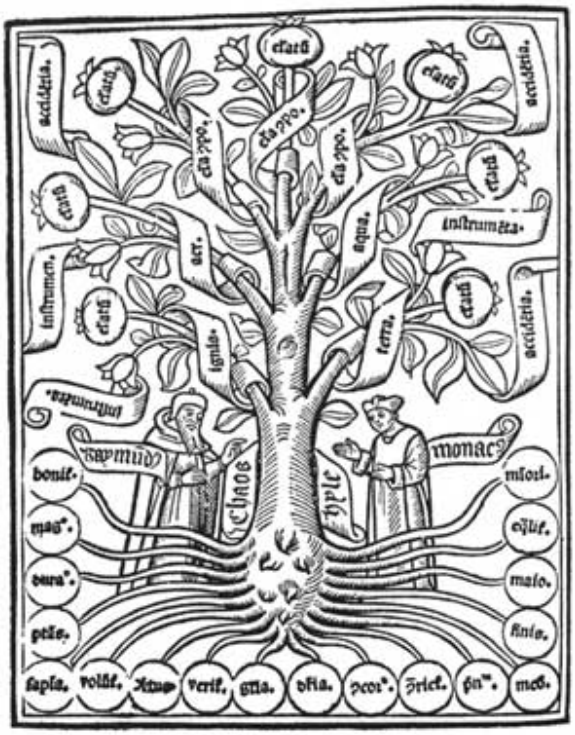
PRELIMINARY GLOSSARY



It is here presented a preliminary approach to the *glossary of concepts, metaphors, theories and problems concerning information*, which the BITrum research group agreed in its constitutional meeting of November the 7th 2008 as a first interdisciplinary action. Project coordinators have developed this preliminary glossary for a short number of entries as an example of what-it-could-be. As it has been previously aware, the glossary –as an interdisciplinary tool- has a two-fold objective: 1st) the clarification of terms, metaphors and theories used by each point of view and, as well as the analysis of the main problems regarding information from each approach. 2nd) To reflect the state of the interdisciplinary research within the project as a result of disciplinary work and the interdisciplinary debate (consequently, being one of the public faces of the project). Because some terms may be of restrictive use in specific disciplines and others are open to general controversy, some articles will be concise while others may exhibit a larger extension.

In the following glossary the main voices are highlighted with bold characters, followed by the most common used names for the same concept –or the nearest ones- in French, German and Spanish. Whenever a voice is used in compound names the simple voice is typed in uppercase before all the compounds ones. Instead of rewriting the simple voice, it is symbolized by the special character ~. Secondary voices are typed in italics within articles of the primary voices. Whenever a voice is highlighted in italics and goes along with the symbol →, it indicates that such voice is further developed in an article of the glossary. In case a particular voice is used in a restricted field or only by a limited number of authors author, these are pointed out between square brackets.

For abbreviation purpose, the following ACRONYMS have been frequently used in the text:

AIT	*Algorithmic Information Theory*
MTC	*Mathematical Theory of Communication*
UTI	*Unified Theory of Information*

A

Alphabet (F. *alphabet*, G. *Alphabet,* S. *alfabeto*)**,** term commonly used in the communication model or information transmission model (especially on the syntactic level, such as in the case of MTC), in order to designate a finite set of symbols or messages that make up the →*code* used in communication and which must be known for both the emitter and receiver.

Aspects of **information** (F. *aspects de l'information*, G. *Aspekte der Information,* S. *aspectos de la información*) (also referred as *dimensions*), the designation of syntactic, semantic and pragmatic aspects proceeds from the conception of the →*sign* of *Peirce* according to a triple perspective which links them with themselves, with the object and subject. The said triadic relationship is taken by *Morris*, who links it to his study: syntax, semantics and pragmatics, respectively (→*levels*).

Autopoiesis (αυτο-ποιησις, 'auto (self)-creation'), neologism introduced in 1971 by the Chilean biologists Humberto *Maturana* and Francisco *Varela* to designate the organisation of living systems in terms of a fundamental dialectic between *structure* and *function*. Although the term emerged in biology, afterwards it came to be used in other sciences as well. Its use by the sociologist Niklas Luhmann is worth pointing out. It can be said that →the *UTI* takes and reproduces the concept in more differentiated categories (→*self-restructuring, self-reproduction* and *self-recreation*).

For Maturana and Varela, *autopoiesis* is a fundamental condition for the existence of living beings in the continuous production of themselves. According to Maturana (*Transformation in coexistence*), "living beings are networks of molecular production in which the produced molecules generate, through their interactions, the same network that creates them". *Autopoietic* systems are those that show a network of processes or operations that characterise them and which have the capacity to create or destroy elements of the same system as a response to the disturbances of the medium. Within them, even if the system changes structurally, the network that characterises them would remain invariable during its whole existence, maintaining its identity.

