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Information Cartilage

On the Role of Information Architecture in Context-Aware Intelligent Systems Design

Abstract

This paper is an attempt to understand expanding information spaces from a phenomenological perspective. As technology continues to challenge the online/offline distinction, phenomenology provides a useful framework for thinking about context, the role of situated being, and the need for order. Artificial intelligence and context-aware computing are used as examples of information environments that specifically call out the benefits of understanding information as a bodily entity—as in a "body of information" or "body of knowledge". Concentrating on a Heideggerian approach to technology, which in part characterizes technology as a call for order and structure, the essay will examine the idea of 'structured flexibility' needed for systems that not only process information but also predict needs, shape information contexts, and actively engage in the user-system interaction. Finally, it will provide new ways for information architects to think about the expanding space of information.

Introduction

> *Every two days now we create as much information as we did from the dawn of civilization up until 2003 (E. Schmidt)* [1]

> *We live in a world where there is more and more information and less and less meaning (Baudrillard 1994)*

Information spaces are changing more rapidly than we can design for them. As context-aware computing and artificial intelligence are advancing into consumer markets, the need to structure information and meaning around adaptive systems has never been more important. The past century has seen significant variation in the ways that information is ordered, disordered, constructed, and broken down. Information architecture is about creating order, but these new technological systems are calling for a form of order that

borders on paradox: a flexible structure, an adaptive constant, an information cartilage. Context awareness and artificial intelligence are making us think about information in new ways; the big question, the one this paper will hopefully help answer or at least usefully frame, is how we design for such systems.

Abundance

A large part of the modern era was spent amassing things. The Industrial Revolution gave us the means of producing consumer products in large quantities, and capitalism gave us the motivation and means of self-justification for such excess. But not only with consumer culture: art and literature also changed in the modernist era, especially high modernism, from relatively ordered realism to chaotic abstraction and purposeful transgression. What is unique about all these objects we collected is that they all existed within the bounds of physical space, at least until the mid 20th century.

As information technology came into being, we saw a shift from physical objects to digital objects at the same time as we embraced disorder in art on a larger scale than ever before. It seems clichÃ© to refer to an "information explosion", as it has become wrapped up in everyday life to the extent that we don't notice it anymore, but we must note that the tendency toward production, coupled with the ability to transgress the bounds of physical space, has resulted in an abundance of information analogous to our abundance of physical objects. As "informational objects" became a reality, we were already conditioned to think in terms of disorder. So we collected them, cherished them, fetishized them, but we didn't do a great job of organizing them.

The problem associated with too many physical objects compared to too much information is a question of organization and space. It seems unlikely that we will run out of space for our digital objects because we have the capacity to create more space. The challenge, however, is to organize these objects in such a way that we can maintain volume and create meaningful associations. Without organization, information becomes a burden.

Information architecture was born out of the need to organize web-based information into a network of meaningful interactions. Mobile computing allowed digital information to slip off the desktop and into the pockets of users worldwide, resulting in a staggering amount new sources, types, and potential categories of information. It created new information spaces that are not only digital but also transitory, fickle, and unpredictable. Artificial intelligence and context-aware computing are just two examples of this

larger movement toward the creation of new information object. Information architects play a crucial role—if not the crucial role—in ensuring these informational objects will remain meaningful.

The success of this organizational project depends on our understanding of the interplay between physical and digital spaces, concentrating on two of the most interesting movements in computing, which have been gaining momentum for decades: artificial intelligence and context-aware computing. The new information spaces these movements create—i.e., adaptive spaces—call for a re-examination of how digital information relates to physical space. Using Jean Baudrillard and Martin Heidegger's work as a basis, I argue that the ways we understand contextual and intelligent systems, and subsequently their ultimate success, depends on how their information is organized and its ability to adapt.

From Postmodernity to Now

Descartes famously declared a separation between mind and body in which the body is simply the mechanical offshoot of mental representations—a problematic statement whose examination is beyond the scope of this paper. But the residue of this dualist mentality has followed us into the information age wherein the digital and physical are viewed as completely separate modes of being.

