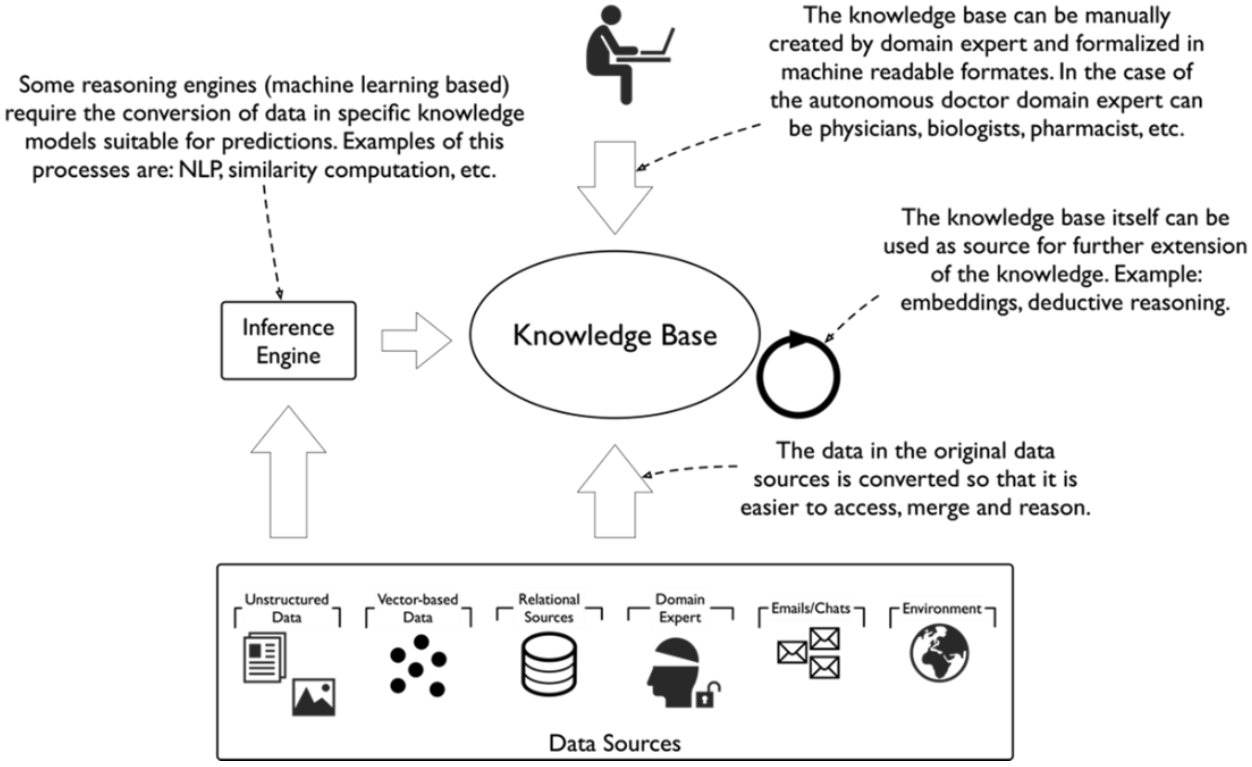


The key characteristics of an intelligent system are: A meaningful objective, The intelligent experience, The implementation of intelligence, Knowledge creation, The orchestration. We also need to focus on some architectural implementations

Knowledge acquisition is a crucial part in driving the learning process and converting it into expertise to act intelligently in the worldly applications which is the process of utilizing the experience is called reasoning.

