archi|DOCT

The e-journal for the dissemination of doctoral research in architecture.

February**2017**

www.enhsa.net/archidoct

ISSN 2309-0103

ALGORITHMIC THINKING

8

The Intricacy of the Otherness

Dr. Kostas Terzidis // CEO at Organic Parking, Inc

An algorithm is a process of addressing a problem in a finite number of steps. It is an articulation of either a strategic plan for solving a known problem or a stochastic search towards possible solutions to a partially known problem. In doing so, it serves as a codification of the problem through a series of finite, consistent, and rational steps. While most algorithms are designed with a specific solution in mind to a problem, there are some problems whose solution is unknown, vague, or ill-defined. In the latter case, algorithms become the means for exploring possible paths that may lead to potential solutions.

Theoretically, as long as a problem can be defined in logical terms, a solution may be produced that will address the problem's demands. An algorithm is a linguistic expression of the problem and as such it is composed of linguistic elements and operations arranged into spelling, and grammatically and syntactically correct statements. The linguistic articulation serves the purpose not only to describe the problem's steps but also to communicate the solution to another agent for further processing. In the world of computers, that agent is the computer itself. An algorithm can be seen as a mediator between the human mind and the computer's processing power. This ability of an algorithm to serve as a translator can be interpreted as bi-directional: either as a means of dictating to the computer how to go about solving the problem, or as a reflection of a human thought into the form of an algorithm. The latter one will be addressed in more detail later in this chapter.

Traditionally, algorithms were used as mathematical or logical mechanisms for resolving practical problems. With the invention of the computer, algorithms became frameworks for implementing problems to be carried out by computers. While the connotation associated with the action of giving instructions, commands, or directions is subconsciously assumed to be aimed at a sentient worker, the computer, despite its once human identity, is not a human being and therefore should not be treated as such. (Perhaps it would be more accurate if a new name was given that would reflect more accurately its true potential, such as portal, transverser, or, hyperion[1].) By liberating the user of a computer from material concerns associated with labor, skill, or complexity or from emotional factors such as compassion, fatigue, or boredom computers can be utilized as tireless vehicles that allow humans to realize, overcome, and ultimately surpass their own physical and mental limitations. The significance of this liberation lies not that much in the amount of work that can be accomplished but rather in the fact that the human mind is in a position to invent devices that will help it exceed its own limitations. Furthermore, through such inventions such as the computer a world is encountered, that of applied computation, which, while intellectual in nature, abides to principles, mechanisms, and performances that lie beyond the realm of the human mind.

An algorithm is a set of instructions given by a human to be performed by a computer. Therefore, an algorithm can describe either the way a problem is to be addressed as if it would be resolved by a human or the way it should be addressed to be understood by a computer (the notion of "understanding" here refers to the capacity the computer has to process information given by a human and not to its conscious interpretation of that information). In taking the first case, an algorithm becomes a rationalized version of human thinking. As such it may be characterized as being precise, definite, and logical, but at the same time may also lack certain unique qualities of human expression such as vagueness, ambiguity, or ambivalence. While this may be true as far as the linguistic expression is concerned, it is not necessarily true for the products of the language. For instance, one can use unambiguous words to articulate an ambiguous statement, i.e. "the man saw the monkeys in his pajamas." In other words, the explicit nature of the statements that compose an algorithm do not necessarily also reflect the explicit nature of the output. Likewise, precise platonic geometrical shapes can be combined algorithmically to produce quite ambiguous geometrical forms. Just because the language elements or even the syntax is rational, it does not mean that the products will also follow the same trend.

1.Hyperion means "beyond-one" and is also the name of a Titan, father of Sun, Moon, and Dawn who was considered to be the god of observation.

13

The Intricacy of the Otherness

Kostas Terzidis

In the second case, an algorithm is seen as a linguistic expression fitted to the needs of the computer. As such it becomes an idiomatic language of conformity or adaptation to an alien reasoning. The word alien is used here not as a means of intimidation but rather as an indicator of an alternative, perhaps parallel, logic to that employed by the human mind. Contrary to common belief, a computer's logic, while seemingly a product of the human mind, is not a subset of it but rather a parallel, if not superset, to it. When inputting information in the form of an algorithm for a computer to process, one must adjust one's reasoning to the reasoning of the computer-worker and not to that of a human-worker. Certain qualities of the human mind such as those that contribute to what is considered "smart," i.e. sharpness, quick thought, or brightness, may not be desirable or even applicable when dealing with the computer's reasoning. What is considered to be smart in one world may be considered dumb in another world; this is precisely the reason why the two reasoning systems are parallel, complementary, or perhaps antithetical. For instance, to find a secret password a human may exploit context-based conjectures, reductive reasoning, assumptions, or even spying as strategies for saving time and effort. In contrast, a computer can solve the same problem by simply checking all possible combinations of all alphanumeric symbols until a match is found. Such as strategy, referred to as brute force, would be considered overwhelming, pointless, naïve, or impossible by a human investigator. Nonetheless, given the computational power of a computer such a strategy may only take a few seconds to check millions of possibilities, something inconceivable to the human mind.