> *I thence concluded that I was a substance whose whole essence or nature consists only in thinking, and which, that it may exist, has need of no place, nor is dependent on any material thing; so that " I," that is to say, the mind by which I am what I am, is wholly distinct from the body, and is even more easily known than the latter, and is such, that although the latter were not, it would still continue to be all that it is. (Descartes 2010)*

With the informational onslaught we experienced throughout the postmodern age, we can no longer simply take the digital and physical as separate entities. The partial reason for this conceptual implosion is that information in the form of physical objects, digital information, and textual constructs have slipped the bounds of our current organizational models. They blend, construct, and mutually maintain one another in ways that were predicted decades ago but are only beginning to come to fruition since mobile computing hit the mainstream.

Jean Baudrillard wrote some of the most important accounts of real and virtual blending. In perhaps his most well-known text, Simulacra and Simulation, he explains some results of the shift from modernity to postmodernity:

> *What we have forgotten in modernity, by dint of constantly accumulating, adding, going for more, is that force comes from subtraction, power from absence. Because we are no longer capable today of coping with the symbolic mastery of absence, we are immersed in the opposite illusion, the disenchanted illusion of the proliferation of screens and images. Now, the image can no longer imagine the real, because it is the real (Baudrillard 2008)*

World War I had a significant impact on the world psyche. Beyond the obvious effects of mass warfare, WWI introduced new technologies that allowed us to kill each other at a much large scale than ever before. Art and literature changed post WWI to reflect the tension that people felt regarding the role of humans within the world. One side, modernity drove artists toward strict order: architecture became symmetrical, genre became more pronounced.

But on the other side, order was breaking: the pronouncement of genre was mostly to undermine its importance, painting became chaotic, music became disorganized, the novel became disordered. Philosophy and psychology became dark. Thinkers like Sigmund Freud, who built his early career on the concept of the pleasure principle, the sense that humans strive toward prolonging existence, shifted focus to the death drive, or the idea that there is an equally pronounced drive toward 'inorganic being,' a desire for non-existence.

There was a certain emptiness felt across the West, which turned out to be a perfect breeding ground for capitalist tendencies toward accumulation and what Baudrillard calls the 'disenchanted illusion.' We started buying, creating an entire consumer culture based on objects. Baudrillard identified this time period as the beginning of events which lead to the image being unable to imagine the real. Advertising was responsible for reducing the consumer object from material to a sign, a virtual representation of an object's materiality, which in turn allowed consumption to occur at a mass scale.

As Frederick Jameson later says, the "textualization" of the world was underway. With all of our consumer objects represented in virtual space as well as physical space, we drown in information, in representations, and in interpretations. The image becomes the real.

Philosophers going back to Plato have grappled with how characterize the difference between the material world and representations of the material world. Baudrillard's claim is that there is no longer a distinction.

> *Today abstraction is no longer that of the map, the double, the mirror, or the concept. Simulation is no longer that of a territory, a referential being, or a substance. It is the generation by models of a real without origin or reality: a*

hyperreal (...) The desert of the real itself (Baudrillard 1994)

The hyperreal is a designed reality. We have moved on from representations—from, for example, an image of a car that we know is supposed to mean "car"—to simulations that force us to think about things like destinations on a mobile map interface as already having a sense of place, even if we haven't been there before. The paper map used to provide a spatial representation of known places. That is, the user of a paper map would have a place in mind before consulting the map as a representation of its spatial relationship to his or her current location. But there was no sense of place if the user has not been there before, if they only have a peripheral concept of the place.

Within Baudrillard's hyperreality, however, the mobile-digital map provides both the representation and the real, the simulation. By overlaying auxiliary information over the location representation—e.g., reviews, photos, suggestions—the mobile-digital map begins to function as the "real" location, giving the user a sense of place in a space where they are not currently located. In addition, the map is no longer a point of reference for an already-known place. It is a tool we use to find new places of which we were previously unaware. The mobile map is literally telling us what is real. Information display and hierarchy plays a crucial role in this idea of simulation.

But we're getting a little ahead of ourselves. The breakdown of consumption into object accumulation and eventually a type of informational chaos characteristic to postmodernity was the root of Baudrillard's conception of simulacra and simulation. As the modernist tension approached its breaking point perhaps best illustrated by Samuel Beckett's literature, which often oscillated between broken narrative structures and hyper-order, a conceptual shift also happened.