For *Luhmann*, autopoiesis means a new theoretical paradigm, which, if applied to social systems, has a self-referential nature that does not restrict itself to the structural level; the nature itself constructs the elements that make it up. So, whereas in biological systems self-reference corresponds to self-reproduction, in social (or psychic) systems, it is constituted through *meaning* (Sinn), which, in its turn, is produced by the "processing differences" which permit to "select" from the "meaning offer" (*Mitteilung*). According to the Luhmannian interpretation, "communication" (*Kommunikation*) melts the difference between "information" (*Information*), the "meaning offer" (*Mitteilung*) and "understanding" (*Verstehen*) (in which each part differentiates the other two and leads them towards a unity), where the *information* is

but a selection within the "meaning offer" through a connection between differences. Therefore, there would not be strictly a transmission of information between emitter and receiver; instead, the first one makes a suggestion for the selection of the second one, so that the information for both is different, although, in any case, it is constituted through communication processes.

B

Behaviour (F. *comportement,* G. *Verhalten,* S. *comportamiento*) [UTI] is generally used to refer to the set of responses of animals or humans to exogenous stimuli (from the environment) or endogenous stimuli (from the organism itself). It plays a key role in the →*UTI* as a fundamental feature of the →*macro level* (where the pragmatic aspects of information are expressed separately) as regards the manner in which the system interacts with its adjacent ones in the network. What *structure* is to the *micro level* and *state* to the *meso-level, behaviour* is here to the *macro-level*, of which external manifestations of the system (or *output*) are a part, whose possible difference must be based on a change of the state. At the same time, the state must be based on a change of the relationships or elements of the structure.

The information appears when the self-organising processes give rise to a qualitative change in any of the three levels, so that only a portion of the entry (or stimuli) of the entrance will entail a change in its internal structure. At the same time, a part of the structural changes will involve a change of state and, finally, only one part of the changes of state will result in a change of behaviour, through which the system will respond to the environmental changes, whose severity will force the system to modify its activity, either following its own interest or that of the network to which it belongs. From this point of view, behaviour involves the highest manifestation of information, where the syntactic and semantic aspects are subsidiary, representing the precondition of behaviour.

C

Channel (F. *canal*, G. *Kanal,* S. *canal*), *Communication* ~, in the MTC and many other information and communication theories by extension, deals with the medium (or set of media) that allow(s) transmitting the signals generated by the transmitter to the receiver. As stated by Shannon: "merely the medium used to transmit the signal from transmitter to receiver. It may be a pair of wires, a coaxial cable, a band of radio frequencies, a beam of light, etc".

It could be said that the objective of the *transmission codifier* is to adapt the messages, send through the information source, to the characteristics of the channel (which has certain limitations and available resources, such as the bandwidth or frequency margin that can be send). In the analysis, Shannon distinguishes between *channels without noise* (which is nothing but a theoretical abstraction that can approximately correspond to a situation in which the noise

is negligible with respect to the received signals) and *channels with noise* (which is the normal situation and must especially be taken into consideration when the noise is notably present with respect to the signal).

A fundamental part of Shannon's theory is aimed at finding the limits of the →*information amount* that can be sent to a channel with given resources (*Shannon's fundamental* →*theorem*).

Code (E. *código*, F. *code,* G. *Kode*) is a system of signs and rules for converting a piece of information (for example, a letter, word, or phrase) into another form or representation, not necessarily of the same type. In communication (especially, in telecommunications) and information processing, **encoding** is the process by which information is converted into symbols (usually belonging to an →*alphabet*), which are communicated, stored or processed. **Decoding** is the reverse process which reconverts code symbols into information that is understandable or useful to the receiver.

Note that from this point of view the code is supposed to be known by the sender (or source) and the receiver (or destination) simultaneously, which explains the intercomprehension between them (in case it involves intention) or interoperability (if the information is understood only at a *pragmatic* or *operational* →*level*). Therefore, we would be dealing with a traditional perspective related to reversibility, which would explain neither the emergence nor dynamics of this code. An improvement of this perspective can be found in Foerster´s criticism of →*cybernetics* of the *first order*, which is intended to be improved in cybernetics of the *second order* in order to explain the self-referential and →*autopoietic* processes.

In *semiotics,* as regards the system of signs, a code is a system of correlations or correlation rules between the coding system (system of signifiers, syntactic space or expression space) and a codified system (system of meanings or semantic space or content space). In the words of Umberto *Eco*, the code "associates a vehicle-of-the-sign (or signifier) with some-thing that is called its meaning or sense".

CONTENT (F. *contenue*, G. *Gehalt*, S. *contenido*)

Qualitative ~ of information: generally used to distinguish it from a purely quantitative consideration on information. It is aimed at highlighting the fact that information can be viewed from different perspectives or →*aspects*. Only when the focus is limited to one of them, it is more easily abstractable, which makes its quantification more feasible (which is normally unidimensional). Nevertheless, given the limitations of the syntactic aspect (relating to a limited group of symbols and rules) regarding the eminently open character of semantics and pragmatics, it is not surprising that the goal of the quantification of information has been a success in the syntactic level and not in the other two.

Information ~ [Chaitin]: $I(x)$ of a binary sequence x is defined as "the size in bits (number of binary digits) of the smallest program for a canonical universal computer U to calculate x".