The term inconceivable is used here to denote an inability to comprehend, and implicitly it refers to the human mind. Clearly, the term is figurative, metaphorical, or linguistic, for if it were literal it would contradict itself as a paradox: how could one conceive that which cannot be conceived? In the pre-Socratic spirit, the negation of something negates its own existence[2]. While it is possible to construct a word signifying a negation or an impossibility it does not mean that what is signified also exists, at least in the sense of being actual as opposed to fictional, predicative, or identificatory. So, to say that something was inconceivable to the human mind means that a now perceived as possible thought would not have occurred to the human mind before. However, within the world of computation the boundaries of impossibility are yet to be defined. The power of computation, which involves vast quantities of calculations, combinatorial analysis, randomness, or recursion, to name a few, point out to new thought

2. Parmenides said: ωςουκ εστι μηε ιναι = what is not, cannot be identifying a key separation between "what is" as a logical predicate and "what is" as a visual interpretation. See Popper, K., The World of Parmenides. London: Routledge, 1998, pp. 70–72.

processes that may have not ever occurred to the human mind. These "idea generators" which are based on computational schemes have a profound ability not only to expand the limits of human imagination but also to point out the potential limitations of the human mind. What was inconceivable once may have been so mainly because it may have escaped the possibility of existence.

Similarly, the term impossible is used here to denote the incapability of having existence or of occurring. Yet, the boundaries beyond which possible starts to be perceived as impossible tend to change constantly in a world enhanced by computer-augmented human thinking. Even within the realm of the human mind those boundaries seems to expand in a Guinness-wise fashion. For instance, recently the total number of digits of the constant number Pi memorized by a human mind is 83,431, held in 2005 by a 59-year-old Japanese person named Akira Haraguchi. At the same time Japan wants to develop a supercomputer that can operate at 10 petaflops, or 10 quadrillion (10,000,000,000,000,000 or 10^{16}) calculations per second, which is 35 times faster than the Blue Gene/L, the current US record holder with 280.6 teraflops – that is 280.6 trillion calculations a second, numbers thought to be astronomical a few years ago. Therefore, the boundaries of what is considered impossible may be shifting constantly based on real facts and not conjectures[3]. Where is the threshold beyond which something is impossible – or should we say the threshold below which something is possible? Theoretically, nothing is impossible. Even if it seems so at the moment, it may be that such a possibility has not yet arrived. The old proverb stated as "if you have all the time and all the resources in the world, is there anything you cannot do?" may indeed seem as a false premise yet it also defines the possibility of the impossible.

Contrary to common belief, algorithms are not always based on a solution strategy conceived entirely in the mind of a human programmer. Many algorithms are simulations of the way natural processes work and as such they must not be regarded as human inventions but rather as human discoveries. Unlike inventions, discoveries are not conceived, owned, or controlled by the human mind, yet as abstract processes they can be codified to be exe¬cuted by a computer system. In this case, the human programmer serves the purpose of codifying a process, i.e. a translator of a process external to the human mind to be compiled into machine language which is also external to the human mind. For instance, a genetic algorithm is a process that simulates the behavior and adaptation of a population of candidate solutions over time as generations are created, tested, and selected

3. A set of graphs and tables that describe, assess, and project the potential of computers appears in the latest book of Ray Kurzweil. See Kurzweil, R., The Singularity is Near. New York: Viking, 2005.

The Intricacy of the Otherness
Kostas Terzidis

through repetitive mating and mutation. The algorithm uses a stochastic search based on the chance that a best solution is possible and that computer processing power is effortless, rapid, and precise from the viewpoint of the human programmer. Yet, nothing in the entire algorithm is about human invention; the process is called natural selection (a process occurring in nature regardless of the presence of humans) and the flow of the calculations is logical or arithmetic (both processes occurring in nature regardless of the presence of humans).

Interestingly, algorithms can generate other algorithms; not only precise, identical, multiple copies of themselves but also structured text (i.e. code) that when executed will behave as an algorithm. In fact, the process of compos¬ing an algorithm is also an algorithm in itself, that is, the algorithm that created the algorithm. This self-referential property (which may be referred to here as meta-algorithm, i.e. the algorithm of an algorithm) is important in designfor at least two reasons: first, like algorithms, design can be seen as a set of procedures that lead stochastically towards the accomplishment of a goal. In studying the articulation of algorithms one may be able to discern similarities with design. While such a study may lead to the development of procedures that may be useful in design, more importantly, it may reveal certain clues about design as a mental process. This possibility opens up a more intricate relationship between design and algorithm that has been previously possible. Rather than using algorithms to copy, simulate, or replace manual methods of design (while perhaps desirable), instead they can be studied as methodologies that operate in ways similar, parallel, or complementary to that of the human mind. Second, along the lines of homo faber homo fabricatus (i.e. we make a tool and the tool makes us), algorithms can be seen as design tools that lead towards the production of novel concepts, ideas, or forms, which, in turn, have an effect in the way designers think thereafter. That way of thinking is incorporated in the next generation of tools that will, in turn, affect the next generation of designers, and so on.

