Computers and Intelligence

Harlan Gilbert

Each year brings new and startling examples of computers emulating what we think of as intelligent behavior. For a long time, they have controlled machines, performed secretarial tasks, and kept track of budgets. More recently, they have begun to beat even the best players at games such as chess and *Jeopardy!*, to respond—sometimes even quite reasonably—to enquiries, and to care for the elderly. In the face of such convincing achievements, it is easy to assume that there must be some form of intelligence present and active in the computer. On the other hand, they are still machines, and what kind of intelligence can a machine have?

Because we can see the workings of simple mechanisms such as mousetraps and grain mills, we are not normally deceived into thinking that these are anything but purely mechanical devices. As technology becomes more sophisticated, however, we can no longer observe its workings, nor can non-specialists readily comprehend the principles by which highly complex electronic devices operate. It is therefore easy to lose sight of their character as machines. Because our intelligence can no longer follow the workings of the technology that produces the results we see, it is easy to believe that these devices show signs of intelligence. Because they are not simple mechanisms, their nature simply as mechanism becomes more difficult to discern.

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Computers show a range of actions and reactions that often lead us to use the term "artificial intelligence." It is a short step from here to go on to ascribe actual intelligence to them. What is the difference between actual and artificial intelligence?

An analogy may help. We know that mousetraps can react to the presence of mice. Most people attribute neither a hunting instinct nor a pleasure in the kill, nor an intelligent plan to a mousetrap. It is obvious that its working is purely mechanical. Because mousetraps are quite simple mechanisms, it is readily apparent that they are endowed with neither intelligence nor a feeling life. This case is a useful reminder that actions or reactions analogous to those of organisms imbued with an inner life in no way prove the existence of instincts, feelings, or intelligence.

The Simulation of Intelligence

To understand the actual nature of the phenomenon often referred to as "artificial intelligence," it will help to review the origins of computing devices. Alan Turing, an early theorist of these devices, laid down principles to which all modern computers still conform. The archetypal computer can be described as a series of digital states (imagined as a row of lights, perhaps a very long row, each of which is either on or off at any moment) and a linear "tape" of information. This "information tape" consists simply of a series of positions, each of which is either punched or not punched (marked or not marked). With each position that the computer encounters on the tape, the computer's state (lights) may change, but only according to certain pre-determined and fixed rules. The limitation laid down is that the new state of the computer after this encounter (its new pattern of lights) must be completely determined by the operation of these fixed rules upon the computer's current state and the tape position currently encountered. After each of these occurrences, the tape may also be moved forward or backward one position; this too must be dependent upon fixed and predetermined rules.

Despite some superficial divergences, modern computers still essentially conform to these original principles. That is to say, every digital computer operates according to (and only according to) a sequence of mechanical operations defined by its construction. There can be no question of attributing any more actual intelligence to any one of these highly complex, but still essentially mechanical, reactions than could be attributed to the action of a mechanical loom or typewriter.

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Intelligence presupposes the ability to conceive the world in various ways. Aristotle categorized four fundamental aspects of the world: Everything can be seen to have a purpose in the grand world plan, an originating cause, a form, and a material composition.

Intelligence consists partly in having a fluid, playful relationship to these four ways of conceiving the world. Human intelligence understands, or can come to understand, each of these modes of understandings' contributions to the current situation and can adjust its relationship to them, both sensibly and creatively—that is, intelligently. Even a cat on the hunt for a mouse will react intelligently to unexpected events. It will *change* its intention if appropriate (e.g., if a dog appears or the mouse doesn't show). It will *modify* its technique if necessary (e.g., if its hiding place is seen or the mice change their strategies). It will *adapt* its conception of form and of substance (e.g., it will learn to ignore a child trying to fool it with an imitation mouse on a string, and if a bird flies by or a bowl of milk is brought, it will happily turn to the alternative foodstuffs).

