(Un)Building Codes: A Style in Ruins

"We are entirely in the dark about how consciousness fits into the natural order."

—David Chalmers[1]

MICHAEL SILVER
University of Buffalo

Beginning in 17th century philosophers and scientists believed that the universe functioned like a giant clock obeying the predictable laws of classical mechanics. Sigmund Freud, inspired by the steam engines of his day, described psychic processes in terms of circulating pressures released as vivid images in dreams. Today, computers have become the dominant technology creating a zeitgeist based on digital media. But can computation accurately account for the world and its diverse inhabitants? Are people reducible to abstract bits, electrical circuitry and programming? Or is computation merely another paradigm that routinizes perception and locks us into a particular way of thinking? If the latter case is true then how do we overcome these models and allow art and design to operate as 'para- critical' practices focused on our liberation from newly minted and constantly evolving techno-centric meta-narratives? Unlike traditional critiques that focus on historically established tropes or post- critical practices that emphasis novelty over analysis, a para-critical strategy can capture the best of both approaches. By considering evolving trends as targets for deconstruction, newness can be engaged without privileging any single frame of reference. In

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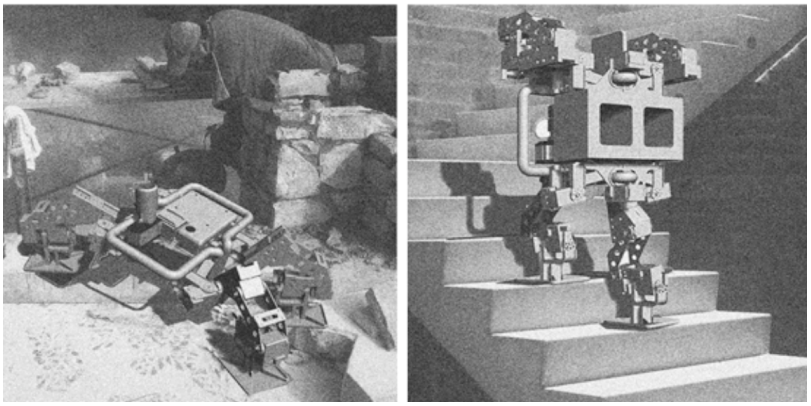
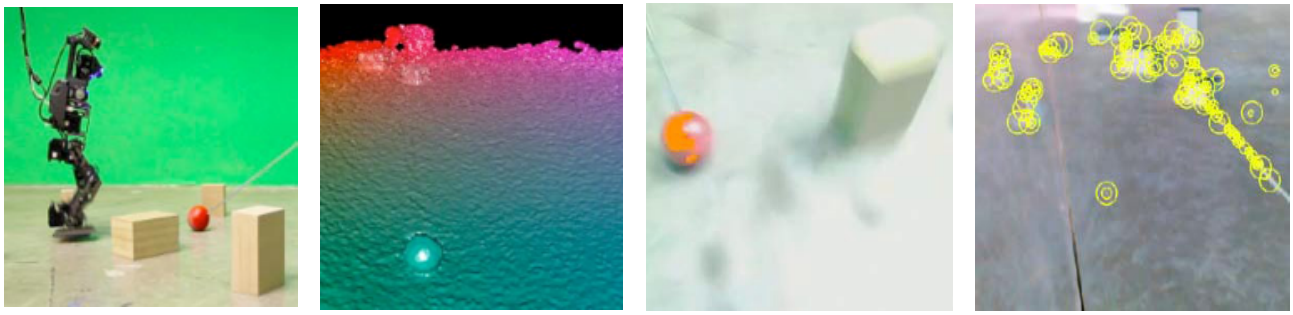


Figure 1: Renderings of hypothetical robot assistants delivering both standard and non-standard masonry units to a master mason on sites under construction.