It may be assumed that meta-algorithmics, that is, the creation of algorithms that generate other algorithms, is a human creation as well. A human programmer must have composed the first algorithm that, in turn, generates new algorithms and as such the initial programmer must be in control of the original idea. However, this is not necessarily true. Unlike humanly conceived ideas, where the author is the intellectual owner of the idea, algorithms are processes that define, describe, and implement a series of actions that in turn produce other actions. During the transfer of actions it is possible for a discrepancy to occur between the original intention and the actual result. If that happens

then, by definition, the author of the algorithm is not in control of, and therefore does not own intellectually from that point on, the result¬ing process. Theoretically, ownership of an idea is intrin¬sically connected to the predictability of its outcome, that is, to its intellectual control. Therefore, in the absence of human control the ownership of the algorithmic process must be instead credited to the device that produced it, that is, to the computer.

Such a possibility, however, will be objected by those who believe that intellectual ownership can only be credited to an agent that possesses enough intelligence to be aware of its ownership, i.e. possesses consciousness. Unlike humans, computers are not aware of their environment. Perhaps then it may be necessary to define some other kind of awareness that may be only theo¬retical. This theoretical entity then would be the owner and the reason behind these intellectual phenomena until they possess a physical substance[4].

It is a common belief among architects and designers that the mental process of design is conceived, envisioned, and processed entirely in the human mind and that the computer is merely a tool for organization, productivity, or presentation. Whatever capabilities a computer may have it lacks any level of criticality and its visual effects are nothing but mindless connections to be interpreted by a human designer. It is a common belief that, at best, the computer can serve merely as a processor of information provided as data by the designer and as code by the programmer outputting simply the results of data processed by algorithms. What makes this process problematic is the fact that contrary to common belief algorithms can produce results for which there is no intention or prediction thereof of their behavior. Further, algorithms can also produce algorithms that also are not connected to the intentions or prediction of the original code. This structural behavior resembles in many ways Dadaist poetry, or Markov processes. In those cases, an algorithm functions as a string rewriting system that uses grammar-like rules to operate on strings of symbols in order to generate new strings of text. While the syntax of the resulting text may be consistent with the grammatical rules, the meaning of the resulting text is not necessarily associated semantically with the inten¬tions of the original code. For instance, the introduction of randomness in the arrangement of text can produce results that are unpredictable, but also accidentally meaningful. Unpredictability is, by definition, a disassociation of intention. But unlike chaos, a random rearrangement of elements within a rule-based system produces effects that, although unpredictable, are intrinsically con¬nected through the rules that govern that system.

4. The problem of ownership, jurisdiction, and responsibility of one human over another is perhaps best documented in the laws of slavery. If a slave makes a great discovery does it belong to the master, and vice versa if a slave makes a fatal mistake should the master be responsible instead?

In the field of design, similarities may exist on formal, visual, or structural levels. Computational rearrangement of formal rules that describe, define, and formulate a certain style can produce a permutation of possible formal expressions for that style. For instance, drawing on Andrea Palladio's original 40-odd designs of villas, Hersey and Freedman[5] were able to detect, extract, and formulate rigorous geometric rules by which Palladio conceived these structures. Using a computational algorithm, they were able to create villa plans and facades that are stylistically indistinguishable from those of Palladio himself. In a similar, almost humorous fashion, the Dadaist engine is a computer algorithm that produces random text based on rearrangement of elements in a grammar. The resulting text, while based on random processes, is readable, often makes sense, and in some cases it is surprisingly intelligent. A version of this algorithm, called the "postmodernism generator," composes essays that appear as if they were developed by a human thinker. While in all of these cases it is quite apparent that awareness, consciousness, or intention is missing, the language patterns produced are convincing enough to lead some to believe that they were authentic, that is, worthy of trust, reliance, or belief, as if they were produced by a sentient author. In one case, a paper constructed using the Dada Engine software was allegedly almost submitted to a conference, which, had it happened, may have passed Turing's classic test of computer intelligence[6].

