Reasoning in every day life

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Abstract

To be rational means to be able to reason. Thirty years ago psychologists believed that human reasoning is depending on formal rules of inference akin to those of the logical calculus. This hypothesis ran into difficulties, which led to creating more categories of reasoning. They are trying to describe human reasoning with all pros and cons and to simulate reasoning of human mind. We will describe some of these categories, show some examples and where are they used in a human every day life. We also try to refer the reader to some more comprehensive articles about particular categories.

1 Introduction

Reasoning is a process by which we attain a belief which we regard as a result of a previous knowledge.[13] It is the cognitive process of looking for reasons, beliefs, conclusions, actions or feelings. We, humans, reason at almost
every moment in our life. We are trying to guess the consequences of our actions, deduce as much as we can from our perception, find a logic in our life. Reasoning helps us to survive, especially in the present world, more dynamic, faster, with more information to process at a time as ever before. Reasoning is the main factor, helping the mankind move forward.

A traditional main division was made by philosophers. They introduced two main categories of reasoning, namely deductive and inductive reasoning. In the 19th century Abduction was introduced and since then, it is generally accepted that these three are the main categories of reasoning.

Deduction proves that something must be; Induction shows that something actually is operative; Abduction merely suggests that something may be.  

However, there are few more categories, from which some are not very well known, nor accepted by the scientific public. These categories are:

- Analogical reasoning
- Cause-and-effect reasoning
- Comparative reasoning
- Conditional reasoning
- Criteria reasoning
- Decompositional reasoning
- Exemplar reasoning
- Modal logic
- Traditional logic
• Pros-vs-cons reasoning
• Set-based reasoning
• Systematic reasoning
• Syllogistic reasoning

, we will try to briefly describe most known categories in the next section and give some examples where and how people are using those categories of reasoning.

2 Types of reasoning

2.1 Abduction

Abduction was first defined by Charles Sanders Peirce as ‘process of thought capable of producing no conclusion more definite than a conjecture’.\cite{13} Abductive reasoning is the process of explaining something that is experienced or observed in some way and where there is no existing knowledge to explain the phenomenon. It is the process of creating hypothesis that may or may not be true. It may require further work to verify.
Formally, we can write abduction as a set of two logic formulas:

\[ B \Rightarrow A \]

\[ A \]

As A is considered true, therefore B may be true.

Consider an example from the real life: A man walks into a restaurant and his clothes are soaked wet with water (formula A). If it is raining outside, people will be wet (B \Rightarrow A). We naturally assume that it is raining outside,
which may be truth and it is probably the best explanation of such a situation. However, we can not be sure if it is raining outside, as we do not have any prove. The man could also have fallen into a lake.

Despite all of this, abduction is useful, as it is the only logical operation which introduces any new idea.[13]

The limits of Peirce’s conceptual abduction and possible alternative forms of abduction are discussed by various authors such as [14], [11] and [10].

2.2 Deductive reasoning

The theory of deductive reasoning was set by Aristotle, when he said:

A deduction is a speech in which, certain things having been supposed, something different from those supposed results of necessity because of their being so.[2]

Each of the ‘things supposed’ is a premise of the argument, and what ‘results of necessity’ is the conclusion.

At the beginning of deduction, there is an assumed hypothesis or a theory. This assumption may be well-accepted or it may be rather more shaky, nevertheless, for the argument it is not questioned. According to [13], deduction is merely an application of the general rules to the particular cases. It is used by the scientists who take a general scientific law and apply it to a certain case, as they assume that the law is true.

Deductive conclusions can be valid or invalid. Valid arguments obey the initial rule. For validity, truth or falsehood of the initial rule is not considered, thus the valid conclusion need not to be true. When the conclusion is both
valid and true, it is considered to be sound. When it is valid, but untrue, then it is considered to be unsound.

In the real life people make deductive conclusions all the time. For example, we can say that every toaster is made of gold. Therefore if we have a toaster, it is made of gold. A logic formula would look something like this:

\[ \forall \text{toaster} \Rightarrow \text{made of gold} \]

The deduction that the toaster is made of gold is valid. However, the premise that every toaster is made of gold, is not true, so this conclusion can not be sound. Consider another theory:

\[ \forall \text{Person} \Rightarrow \text{is mortal} \]
\[ \text{Socrates is a person} \]
\[ \text{Socrates is mortal} \]

As this deductive conclusion is valid and the premise is generally accepted to be true, it is also sound conclusion.