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essence para-critique allows architecture to hold technology ‘at arms length’ while keeping pace with contemporary developments in engineering at a time of ‘accelerating change’. I believe that design can accommodate ‘disciplinary specificity’ and ‘trans-disciplinary’ engagement without artificially placing these terms in opposition. What results is a dynamic fusion that can produce meaningful insights while shedding new light on some important philosophical questions.

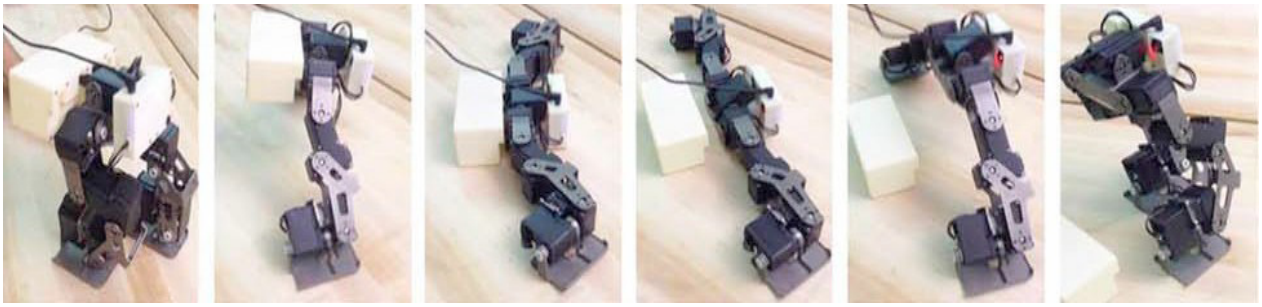
Along these lines the following essay attempts to articulate fundamental flaws in the materialist conception of nature and the paradigms that underpin current theories in the field of artificial intelligence (Strong AI) and robotics. It also explores the limits of ‘computationalism’ as a credible ‘theory of everything’ by proposing new ways of building masonry structures. The notion that our world and all of the creatures living in it are just universal machines running programs seems to me implausible. Through design architects can explore alternate theories and encourage the development of novel practices, which serve to enhance the cultural relevance of their work. Any comprehensive understanding of reality must therefore account for the existence of conscious life. If a ‘big picture’ theory can’t do this then it should be abandoned. By exposing the problematic reduction of minds to hardware and software the critic/builder can actively participate in the search for a truly “New Kind of Science” – a science that explains how consciousness fits into the natural order.

With the advent of algorithmic architecture, a rational approach to building that derives its values from the expression of discrete, mathematical functions, e.g. genetic codes and recursive systems, we see an almost complete return to the Modernist preoccupation with formal abstraction. Might it be possible then to make a work that allows us to openly examine the contingent, “value-laden” nature of these founding principles? Might it even be possible to suggest the futility of erecting any sound metaphysics on the basis of language itself?

Certainly consciousness must exist before we can form words and concepts. (An infant can perceive things without first knowing their names.) But just as the fine-grained details of the world outstrip our ability to adequately represent them conscious experience must be, in some basic, way non-conceptual [Peacock, 1992] or better yet pre-linguistic. That is it cannot be turned into an object of thought, a picture or an image. And since codes and computations are also languages it is hard to see how they can encompass non-representable phenomena. On this account the mind, which has no concrete form, essential content or fixed identity, is much like space. It is a fundamental property that cannot be reduced to something more basic. The belief that brains, Turning Machines or even analogue systems can give rise to subjectivity makes little sense in this context especially, if awareness is not produced by anything antecedent to it. Another way to distinguish computations from consciousness is through the concept of

Figure 2: (Left to Right) Humanoid robot following a moving ball, 3d terrain map, video camera POV, and an edge detection scan.

a-temporality. Algorithms are step-by-step processes implemented in time. They leverage memory and logic to calculate results. But experience seems to be very different–it does not by definition exist in the past or the future. It is in effect timeless. Only through the selective conceptualization of what has happened already and what might be (nostalgia and desire) can anyone say they sense the flow of time. But this flow is a constructed illusion that does not exhaust or