Informational ~ [Israel and Perry]. In the *situational semantic* approach of Israel and Perry, where the relationships between the contents of

an information system are considered as architectural, the *informational content* of a fact may involve very remote objects from those involved in the particular fact and will "only be *information* when the constraints and connecting facts are actual". ("Information and architecture". In J. BARWISE, *et al.* (Eds.), *Situation theory and its applications*, 1990, pp. 147-160).

Semantic ~ or '**Semantic ~ Amount**' [Bar-Hillel, Carnap], in the probabilistic approach to the semantic information provided by a proposition *p*, the authors suggested a measure of content, CONT (*p*), which would be additive for statements with exclusive contents: $\mathrm{CONT}(p) = 1 - \mathrm{P}(p)$, where P(*p*) is the so-called "absolute logical probability" of statement *p* build from atomic proposals (description of state) in a given formal language. This measure deviates from the Shannonian quantification, because it is not additive for inductively independent statements, and, instead, it is proposed the *informativity* INF(*p*), which is indeed similar to the standard measure.

Context (F. *contexte*, G. *Kontext,* S. *contexto*). Coming from the Latin verb *contextere*, meaning 'to weave' or 'interlace'; in a figurative sense, it refers to the interlacement of the meanings contained in a text or communication, in general, as well as to the circumstance in which this communication occurs (e.g. physical, pragmatic and cultural environment), which allows for the specification of the meaning of the transmitted information. Although the meaning of 'context' in relation to statements is common, by extension it is also applicable to the structure in which it is situated, and without which it would be unintelligible or less intelligible.

A distinction can be made between *situational context* (or non-expressive context) and *expressive context,* relating to the set of syntactically and semantically related expressions, which, at the same time, are articulated through *deixis* and modal indicators in the situational context. In its turn, the *situational context* can be divided into: *general* (related to the communicational situation defined by the time, place and action within which the communication is framed), *social* and *personal* (defined by the relationship between the statements, their attitudes, interests and their respective meanings of knowledge).

There is great disparity in the analysis of context from the different notions of information: from complete oblivion (in the more objectivisable meanings of information, according to which the information is entirely contained within the message), to central attention (in those perspectives for which information makes only sense in social frameworks or in the adaptation to the environment, according to which the message is a mere key to release the information contained in the context). It is ironic that, while in linguistics the consideration of context was brought to the forefront and in physics the classical conception of the outside observer was lost, at the same time the →*MTC* defined information as a characteristic typical of the information source, without making reference to its context. Something similar

could be said about the founding of the "cognitive sciences" in the "symposium on information theory" of 1956, which minimized the consideration of cultural and historical contexts in which cognitive processes happen. Nevertheless, although we could talk about epistemological anachronism, there was still a discussion going on about the hidden variables in quantum theory, and also the project on the unification of sciences of Vienna´s circle was still running, whereas the so-called historicist turn, which would underline the importance of cultural contexts, was still far away.

In any case, in →*cybernetics,* the contextualization of information has been an intrinsic aspect of its theory from the very beginning, as it is in the pragmatic situation (which, in its turn, involves the environment) that information gains meaning as a fundamental means to pursue an objective. Even so, it is cybernetics of the second order which will put a bigger demand when it comes to contextualisation, as it will make the system's regulative structure dependent of the possible changes in the environment, in order to survive.

On the other hand, from a quantum physics point of view, information is – as stated by Mahler – a "contextual concept", intrinsically linked to a "situation". This *situation* is but the dynamic scenario in which a system takes "decisions", giving place to an "information flow". Therefore, in accordance with current physical theories, one cannot say that information is encoded in physical, elementary components, but that it appears after measuring. (*v.* →*qbit*; MAHLER, G., "Quantum Information". In KORNWACHS and JACOBY (Eds.), *Information. New questions to a multidisciplinary concept*, 1996, pp. 103-118).

It is also from the analysis of the semantic aspects of information that a change has been observed in which there is more consideration for the context: from the "ideal receiver" of Bar-Hillel and Carnap (1952), capable of assessing information in terms of a structure of atomic statements (in an almost formalised language), to the *situational semantics* of Barwise, Perry, Israel… (1980s and 1990s) in which language ceases to be the property of events and comes to depend on the context and the consistency restrictions between statements (→*informational contents*). Here, it is also worth pointing out the proposal of Dretske of considering information in relation to a knowledge background and the proposal of Floridi of basing information not on terms of truth (as Dretske or the situationalists do and which, in a certain way, involves a privileged view beyond all context), but on terms of veracity, which, in its turn, entails the fallibility of the interpreter and the pertainance to a temporality and a finite knowledge.

Although, as mentioned before, many of the information theories related to cognitive sciences show a reducing trend to minimise the role of context, in other fields of social science, concepts have arisen that highlight it as an essential element. Therefore, while under the cognitive interpretation the subject extracts information from the physical-chemical properties of the sensory stimuli, in

the hermeneutic, historical, critical-sociological and Luhmannian approach, the reference and meaning only appear contextualised in a cultural world.

