Context, information's meaning, and perception

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Abstract

Computer representation of human knowledge must be approached using the human ability to assign different meanings to information according to our perceptions, which at the same time are constructed and constitute the interpretative context in which possible meanings acquire varying degrees of validity.

This work proposes that humans construct our perceptions based on the context of our past experiences. Starting with this supposition, this article explores the relationship between the L. Zadeh's 'computing with words' 'computing with perceptions' proposal to discover if it allows us to advance toward a representation of human perception.

Keywords: Perception, meaning, information, knowledge, context.

1. Introduction.

In the field of computer science it is widely accepted that there is a difference between processing information and representing knowledge.

The former can be incorporated into computational processes which represent linguistic sentences using logical propositions and logic models (boolean one, multivalued, temporal, modal, non-monotonic, etc.). However, representing knowledge requires something more: the ability to represent processes using those that humans employ for information.

In human processes, the meanings of the information available to us are not fixed; different meanings are assigned and acquire a degree of validity according to the context.

Therefore, meaning is assigned based on the context in which individuals find themselves, which allows the information to be converted into knowledge about the reality in which the human acts.

This work is organised in the following sections: First of all, the way in which the concept of human perception is used will be established. Next, the relationship between perception and context will be discussed to establish the importance of context when constructing meaning. Then the reason why human perceptions are 'diffuse' will be explored. I propose that perception is an emergent property in which the context provided by a human's past experience is involved. Finally we will examine the relationships between perception in human terms and L. Zadeh's proposal [1], computing with words and perceptions.

2. Considerations on perception

Human perception is more than just the ability to operate using the stimuli received by the brain. Although these stimuli are the origin of the construction of perception, the ability to assign meaning (approximate or precise) to those stimuli is learned throughout the life of every human and constitutes an emergent property in which an individual's 'domain knowledge' is based.

2.1. Perception and knowledge

Perception is the foundation of human knowledge.

Humans construct our knowledge of the world using information captured by our senses and the cognitive abilities associated with different intellectual competences.

For example, one human intellectual competence is the ability to analyse the information that enters into the brain to assess the type of information (sensory, cognitive, intellectual, etc.). That information is then interpreted to give it value (doubtful, imprecise, incomplete, vague, inexistent, etc.). The estimated value of the information allows meaning to be attributed to it (adequate, inadequate, acceptable, etc.). Finally, degrees of validity are assigned to the attributed meanings (possible, probable, improbable, etc.). All of this constitutes the process by which humans develop our perception of the world and construct our knowledge.

The abilities and processes which generate perception depend on the contexts in which humans evolve and develop our experiences. The context of each experience is what permits us to analyse, assign meaning, assess their validity and, finally, to act in consequence.

In this sense, we can state the domain of competences which constitute perception is linked to the domain knowledge and problem solving of humans. Therefore, a human's domain knowledge interacts with their perceptions.

So if perception is not a stable state, it develops and grows, or it consolidates, in accordance with the learning opportunities that individuals experience throughout

their lives in contact with the environments in which they evolve.

2.2. Perception and intelligence

This work accepts cognitive proposals that define intelligence as a person's ability to use knowledge, abilities and competences to resolve individual or socially relevant problems. [2] [3] [4]

From this perspective, human intelligence is not exclusively limited to the amount of information available to an individual. It is also associated with the ability to estimate the value of the information available to try and resolve a problem.

Humans use the ability to analyse, interpret and assign meaning to the information that we have available in specific situations, as well as to attach value to different possible meanings, and in this way we are able to generate solutions to problems. We are able to evaluate if solutions coming from past experiences (even when they are different) can be applied to a new situation; or whether (previously successful) solutions related to a different category of problems are still valid in a different context.

In summary, we use the context of prior experiences to evaluate our information, the relevance of each problem, and to evaluate possible cognitive or physical operations that will allow us to resolve each problem.