In contrast, simulated ("artificial") intelligence can only adequately react to any situation foreseen by the developers: "If the yarn runs out, stop the machine." We do not consider a loom clever for stopping when there is no more yarn; rather, credit goes to its inventor and makers. There are, indeed, so-called "learning programs" for computers by means of which they react increasingly appropriately through experience (e.g., handwriting recognition programs that improve their accuracy each time they are corrected). These are not exceptions to the principle of mechanical reaction any more than a mechanical device for adjusting the loom tension on the basis of the already produced weave would be. The possibilities for recognizing and adjusting are actually static, and truly unpredicted events (e.g., a person writing Chinese, or backwards, or employing an unfamiliar letter—á, ö, ø, π—or putting the wrong document into the machine, or the right one upside down) will always show up the precise limits of the makers' forethought. Note well: We encounter the *makers' intelligence* (and the limits of their forethought), not the intelligence or forethought of the machine; the latter has neither of these.

Faced with any of the difficulties mentioned in the last sentence but one, a human being would discover the nature of the problem and try to find a way to sort it out; a computer can, at best (that is, if it even discovers that there is an unexpected "input"), give some form of response equivalent to: "Unpredicted situation encountered. The limit of the technology has been surpassed. Please call an intelligent being."

For a human being can learn to read Chinese or ask for a translation, to pronounce an unfamiliar letter, and to check if a document is the correct one and oriented properly. A computer can only be re-programmed to do these things.

A computer cannot formulate any sort of conception of Aristotle's ways of experiencing the world: cause, purpose, form, or substance. All that it has are electronic states that we then choose to interpret as being "about" the world.

The extraordinary range of simulated intelligence already and soon to be achieved must not, and indeed cannot, fool us. Computers are unintelligent machines, and anyone who works with such devices quickly discovers that the user's behavior must be made equally unintelligent— that is, we must conform precisely to the machine's severely limited schema. Any activity outside its schema is either ignored or promptly leads to unexpected and normally undesirable results. A computer is completely unable to become aware that it is trapped in a schema of behavior. It is left to the human being to discover this about it, and then to progressively discover the nature, possibilities, and limits of the device's programming.

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When a radio plays music, a child may wonder where the musicians are inside the box. As sophisticated adults, we might smile at the question, for we know that the radio contains no musicians, only a mere reproduction of music. We must be careful not to do something similarly childlike when we are faced with sophisticated modern computing devices. We must learn to look at computers and know that there is no intelligence there, simply a cleverly made recording of intelligence, subject to all the limitations of any recording and, above all, to the limitations of its fashioners.

The Imprint of Intelligence

This raises quite a few questions. How is it possible that even a remotely plausible or momentarily convincing illusion or simulation of intelligence can be produced by a mere array of switching devices? What do we mean by intelligence, if this looks like a case of it? Which aspects of intelligence are present in a computer and which are absent? Finally, what is the ultimate limit of the simulation—how far can it be taken?

A great deal of our thinking has been systematized over the last centuries. The beginnings of this systematization can be traced back to the fourth century BC, when Aristotle formulated rules on how to think logically. This gave thinking a direction toward understanding the material world and its laws and away from the imaginative, pictorial thinking that had previously held sway. By now, having been practiced for two thousand years, Aristotelian logic has been absorbed into humanity's evolution. Who is unfamiliar with causal logic today? Logical thought has accompanied and perhaps even guided the process of incarnation into our physical brains, allowing us to use their workings as a (perhaps largely unconscious) model for the computing devices of the last century.

Today we are masters of many intellectual faculties that were once reserved for a rare few not many centuries ago. Reading, writing, calculating, and logical analysis were rare accomplishments until the Renaissance, and the popular revolutions of the 18th century brought their impulses into universal intellectual education. When we speak of this advance in universal education, however, we should be careful to note that the education of many skills—spinning, weaving, milking, mowing, and reaping, etc.—was nearly universal in earlier days and has been almost completely replaced by the intellectual skills taught in our schools today. There is not necessarily more education today; instead, we have traded education in practical and artistic skills for education in intellectual attainments.