In *hermeneutics*, understanding is seen as something determined by schemas of pre-understanding determined by the cultural context of the interpreter. In the *historical approximations*, information acquires the level of genuine historical phenomena (*cf.* BROWN, J. S. and DUGUIN, P. *The Social Life of Information*, 2000; BORGMAN, A., *Holding on to reality. The nature of information at the turn of the millennium*, 1999; regarding that essential temporality of information, Matsuno starts from assumptions that are strictly physical, "The Internalist Stance. A Linguistic Practice Enclosing Dynamics". *Annals of the New York Academy of Sciences*, 901, pp. 332-350, 2000). In Luhmann's →*systems theory*, there is not exactly a transmission of information, but the emitter limits him/herself to making a suggestion for the selection within the "offer of meanings" (Mitteilung), which defines a communication process in a specific, socio-linguistic case. However, in Habermasian critical sociology, the subject (or receiver) –although framed closer to a specific vital horizon– has a reflexive faculty (or communicative competence, attained by virtue of being part of a certain social group), which allows him eventually to show the distortions, irregularities and censures that condition all factual communication processes. In this way, Habermas, in the contextual interpretation of information, makes it possible –to put it this way – to go beyond the Luhmannian "offer of meaning" or to move –by means of willpower– the hermeneutic vital horizon.

Contradiction (F. *contradiction*, G. *Widerspruch,* S. *contradicción*). Relationship between an affirmation and a negation with the same subject and predicate. It was traditionally studied under the "principle of contradiction" (or of "non-contradiction") and initially formulated and studied by Aristotle as a supreme principle of beings and of thinking; it can be formulated as follows: "It is impossible for the same attribute to belong and not belong to the same thing, *at the same time and under the same respect*".

Its interpretation can fall on two main aspects: the ontological and logical one, going so far as to become, when it comes to the ontological principle, an expression of the structure constituting what is real. However, its decline as an unquestionable principle could situate itself in Hegel's consideration of contradiction as a basis of reality's internal movement (although one must take into account that, in most cases, the philosopher refers more to opposing realities than contradicting ones). Within the dialectic tradition of Hegelian origin, Adorno considers that a link would exist between the ontological and logical aspects, according to which "reality's repressive structure" and survival's coercive character are reflected in the logical principle of contradiction. According to its negative dialectics, the possibility of transcending the said principle and the one of identity summarises the self-improving capacity of the social

contradictions. Therefore, according to the dialectical tendencies, in general, the consideration of the logical principle is only subordinate to the need for improvement of reality's contradictions.

From this –so to speak– utilitarian consideration (or genetic one, according to Adorno's interpretation) of the principle of contradiction, some of the theories of information based on *self-referential* systems would participate. For example, from a *cybernetic* perspective, the logical principle of non-contradiction can be considered as being a part of the mechanism of regulation, under normal conditions, whereas its improvement would correspond to the need of readapting the said regulation to changing circumstances (→*positive* and *negative feedback*).

Although the principle of contradiction would be easily refutable in its most brief expression (deleting the part in italics of the previous formulation and without which it would be exposed to a large number of paradoxes), it is advisable to notice that the consideration of "*at the same time and under the same respect*" makes it less vulnerable and introduces a necessary *contextualization* of the statements (to which we have referred to in the *context* article) for a correct analysis of the consistency of the semantic content of information, such as the approximations of Bar-Hillel and Carnap, Dretske and the situationalists propose (but only the lasts consider the key issue of contextualization).

In any case, the claim to consistency in what will be considered →*informational content* means that contradictions have no place and, consequently, the probability of receiving self-contradicting information would be zero (according to a naturalistic vision on information, such as the one of Dretske, the ontological version of the principle of contradiction would say that reality cannot emanate from contradictory information, because reality proper rejects it). Therefore, in case of considering the semantic content of an informative statement –according to the *inverse relationship principle* of Barwise– as opposite to its probability, one would come to the paradox that one contradiction would give us a maximum amount of information. Floridi calls this the →*Bar-Hillel-Carnap Paradox* and the most common point in most of semantic approximations is to get rid –one way or another– of the said contradictions. Nevertheless, if a dialectical point of view were to be adopted (for example, the critical theory of the Frankfurtians), then contradiction is not something to which to turn a deaf ear, but, on the contrary, the possibility of updating the vision of reality with less contradictions. That is to say, somehow it could be that contradictions would announce a new world to us –to call it this way– a new way of seeing things (Weltanschaung) in which perhaps, when achieved, new things could be seen while the things seen before would dissolve along with past errors. An example of this is the abandonment of classical physics and the birth of contemporary physics according to the contradictions which piled up from the reading of experiments of a very diverse nature –optical, electrical, astronomical … (*v.* POINTCARÉ, "The principles of mathematical

physics (1904)", in EINSTEIN *et al.*, *The theory of relativity*, 1995).

Nevertheless, it should be pointed out, on the one hand, that in few cases the so-called contradictions follow the clause of "*at the same time and under the same respect*" and, on the other hand, that in a normal situation –or what Kuhn would call, concerning research work, "normal science"– the contradictions serve to detect false information, wrong interpretations… and, in this way, the principle of contradiction becomes an essential tool to receive information, as well as for the incorporation of it in a knowledge system.