3. Context and perception: the construction of meanings

As stated earlier, perception is linked to the construction of meanings. In every language each word is associated with established meanings. However, the linguistic sentences in which those words are used determine which of those possible meanings correspond with the context of the information that is being used. At the same time, the perception of reality determines what in every moment, or every context, acquires a specific meaning. J. Dewey described how meaning is assigned using the following example:

> If a person comes suddenly into your room and calls out "paper," various alternatives are possible. If you do not understand the English language, there is simply a noise which may or may not act as a physical stimulus and irritant. But the noise is not an intellectual object; it does not have intellectual value. To say that you do not understand it and that it has no meaning are equivalents. If the cry is the usual accompaniment of the delivery of the morning paper, the sound will have meaning, intellectual content; you will understand it. Or if you are eagerly awaiting the receipt of some important document, you may assume that the cry means an announcement of its arrival. If (in the third place) you understand the English language, but no context suggests itself from your habits and expectations, the word has meaning, but not the whole event. ([5] p. 117)

When constructing our perception of the world, the context in which acts and events occur is the reference which defines the universes of discourse and reality, in the assignation of meaning to information (linguistic sentences) which humans use.

The basis for assigning meaning (context) can be an intellectual discipline, a social reality or a physical reality.

In the case of interpretation linked to a discipline, the context is determined by the domain knowledge of that discipline. For example, the linguistic label 'revolution' can be linked to History, Sociology, Geometry or Physics. Without considering the discipline that provides context, the statement *'this is a revolution'* will be meaningless.

In the habitual case of social reality, the context can be represented by the universe of discourse that individuals in a community share. So in a teacher's social context, references to ICT (Information and Communications Technology) are associated with certain procedures and tools used in teaching. When a teacher says *'I use ICT'*, we interpret that they are referring to something carried out in the (physical or virtual) classroom to aid them in teaching. In a broader context, when an individual says *'I use ICT'* we interpret that it could mean that they use electronic banking or commerce, that they habitually use email, they the play online games in their free time, etc. Depending on the social context, the meaning of this statement can refer to very different activities.

From the perspective of physical reality, the context for interpretation could be associated with the functionality of an object. A hammer could be a tool used by doctors in physical examinations to check the reflexes of a patient. It could also refer to a piece of equipment used in certain athletic events. So the context for interpretation of the linguistic label 'hammer' depends on whether the object will be used by an athlete or a doctor. The 'hammer' used by a doctor for diagnostic purposes does not correspond to the 'hammer' used by an athlete. Their functionalities differ significantly and nobody would give a doctor's hammer to an athlete for the athletic event. [6] Moreover, if we could perceive the clothing of the potential user of the hammer, we would be in a better position to give that person the object that they are asking for with greater precision.

In other words, humans use information (sometimes accidental) derived from context to reduce the level of uncertainty when assigning meaning to linguistic propositions.

> All knowledge, all science, thus aims to grasp the meaning of objects and events, and this process always consists in taking them out of their apparent brute isolation as events, and finding them to be parts of some larger whole *suggested by them*, which, in turn, *accounts for, explains, interprets*

them; i.e. renders them significant. ([5] p. 117)

It can be argued that the preceding examples refer to subjective areas and that in the objective world meaning can be assigned precisely. Take for example, distance; if we say that the distance between my house and my job is 60 km, this is precise information that does not require meaning to be assigned to it. However, this does not constitute a perception; what I can perceive is if the distance is long or short. Are we stating that my job is close to my home? Are we saying that it is far away?

The perception of whether a distance is long or short will depend on the experiences of each individual. If we are on a large continent, 60 km is a short distance; if we are on a small island, it could be a pretty long distance. If we have good means of transportation, the distance will be small; but if we do not, the distance is enormous. In this case, the perception of what is far or close (the assignation of these meanings) is going to depend on the relative value of the parameters of the physical environment in which we find ourselves and of the possibility that the distance can be translated in operative terms for resolving the problem of travelling that distance.

Therefore, assigning a meaning will also depend on the subjective perception of the physical environment in which we are situated and on the ability to act in that context. These factors will be present in the resolution of the problem of deciding whether or not to move to another home or to change jobs. Along these lines Zadeh states:

> A basic difference between perceptions and measurements is that, in general, measurements are crisp whereas perceptions are fuzzy. In a fundamental way, this is the reason why to deal with perceptions it is necessary to employ a logical system that is fuzzy rather than crisp. ([1] p. 322)

It is true that perceptions cannot be represented by assigning precise values. However, Zadeh does not take into consideration that the context determines that characteristic in his approach to the problem of computer representation of perceptions.

