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SUMMARY

"CONDITIONALITY IN NATURAL AND PROGRAMMING LANGUAGES"

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SUMMAY

Keywords: command, conditionality, connectors, interconnection, interdisciplinarity, natural language, programming language, logic, semantics, syntax, structure.

1. Motivation

This present paper represents an interdisciplinary approach to the idea of conditionality in the structure of human thought and communication. Regarding available literature, there is no special work dedicated to the close relationship between conditionality as a logical act, as a speech act and conditionality in programming languages.

As a starting premise, implanted in our minds, we consider the conditionality mechanism as a given schema quite simple: "If X ... then Y". This scheme makes people articulate communication primarily through natural languages, even in several tones. For example, surreal conditionality is expressed by making use of verbal modes of unrealized possibility, i.e. the conditional-opted:

If I would have known you were coming, I would have come too.

Moreover, real conditionality appears in the current language of people:

If this is the case, I'll come too.

As part of the natural language, it was natural that such flowchart to transfer, as well, to artificial languages: the language of mathematics, Morse code, sign language movement, programming languages, etc.

In programming languages, conditionality takes different forms in commands, expressions, conditional statements, logical functions, looping or repetitive instructions (loops), but with the same meaning as in natural languages. For example:

IF (if X...then Y)

WHILE (while X...then Y)

UNTIL (until X...then Y).

In the present paper, I have approached conditionality from the point of view of a few programming languages in relation to the basic logic of conditionality and its expression in the natural system of the Romanian language.

I consider that this approach is able to view all three domains (logic, linguistics and computer science) regarding one of the most common manifestations of judgment and human expression.

2. Working Methods

The main research method used in the paper is descriptive analysis of conditional structures. More specifically, I have started by dismantling and describing the mechanisms of the conditionality relationship by appealing to formal logic (Aristotelian logic).

Secondly, I have used the tools of descriptive grammar in order to analyze the syntactic structures of conditionality that is the relations within a sentence, which contains a circumstantial conditional complement and, especially, the relations between the conditional subordinated and its regency, at phrase level. Thus I have analyzed connectors, regent types, subordinate types, modes and tenses of verbs from the two components of the conditional sentence, word order, any inference situations, overlaps and false conditionals.

Third, I have described the procedures for implementing IF-type structures in the programming languages.

From all three perspectives I managed to form a complex grid of analysis which helped me establish common elements and specificity of each area, in terms of conditionality, which, in turn, provides new data about each of the three domains of human knowledge.

3. Working material

Our research is based on the analysis of the three fundamental fields:

a) Basic logic schemes of conditionality;

b) The Romanian Grammar system, as it is codified in normative grammars (GAR GALR, GBLR), but with references to other natural, ancient and modern languages (Latin, English etc.).

c) Programming languages: C, C + +, Pascal, Java, PHP, PERL.

4. Specifying the terms

Among the common meta-language elements of logic and linguistics, the most commonly used is “sentence”. In this paper, I use the broad concept of “developed statement” corresponding to a phrase from descriptive grammar in natural languages and respectively, to a judgment from the formulas of formal logic, of mathematical logic and

even of modern, alternative logic. By classical, formal “reasoning” deductive we mean deductive judgment, based on premise / premises and conclusion (major, minor and conclusion of Aristotelian and scholastic logic):

If all men are mortal and Socrates is a man, then Socrates is mortal.

Considering, on one hand, that decomposition of logical operations is carried out through verbalization, which explains any graphical symbols, and, on the other hand, programming languages are constructed and operate based on a syntax (set of rules), and on semantics (senses of specialized terms and terminology) taken and adapted from natural languages, conditionality showed us not only the logical unlimited virtues of thought expressed in different languages, but also the corresponding value of meta-languages, corresponding to the analysis of these processes.

All programming languages used for writing applications, known elements, such as:

a) an alphabet of the language, which contains a set of elementary symbols with uppercase and lowercase letters of the Latin alphabet, decimal system numbers and special characters (+ - * /,% ...);

b) a vocabulary of the language consisting of keywords or expressions that form instructions, commands, functions;

c) a “grammar” of the language consisting of all rules which build instructions;

d) a meta language that contains "grammar" rules from the programming language.

The most commonly used meta elements are:

a) reserved words written in capital letters, namely the terms we use for commands, functions, clauses, i.e.: IF (...), ELSE, FOR, WHILE;

b) user words written in lowercase, set by the user and which represent the constructions used in computer science. Example: denprod (product name), codprod (product code), um (measuring unit);

c) brackets “[]”, employing an optional command, the programmer decides if they will be used or not.