Consider the permutational style of Watt ("Here he stood. Here he sat. Here he knelt. Here he lay. Here he moved, to and fro, from the door to the window, from the window to the door") to the last line of The Unnamable: "I can't go on, I'll go on." We move from the obsessive need to account for every possible event to the desire to reduce all human experience to a simple binary opposite (Beckett 2009a; Beckett 2009b). We can see the modernist tension give way to complete breakdown in Beckett's later works like "Waiting for Godot", a play in which two characters literally wait for a man named Godot who never comes.

The play highlights futility and the random chance happenings when one is not focused on anything in particular. But it also focuses on the myriad

of distractions one experiences during any task at hand. This latter point in particular is illustrative of the postmodern mindset: there is simply too much information to make sense of anything in broad terms. We are forced to concentrate on the tiny details while any notion of purpose fades into the background. It is this lack of real focus that allows the simulacra to breed. While we focus on the little things, the big ones emerge independently.

> *Baudrillard is quite clear, moreover, that the process of simulation that produces these 'objects' of fashion, of exchange, is linked to a shift in the conception of technology, to a "mutation of (a) properly industrial society into what could be called our techno-culture." In this "techno-culture"; the "rationalization" of consumption has turned on itself, has begun to consume its own tail. Any end or value above or beyond this cycle has been discarded, liquidated. Style has become its own end, its own value. Here too, the technology of mass production can no longer be seen simply as functional, but in terms of a truly simulacral technology—allegorical and arbitrary—where technological reproduction and montage continually cut and reassemble their own technological forms. Consumption has become, in other words, a self-generating machine whose only 'function' is to reproduce an increasing surplus of its own technological style, its own simulacral technology—a surplus value whose only end is more consumption, more sales. (Rutsky 1999)*

Rutsky's mention of the 'self-generating machine' here is a symptom of informational abundance. Through the lens of consumer objects—which more importantly than 'objects,' they are also 'signs' —we can see how 'textualization' has created a world in which these objects exist only to replicate their own meaning ad infinitum. And while it is not at all new to think about technological objects as also consumer objects, it is becoming more pronounced to situate technological devices within consumer culture. Devices that once granted us access to "unseen" and "other" digital information spaces are now wrapped up in the everyday, including everyday consumption; they are designed for consumption, with all its implications regarding information abundance.

The postmodern era has put us in a strange relationship with technology and information. While we have been incorporating them into everyday being for some time, and while this physical-virtual blending is not inherently good or bad, we are reaching a point where skilled organization of this information is necessary for continued use.

Reformation

Those who design technological systems are keenly aware of this problem. Practitioners have created vast amounts of 'best practices' and models for simplifying and organizing information in useful ways. While this approach

might fix some immediate problems, it largely ignores the underlying complexity of the issue. Information abundance extends beyond design patterns.

Thinkers like Andrea Resmini have been approaching this problem from an informational perspective — essentially fighting fire with fire. Resmini articulates what he calls the 'post-digital,' or the current—post-postmodern, to risk sounding silly — time in which there is no longer a distinction between online and offline. Perhaps it is a stretch, but we might also say mobile computing has resulted in the physical and virtual becoming no longer distinguishable.

Resmini calls for a reformulation of the online-offline divide from one exclusion to one of pervasiveness, context, and banality — pervasiveness because information is wrapped up in everyday life, context because we are now able to design technological systems that adapt to users' context, and banality because information is no longer a novel aspect of life.

When technology becomes pervasive, banal, and contextual, information spaces need to become adaptive. If we can entertain Baudrillard's idea that information began to self-replicate in the postmodern era, then we must also acknowledge the idea that artificial intelligence and context-aware computing hold the capacity to exponentially increase the speed of such replication. We are no longer doing all the interpretation ourselves. Machines are helping.

Context-aware Systems, Phenomenology, and Information

As Fredrik Ohlin (2012) articulates, the major question in the relationship between information architecture and what he calls "context-aware adaptive systems" is how to design information structures that are static enough to allow users to accomplish discrete goals but also adaptive enough to account for complex contextual shifts. Stated differently, how can information structures be adaptive to adaptation itself, and be intelligent enough to know when adaptation is necessary and when it is not? It's a highly complex question, which by definition has no models we can use to formulate answers. But that doesn't mean we can't learn from analogous technological movements.

