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The "Algorithmic Logic" as a Synthetic or General Logic

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"Logic" can be seen the rules with which to produce new knowledge from existing knowledge, or to decide next thinking steps following the current ones. Besides various logics, unprecedentedly, there have been one logic that works furtively all along in human thinking and thus needs to be revealed and identified, namely, the "Algorithmic Logic", a borrowed term[1], following the terminology of Algorithm Framework Theory (AFT)[2].

AFT says that human thinking entails various Instructions processing information or data serially and selectively, i.e., one computation, as execution of one Instruction, to be followed by another selected, and so on, finitely or infinitely. The sequence of computations or Instructions constitutes a flow of thinking. Different logics entail different sequences that are formed fixedly relatively, applying to certain data relevant to certain environments or problems, and outputting results of certain genres. However, what logic is used to select and arrange the different logics to be performed? It is Algorithmic Logic.

Readers may ask: "since this job relates to metalogic or higher-order logic, how can Algorithmic Logic do it again?" The answer lies firstly in the philosophical implications of AFT, which take thoughts or thinking activities, uniquely, as entities, actualities or realities that occupy space and/or consume time, rather than as something that go at infinite speed or for zero time; therefore, whether launching a logical operation or not becomes, unconventionally, an issue of economy, or of behavioral science; then, it must be assessed first, and this assessment must inevitably differ from conventional metalogic or higher-order logic that primarily excludes the behavioral or economic considerations. This computational-economic logic has been underlying any other logical performances, controlling, combining and coordinating them. As its revelation can be conducive to find out many hidden logical relationships among various thinking activities and spiritual phenomena, it needs to be identified solely as

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a new kind of logic, or a new metalogic.

According to AFT, a computation as a minimal thinking behavior can process only two data and obtain one result in the most, therefore any meaningful thinking activity must comprise of many computations that proceed serially. Once a computation finishes, what to do next? What problem to answer? What Instruction to choose? What datum or data to choose? What operational sequence to arrange afterwards? As any Instruction or computation is functionally independent of another, it often has had much freedom to go forward, in respect to the concurrent existence of many Instructions and tremendous stocks of datum, as well as the affluence or shortage of computing resources and time. These Algorithmic[3] factors trade off with the conventional logical relationships themselves among the current thinking steps, consequently deflecting them elsewhere. For example, if a=b, and b=c, then…? In conventional logics, the answer is a=c. However, as this problem requires a computational performance that is costly, one has to prioritize considering the whole real thinking or behavioral situations he/she faces, and possibly suspend the problem and turn to study another question such as "if e=f…?", distractedly. While conventional logics regard the latter as a false, illogical, or irrational response to the former problem, now it can become "logical" and "rational"; this is to say, new logical relationship between them is unprecedentedly discovered.

Thus, under AFT, thinking or computations proceed in a dual-layer structure: one is to conceive, assess and decide what logic or computation to do next economically, the other is to execute the above decision and compute on the data given. The former runs Algorithmic Logic, and the latter runs any other logic than Algorithmic Logic. Algorithmic Logic focuses on recognition of the factors such as computing economy & efficiency, limited computational power, the spatiotemporal dimensions of computations, the existence of the whole world and history beside current operations, urgency of decision-making, the predicament of big data, different functions of various logics and their comparison and coordination, the importance and the subjectivity of data search, the usefulness of various subjective or simplified logical operations, the necessity of suspension of some logical operations, the importance of sacrifice of some computing accuracy and even correctness, the tolerance of imperfection, conflicts and plurality, etc. AFT inspires the issue of computing economy; when this economy is considered, the above factors reasonably and logically arise, and the subsequent Algorithms[4] and operations come up; this is why it can be identified as a "logic".

In terms of economics, Algorithmic Logic conducts the cost-benefit analysis of human thinking; however, due to the Algorithmical bounded rationality, the analysis cannot be completely conducted quantitatively, therefore must be structured qualitatively, more or less. This means that some rules have to be formulated and used, and the pluralistic perspective have to be adopted, etc. This analysis shall be imperfect, even futile, thereby using lottery to decide,

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occasionally; or, the actor loses his/her head, deciding to do nothing. These choices are all logically on the menu. Hence any question, Algorithmically, has infinite possible "responses" as the "answers" to it[5], and the final real answer must be singled out among them. And, the conventionally correct answer is selected only when excluding the computing economy and confining computations within the given scope. Thus, conventional logics can be deemed in principle some particularities of Algorithmic Logic.