Unlike grammatical attempts to generate seemingly coherent thoughts based on linguistic patterns encapsulated through sentences, paragraphs, or essays, formalistic languages have already permeated the inspirational, conceptual, and critical aspects of architecture. Computer modeling software is being increasingly used by designers to produced form, shapes, or diagrams that while unaware of their logic are used as a means to address complex problems. Many architects and designers refer to their use of computers as intentional, their language for describing digital practice or formal phenomena has become part of the mainstream nomenclature, and, as a consequence, many so-called digital designs have even been publicized by critics as meaningful. In the last decade, architects have been using the computer as a device to generate, discuss, and critique new forms in an attempt to introduce a new way of thinking about design. While many have attributed the term "tool" to the computer because of its role as a device assisting during the design process, this assumption is not necessarily or entirely true[7]. Computational tools are based on algorithms, that is, processes written by programmers to utilize the arithmetic and logical capabilities of a computer in order to produce certain results. As with mathematicians, the invention or discovery of a mathematical formula does not necessitate the mathematician's knowledge of all the possible uses,

5. See Hershey, G. and R. Freedman, Possible Palladian Villas: (Plus a Few Instructively Impossible Ones). Cambridge: MIT Press, 1992.

6. The Turing test is a proposal for a test of a machine's capability to perform human-like conversation. Described by Alan Turing in the 1950 paper (Alan Turing, "Computing machinery and intelligence." Mind, vol. LIX, no. 236, October 1950, pp. 433–460), it proceeds as follows: a human judge engages in a natural lan¬guage conversation with two other parties, one a human and the other a machine; if the judge cannot reliably tell which is which, then the machine is said to pass the test. It is assumed that both the human and the machine try to appear human. In order to keep the test setting simple and universal (to explicitly test the linguistic capability of some machine), the conversation is usually limited to a text-only channel such as a teletype machine as Turing suggested.

7. Architects such as Neil Denari, Greg Lynn, or Peter Eisenman use the term tool to describe computational processes yet none of them has any formal education in computer science.

repercussions, or consequences of the formula.

Similarly, it is possible that while a programmer has conceived an algorithm that will address a specific problem, the same algorithm might be used to address another completely different problem that was never predicted by the original author. Further, it is possible that using the same algorithm but utilizing different parameters than the ones that were originally designed, may result in a behavior that is completely unexpected. Consequently, when a designer uses an algorithm to design, the designer may not be aware, knowledgeable, or conscious of the mechanisms, specifications, or repercussions of the programmer's algorithm. The gap of discrepancy that separates the programmer from the designer is indeed problematic mainly because of the nature of algorithms. Unlike physical tools where unpredictability is of a mechanical or chemical nature, algorithmic tools are abstract, rational, and intellectual in nature and therefore related to the human mind. So, in that context, the output of an algorithm must be associated to a human mind, either the programmer or the designer. Anything else would be absurd because it would involve an intellectual process without the pres¬ence of a human mind. Therefore, critique on the output of an algorithm must be associated to the designer who creatively used the algorithm or to the programmer that made the algorithm available to the designer. In other words, it always has to be a human being responsible for anything that resembles intellectual behavior. However, if someone abandons the humanistic premise and introduces an intellectual entity that, while not identical, nevertheless resembles the human mind, then a different interpretation of design might be possible. Under such a possibility, the human mind is enhanced, complemented, or synergized with an intellectual entity of a computational nature, independent of a human presence, which we will call here otherness, or, in Greek, allo. The reason for the existence of such an entity and its disconnection to the human mind is due the unpredictable, inconceivable, and impossible nature of its origin. In other words, its existence starts where the human mind fails. Consequently, any intelligent behavior by this entity is not a matter of chance, accident, or disguise but rather the output of an allo-logic whose complexity is beyond human comprehension. Armed with such allo-reasoning the human mind can be described as a cyborg, not in the mechanical or electrical sense, but in that of an intellectual one.

While the computer is a device conceived, designed, and built by humans, the processes running within its circuits are not necessarily a human invention as well. Like mathematics or geometry, computation is not an invention but rather a discovery. It is not necessary for a human being to exist in order for computational processes to occur. In other words, computation is

of an independent nature and can be implemented on various devices including the computer or, to some extent, the human brain. Otherness is that part of computation that would be described by humans as inconceivable, impossible, unpredictable, or unbelievable, not as linguistic terms but as undiscovered concepts. And yet the possibility that something may exist beyond the comprehensible defines the notion of otherness, that is, of something else. While the human mind has the ability to combine events from the past in order to predict their possibility of existence in the future, otherness is about those possibilities that were missed, overlooked, considered impossible and therefore omitted, or those whose chance of probability were too far into the future or lost into the oblivious past[8]. In any case, their chance to exist is being brought to life by devices that have the ability to perform calculations far more complicated than any human brain or brains together can. However, it is important to mention here that certain tasks or events observed in nature are indeed impossible, yet they are not intellectual. In contrast, impossible tasks related to human thinking are by definition intellectual and, as such, challenge not only the intellectual nature of the human mind but also its own existence.