CYBERNETICS (E. *cibernética,* F. *cybernétique*, G. *Kybernetik*) comes from the Greek Word *Κυβερνήτης*, meaning the art of steering a ship, used by Plato in the sense of guiding or governing men. Nowadays, it refers to the study of the control and communication of complex systems, whether they are living organisms, machines or organisations, paying special attention to the →*feedback* as the main way of regulation. It is usually considered that it has been properly formulated in a work of Norbert *Wiener* of 1948 (*Cybernetics, or control and communication in the animal and machine*, 1948), for whom cybernetics is a science that studies control systems, especially, self-control systems, whether in living organisms or machines, where this "control is the sending of messages that truly change the behaviour of the receiving system". Both in its genesis in the 1940s –with contributions coming from evolutionary biology, von Uexküll, psychology, Anokhin, systems control, Wiener, neurophysiology, McCulloh and Rosenblueth, psychiatry, Ashby…– as in its last development, it has been an eminently interdisciplinary discipline.

For cyberneticist *Gregory Bateson*, cybernetics is the "branch of mathematics which deals with issues of control, resources and information", while from a more general point of view for *Stafford Beer* (who is considered to be the father of management cybernetics) it is "the science of effective organisation"

First order ~ or **classical ~** and **second order ~** (E. ~ *de primer y segundo orden,* F. ~ *de premier et deuxième ordre*, G. ~ *erster und zweiter Ordnung*). In 1958, Heinz von Foerster conducted a critical review of the cybernetic theory of Wiener, observing that although this theory was introducing significant changes regarding the previous conceptions of regulation and control, it did not involve an epistemological break with the traditional conception of science, because a model continued to be applied in which the observer contemplates the object or the system from outside without influencing it and achieving to study it objectively. Von Foerster believed that cybernetics should overcome this epistemological anachronism, so that the observer would be part of the system, asserting his own goals and his own role within the system. Since then, there is a distinction between *traditional cybernetics* or *cybernetics of the first order* and *cybernetics of the second order*, also named *complexity theory*. While cybernetics of the fist order is formulated in a

fundamental way: What and how are the mechanisms of feedback of the studied system? Cybernetics of the second order would raise a question: How are we able to control, maintain and generate this system through feedback?

Cybersemiotics [Søren Brier]. By means of connecting Peirce's semiotics (→*sign*) with the →*cybernetics of the second order*, Brier defines *cybersemiotics* in terms of a dynamic and contextually adaptive relationship between a sign, an object and an interpreter. According to Capurro it is conceived as a "hermeneutics of the second order that extends the concept of interpretation beyond human knowledge, relating it to all kinds of selective processes".

E

Encoder (E. *codificador,* F. *codificateur*, G. *Kodierer*) is a device for converting data or signals by using a specific *code*. It is normally used with four clearly differentiated purposes: 1) To remove redundancy or anything that is not going to be perceived by the information receiver or remain beyond the quality objectives of the received signal, in which case we talk about a *source encoder*; 2) To increase the redundancy so that the decoder can eventually detect and correct the errors that have occurred during the reception of signals or symbols; in this case we talk about a *channel encoder*. 3) To make the coded data unreadable, except when the code is known, by using the *encryptors or ciphers*; 4) *To allow* the transmission of data through a channel with certain resources and limitations that would correspond (in a model used in the MTC) to the *transmitter-encoder,* which, especially in telecommunications, is called *modulator*.

The **decoder** (E. *decodificador,* F. *decodificateur*, G. *Dekodierer*) would be a device that performs the inverse operation, whatever the purpose of the code: the *source* decoder would try to restore the eliminated redundancy; the *channel* decoder would remove the redundancy that has been introduced by the corresponding encoder, and correct the errors that can be detected; the *decryptor* would make the data readable; and the *demodulator* or receiver/decoder would identify the symbol transmitted through the channel –normally according to a maximum likelihood criterion– and restate the data into the form that it had before the modulator.

Entropy →*Information Amount*.

Erotetic Analysis [Floridi] (from Greek ἐρωτάω, 'to ask') refers to asking questions in order to determine what the source is communicating. If all questions accept a binary response (yes, no), the number of questions and answers corresponds to the information given by the source (in bits). This interpretation of the →*information amount,* which is Shannonian and compatible with its conception of information in terms of the receptor's uncertainty, is possibly the one most closely linked to the common notion of information as "that which allows us to know about something" and which is naturally linked to the fact we are uncertain about what has happened. One logical way of remedying this ignorance would be through questions. Note that if the uncertainty would

be reduced to only $N = 2^k$ states of equiprobable things, $p = 1/N$ (for example, picking a card out of a deck of 32), the most economic way of knowing what is the case through binary answers would be through $\log_2 N = k$ questions.

It can also easily be guessed that if any of the cases were to be more probable (for example, in half of the cases the same card would be picked) then the questions could be asked in such a way that, on average, they would require less questions and answers. In short, one can observe that the Shannonian expression $-\log_2 p$ (for a message) has a certain naturalness or coherence with one of the basic intuitions related to information.