The relationship between context-aware systems and artificial intelligence is one of parts and wholes: AI is part of the whole context-aware system.

Early AI researchers like Alan Turing and Marvin Minksy shaped decades of subsequent work around the computational theory of the mind. Simply put, computationalism holds that the mind works essentially like a computer; it takes perceived facts from the surrounding world, makes sense of them by referring to existing models, and acts accordingly.

This articulation, prevalent in both AI research and classical cognitive science, is based on a Cartesian theory of mind, which posits a strict separation between mind and body, subject and object, self and world. Cartesianism categorizes consciousness as an inherently disembodied phenomenon, one that, in its most basic form, is separated off from everyday experience. In order to participate in reasoned cognition, Descartes believed, one must divorce oneself from everyday experience.

Such a conception de-emphasized the role of the body in early AI. The running belief was that if we could simply account for any and all possible outcomes, we could then program them into a computer mind that, in its vast factual knowledge, would be able to infer further knowledge. It was a rule-based model of intelligent interaction. But, as Hubert Dreyfus's critique suggests, this a more comprehensive approach to the problem might be necessary, one that looks to philosophy for answers:

> *Minsky, unaware of Heidegger's critique, was convinced that representing a few million facts about objects including their functions, would solve what had come to be called the commonsense knowledge problem. It seemed to me, however, that the deep problem wasn't storing millions of facts; it was knowing which facts were relevant in any given situation. One version of this relevance problem was called "the frame problem." If the computer is running a representation of the current state of the world and something in the world changes, how does the program determine which of its represented facts can be assumed to have stayed the same, and which would have to be updated? (Dreyfus 2007)*

This idea of the "frame problem" became one of the major setbacks to classical AI. By assuming that information is organized in static structures, it follows that we can write rules associated with these closed systems that account for any and all variations. Although this might be true for truly closed systems, the complexities of changing contexts presents a problem to framed solutions. That is, when something changes within an assumed static environment, rules must be adaptive to account for that change. As Michael Wheeler puts it, "The frame problem is the difficulty of explaining how non-magical systems think and act in ways that are adaptively sensitive to context-dependent relevance".

Early AI failed to account for this problem. But Dreyfus's work on the relationship between AI and the phenomenological philosophy of Martin

Heidegger helped to point out that successful AI systems will need to account for uniquely human qualities of intuition, context, and adaptation. Put in the perspective of information architecture, these systems must be built upon an adaptive structure that is flexible enough to seamlessly account for change.

Where does that leave us with regard to information architecture and context-aware AI systems? It is helpful to turn to Heidegger's concepts of enframing, (un)concealment, and technology's relationship to being-there.

Heidegger's assessment of technology is a massively important contribution to philosophy. The Question Concerning Technology is one of his most complex texts, one that reveals new ideas every time it is read. His concept of enframing is particularly important for both his own theory and its application to information architecture:

> *Enframing means the gathering together of that setting-upon which sets upon man, i.e., challenges him forth , to reveal the real, in the mode of ordering, as standing-reserve. Enframing means that way of revealing which holds sway in the essence of modern technology and which is itself nothing technological. (Heidegger, 182)*

Notice that Heidegger emphasizes the idea that enframing is specifically a challenge or provocation to reveal something that is hidden, and through that revelation comes a sense of order. Heidegger uses the word Herausfordern in German to describe this challenging-forth, a word that is also associated with order, structure, and provocation. His goal throughout this essay is to determine the essence of technology, which as the above quote says, is not necessarily technological. In other words, speaking of technology only in terms of technological manifestations or products misses the point; it will always fail to fully explain the essence of technology. For Heidegger, this essence is associated with technology's capacity to challenge, provoke, and order being-there. Technology is in itself a provocative challenge; it's as if technology is taunting us to make sense of it, to bring order to its seemingly infinite potential.