Example:

SORT TO <file> ON <field1> [/A | /D] [/C]
[, <field2>[/A | /D] [/C] ...]

d) Accolades "{}" or vertical line "|". In command lines from program files we will use a single element or "{}" or "|".

Example: *[ASCENDING | DESCENDING]*.

5. Analytical Procedure

Our analysis followed a double dichotomy of the working perspective: diachronic and synchronic, on one hand; monographic and interdisciplinary, on the other hand. In other words, we watched how the idea of "conditional" found its purpose in schemes more sophisticated, more subtle analysis of human judgments present in historical logic stages, gradually becoming an independent science, drawn from philosophy. We proceeded somewhat similar to the case of linguistics, which has developed as a science of speech, being parallel to logic, and then we showed how researchers were trying to go beyond their boundaries, by creating artificial intelligence. But each time, we considered as well, the permanent interconnection of the two 'traditional' disciplines, as well as their evolution towards languages of highest focus and having an unlimited self-generated capacity, that are actually programming languages. We showed how thinking and communication schemes moved from one field to another, by mutually enriching their possibilities of analysis and signification and how it's creating a meta-language somewhat common, similar, in any case; the key term used by us always being the same - " conditionality".

6. Conclusions

1. The logical-philosophical concept of "conditionality" reflects very well the principles of how human reasoning works because it highlights very clearly the circumstances that the ideal or practical accomplishments from our judgments and actions depend upon. It reflects the limitation of our ongoing reasoning, facts and existence in a hypothetically (unreal conditionality) or real (valid conditionality) way. Given such facts, conditionality links to the most apposite logical-philosophical coded categories in both modern and old theories about thinking: negation, assumption, cause-effect relationship, temporal circumstantial.

Our research took into consideration the connection of these logical-philosophical categories. In every day speaking, real/unreal relationships, valid/invalid, affirmation/negation, inter connected, as you can see, are more stable and deliver more complicated results.

A statement with an unreal and negative apparent can lead to a positive conclusion.

Beyond the encoded truth in mathematical logic, according to which two added negations result into an affirmation by the means of reciprocal annulment, the hypothesis remains valid only at the verbal mode grammatical category named conditional-opted in concordance to the Romanian language. The association with the other grammatical category of the verbal tense, specifically the present tense, in our example, it cancels the

assumption, inverting the order of the logical terms:

[Certainly it is told, so it is true.]

2. Among the conclusions that our research provided, in the specialized studies, constructing the logical mechanisms and the processes of reasoning, generally, as well as their deconstruction, dismantling the components is always done through the language. More precisely, building the logical processes generates a corresponding language and the explanatory deconstruction is a meta language.

3. The questions that we asked ourselves were targeting the depth of these relationships and their extension with respect to time and space: how deep, intimate and indestructible is the connection between language, logic and exact sciences? Can the options of formalization be diversified even more through natural languages and even more, through artificial ones, as long as new mechanisms of human reasoning and new ways of investigation are discovered? Being known that the logic of the language means most of the time something else than formal and mathematical logic, the questions that arouse are the following: where are the malfunctions produced and more precisely by what expressive means are the mental processes produced that cannot be highlighted well enough neither through traditional logical symbols nor through the first artificial language organized in a big system that is comparable and unbreakable related to logic - the mathematical language?

4. With these questions in mind we reached the second working direction that holds the basis of the given study which is that the informatics languages appeared as a necessity of improving the models of the explicit formalization of the logical schemes, in all their depth and amplitude, highlighted by the huge progress of new methods of logical analysis and also of the new logic systems. Informatics, defined in its primary sense of artificial intelligence, represents at the same time an universal language that includes logic and philosophy; natural languages and communication sciences, mathematical and exact sciences as well as other components: psychology, visual arts (graphics); applied sciences, engineering sciences, anatomy and last but not least, human knowledge. On the other side this universal language generated already a lot of sub-languages that include also formal codification components.

5. Of course, these truth statements are not unknown and they didn’t work as hypotheses but as methodological initiative for our research. What we proposed, in particular, was to check how this interconnection from the perspective of a single logical mechanism, the one of conditionality, works. We chose especially a fundamental, simple

concept that was visible in building of any logical reasoning, so that we could monitor its evolution without the fear of too many ambiguities, confusions and implicit superposition in the meanders and arcades of human thinking and talking. Observing its presence in all three components of analysis - logic/natural language/artificial language - we targeted in the end their interconnection on one side and their individual capacity of generating new relational schemes in themselves and in each of the other two, on the other side. In other words, we considered that description of a detail item from our complicated processes and logical mechanisms can prove general mental and human expressivity.