As Floridi points out, an erotetic analysis allows us to separate data from semantic content, reducing them to binary answers, which are represented by their corresponding questions. In a Carnapian sense, the questions would correspond to the intensity and the responses to the extension, which in Fregean terminology could be linked to sense and reference, respectively.

Following Floridi, "semantic content is unsaturated information", whereas data may be considered as "a key to unlock [semantic] information contained in the query". The Shannonian entropy, which is characteristic of the data, would, therefore, represent the average "amount of details… to saturate the informee's unsaturated information", which can also be interpreted as a "measurement of the freedom of choice" when it comes to answering.

EVOLUTION

~ phases [UIT] physical phase (Reflexion, →*self-restructuring* systems), biotic phase (Representation, →*self-reproducing*), cultural phase (Anticipation, →*self-re-creating*).

I

INFORMATION

Common or **Mutual ~** of two strings, $I(x:y)$ [Chaitin]

Conditional or **Relative ~** of a string x given y, $I(x|y)$ [Chaitin]

Saturated and **unsaturated ~** [Frege] →*Erotetic Analysis*.

~ Aesthetics or **~ Aesthetics Theory** (F. *Esthétique informationelle*, G. *Informations-Aesthetik*, S. *Estética de la informacion*)

~ Amount or **Entropy** (E. *cantidad de información, entropía,* F. *quantité d'information, entropie*, G. *Informations-gehalt, -entropie*) [Shannon], from a discreet information source, characterised by the probability p_j of producing each of its symbols j, the *entropy* of such a source of information:

$$H = -\sum_j p_j \log_2 p_j \text{ (bits)}$$

Which is delimited by $0 \le H \le \log_2 N$, where N is the number of symbols.

In case the source shows various states i, with Pi being the probability of the state, and each of them being characterized by a probability $p_i(j)$ of producing symbols j, then the *entropy* is defined as the average of the entropies of each state:

$$H = \sum_i P_i H_i = -\sum_{i,j} P_i p_i(j) \log_2 p_i(j) \text{ (bits)}.$$

In accordance with Floridi (→*Erotetic Analysis*), *entropy H* can designate, in the ideal case in which a channel has no noise, three equivalent quantities: 1) average of the information generated by the informing agent (by each symbol); 2) average of the deficit quantity of data (Shannonian uncertainty) by the part of the informed agent before he inspects the output of the informing agent; 3) informative potentiality.

Given the fact the first two interpretations assume that a defined uncertainty corresponds to each symbol (whether it is in the input or output), at the same time this involves a certain tactical agreement of the alphabet or informational game in which the agents are immersed. In both cases, the information can be quantified under the condition that the distribution of probability can be specified.

According to the third sense, one could understand entropy in terms of a physical magnitude related to the amount of disorder in processes or systems that carry energy or information.

The bigger the entropy, the bigger the number of physical states in which the system can find itself and, consequently, the more information it can refer to or, differently said, the specification of the state in which a certain system finds itself will require more information as its entropy increases, which will be numerically equivalent to the amount of information or data that has to be brought in order to specify the state.

~ Sciences (F. *sciences de l'information,* G. *Informationswissen-schaften,* S. *ciencias de la información*) →*Library Science.* Although in Spain it tended to be considered a synonym of *Communication Sciences,* with special emphasis on the field of journalism, in other Spanish-speaking countries it was used in the English sense of *Information Science* (→*Library Science*). However, also in the Spanish academic field the English discipline is framed within the *Information Sciences*, as it teaches *Library Science* in many of its faculties.

Informativeness or **Amount of Semantic Information** [Bar Hillel, Carnap]

Input *vs* **Output** (input –system) [Fenzl] Action *vs* Reaction [Karpatschof]

K

Knowledge (F. *connaissance*, G. *Erkenntniss*, *Wissen,* S. *conocimiento*). From the majority of viewpoints regarding information and knowledge, the relationships between these two concepts is close, especially as far as the common use of both terms is concerned. As a rule, the position of information is lower than that of knowledge, with information somehow 'nourishing' knowledge. Nevertheless, this connection is ignored in cases of a *syntactic radical* vision, where the problem of the relationship is avoided to address only its technical dimension (as in the →*MTC*) from a *radical pragmatic* point of view in which only what-is-being-done is called into question, so that the information is

considered as a mere instrument of the action and, therefore, the problem of whether the information refers to objects (be it in terms of whether we are dealing with a correct perception or if it is known that *p* be the case) is ignored.

Although conceptions of knowledge are and have been very different, such as for the opinions regarding its *definition*, *possibility*, *basis* or its *modes*, we can say that two fundamental models have prevailed: the *iconic* one, according to which knowledge is an accurate picture (of mental nature) of the object of knowledge, and the *propositional* model, whereby knowledge is a real proposition. The problems of the *iconic* model, where perception and apprehension play a key role, lies in the specification of the limits between object and subject, as well as in the explanation of non-iconic knowledge (such as logical, mathematical and relational "truths"). However, in the *propositional* model, where the scientific statement plays an exemplary role, the inevitable circle, which comprises the justification of knowledge, becomes problematic (→*Gödel´s incompleteness theorem*). But, whatever the model of representation, there would be a difference between knowledge and a *true opinion,* insofar as only that one knows how to justify himself (although its justification is only partial or problematic).