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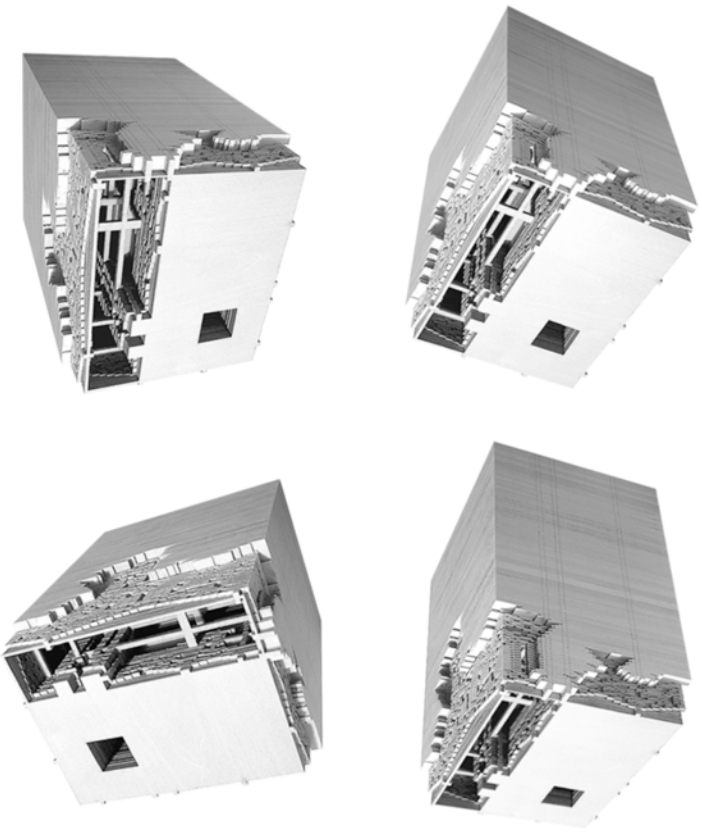

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Figure 3: Bipedal Robot moving a brick. This working prototype includes custom designed, 3d printed ABS plastic servomotors, a laser sintered titanium exoskeleton and an on-board computer.

Figure 4. Model of the San Jose Sate University Museum of Art and Design, San Jose California. Low- cost, peripatetic robots could help facilitate the construction of this complex, non-standard brick and glass block structure.

explain being itself. (If awareness is always in the present then for an observer there is no becoming– just an existence that is unchanging and without duration.)

This brings us to the heart of the problem of defining what consciousness is and how we distinguish between the subjective and objective. When I find myself enthralled by the blare of a trumpet or shimmering light from an orange sunset, what I actually perceive is confined entirely to a first-person perspective. No matter how much a scientist knows about my brain and its bio-chemistry he or she will never be able to know exactly how I feel. In fact what it is to hear or see will be entirely absent from any empirical description of outwardly measurable

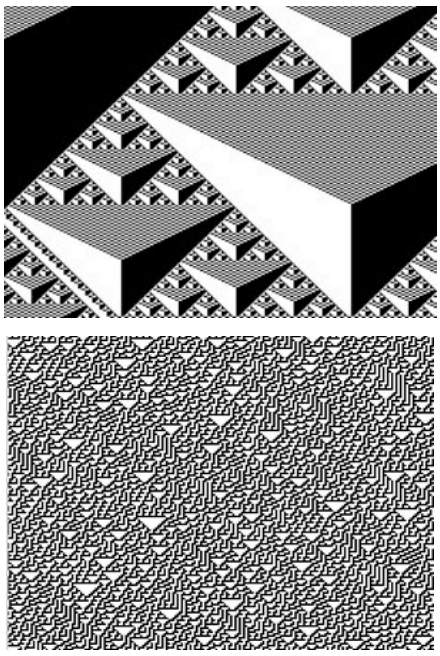
structures, functions and behaviors. In other words as philosopher Thomas Negal writes, “If the subjective character of experience is fully comprehensible only from one point of view, then any shift to greater objectivity—does not take us nearer to the real nature of the phenomenon: it takes us farther away...”(2) Yet, another approach to explaining the difficulty of reducing mental life to observable, spatiotemporal phenomena comes from Frank Jackson’s canonical thought experiment about Mary the colorblind neuroscientist. Mary knows everything there is about the physical process of color perception but she was born and educated in a black and white room. Despite her understanding of anatomy and optics she has never actually experienced any red things. Her understanding is therefore lacking something crucial, namely what colors are like from the inside. This observation bears directly on materialism, computation and the mind/body problem.