For the last five decades, beginning with early CAD programs and continuing through high-end computer graphics, modeling, and animation systems, architects have been increasingly concerned with the possible loss of control over their own designs due to the powerful yet complicated, if not mysterious, nature of computers. This concern has led them to position themselves within a wide spectrum of speculations about the effect of computers on design that ranges from complete rejection, elitism, or demonization of their use as design generators to the complete antithesis, that of adoration, worship, or popularization of their use. When comparing avid computer users to those reluctant to engage with them it is necessary to overlook many significant and distinguishing differences in order to identify at least one common theme: the assessment that there is something different, unprecedented, and extraordinary about the computer as it compares to traditional manual tools.

Both non-users and users agree that the effect computers will have on design whether desirable or not will be significant, profound, and far-reaching. This agreement is based on an important yet peculiar relationship between design and its tools. It is apparent that design is strongly dependent on the tools utilized and, reversely, tools have a profound effect in design[9]. Traditionally, this dependency is controlled by the human designers who decide which tool is to be used when and where as well as the range of possibilities a tool has for addressing, resolving, or accomplishing a design task. Further, it is possible that the use of

8. Marcos Novak points out that while the clause "if-then" is a syllogistic structure that leads on to new knowledge, the clause "if-then-else" involves the alternative "else" that may point to the opposite of knowledge, that is, to "that which does not follow from its roots, or, indeed, that whose roots can no longer be traced, or have become irrelevant, or are unknown, or follow from principles outside previous understanding." See Novak. M., "Alien space: the shock of the view," article reproduced from Art + Technology Supplement of CIRCA 90, pp. s12–13.

9. In the words of Marshall McLuhan "first we build the tools, then they build us." Perhaps, Stanley Kubrick and Arthur Clark's movie "2001: Space Odyssey" is a good fictional example of this possibility.

have further implications in the process of addressing a task: just because a tool is available, a task is now possible, or, further, a tool implies a task. However, a problem arises when the tool is not entirely under the control of its user. In the case of a computer as a tool, the results may be unexpected, surprising, or unpredictable even by the users themselves. While such moments of surprise may be advantageous, enlightening, or perhaps even undesirable, they do exhibit a theoretical interest because they challenge the basic premise of what a tool is or how a tool should behave. Further, such behavior may lead to alternative ways of executing the task that were not intended and may lead to results often superior than intended. Such a possibility in turn challenges one of design's most existential qualities, that of intention. Is intention necessary in design? Is intention a human privilege only?

Intention is a term used often in the context of consciousness. The definition of intention is associated with a plan on action, a determination to act in a certain way, a thoughtful and deliberate goal-directedness. In all cases, intention is attributed (at the absence of any other source) to the human mind as the source of intention. Further, intention is also associated with design, because design is traditionally considered an act of conscious decision-making with an intention in mind. The problem with this approach is that it assumes that behind every decision a conscious mind must be present. However, if we disassociate the act of decision-making from the involvement of a conscious plan, if we simply accept that decisions can be made by unconscious agents, then a more intricate relationship between decision and intention emerges than has been previously possible. Rather than confining the act of deciding within the human domain a more loose interpretation of decision-making can be established that includes other decision agents not necessarily human. In such a context, the notion of intention does not have to be associated with its source but rather with the process itself. For instance, a design decision may be made by an algorithmic process not intended by the designer, yet as the result on the decision may have been assessed as "successful" the designer may adopt it as one's own idea. In this case, intention was assigned after the fact. While such action is impossible within a humanist world, it is so only in the absence of anything else. Because, if a human is not responsible for an intention then who is?

In response to a possible shift away from the traditional view that the human mind is the central point of reference for any intellectual activity, two theories have been dominant; either a self-referential reconfirmation of the uniqueness of the human

mind as the only conscious, sentient, and intelligent system that exists or an acknowledgement that the quantitative limitations of the human mind and the superior computational power of the computer are indications that the human mind is not as central and unique as previously thought. Humanistic approaches to new knowledge have traditionally stressed the importance of self-determination and rejected any dependency on supernatural, mystical, or magical phenomena. It doing so they endorse the ability of humans to rationally determine, evaluate, and justify their actions. Implicit, however, in this determination is the assumption that humans must be in control and therefore be reliable for their thoughts, morality, and actions and not rely on supernatural means. The notion of control is therefore central to the humanistic position. Nonetheless, while the notion of predictability (and consequently responsibility) is typically linked to human control, its negation implies the presence of a supernatural alien realm. Such an alien realm can be unveiled through inductive algorithms since such processes embed an equivocal ability to connect logical patterns with electronic patterns. In the field of design, the notion of unpredictability challenges one of its traditional modes of thought where typically the designer is in full control of the tangible or virtual representation of one's design ideas.