According to what is said, it is clear that in all those ideas on information in which semantic dimension is considered, its link with knowledge must appear. Normally, a more analytic concept for information is adopted and a more synthetic one for knowledge, as well as a bigger proximity to the object on the part of the information and to the subject on the part of knowledge.

For Dretske "knowledge is belief produced by information", and belief always relates to a background of knowledge. From a naturalistic perspective, in which a casual dependence occurs among the internal states of a living being and external conditions, information for Dretske creates experience (sensory representations) and causes beliefs (cognitive experiences), which underlie the sedimentation of knowledge.

According to Floridi´s semantic approach, *knowledge* is constituted in terms of justifiable *semantic information*, i.e. information constitutes the elements for further inquiry. In its turn, *information* is the result of a *data* modelling process, which –unlike the Dretske's naturalistic assumption– does not necessarily represent the intrinsic nature of the studied system (or is not necessarily directly linked to it by a causal chain), instead, it will depend on the development of the data by knowledge. In turn, the data are conceived as resources and restrictions that allow for the construction of information. Therefore, one can say that Floridi proposes an architectural relationship between knowledge, information and data, where the first one is situated on the summit and the data on the base. At the same time, and as a result of this interrelationship, he replaces the requirement of *truth* of Dretske (who also endorses the situational semantic theory) by a requirement of *truthfulness*, so that instead of searching for

a correspondence between the statement and the content of the information, a correspondence is rather being sought between what is reported and the informant.

In the →*UTI, knowledge* is constituted by means of interpreting the *data* (or assigning meaning), which, in turn, is the basis for decision-making that makes up "practical wisdom". In this case, we are talking about different levels of information rather than a dependency relationship, so that information is gradually processed: first, at the syntactic or structural level, then at the semantic or state level, and, finally, at the pragmatic or behavioural level. The information processing is performed by means of interrelationship between the adjacent strata and not in terms of a casual progression (as in Dretske's naturalism).

L

Library Science and **Special Librarianship** (F. s*ciences des bibliothèques*, *bibliothéconomie*, G. *Bibliotheks-, Dokumentations- wissenschaft,* S. *biblioteconomía,* –Amer.– *bibliotecología*). At the beginning of the 20th century, the term 'information' was frequently linked to *Special Librarianship* in the English speaking world. After a period of time in which this activity had been associated to *Documentation*, in the 1960s it came to emerge with what came to be called **Information Science** (which in some Latin-American countries has been translated into "Ciencia de la Información", which is close to the English meaning). According to Capurro and Hjørland, this was caused by the growing interest in computer applications, the influence of the Shannonian theory and the current information processing paradigm in the cognitive sciences. When it comes to the academic disciplines regarding librarians and documentalists, two clear trends have been distinguished in Library Science: the *general* one, which, in a certain way, is aimed at public libraries and which highlights general education and is widely separated from the knowledge it serves, and the *specialised* one, aimed at specific subjects. However, although this second stand was relatively dominant until the 1970s, from that moment on it came to lose its dominant position as education tended to become more general and inclined towards psychology, subjective idealism and methodological individualism. At the same time, it can be spoken about the emergence of an intermediate way which could be branded as a neutral specialisation (even formal or abstract), the *domain analytic approach* (which, in its turn, is related to hermeneutics, semiotics and social constructivism).

According to Griffith's definition (*Key papers in information science*, 1980), "Information Science is concerned with the generation, collection, organisation, interpretation, storage, retrieval, dissemination, transformation and use of *information*, with particular emphasis on the applications of modern technologies in these areas". The objective of its disciplinary framework is "to create and structure a body of scientific, technological and system knowledge related to information transfer". That is to say, – despite the problematic or contingent link

Griffith makes with respect to the used tools– one can say that we are dealing with a science which contains elements that are *theoretical* (except for its specific application) and *applied* (aimed at services and products).

Regarding the conceptualisation of information that is carried out in this field, it could be said that special focus is put on two opposing meanings: 1) the information as an object in documents and 2) its radical subjectivisation, i.e. information as everything "that can be informative to someone".

N

Negentropie [although the concept was introduced by Erwin *Schrödinger* in 1943 the term was first used by Léon *Brillouin* in 1953…]

Self-re-creation [used in the *Unified Theory of Information* as one of the three basic capacities of information systems –the most advanced]: capacity of the **self-re-creating systems** to create the necessary conditions, not only for their reproduction, but also to create themselves according to the objectives that they have established themselves. In their capacity to change the environment for their own settlement, they show an even bigger capacity to adapt than the systems that are merely biotic (→*self-reproducing*) of which they are a part and which involve the most advanced evolutionary stage (or *stage of cultural* →*evolution*).