We have established that in mundane and scientific knowledge we base the construction of perceptions on context and in those perceptions reside the possibility of disambiguating the information we receive or use. By contextualising information we are able to indicate what kind of information we are using (sensorial, cognitive, intellectual, etc.). Context also allow us to interpret if information is uncertain, imprecise, incomplete, vague, inexistent, etc. and this estimated value makes it possible to give it a meaning. Finally, the context allows us to assign degrees of validity to the meanings that we might be considering.

Without assigning meaning not only are we incapable of comprehending and building appropriate knowledge about the world we are experiencing, but we are also incapable of acting adequately in that world.

In this sense, humans are able to use perception of the context to assess the value of the meanings assigned to information that we use to solve problems. Said in another way, we build our perceptions in accordance with our experience of the context and, in this way, all perception is subjective.

Finally, sharing the contexts of meaning, sharing perceptions, allows us to construct a system of shared knowledge, an inter-subjective system in which the attributed meanings acquire validity (even when some shared information is incomplete, imprecise, uncertain or vague), and adopt inter-subjectively valid decisions.

As we shall see, Zadeh's examples eliminate context, which is what allowed us to assign meanings and, in consequence, construct perceptions. His proposal would correspond to what Dewey indicates as the possibility of interpreting and giving meaning to language, while being incapable of giving meaning to the event that is described. If we do not build the meaning of the event we have to question whether we are in the condition to make decisions. Are we in the condition to resolve problems?

4. Is perception fuzzy?

Let us analyse some examples proposed by Zadeh to understand the *fuzzification* of perceptions.

Robert is highly intelligent. This statement has no meaning unless we share a meaning of intelligence. In the context of positivist psychology we could interpret that Robert has an IQ above 145; in the context of cognitive psychology we could interpret that Robert has mastered abilities that allow him to successfully resolve many and different kinds of problems. Both attributed meanings are valid in different contexts.

Carol is very attractive. This statement also lacks meaning unless we contextualise the concept 'attractive'. This statement supposes that Carol has a certain height/weight correlation, a certain capacity for facial expression, a certain body language, etc. Of course these standards vary quite a bit between different societies and cultures. The meaning of 'attractive' is not univocal and can be attributed equally to two completely different people and what makes Carol 'attractive' would depend on the socio-cultural context in which that linguistic sentence is used.

These two examples were meant to demonstrate that, regardless of the vague or explicit nature of quantifiers like 'highly' and 'very', qualifiers are always diffuse and when we do not contextualise the information of both linguistic expressions. As a result, we can state that the fuzzy nature of perceptions is not caused by the absence of precise quantifiers, but rather on the possibility of knowing and perceiving our environment.

The context is a very valuable source of information when establishing less imprecise or vague meanings for the information that we process when constructing our perceptions and building our 'knowledge domains'. This information allows humans to exist in less ambiguous universes, in which the degree of certainty is greater because information that is not always universally meaningful is taken into account.

4.1. Perception: an emergent property

> The fuzziness of perceptions reflects the finite ability of sensory organs and the brain to resolve detail and store information. A concomitant of fuzziness of perceptions is the preponderant partiality of human concepts in the sense that the validity of most human concepts is a matter of degree. For example, we have partial knowledge, partial understanding, partial certainty, partial belief and accept partial solutions, partial truth and partial causality. ([1] p.309)

Fuzziness as described by Zadeh in the preceding statement is the consequence of our partial and finite knowledge, and this determines that the concepts and information that we use to resolve problems are associated with degrees of validity or certainty. However, we have to take into account that perception is not built exclusively by adding the components that constitute it together.

We agree with Zadeh that none of the components of perception generate perception themselves. However, when they all interact they create a cognitive map or network which allows us to construct our perception of the world.

Individuals can develop different perceptions of the world using different cognitive strategies, different information, different beliefs or suppositions, according to the abilities and competences they have acquired and developed in their past experiences. The individual processes that are activated to establish relationships between the components of their perceptions, to give meaning to the stimuli or information that is being considered can be carried out through different procedures and processes given that their previous experiences will be different.

However, in Zadeh's statement perception is a closed system in which diverse components interact to give rise to perception. His proposal is linked to a structuralist view of perception that omits the fact that perceptions occur within a context of experiences that acts as a source of implicit information.