Designers and architects have traditionally maintained control over their design work by employing explanatory, analytical, generative, or representational ideas directly linked to the principles of human understanding and interpretation. Of course, any human-centric approach is associated by definition with subjective phenomena and personal interpretations. Within that realm, any logic that deals with the evaluation or production of form must be, by default, both understandable and open to interpretation and criticism. The problem with this approach is that it does not allow thoughts to transcend beyond the sphere of human understanding. In fact, while it praises and celebrates the uniqueness and complexity of the human mind, it becomes also resistant to theories that point out the potential limitations of the human mind[10].

Intellectual property is defined as the ownership of ideas and control over the tangible or virtual representation of those ideas. Traditionally, designers maintain full intellectual property over their designs or manifestations thereof, based on the assumption that they own and control their ideas. This is not always the case with algorithmic forms. While the hints, clues, or suggestions for an algorithm may be the intellectual property of the designer–programmer, the resulting tangible or virtual representations of those ideas is not necessarily under the control of their author. Algorithms employ randomness, probability, or complexity the

10. Strange as it may sound, acknowledging lack of control is, in a way, more human than rejecting it. Humanism is not about rejecting anything that threatens human control but rather about accepting limitations and working towards solutions.

outcome of which is unknown, unpredictable, and unimaginable. If there is an intellectual root to these processes it must be sought in a world that extends beyond human understanding[11]. Both the notions of "unknown" and "unimaginable" escape from human understanding since both negate two of the last resorts of human intellect, that of knowledge and imagination. An algorithm is not about perception or interpretation but rather about exploration, codification, and extension of the human mind. Both the algorithmic input and the computer's output are inseparable within a computational system of complementary sources. In this sense, synergy becomes the keyword as an embodiment of a process obtainable through the logic of mutual contributions: that of the human mind and that of the machine's extendibility.

There are often misconceptions about the computer as a machine (i.e. a box with electrical and mechanical interconnections) and its role in the process of design. Design, like many other mental processes, at the information-processing level has nothing specifically "neural" about it. The functional equivalence between brains and computers does not imply any structural equivalence at an anatomical level (e.g. equivalence of neurons with circuits). Theories of information processes are not equivalent to theories of neural or electronic mechanisms for information processing[12]. Even though, physically, computers may appear to be a set of mindless connections, at the information level they are only a means of channeling mathematical and logical procedures[13]. However, there is indeed a fundamental difference between the quantitative nature of computation and the abstract holistic nature of human thinking.

Is design thought quantifiable? In response to this question, two options appear to be possible; either that design is a process based upon finite elementary units, such as bits, memes, nodes, atoms, etc. or that it is a holistic process with no beginning, end, or any in-between measurable steps. The negation of discreteness implies a continuity of thought that permeates throughout the process of design but is confined within the boundaries of human domain. By definition, subjectivity depends on interpretation and only humans are in a position to do so (yet). Certain intellectual activities, such as intuition, interpre-tation, choice, or meaning are considered human qualities that can hardly be quantified, if ever. In contrast, the discretization of design opens up a multitude of possibilities as it invites discrete mathematics to be involved in the design process, such as logic, set theory, number theory, combinatorics, graph theory, and probability.

Discretization of design by definition can be addressed, described, and codified using discrete processes executed today by discrete numerical machines (i.e. computers). However, the

11. Sir Karl Popper argued that the world as a whole consists of three interconnected worlds. World One, is the world of physical objects and their properties–with their energies, forces, and motions. World Two is the subjective world of states of conscious¬ness, or of mental states – with intentions, feelings, thoughts, dreams, memories, and so on, in individual minds. World Three is the world of objective contents of thought, especially of scientific and poetic thoughts and of works of art. World Three is a human product, a human creation, which creates in its turn theoretical systems with their own domains of autonomy. See Popper, K. R., The Logic of Scientific Discovery. New York: Harper & Row, 1968.

12. The works of Herbert Simon and Allen Newel in the 1960s and 1970s are undoubtedly some of the best examples of the study of artificial intelligence.

13. Greg Lynn, in Animate Form. New York: Princeton Architectural Press, 1999, p. 19, describes machine intelligence "as that of mindless connections."

problem is that discrete/quantitative design provokes a fear of rationalistic determinism that is long considered to be a restraint to the designer's imagination and freedom[14]. Such resistances have attempted to discredit Computer-Aided Design (CAD) products or processes as inadequate, irrelevant, or naïve. According to one position, design is considered a high-level intellectual endeavor constructed through uniquely human strategies, i.e. intuition, choice, or interpretation. Such theoretical design models negate computation as a possible means for design realization mainly because it is based on discrete processes that are finite and, as such, restrictive.

In contrast, human thought appears to be continuous, infinite, and holistic. However, in practice neither case alone seems adequate enough to serve as a concrete model for design because both suffer from a lack of autonomy. Human designers fail to compute extreme quantitative complexity and computational processes fail to justify consciously even simple decisions. However, these disjunctions result from a logic that seeks to compare two separate, disjoint, and unconnected processes, neither of which has any effect on the other. While traditional human strategies have a long history of success in design, computational strategies are not exclusive, divisive, or restrictive, but rather alien, foreign, different, and, as such, incomparable. Rather than investing in arrested conflicts, both strategies might be better exploited by combining both. What is considered smart in the one world may be considered naïve in the other and vice versa, but by combining both, a strategy can always be available.