They can be classed as self-determining in so far as their self-organising capacities offer, under certain circumstances, a set of possibilities, which they can choose themselves. Given the fact that such a choice takes the form of a decision adopted under the condition of freedom of choice, which cannot be reduced, the pragmatic and semantic levels are separated. Consequently, in the stage of social, self-recreating and self-determining systems, the semiotic relationship spreads in its three speech production levels, which can be described in terms of the creation of ideas. Such creation happens in three stages: 1st) the perception of signals from outside the system causes the appearance of a sign, which is a modification of the system's structure; 2nd) the interpretation of the perceptions by which the system's state is modified and another sign –meaning something– emerges, which is given to the system as its objective; 3th) the evaluation of the interpretations that cause another sign to emerge, by means of which the system, as subject, completes its meaning, considering the object as an initial state to reach the end and affects the behaviour of the system in a way that it can be modified.

The sign, in each of these three levels, is called (in UTI) *data*, *knowledge* and **wisdom** (or **practical wisdom**), respectively, each one corresponding to the field of the perceptive, cognitive and evaluative capacities, which together make up the characteristics of *conscience*, which appears in systems. In each stage, a break in the self-organisation occurs, which is a starting point for another one to occur (or not occur) afterwards.

Self-regulation (or *automatic regulation*) used in systems theory and cybernetics in the sense of *homeostasis* (→*feedback*), that is to say, the capacity of a system to maintain itself in a situation of balance. Automatic regulation is mainly found within the field of electronic systems and control engineering.

Self-reproduction [used in the *Unified Theory of Information* as the intermediate capacity of information systems]: the capacity of **self-reproducing systems,** which do not only change their structure into another one more or less chosen by themselves, but they also insert these modified structures into a wider context, that of making them to help to keep their own existence. Here, a functional structure is not a simple pattern anymore, but a 'thing' that has meaning, and this 'thing' will be called here a symbol, so that the production of signs in this evolutionary stage of living systems changes from creating patterns to creating symbols.

The *self-reproducing* systems are considered an evolutionary stage (called *biotic*) among the →*self-restructuring* and the →*self-recreating* ones, so that they involve a special case of *self-restructuring* systems, as well as a case more general than the *self-recreating* ones, which encompasses them.

As far as the evolution of the semiotic relation is concerned, one can observe here a ramification in which the syntactic level is separated from the semantic-pragmatic one, the first one referring to the *sensations* of the living systems. These sensations consist of self-organised restructurings, evoked by the environmental disruptions and limited by the "offer of sensitive mechanisms" in a recursive process of symbolic production. On the semantic-pragmatic level, actions are developed according to sensations. Given that the living systems act according to what such sensations mean in terms of relevance for survival, we could talk about both meaning and action, although in an indissoluble manner: the syntactic difference means in practice a difference with regard to the objective of the survival, so that the signs now *represent* the aptitude of the system towards the environmental conditions (whereas in the self-restructuring systems one talks about *reflection*, one could talk now about *representation*).

Self-restructuring [used in the *Unified Theory of Information* as the lowest capacity of information systems] is the most primitive type of *self-organising processes* and in which the most primitive manifestation of signs also occurs. This type of systems is also called *dissipative*, because, in thermodynamic terms, they dissipate the entropy as a sub-product of the work carried out during the restructuration, in which, at the same time that the energy degrades, the system manages to get rid of it. This is necessary for the new structure to be considered a creation of a superior order, instead of a degradation of the system. The structuring process leads to a special and/or temporal pattern.

Understood as information processing, the creation of patterns is the rudimentary way of producing signals, being the pattern the distinction carried out by the system in which the three semiotic relations can be found

(→*sign*): 1st) a *syntactic* relation can be observed to the extent that the creation of the pattern is a type of recursive process which builds on the previous pattern and chooses one amongst various possible patterns; 2nd) as far as the incoming energy allows the system to change its pattern, the entrance becomes a signal that makes the new pattern arise, although it does not establish it completely. The state adopted by the system when creating a new pattern can be interpreted as a representation of the entrance, so that it can be said it is a *semantic* relationship. 3th) As long as the new pattern corresponds to the observable behaviour in which the system expresses its activity, the *pragmatic* relation remains also thematised here.

However, the three semiotic relationships coincide with the pattern and, therefore, they are not differentiated yet. It can be said that the pattern *reflects* the conditions of its environment, as the pattern depends on it. Such *reflection* of the environment constitutes a precondition for the appearance of a sphere of influence in which the behaviour of the system launches that of the adjacent ones, so that the appropriate conditions can emerge for the maintenance and improvement of the system, which will be possible in →*self-reproducing* systems.

T

THEOREM

Gödel's incompleteness ~s: *1st GIT*) Any effectively generated theory capable of expressing elementary arithmetic cannot be both consistent and complete. In particular, for any consistent, effectively generated formal theory that proves certain basic arithmetic truths, there is an arithmetical statement that is true, but not provable in the theory.

2nd GTI) For any formal recursively enumerable (i.e., effectively generated) theory T including basic arithmetical truths and also certain truths about formal provability, T includes a statement of its own consistency if and only if T is inconsistent