To define mental life as an emergent property of brain mechanics makes little less sense. Epiphenomenalism fails to explain how subjectivity arises from dead matter because it ignores what it actually means to be aware. In other words how can an ineffable, yet internally accessible reality like “subjective experience” arise from such a concrete, externally posited thing like “a neuron”. The connection remains a total mystery and it should cast some doubt on ‘Neo-materialist’ attempts to endow emergence, self-organizing systems and bio-design with overarching cultural and cosmic significance. When our understanding counts mental life as fully reducible to atoms in motion or worse, automated symbol manipulation, then its veracity as a totalizing metaphysics is diminished. (Remember, consciousness is immeasurable, formless and without time.) If such insights are to be meaningful for contemporary architecture they must be posited from within the discipline of digital design in a way that can be expressed in built form, using the same terms employed by the algorithmists themselves. In other words we must “un-code” the “coding” process through an engaged practice rather than merely rejecting computationalism out of hand. A good place to start this critique is with the now fashionable interest in computer-generated ornament.

NEGATIVE ENTROPY AND THE PICTURESQUE

Cellular automaton programs (CAs) consist of discrete cells (black or white, transparent or opaque, hollow or solid) organized into small groups, or neighborhoods. The configuration of each neighborhood is used to determine the future state of the next generation of cells. Both complex and uniform patterns emerge from the ground up forming a recursive network. In an auto-masonry wall (a structure made with simple programs) every brick affects its immediate neighbors and the order of the whole. Because these systems are usually very sensitive to small changes, the state and position of each unit counts. (What results is not dependent on a continuous differentiation of parts, but on the application of fixed rules in a discrete composition that requires only two primitives.) Here building details obtain their complexity for free: no external agent or extraneous system is needed to design them. (3) This expression of part-to-part and part-to-whole coherence follows one of the guiding principles of modernism, but with a difference: structures driven by simple programs need not be reduced to a limited inventory of ideal types. A brick does NOT want to be an arch. The best way to know how a given rule will behave is to set it in motion.

For the San Jose State University Museum of Art and Design competition (2003) a ‘class two’ CA (4) was used to produce both open and closed surfaces from strait