Unlike the interpretation posed by Zadeh, perception is an open system that involves capturing information within the context that it is produced. This process is not limited to the interaction of pieces of information, comprehension, certainty, etc., to which fuzzy values are attributed, but rather, at the same time, the relationships themselves are fuzzy. The problem is more complex because it incorporates information (which can be very imprecise) on the environment and that information is chosen by or suggested to individuals according to their past experiences.

> Just what is suggested to a person in a given situation depends upon his native constitution (his originality, his genius), temperament, the prevalent direction of his interests, his early environment, the general tenor of his past experiences, his special training, the things that have recently occupied him continuously or vividly, and so on; to some extent even upon an accidental conjunction of present circumstances. These matters, so far as they lie in the past or in external conditions, clearly escape regulation. A suggestion simply does or does not occur; this or that suggestion just happens, occurs, springs up. ([5] p. 117)

Take for example a roundabout. If we study its traffic, analysing the number of vehicles that enter the roundabout in a given moment, where they enter from, the space each vehicle occupies until it exits, and so forth, we can use this information to efficiently programme a stoplight to regulate its traffic. However, if we eliminate the stoplight altogether, allowing drivers to enter and exit the roundabout freely, we can observe that the traffic flows just as efficiently, or even more so, than with the automated stoplight.

In an urban roundabout the drivers are often habitual users and, in this case, they know the relevance of the explicit information (the number of vehicles that use it at a given time, where the cars enter from, the space that the each vehicle will occupy until they exit, etc.). Moreover, habitual drivers will also keep in mind implicit information, such as the possibility that there will be pedestrians near the roundabout, the kind of pedestrians (children, adults), the weather conditions, etc.

Habitual users assign meanings to all of this implicit information and they continually evaluate it in order to take decisions. The decisions that habitual users adopt provide information to occasional users about the dynamics of the roundabout and this information is what ultimately regulates the traffic. So the self-regulated behaviour of the habitual users which incorporates information on the environment becomes explicit information for occasional users and is significant to use the roundabout efficiently.

How humans use information, sometimes irrelevant, to construct a context for meaning that allows us to build our perceptions of the world, its problems and possible actions to resolve them, is still hidden from the proposals to represent perception offered by Zadeh.

Although his 'computing with words' proposal has the potential to open new areas of research in soft computing by incorporating the need to represent language meanings (and not only the meanings of the words), it is still falls short of justifying that this methodology

makes ‘computing with perceptions’ possible.

Advancing the representation of perceptions could increase the ability to represent the way that humans use our problem solving abilities, but this will require going beyond merely representing language meanings; we will have to be able to represent perceptions, considering how humans use implicit information to give meaning to events that occur in the real world.

5. Conclusion

It is often stated that humans are able to take decisions and act even when working with vague, imprecise, uncertain or incomplete information. However, while it is true that ‘explicit’ information is relevant in decision making and problem resolution, we do not limit ourselves to just this kind of information.

Humans construct meanings, we attribute meanings and we assess that attribution in accordance with information that is usually not considered in computer representation processes. The source of ‘implicit’ information that humans use to make decisions is the information provided by the perceived context which determines the assignation of meaning to explicit information.

In human processes, the construction of perception is a property which emerges from the relationships that we establish between knowledge, comprehension, the assignation of certainty, beliefs or suppositions, mastery of causalities and the ability to resolve problems. We can describe these components as the ‘explicit’ information used. But beyond this explicit information, humans also use ‘implicit’ information which comes from the environment or the context in which we find ourselves. This kind of information is just as powerful as explicit information when constructing meaning, and our perceptions of the real world.

Our knowledge, always under construction, forever incomplete, requires the information we use to be contextualised in order to establish degrees of validity when assigning meanings. Sharing the context of meaning allows perceptions to be shared and it gives social value to expressions such as ‘very intelligent’ or ‘attractive’. Sharing perceptions, in terms of contextualising information, allows the resolution of problems to be acceptable or shared by members of a community and allows social validity to be assigned to the resolution of problems.

From this perspective, computer representation of intelligence (in terms of problem solving) requires representing processes involved in analysis, interpretation, the assignation of meaning and the assignation of validity to (explicit) information in accordance with our context (implicit information) in order to resolve problems. In summary, the possibility of using computers to represent experiential context could constitute a perception representation model and, in consequence, the representation of human knowledge.

References

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