For example, any painting can be represented as a finite grid of finite colors. The exhaustion of all possible combinations of all possible colors within the grid of pixels eventually will reproduce any painting that was ever created in the history of humanity and, as a consequence, any painting yet to be created. Formally, such an argument can be written in the following way:

$$P = \{(x, y, c)\ x, y, c \in N, 0 \leq x < w, 0 \leq y < h, 0 \leq c < d \}$$

where w = 132, h = 193, and d = 2. In this case, the possible combinations are $2^{(132 \times 193)} = 10^{7669}$.

While the possibility of creating a specific painting, i.e. Matisse's Icarus[15], from a random arrangement of colors may appear to be "almost impossible" it is indeed not so; specifically it lies somewhere between 1 and about 10^{7669} possibilities. If there is a possibility, whatever remote it may be, there must be a chance that it will occur. While the human mind may be bounded to the limitations of quantitative complexity, its computational exten

14. Colin Rowe's criticism on Alexander's Notes on the Synthesis of Form and consequently extending it to all value-free empirical facts is that they are only "attempts to avoid any imputation of prejudice." See p. 78 in Rowe, C. and F. Koetter, "Collage city", in Architectural Review 158, no. 942, August 1975, pp. 66–90.

15. Icarus, the son of Daedalus (creator of the Labyrinth), is a metaphor for an impossible task, consequent failure, yet eternal remembrance. Of course, any bitmap image of those dimensions would require the same number of calculations.

sion, the computer, allows those boundaries to be surpassed. The notion of "impossible" is no more the assessment of human imagination but rather a degree of probability[16].

In contrast to this example, assessing the notion of possible can be enhanced by another model. This model is based on the idea that, in search of a known target, not all possibilities are equal. Certain possibilities may have a higher chance of success than others. This possibility of possibility opens up a more intricate relationship than has been previously possible. Rather than simply enumerating all possible patterns in search for a known one, genetic algorithms assess each random step. By assessing the degree of promise that a certain pattern has the notion of selection is introduced in the decision-making process. The selection starts from a population of completely random patterns and occurs in steps (i.e. gener-ations). In each step, the fitness of the whole set of patterns is evaluated, multiple patterns are stochastically selected from the current population (based on their fitness), modified (mutated or recombined) to form a new pattern, which becomes current in the next step of the algorithm. For example, using the previous example, instead of assuming that each random pattern is equal in importance and therefore going through all of them until a perfect match is found, a preferential selection may occur instead. The number of iterations in the case of Icarus will be reduced quite significantly from 10^{7669} to merely 3,280,000 (i.e. 3.28×10^6).

Randomness is often associated with lack of control, arbitrariness, and incoherence but more importantly the possibility of a random occurrence in essentially dependent on time. Possibility is the state occurring within the limits of ability, capacity, or realization in response to both time and resources. So, the question arises as to whether there is anything that cannot be done if one has infinite time and infinite resources? If anything is possible, then isn't merely thinking of something in itself its own definition of being? Information, the root of knowledge, is derived from the prefix in-and the noun formation. In its linguistic context, information means giving form, figure, shape, and therefore organizational structure to, apparently, formless, figureless, and shapeless notions. Information should be understood not as a pas¬sive enumeration of data but rather as an active process of filtering data, not in the trivial sense of awareness, but in the strict sense of logical proof. While the quantity and composition of external data may appear to be infinite, random, or incoherent logical filtering will lead progressively to an ordered formation. Unlike blind randomness, certain algorithms (i.e. genetic) are capable of selectively controlling the shaping of information. Such algorithmic events result from factors that are neither arbitrary nor