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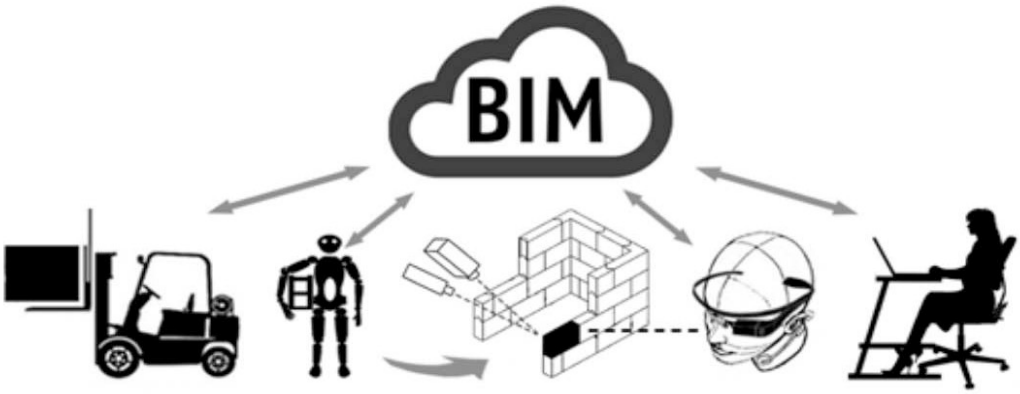
courses of stone and glass block. Rooms with windows and galleries requiring large, blank walls for display were laid out in accordance with the client's brief. Once these parameters were set in place a search was made through multiple iterations in order to find the most appropriate patterns. For the museum's exterior and internal subdivisions a five-cell, outer totalistic cellular automaton (5) was found that erased useful fenestration from the lower levels creating a series of windowless walls on the upper floors. In other words the project's rules and initial conditions produced the negation of their own porosity generating constraints. (Thin masonry screens containing stairs and elevators were created by the same code using a different sequence of starting blocks.) While the surfaces of San Jose are not themselves governed by structural necessity, they are also not applied decoration. Class two cellular automata visibly drive the organization of structure and space. On both the micro and macro scale each element of the project is co-dependently produced. Far from a routine minimalism achieved through the prohibition of intricate details, unadorned surfaces emerge systematically out of heterogeneous patterns that eliminate themselves. Literally, ornament self-organizes its own disappearance. This approach escapes the narrow dialectic that pits excess on the one hand against a strict return to simplicity on the other.



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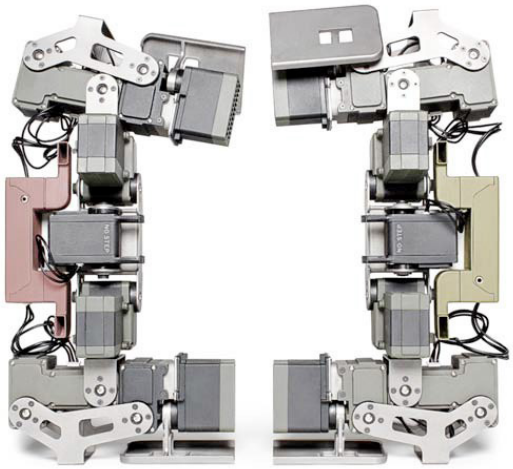
A critique of computationalism in built form can be accomplished by exploiting an important yet less frequently acknowledged feature of simple programs. Consider the two images shown in Figure 5. The first looks random while the second appears as a more coherent set of nested triangles. Where one image seems flat the other can be perceived in low relief. Both were produced algorithmically but there is nothing in the second rule set that specifies a "z" value. The perception of three-dimensional space is entirely dependent on the presence of an observer. Flatness and depth in this comparison clearly foregrounds the difference between subjective awareness and code. A similar effect is exploited in the San Jose design.

Figure 5: Two kinds of patterns generated from simple rules. The illusion of depth in the image on the right is not an inherent property of any underlying computational logic. It is observer-dependent.

Figure 6: With new sensors, networked controls and a remotely accessible Building Information Model (BIM), humans can control co-robotic builders using augmented reality eye glasses.

Through picturesque eyes the project can appear like a ruin, precarious, forlorn, dissolving inevitably into the ground. The same form can be interpreted in reverse as a single brick spiral moving vertically toward the sky forming a plain white box. This double reading is important for two reasons. On the one hand it shows how our cognitive faculties are able to derive evocative content from totally abstract forms. In other words there is something it is like (6) to encounter architecture. Turing Machines don't feel anything. Their switches and software have no awareness whatsoever. A smile on a robot will lack depth if there isn't

