Architecture is computation

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It is now clear that architecture, whether it is considered as an intellectual discipline or as a practical activity, will no longer remain the only human property it has been so far. As numerous developments in Artificial Intelligence, Robotics and Interface Design show on a daily basis, computational machines – abstract or material – do not simply replace humans in low-skilled jobs and activities, but profoundly disrupt the role that humans play in all domains. From industrial production chains to cancer treatment, and from the management of public transport to the translation of natural languages (considered for a long time as a bastion of semantic complexity), nothing seems to escape calculation. In this context, which seems to jeopardize human authority, considering architecture as a computational discipline is no longer a marginal issue. We understand today that computation does not only modify the way we design and make architecture (by the use of software always including more know-hows and allowing to automate a more and more consequent number of operations), but also transforms the nature of architectural practice and its possible ends.
For more than twenty years, the computational avant-gardes have been exploring the consequences of the rapid progress in computers. In doing so, they have participated in expanding the field of architecture and research, and the fact that beyond architecture itself, it is our entire existence that is today profoundly transformed by the production of digital technologies. The awareness according to which architecture could be only a modality of computation does not concern only architecture but all disciplines and all social phenomena.

From scientific research stemming from, logistics to energy resource management and communication, computation has led to fundamental transformations which we are only starting to understand. At the same time, the emergence of global surveillance, the outsourcing of policy and legacies of the digital economy will, over the years, be revealed and its distribution are all evidence that its growing expansion also profoundly disturbs everyday life.

In architecture as elsewhere, uncertainty has become a primary condition that breaks with the metaphysical positivism that had prevailed before. Unpredictability, which was a linear and deterministic discourse to be replaced by short-term visions of an "intelligent" future, without anyone being able to say, however, what this intelligence consists of... A superficial look at the state of the discipline gives the impression – perhaps illusory – that there are very few options left. Architecture seeming to navigate between the celebration of free market principles and forms of retreat on historical patterns.

In this context, the relationship between the means and the ends of architecture seems anything but obvious. Although its technological roots have considerably deepened, very little has been done to reflect on the role of computation itself in the elaboration of a project. The problem of whether it is a tool, a medium, a technology or, more radically, an ontology remains an open question. Based on this observation, these two days study proposals to question the role of computational models in the process of architectural production. One of the possibilities, once the field of architecture is fully engaged in a process of automatization, to analyze the specific design (according to principles similar to those used for image recognition, games as chess and Go, discussion and robots, states of matter, etc.). Another consequence could take the form of a question: if computers design architectures that are skilled in the art identity as constructing or even superior to any "human" architecture, in what capacity should we reject them? How not to reconceive with the idea of the "end" of architecture and history (history and human nature)?

While it is still difficult to deduce on this point, the concepts presented below should be interpreted as an introduction to the understanding of which these consequences can be explored and questioned. Far from being exhaustive, this list offers points of entry in the global discussion that these studies aim to unfold.

**Abstraction**

Abstraction can generally be defined as the ability to consider any phenomenon, however modular and modulated, as the contingent of the emergent condition of their existence. As such, it can be conceived as the process by which thought can model and thus understand the world. The continuous production of modern, modern science, this process has also been crucial in reducing the amount of data and opening up the possibility to consider the concept of the continuous dualism as an abstraction. The discrete / continuous couple has long known simply manifested in construction when a continuous element such as a surface could not be subdivided. Our new understanding of the concepts of abstraction, however, has been that computing is an abstraction specifically as a human rational process or is abstraction the cornerstone on which the difference between human intelligence and artificial intelligence can be elaborated? From this point of view, should computational architectural models still be considered abstractions?

**Automation**

While automation is increasingly discussed and debated, it is not a new issue. From the invention of the industrial model of architecture as a system in 1830 to the almost entirely autonomous warehouses and logistics systems through which goods cruise the globe today, its exponential development has, however, reached a tipping point. Not limited to the simplest and most repetitive tasks, computational models can be conceived of as a new model for architectural introduction in a world in which everything we do will be automated. As in many other areas, the question that raises in architecture is less about the extent to which things could or should be automated or what can be automated and more about how architecture can be automated and what architecture is. More generally, how does abstraction transform the practice of architecture? What architecture is it about in a fully automated world?

**Complains**

To say that we live in a complex world has become commonplace. However, what is at stake is that this variance varies greatly depending on the situation and the interlocutors we are considering. Often referred to as a vague idea registering our inability to understand the current state of matters or, more precisely, to define a globally meaningful term, 2016 is not the only one to have become a poorly defined notion, most commonly mobilized against the possibility to act on them. This appears especially true in architecture, where complexity has not only constituted one of the principal weapons used against the Modern Movement and its pretension to planning, but also as an argument against the concept of architectural system, generally understood as being an exhaustive, this list offers points of entry in the global discussion that these concepts present below should be interpreted as an introduction to the understanding of which these consequences can be explored and questioned.