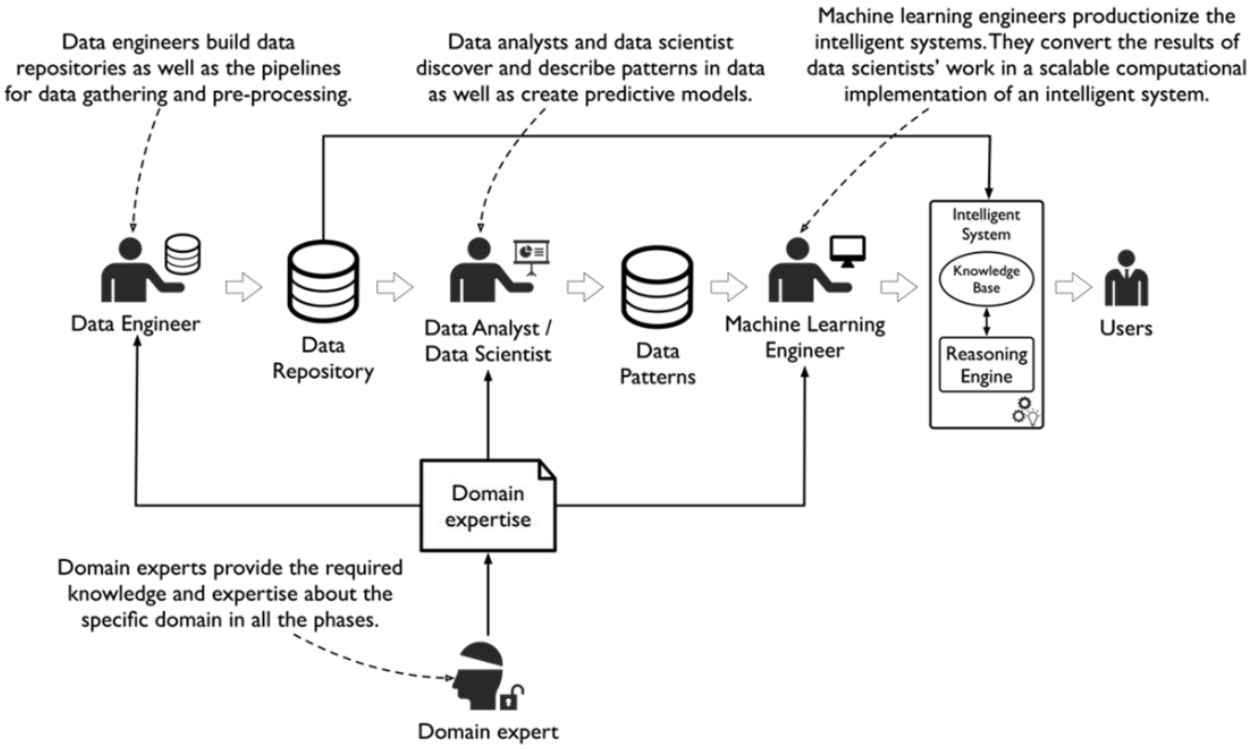


Algorithms in the reasoning engine use the created models to generate conclusions from given premises and to select the next reasonable action and it is more so in the case of creating a medical domain expert. Such rules are processed by an inference algorithm to determine a patient's illness. Since the inference algorithm is universal, generic software tools can be used to implement it. The knowledge model's rules, however, are particular and need to be developed for an expert system. This process is pictorically represented as:



Such carefully curated knowledge bases typically take a lot of work to create and maintain. Since it is one of the most challenging jobs in the construction of an intelligent system, this is known as the knowledge acquisition bottleneck.

Natural language processing (NLP) or machine learning (ML) can be used to automatically learn new information. For instance, we create knowledge models from examples using machine learning techniques. For example, a neural network can be trained to identify flaws in pictures of an airplane's surface. Natural language processing (NLP) techniques can be used to extract entities and their relationships from text texts. Large Language Models (LLMs) are particularly good at this task. Their models can identify and classify named things and derive links between them since they have been constructed on large volumes of text data.

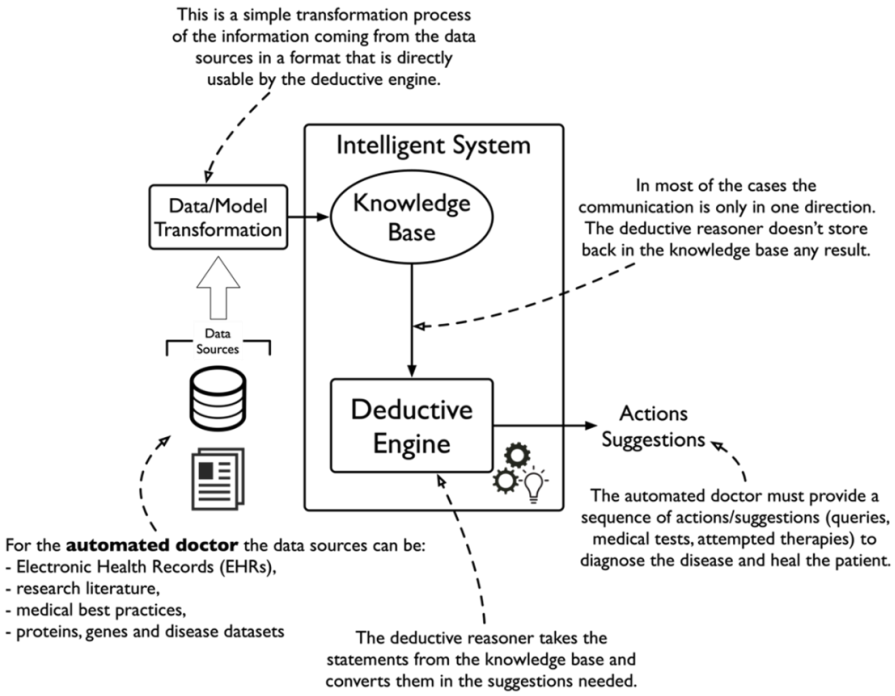


The goal of knowledge representation and reasoning in computer systems is to: Store a representation of the world that can be understood by a machine, or more accurately, the precise area of reality that we require in order to achieve our goals (the designated domain of interest), They are able to reason, which entails modifying the symbols that stand for our areas of interest in order to draw conclusions, resolve issues, or come to their own conclusions.