16. A single processor working 1000 GIPS can only perform 10^{18} operations in a year. So, if 10^{400} computers will work in parallel (because the problem is not sequential), they will be finished in a year; or 10^{800} computers in half a year. In other words, 10^{7K} is indeed an impossible number for us but not necessarily so for a network of computers.
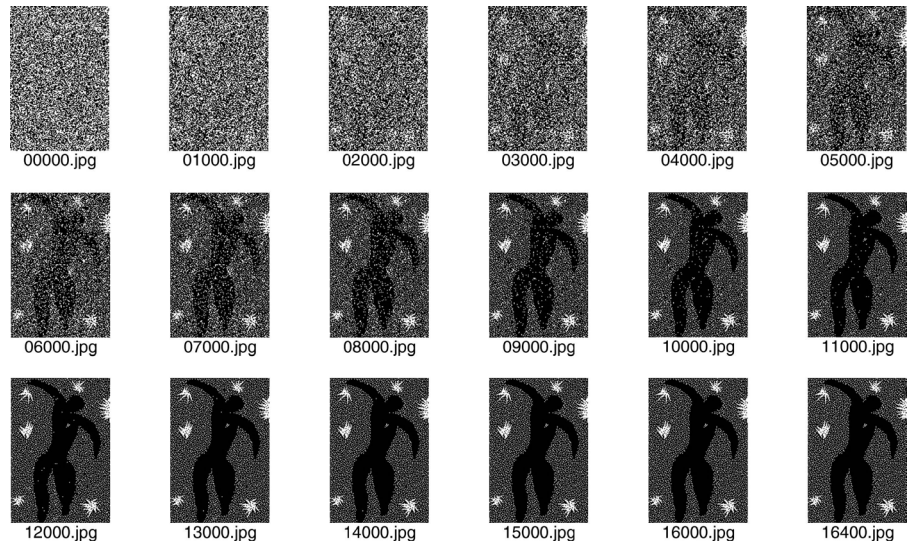
00000.jpg	01000.jpg	02000.jpg	03000.jpg	04000.jpg	05000.jpg
06000.jpg	07000.jpg	08000.jpg	09000.jpg	10000.jpg	11000.jpg
12000.jpg	13000.jpg	14000.jpg	15000.jpg	16000.jpg	16400.jpg

Figure 1.

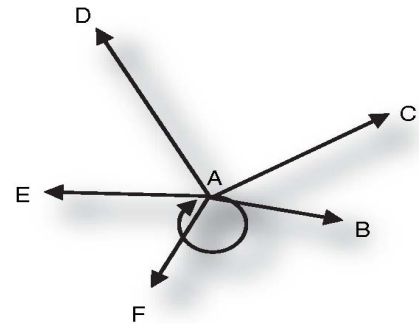The phases of a genetic algorithm that seeks to produce an image

Figure 2.

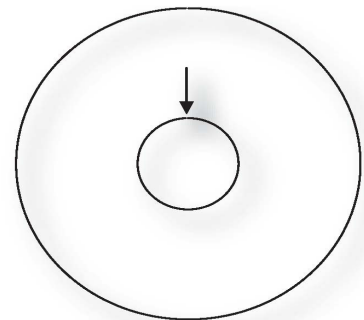The relationship between one and another is not the same as with one and itself

Figure 3.

Observing a system from outside still lies inside another system

The Intricacy of the Otherness
Kostas Terzidis

predictable yet seem to be guided by some sort of intelligence. While these events are made possible by simulating natural processes without involving human intelligence, yet it is inevitable to assume that some human intelligence is involved in the selection of the natural process that best fits the problem of randomness. Human intelligence arises as an act of preference.

Preference is the grant of favor or advantage to one over another. It is a subjective formation of an idea that leads eventually to choice. As subjective actions are dictated by one's own criteria, a problem arises when such actions refer back to the same person. For instance, an architect, in designing a house for a client, is trained to observe, detect, and address certain preferences of the client. Yet, when the client and the architect are one and the same person, then preferences tend to elude one's own mind. This happens either because one is not able to comprehend fully one's own mind or because one may miss certain aspects. "While one knows what one knows, one certainly does not know what one does not know." This seemingly self-evident statement is not so, in at least two ways. First, the assertion that one is unaware of one's own ignorance is impossible within the sphere of that person's knowledge; for if it were true then one would know what one does not know, which is an apparent contradiction. Second, the fact that the statement is in quotes means that it is being stated by a third person in which case the lack of knowledge of ignorance may be viewed as such from the third person's viewpoint. In other words, only a third person may be able to detect the incompleteness of another person's knowledge.

In mythology, Ulysses introduced himself to the Cyclop as "nobody." Later on, when the Cyclop was looking for help nobody would help him because nobody hurt him. This last statement is self-consistent within its own linguistic context but not if one gets out of the context and assigns the name "nobody" to somebody. Then the whole statement has a different meaning, yet undetected for those inside the system. Godel's incompleteness theorem claims that within any consistent formalization of a quantifiable system a statement can be constructed that can be neither proved nor disproved within that system. The beauty of Godel's argument is not only in pointing out a discrepancy in reasoning but, most importantly, in revealing the existence of an alien realm that bounds the known universe.

Allo can be defined as a representation of something else, not in the sense of a metaphor, but in the realistic sense of referring to something unknown and therefore evasive, whose entrance point, gateway, or portal can be glanced through by negating reason and venturing instead on alternative paths. Allo is by defini-

tion a-logical as it. arises when the if-then clause fails. Yet, while it is not illogical, devoid of logic, or senseless, it represents those possibilities that are out of the bounds to which the first logic can apply. Allo is not human; it is a human discovery that helps describe, explain, and predict lack of knowledge. It demarcates the end of human reasoning. It is the opposite of "is"; allo is everything else.