**Energy**

Energy is what through which we value the capacity of our world to transform itself: to produce heat, to set something in motion, to change the state of matter or, in general, to change the world. In doing so, it has imbued always more numerous instances of the nature of energy. As we were told by Richard Buckminster Fuller that “there is no energy crisis but only a crisis of intelligence”, we must however be wary of the fact that crisis can also appear as a support preventing us from asking the right questions. Today, computation plays a crucial role in the equation of energy consumption. Contrary to what the first decades of data development might suggest, it is now clear – as data centers and the blockchain embody – that computing is a material process that consumes energy. This question allows us to go beyond its technocratic approach of energy issues, in order to embrace a broader vision. Should architecture abandon its idea of immateriality of matter to consider its objects in terms of material transformations and energy exchanges? Traditionally at least since, how can architecture accommodate ideas of energy and sustainability? What is involved in the concept of architectural system, generally understood as being in equilibrium?

**Grammar**

In 1977, the proton was the smallest element known. Forty years later, not only are we capturing “really” at higher resolution levels than before (as evidenced by the visualization of the Higgs boson particle), but we can also operate on increasingly finer scales (as shown by the example of nano-robots). While the power of our smartphones surpasses today that of most supercomputers of the 1980s, increasing processing power allows us to continuously deepen our access to the “real”. The ability to find and manipulate information at the finest scales suggests moving away from abstract processes characteristic of modern science and architecture and replacing traditional reactionist models with immersive simulation strategies. Let matter, data can be manipulated to never reach a level of granularity. How does this displacement the traditional articulations of architecture in terms of scale? How can architecture take advantage of this descent into the smallest constituents of matter and energy? How can architecture reconsider the notions of local and global? In what form of reconfiguration is the abstraction fundamentally transformed by granularity?

**Orientations**

Architecture has long been considered as an art of measurement, a science of limits, compartmentalization or even meditation. Traditionally based on a dichotomy, it has been conceived as a mediator between what constant problems and what is an easily countable. Architecture has measured, weighted, framed, framed the world by judging magnitude and magnitude. It intends to construct models to abstract information and extract qualities, making sense of pure concepts and concepts. As our data is growing exponentially, architecture is one again confronted with quantitative changes that are based on the recurring question of data size ("the multiple") (as Yona Friedman put it) How can architecture still design models when large data and large scale seem to move away from abstraction? Does this increase in data create a new numerical nature, in the qualitative sense of the term, or does it simply and quantitatively add information to information within a big data cloud in which no human is able to orient itself?

**Mass**

Apart from radical idealists and the proponents of digital philosophy, for architects it is a matter of mind – it exists, few venture to challenge the existence of the materiality of the world. This may first of all stem from caution, for in the present condition of the world, the concept of material identity remains rather a metaphysical than a scientific question. If the problem of a matter is obviously centred in architecture, both the concept and its industrial forms have evolved as radically during the past century – with the advent of organic chemistry, the invention of concrete and the development of nanotechnologies – that it has become very difficult to know what we mean when talking about material. Every time we talk about structural mechanics, a building life cycle, "modular" design or neurodesign, we implicitly or explicitly refer to material at different scales and in different contexts. How can an engineer in material mechanics, and although the concept of information is obviously not to say, can we say that matter “really matters”? How can control the materials and matter are still usable. This is, for example, the claim of functional transhumanism for whom neural states are mainly "logical" states that are instantaneous in matter (more or less any kind as long as "as works") but not necessarily in biological matter such as which constitutes the brain. It is thus necessary to approach the concept of matter both practically and conceptually in order to study how the evolution of this notion leads – or not – to an evolution of architectural practice and discourse.

**Information**

Any concept has had a deep impact on contemporary society than that of information. Since its rigorous definition by Claude Shannon (1948, “Mathematical Theory of Communication”) it has acquired immeasurable numbers. It could seem paradoxical to use a concept defining the immaterial that which is not seen, to have such an impact on the material evolution of the world, but science has always relied on this principle, by rigorously defining what could not be seen, from geometry (with great success to ethics (with much less success).... As we are far from conceiving today, ignoring the relationship between architecture and information has become more than a mistake, is an intellectual deficiency. Information, through the machineries of information processing or thanks to the calculation that one operates with, it is, at least in its vector through which architecture is conceived and built... Without going too far as to summons the hypothesis of digital philosophy ("there is only information") it seems even today possible to entitume a computer machine the entire architectural achievement, so that at maximum, information could be considered all that architecture needs to exist. The problem then, first concerns the nature of this information (social data, etc.), its origin and its consequences (how it is gathered, how it is processed and through which conduits), but also a much more direct problem: that of the exact role of architects.

**Contingent Discourse**

The continuous and discrete dualism manifests itself in architecture as much as in construction as in design. It concerns the modes of implementation, the economy of the projects, the logistics and of course the formalism of the architecture. This dualism of architecture can be considered. It is obvious, even highlighted, or on the contrary simply manifested in construction when a continuous element such as a vault is made of discrete elements (e.g. stones or bricks) leading to a kind of “dialectical understanding”. The discrete / continuous couple has long known its evolutions that we could describe as scenes, until new design and construction techniques recently broke this scenery. This is the case of algorithmic design (generative design, etc) as well as robotic manufacturing, including, most evidently, 3D printing. The transition between the discrete and the continuous seems to have become a question of parameters, proceeding from a choice: that of the “good formalism” with regard to a given architectural problem. We have seen with recent year the parameters and with the joint development of concepts like Feldman, Blomberg, Discretism, etc. the continuous and the discrete are therefore as much formal, visual and tectonic concepts, as they are not only different forms, but also different angles that we would like to explore the transformation of their relationships.