The principle that we started from was the one that the idea of "conditionality" is part of the system, which means that the whole piece influences every element that is part of the organism - human thought, coded through language, as well as any constitutive element, unimportant as it might be (which is not in fact the case of conditionality), influences every other element and in any way, the whole piece. Therefore, our objective was modest and vainglorious. Meanwhile we checked how does an essential process which defines human kind works - the logical expression of this kind by describing the behavior of a small piece which is the connection: "**if…, then...**"

Our hope is that we succeeded to highlight those significant details that can ease, modify or even stop the functionality of the whole process. We targeted the subtle human thoughts and expressions by creating a mono-graphical analysis of a simple logical-syntactical construction that can be reduced to a simple logical-semantically connector "if".

6. A general observation that was imposed by this entire research organization - hypothesis formulation, objective establishment, choosing the principles, methods and working tools, distribution of research steps with their according structure - was that the language is always present in the human reasoning process. The historical analysis of the conditionality proved us a very interesting fact: the strive of the logicians to deepen the study of cognitive processes down to their most profound and pure level, symbolized at its maximum potential and voided of the formal coat of verbal expression, is doubled in compensation by the proliferation of the research methods based on diverse languages. Modern logical alternative systems are more associated with language theories and one of them is called "linguistic logic". At this point we are talking about the codification of operations as well as the meta language of its analysis.

7. As long as the study of logic evolved, the conditionality profound manifestations diversified. In modern ages, when Gottlob Frege created the basics of mathematical logic

which was later improved by Bertrand Russel, concepts like “necessary condition” and “sufficient condition” appeared. A few decades later, when the semantic logic of Alfred Tarski or pragmatically approach of Charles Morris were formulated, conditionality enriched with the idea of “formal correction” (the so called “if” constraints), or with the so called “implicit condition”, which defines in the field of future talking acts theories “set of assumptions, expectations, beliefs, intentions, desires, attitudes” comprised into a logical statement.

All these subtleties of the conditionality existed in the mind and speech of humans since their beginnings, for sure, but the research unveiled them one by one, through the ongoing integrated analysis: logic/language/parlance.

8. It is highly probable that any other logical and syntactical connection reveals in the same way the profound mechanisms and formal, verbal manifestations that are symbolized by thought processes. If we would have proposed causality, concession, finality, temporally as analysis subjects we would have reached, almost certainly, to interesting conclusions both at details level and big picture level. By choosing conditionality, we found that it includes in its action all the other types of logical, syntactical and semantically connections. And here we are not talking about linguistic redundancy, but about the systematic, powerfully and structural character of human reasoning that is reflected as such in the structure of natural tongues and also in the artificial, cybernetic languages.

9. The pragmalinguistic modern analysis eased a lot the analysis of these underground connections between logical and linguistically schemes and their impact upon the recipient of the communication and it is by no chance that the founders of the greatest modern linguistically theories and their associated analysis methods are the philosophers and logicians (to the extent that the scientific modern level imposes separation of these domains).

10. Given the above, we reached another general conclusion, among the ones that we limited to note in the final part of our attempt: *formal and encoded statement of the connection and logical schemes imposed a continuous development of languages, from natural language, to graphical and symbolical systems, then to mathematical language and from all these to the cybernetics languages.* Like we shortly described in the introductory pages, the ancestors of mathematical and modern logic were also the ancestors of the informatics. For instance, George Boole, tried to build a so called “mathematics of human spirit”. Through his logical algebra he imposed “a fundamental

algebraic structure that is used especially in informatics". Mathematician August De Morgan highlighted, for the first time in history, the notion of "relationship of relationship", as a result of our research efforts on the conditionality interconnections.
The evolutions can continue with the "Truth concept in formalized languages" (1931) of Alfred Tarski, who proposed a semantic that was aimed to outrun the natural languages limit, with calculable made by a theoretical machine that possesses an unlimited memory, given a set of "instructions" in meta-logical theory as well as in many others.

In our paper we discovered them, one by one, either more superficial or more explicitly stated, from the *perspective of conditionality relationship*.

We state once more our belief, that any other grammatical structure would have unveiled most likely the same logical, linguistically and informatively connections and in any case would have highlighted each of them separately, if we would have studied those ones instead. Choosing this one, generated by an "if" statement that was extremely powerful in relational suggestions, we reached the conclusion, most probable to be labeled as hypothetical, that in cases of reasoning, natural and artificial languages (mathematical and cybernetics etc.) - conditionality represents a connection of connections.

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