anyone behind it. Real emotions presuppose the existence of conscious experience which is why the computer that beat chess master Gary Kasporov did not enjoy its victory. While nothing physically collapses in the museum there is still a palpable anxiety produced by its comparison to a death trap with visitors menaced by a simulation of falling masonry. On the other hand as a literal unit-by-unit calculation changing from simple initial conditions to complex fenestration to blank walls that abruptly terminate the project implies the expressive limits of computation in yet a third way. If the first reading regards art consumption suspiciously as a grim conflation of commerce and death the second produces an instrumental transition that is both organic and uplifting. San Jose can be seen as a building rising in stages towards increasing levels of emptiness. Through long rectangular apertures located above its blank surfaces the project reaches into an infinite void of light. This vertical progression is ultimately a move beyond glass and stone, ornament and structure, use and uselessness, inside and out, container and contained, minimalism and the baroque, memory and desire, here and there, becoming and nothingness. Above the roof the 'machine stops' and all dualities vanish. At this moment without hope or nostalgia architecture opens spontaneously into a boundless freedom existing before the establishment of codes and constraints, prior even to the division of the perceived world into 0's and 1's



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SUFFERING MACHINES

In early 2012, following the success of its driverless vehicle initiative, the Defense Advanced Research Projects Agency (DARPA) issued a call to engineers around the world to develop bipedal robots capable of performing a wide variety of tasks in real world environments. The main goal of the challenge was to spur the creation of machines that could be used on disaster sites like the now defunct nuclear reactor in Fukishiama, Japan. But couldn't these technologies also be employed for more creative purposes?

Developing tools for building complex 'automasory' structures followed three primary tracks. The first pursued the creation of a cell phone 'app' that specifies block types using a simple MP3 player, the second explored the development of new augmented reality headgear for in-situ, geo-spatial data transmission via 'Simultaneous Localization and Mapping' (SLAM) while the third explored possible applications for humanoid robotics. Moving digital fabrication from the factory to the job site represents an important shift away for the current approaches which mainly focused on stationary devises like 3D Printers and CNC mills. The cost and size of high-powered chips and sensors is also making it easier to build sophisticated hardware endowed with high degrees of autonomy and situational awareness. Humanoids have a key advantage over body-mounted systems because they can relive the drudgery associated with hard, manual labor. They are also incredibly flexible and can access tools originally designed for people. Robots with feet, eyes and hands also force us to consider the difference between skilled labor and computers. While no one can say with absolute certainty that sentient machines are impossibility would we still want to mass-produce them even if the technical hurdles were overcome? Artificial being with feelings would deserve the same rights as ordinary workers, which simply means they could not be exploited. (We don't need them because we don't want them.) Owning a slave is bad for the master but it is even worse for the slave! Non-conscious robots or functional zombies are preferable because they're incapable of suffering and because they can be used as extremely powerful

Figure 7: (Left) Two fully functional ABS 3d printed and titanium-sintered robot prototypes shown in stowed positions. (Right) A medium-scale humanoid mason uses an on-board video camera to navigate space and track objects in the environment.

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extensions of our own bodies. (A driver doesn't want to ask a car if it feels like going to the supermarket for milk.) But without consciousness these technologies will end up having serious limitations and that's a good thing. Far from being threatened by extinction humans can maintain their worth by making creativity, aesthetic judgment and social intelligence highly valued resources in an increasingly automated world. In the bargain workers might also acquire new skills as operator/programmers capable of enhancing the behavior and operating capabilities of their tools. Ancient materials like masonry could take on a new life while assuming more complex and efficient configurations. What's more the health risks associated with dirty and dangerous jobs could be mitigated by the introduction of highly capable, co-robotic systems. Just as new industries fuelled the rise of Modernism in the early 20th century, the inevitable development and potential ubiquity of autonomous and semi-autonomous technologies implies the need for a critical assessment of a how the building design and construction industry will change over time. Along these lines we can point to a series of important shifts in computer aided manufacturing and architecture theory that are just now coming into focus:

OLD	**NEW**
ROBOTICS (Isolated from people)	CO-ROBOTIC (CONNECTED TO PEOPLE)
INDOORS	INDDORS AND OUTDOORS
FIXED IN-PLACE/WHEELED	PARIPATIC MOBILITY
LOW AUTONOMY	HIGH AUTONOMY
MATERIALISM	POST-MATERIALISM

Figure 8: Automason MP3 running on an Apple iPhone, Google Glasses and Asimo the humanoid robot all have the potential to radically transform the way buildings are constructed.