More information about deduction can be found in [4], [13], [1] and [8].

2.3 Inductive reasoning

Inductive reasoning from a specific case or cases and deriving a general rule. It draws inferences from the observations in order to make generalizations. Inductive methodologies as part of the scientific inquiry was established and popularized by the Francis Bacon’s magnum opus, Novum Organum.[3]

In inductive arguments, we can:

- Derive a general rule in an accepted area and then apply the rule in the area where we want
• Give lots of details, then explain what it all means

• Talk about the benefits of all the parts and only get the overall benefits later

• Take what happened and give a plausible explanation for what happened

Inductive arguments can include:

• Part-to-whole: the whole is assumed to be like the individual parts. As an example, we observed that lots of people like to eat broccoli. We can generalize this observation and say that every human likes broccoli. Part-to-whole is also used in the proofs with the mathematical induction.

• Extrapolation: where areas beyond the area of observation are assumed to be like the observed areas. Humans often extrapolate their observation, for example: it is very cold in this room. It will be very cold in the next room.

• Predictions: the future is assumed to be like the past. E.g. My favorite restaurant was closed yesterday and so it will be closed today too.

More information about inductive reasoning and induction can be found in [13], [7], [3] and [1].

2.4 Analogical reasoning

Analogical reasoning is suggested as a useful new mechanism for the manipulation and derivation of some kinds of deep knowledge. The starting-point for the suggestion is the observation that the experts often express parts of their non-shallow knowledge in the terms of cases and reason by trying to
identify relevant similarities between past cases and the current problem.[5] In analogical reasoning, an analogy for a given thing or situation is found, where the analogy is like the given thing in some way. In the every-day life we face analogy when we are compared to someone else, or if we compare something to another thing. E.g. ”You are just like your father. Always sitting in front of the television.” or ” This is like I am in the heaven.”. More about analogy can be found in [5], [16] and [15].

2.5 Cause-and-effect reasoning

Helping people to see what will happen (effect) when an action is made (cause). It also helps to interpret why has something happened. Humans use causal reasoning all the time when we predict future state. For example we know, that if there is a cherry in a long narrow cup and our hand is just too big to grab it, we simple turn the cup bottom up. We know that this will cause the cherry to fall out of the cup.

It is sure that humans use causal reasoning when using tools, but it is not, that animals use it too. Example of an elephant using causal reasoning when using tools is shown in [12]. Using causal reasoning in the AI is mentioned in [9].

2.6 Comparative reasoning

Helps to established an importance of something by comparing it against another thing. It is a very natural form of judgement. We use comparative reasoning in many ways, e.g.:

- Comparing what we have and the others have.
- Comparing the past and the future.
• Comparing the current state with the ideal state.

• Comparing things with others to look them better/worse.

2.7 Decompositional reasoning

Decompose something into smaller parts, analyze them, figure out how they fit together and then draw a conclusion about the whole. For example if we want to understand how the engine works, we decompose it. We discover several parts, figure out how they work and what they do. Then we can draw a conclusion that the fuel is pumped into the cylinders and mixed with the air, then this mixture is pressed by the piston and fired which will lead to the explosion. The power of the explosion is then transferred on the wheels of the car.

2.8 Syllogistic reasoning

Uses syllogism to draw the conclusions from the premises. It uses rational logic and hence set theory applies. Consider following theory:

All men are animals
Some animals are aggressive.

Syllogic conclusion would be that some men are aggressive. It is intuitive, thus this conclusion need not to be valid. The best way to visualize syllogic
reasoning is to draw a Venn diagram (Figure 1). As we can see, not every man need to be necessarily aggressive.

3 Conclusions

People use many types of reasoning in different situations. Using the right category for the specific type of an assignment is crucial. Sometimes the speed is the most important factor, some other time the exactness of reasoning. Some animals in the world are capable of performing some of these types of reasoning, but only humans can combine few of them and use them in the same time, probably because of the structure of the human brain. This can be shown, because different kinds of reasoning activate different parts of the brain[6].

References