Further, multiple conventional logics can be re-interpreted Algorithmically. A syllogism, in fact, contains multiple hidden logical steps such as the "associate" as an Instruction executed on a given premise to decide what data to search for, and "search" as the subsequent Instruction, and then the analytical and selective performances to decide what proposition to be used to deduce with the given premise, and finally, the deduction itself. The various subjectivities in the above performances will make the syllogism much subjective, despite the process of deduction itself is "objective". Thus, a syllogistic process should be deemed synthetic and "productive", because any of the steps uses resources to produce the resultant knowledge that did not exist and that the actor did not know before. This perspective is distinct from the conventional one that "deduction does not create new knowledge".

Algorithmic Logic hides also in inductive reasoning, especially in incomplete inductions. Why a general conclusion is made only on finite specific cases, instead of all cases? Undoubtedly, it is because that the cases, available greatly in number, could drown the induction by big data, making it economically impossible; hence, induction must stop somewhere among the cases, and arbitrarily and adventurously (but "rationally") make its conclusion.

Algorithmic Logic also applies to re-interpretation of higher-order logic. Why can a logic be objectified by another logic, hence the higher-order logic? If logical processes do not occupy space or consume time, or they run at the infinite speed, this objectification between them would be impossible. Conversely, only when one "exists" actually, keeping static in the spatiotemporal environment, it could be possible to be objectified by another. Moreover, this means that a logical operation, self-evidently, cannot objectify itself, just like that a person cannot bite his/her own nose. If it can, then, can it re-objectify the one that is objectifying itself? And, can it re-re-objectify the one that is re-objectifying the one that is objectifying itself? Obviously, the predicament of infinite regress happens. However, restricted by finite computational speed and time, the infinite regress is impossible, hence, any logical operation, proposition, or narrative must be naturally deemed not self-contained, or only self-contained in some specific and limited senses. This meaning of Algorithmic Logic, apparently, can be used to solve Russell's Paradox (Russell, 1903) and many other paradoxes.

Algorithmic Logic justifies the phenomenon that a typical world state must be the mixture of "finished knowledge" as the final products, unfinished knowledge as the semi-products, the

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arbitrary or temporary conclusions, mistakes, conflicts, plurality, irrelevance, etc. Therefore, the paraconsistent logic (Priest, 2018), or Hegelian dialectic logic, is reasonably endogenized. Dialectic logic suggests that when in trouble to infer, one can go to the contrary, tentatively, although the correct answer often lies between the two poles.

Intuitionistic logic (Heyting, 1975) interprets natural numbers and continuum with human intuition, and regards thinking as generative and infinite, which, instead, can be clearly explained by the discrete and dynamic manner of Algorithmic thinking operations that economically require the objects to be divided into different units and their sequences.

Human thinking should be depicted continuously and comprehensively, instead of partially or segmentally; so should the logics; therefore, the hidden Algorithmic Logic ought to be identified and revealed. And, since any formal logic can in principle be simulated with computers, and according to AFT, any informal logic can in principle be simulated with Artificial Instructions[6], we can assume conclusively that all logics, including any extant logics and Algorithmic Logic, are able to run in the Algorithmic framework. Then, the meaning of Algorithmic Logic could be extended to the "General Logic" that endogenizes various logics that are arranged to perform with Algorithmic Logic.

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[1] The term was proposed initially by Banachowski et al. in 1977, in a quite narrow sense, it is borrowed and extended hereinafter. [2] AFT was introduced by the series of writings of Bin Li in References, especially by Li (2022a). [3] The word "Algorithmic(al)" means "of AFT", "given or emphasized by AFT", etc. [4] Algorithm is defined as the method to select and combine Instructions to compute. [5] This relates to many-valued (or fuzzy) logic (Łukasiewicz, 1970). [6] Artificial Instruction refers to the Instruction in human minds that cannot be simulated by a computer but that is assumed by AFT to run in the "Instruction + information" manner like that of computer instructions.

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