There is something mysterious going on here. Heidegger alludes to something hidden that is called forth in the technological interaction, but he is not terribly specific about what that thing is. At certain points, he refers to 'oblivion' and the dangers of technology as a means of 'revealing too much.' This sense of something beyond, unknown, and in some cases transcendent is theme that runs throughout philosophy. From Plato's ideal realm, to Freud's unconscious, to Lacan's Master Signifier, to Kant's thing-in-itself, there is a tendency for philosophers to acknowledge that there is something beyond what the human mind is able to conceive. In our modern

age, Heidegger's oblivion is akin to information abundance, simulation, and the threat of losing ourselves in unordered information.

Revelation, showing what is unknown, and creating order are all characteristics of what a good context-aware AI system do. The power of these systems stems from their potential to enhance everyday experience by exposing new layers of information otherwise unknown, and perhaps unknowable. Context-aware AI brings a sense of revealed knowledge and unearthed information. But this new information comes unstructured and must be ordered for it to make sense. Conceiving new information in such a way allows us to also think of information architects as key figures in not only the overall restructuring of all information in the post-digital age, but also specifically in terms of restructuring the products modern technological advances.

Heidegger also refers to technological revealing as a 'bringing-forth': "Bringing-forth brings hither out of concealment into unconcealment (â€¦) The coming rests and moves freely within what we call revealing." (Heidegger 1982) There is a sense of transition from concealment to unconcealment to revealing, suggesting that we can think of a transitional state between full concealment and revelation. "Unconcealment" is the English translation of the German das Entbergen. Ent means 'forth' or 'out,' and Bergen is to rescue or secure by concealing, so das Entbergen is to bring forth out of a secure, concealed state. Thus, there is a danger to this revealing that technology provokes. Technology coaxes being-there our from a secure, hidden place into conscious awareness.

Just like the seeds of postmodern deconstruction of order were present in the modern era, we can see a movement toward ordering in postmodernity. Given that one aspect of the postmodern is the influx of information technology, Heidegger's idea of the bringing-forth of technology can be applied to show how even while the cultural trend toward disorganizing information was strong, the essence of technology worked to create structure. The seeds of order were present in disorder itself:

> *What is modern technology? It too is a revealing. Only when we allow our attention to rest on this fundamental characteristic does that which is new in modern technology show itself to us. (â€¦) That revealing that rules in modern technology is a challenging (Herausfordern), which puts to nature the unreasonable demand that it supply energy that can be extracted and stored as such. (Heidegger 1982)*

Heidegger differentiates 'modern technology' from an older form by means of the ability to extract and store energy. He calls this characteristic "standing reserve," which essentially means that modern, information technology (if

the two are synonymous) hides itself until needed; it is stored up until an individual needs to use it. We can see how this type of thinking has been adopted in contemporary design practices, especially with regard to mobile and ubiquitous computing. Designers often talk about creating "intuitive" interfaces that are invisible until they need to appear. The success of this goal is still in question, but as information architects, we should notice that Heidegger emphasizes that the tendency for technology to demand nature to store energy and (re)present it as needed is unreasonable. Why is it unreasonable?

There is a certain anxiety in Heidegger's work around the role of nature. On one hand, he wants to avoid the Cartesian mistake of assuming the primacy of nature—i.e., when dealing with objects, a mobile phone for example, there is nothing about the phone's nature that give it phone-ness. Only when someone interacts with the phone does it obtain meaningful status as a phone. It's nature is constructed by its users. But on the other hand, users' interaction with the phone as a technological object places it within the bounds of standing reserve. We need it to be there certain times and disappear other times.

One way to interpret Heidegger's wavering is to note that his conception of modern technology was bound up in a specific time in history. Information technology was just beginning to gain momentum when he did most of his writing, particularly his essay on technology. Computers were in their infancy, and people like Alan Turing and Marvin Minsky were starting to think about the possibility of intelligent machines.