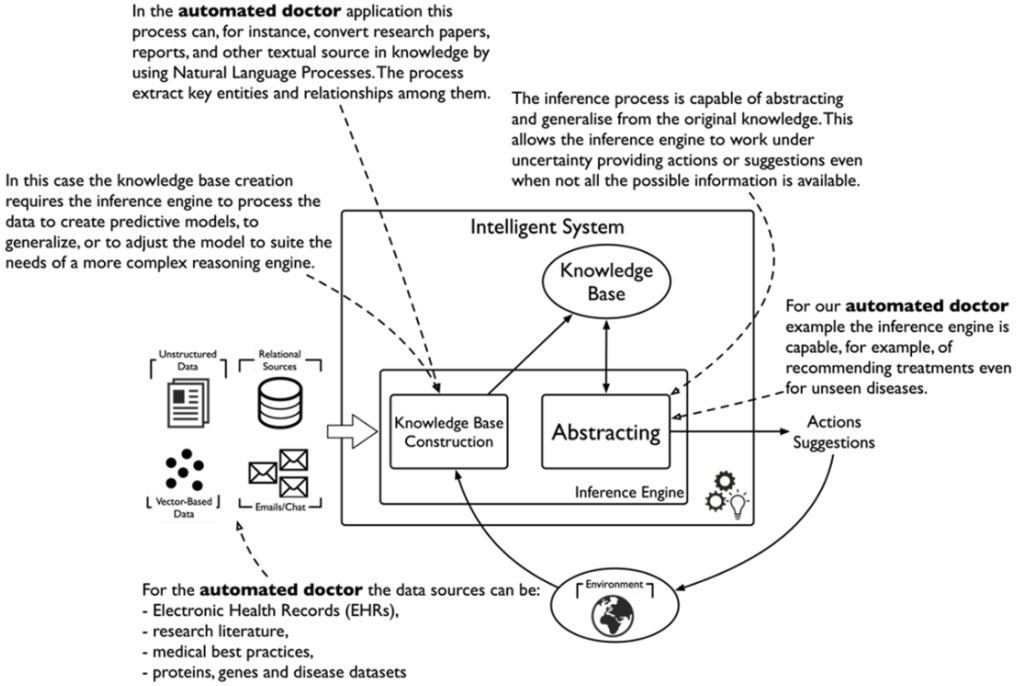
There are different kinds of knowledge present in the knowledge graph like: Entities, Relationships, Ontologies, Goals and utilities, Policies, control rules, and heuristics. Because the last sentence reflects a logical conclusion from the original propositions, this type of reasoning is known as logical inference or deductive reasoning. This perspective, holds that reasoning is a type of calculation that is similar to arithmetic but uses symbols to represent propositions rather than numbers. The knowledge base can be used to store the new propositions that result from reasoning, which will make them more accessible when responding to particular queries or offering thorough recommendations for courses of action.

The ability to generalize i.e. transforming the individual examples to a more broader view is called as inductive reasoning/inference.

The deductive reasoning can be pictorially represented as:



The inductive reasoning can overcome the limitations faced by deductive reasoning in the following ways: through acquiring and developing pertinent ontologies, connections, and tools that aid in expanding the knowledge base's coverage of additional situations, By drawing conclusions when there is uncertainty or when all the information required is not accessible, and by drawing conclusions from the existing samples in order to offer the required generalization.



The program can learn how to better describe the data for the following phases through representation learning. When compared to hand-picked characteristics, learned representations frequently yield significantly higher performance. Furthermore, the machine can quickly adjust to new jobs with less human effort because it can learn representations from simpler input (only the photos or a collection of text, for example). Humans could need decades of research to accomplish tasks that a machine can complete in minutes or days.

By providing representations that are described in terms of simpler representations, deep learning tackles the representation learning problem. The machine constructs several progressively more complicated levels on top of the underlying, simpler ideas in deep learning. For instance, combining corners and contours—which are further defined by edges—can convey the idea of a person's picture.