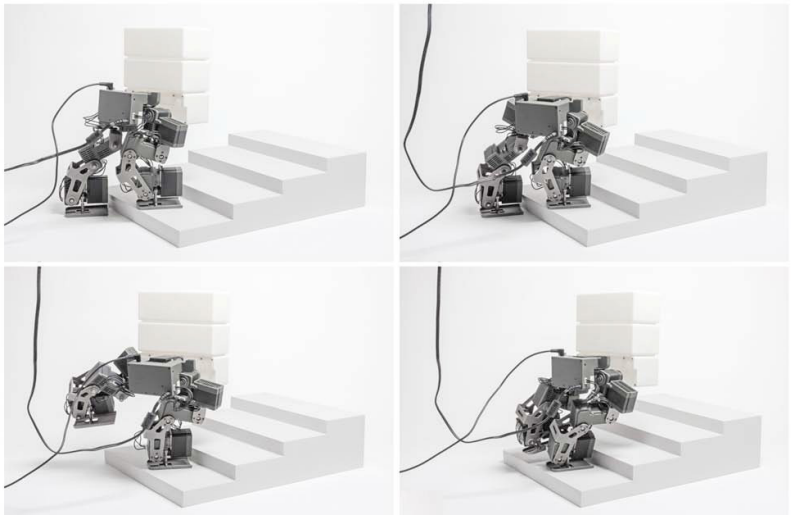

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Figure 9: Three bricks ascending a staircase. At each step the robot is able to maintain a relatively level payload.

ENDNOTES:

1. David J. Chalmers, “The Conscious Mind: In Search of a Fundamental Theory” Oxford University Press, Oxford, New York, 1996, p. xi.

2. Thomas Nagel, “What Is It Like to Be a Bat”, from Mortal Questions, Cambridge University Press, 1979, p.174.

3. This does not mean, as some have suggested, that authorship and individual expression are denied in a design process that employs self-organizing systems. Actually, it is the architect who writes the code, adjusts its starting conditions and determines the fitness of the resulting pattern based on an open reading of the client’s needs. But the author is not an absolute dictator either. Instead, “design agency” is distributed in an expanded network of interacting processes involving simple programs, material effects, and personal taste.

For a detailed description of the classification system for cellular automaton programs, see: Stephen Wolfram, ‘Universality and Complexity in Cellular Automata’, Cellular Automata and Complexity: Collected Papers, Westview Press (Philadelphia), 1995, Pp 140–57. A class two pattern starts out complex and ends up simple. (See also, Stephen Wolfram, “A New Kind of Science”.)

‘Outer totalistic’ is a shorthand format for specifying cellular automaton rules.

Thomas Nagel, “What Is It Like to Be a Bat”, from Mortal Questions, Cambridge University Press, 1979, p.166.

PROJECT CREDITS:

Ball State University Team: Faculty: Mike Silver, Mahesh Daas Ball State University, Josh Vermillion and Josh Coggeshall. BSU Students: Yevgen Monakhov, Jason Foley, Matthew Fullenkamp, William Zyck, Justin Krasci, Michael Bolatto, Tyler Cox, Glenn Cramer, Robert Cichocki, Antone Sgro, Derek Anger, Tianxia Peng, Derek Newman, David Smith, Yao Xiao, Mathew Wollak and Thomas Friddle. University of Buffalo Team: Faculty: Mike Silver, Karthik Dantu, Students: Colin Jacobs, Tim Ruhl. Albis Del Barrio, David Heaton, Gary Chung, David Lin, Georine Pierre, Rob Miller, Johnny Lynch, Dan Fiore, Dylan Burns, Jia Jian Feng You, and Marc Velocci. Photos: Courtesy Paul Qaysi.

FICTIONAL FRONTIERS AND SPECULATIONS ON THE REAL