It was also a time when late modernism was blending into postmodernism and all its associated information abundance. Heidegger's historical context for thinking about technology was also a time when the amount of unstructured information and textualization was increasing exponentially. It's no wonder that he was anxious:

> *(W)hen destining reigns in the mode of Enframing, it is the supreme danger. This danger attests itself to us in two ways. As soon as what is unconcealed no longer concerns man even as object, but does so, rather, exclusively as standing-reserve, and man in the midst of objectlessness is nothing but the orderer of the standing-reserve, then he comes to the very brink of a precipitous fall; that is, he comes to the point where he himself will be taken as standing-reserve. (Heidegger 1982)*

Heidegger's fear is that technology as standing reserve can force humankind into a passive position. If humankind assumes an all-inclusive technological standing reserve, eventually the dynamic undergoes a strange reversal in which humankind itself is in a position of standing reserve. Heidegger

does not do a good job of articulating what that would look like, but he does express an associated opportunity: humankind becomes what orders the standing reserve, the information. Similar to how the seeds of disorder were present in modernism, and order in postmodernism, we are approaching the opportunity to bring that order to fruition through informational structure.

Conclusions

The challenge for information architects is to design for the structurability and reframibility of digital information in a way that allows for flexible, context-aware systems but also ensures that humans remain in an active role within that relationship. If we take the movements around order/disorder in modernism/postmodernism and Heidegger's warning seriously, then we can see how the relatively new field of information architecture is at the forefront of actively manipulating the future of information structure.

Our task is to balance informational order and disorder into a harmony that allows structured flexibility. Take the example of cartilage in the human body. If we were to map anatomical flexibility on a continuum, we might have skin at one end, bone at the other, and cartilage somewhere in the middle. It has the pliability of skin and the strength of bone. Skin is meant to keep organs and flesh contained, but it has no structure. Bodies of skin and flesh would be just blobs on the ground: precise movement, speed, and agility would be impossible.

Bones provide the structure our bodies need, but they are also rigid, moving only in discrete directions. Cartilage allows skin and bones to work together. It is located mostly in places that need sustained movement and pliability, namely the joints. Without cartilage, our joints would be stiff, rigid, and fragile. Cartilage provides the body with structured flexibility.

Returning to the two quotes from Schmidt and Baudrillard that opened this paper, we should note that the two authors were referencing different kinds of information. Schmidt was talking about quantifiable data that can be measured in bytes; this is the digitized information we create every day. Baudrillard, however, was talking about textual information, the qualitative stuff we create, sometimes unconsciously, that becomes the background material of everyday life. If we think about information space as a body, quantified information is the bones: it is static, determined, and resistant to change.

Quantifiable information is absolutely necessary to knowledge and understanding, but it is too rigid to allow any kind of meaningful

interpretation on its own. Textual data, on the other hand, is composed of skin-like qualities: it is much more free flowing, flexible, and varied by situation. Again, it is necessary for knowledge and understanding, but it cannot stand on its own.

We need a sort of information cartilage that will be able to bend and flex with intelligent, adaptive systems, but will also hold its general shape to prevent structural breakdown. Information cartilage will facilitate the coexistence of quantified and textual information, allowing for the finitude of what we quantify and the interpretation of what we textualize.

As context-aware intelligent systems continue to become more sophisticated and ubiquitous, their key difference from static computing will become more pronounced—i.e., because context-aware intelligent systems are designed for everyday individuals, they necessitate attention to design for the everyday user. The architecture of contained information is the starting point for this effort.

While context-aware computing and artificial intelligence have yet to 'prove themselves' as technologically feasible or market compatible, they offer a certain Herausfordern—a challenging-forth, a provocation that extends outward into other domains relevant for designers and information architects. Much like Heidegger rejected Cartesian dualism of mind and body, information architects should (and mostly already do) approach the online and offline as co-constructive entities. They come together in 'bodies of information' organized around 'structured flexibility.'

The challenge is designing places for these bodies. Context-aware systems and AI are essentially systems built on larger systems built on even larger systems. In this way, information architecture is a living practice. It is never complete. Like the infinite and perpetually changing task of understanding user behavior, information architecture's job is never done.

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Footnotes

[1] Eric Schmidt, then CEO of Google, opened his intervention at the 2010 Techonomy Conference reporting these numbers. In Siegler, M. G. (2010). Eric Schmidt: Every 2 Days We Create As Much Information As We Did Up To 2003. TechCrunch. https://techcrunch.com/2010/08/04/schmidt-data/.

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Surrounding Signifiers

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