There is good reason for this transformation. Over approximately the last five centuries, through the increasing consciousness of the physical body, it has become possible to create machines that imitate various bodily functions externally. The physical experience of the limbs as mechanical apparatus has led to the development of a wide variety of machinery that works on analogous mechanical principles: for example, digging, hammering, sawing, kneading, weaving, and sewing. These "limb-machines" can be driven by devices that transform energy into usable power through rhythmic action: water wheels, electrical motors, and steam, diesel, and internal combustion engines. Most recently, devices have been developed which record and process information in order to control machines of the first two types. The mechanization of practical work and of power production has considerably reduced the need to educate people in the practical work a society requires.

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Similarly, the reproduction of artistic works has considerably diminished the need for artists. A great many small towns used to have their own opera companies and theaters. If you wished to hear music, you had to find a musician. Skilled artisans duplicated great works of art so that many people could have a reproduction hanging in their houses. Today, factory-produced recordings of music and reproductions of art have replaced an entire culture of middle-level artistic production.

After mechanizing practical and artistic skills, we are beginning to turn our attention to intellectual achievements and discovering that these, too, are capable of being mechanized by a computer. In order to simulate an intellectual skill on a computer, this skill must be reduced to a series of mechanically executable steps. These steps must be capable of being translated into a series of automatic operations on a range of electronically simulated zeros and ones ("off"s and "on"s), though this process is often invisible to the user. This reduction of intellectual work to a series of primitive operations on a series of binary values results in the highly impressive achievements of calculation, presentation, and systematized record keeping with which we are familiar.

The history of computing is thus in part the history of the reduction of intelligent activity to mechanical process. Important to note here is that the mechanization of thinking has often preceded computerization. It was because bookkeeping, for example, had become a rather dull, mechanical activity that Pascal designed the first automatic calculator. Tasks have often become fit for computers (and unfit for human beings) long before they were given over to the machines. To a considerable extent, the activity of computers frees human beings from dreary, repetitive intellectual tasks just as we can be freed from wearying, back-breaking, repetitive mechanical tasks by the practical machinery that surrounds us.

Perhaps it is worth emphasizing one last time, however, that, though a great deal of creative ability and intelligence is devoted to developing the machines in our times, these same human creative abilities and active, penetrative understanding can never be accessible to automatic machinery. As they lack all understanding and creativity, these devices can take over only processes that can be translated into a series of automatically followed steps.

The physical processes of the metabolic-limb, rhythmic, and sense-nervous systems are accompanied by soul processes. Our limb activity is directed by an active will; our rhythmic activity of the circulation of fluids and of air is interwoven with feeling; our nervous system is active as the expression of meaningful thought activity. In the machine, none of these soul qualities is present; it is as if we had before us a being that is just limb movement, without direction, or one that is purely endless rhythmic circulation, without significance, or one that is purely calculation, without understanding. Of course, we can employ these dumb servants for our own purposes, significance, and understanding. Who is it that we are employing here, though? Perhaps at times we will even begin to ask: Who is serving whom?

The Role of Artificial Intelligence in Earth's Evolution

Humanity is becoming increasingly responsible for guiding the evolution of the earth. We already have great power to shape the inorganic world: to build with stone, tunnel under mountains, and create new metals. Huge regions of the earth have been settled and given a physical formation completely determined by human influence: flattened, tarred streets and concrete sidewalks connecting brick, stone, and wood buildings. The plant and animal realms are also coming to an ever-greater extent under human influence and control. Given the alarming rate of human-induced loss of species, on the one hand, and the rapid increase in human-produced hybrid and gene-modified organisms, on the other, it is fair to say that life on this planet is becoming increasingly dependent upon human direction for its evolution. We are becoming the lords of all creation.

To care for the natural world is a valid and extremely important part of our task on earth, but one that comes with great responsibility. The difficulty here is to keep the balance between two extremes. One extreme is the wish to deny this task and hand nature over to "itself" (a self that it has not yet developed). This view ignores the fact that human beings are also natural beings, which is to say that in denying a human role in nature we deny part of nature itself. The opposite tendency is to impose our might and will on the lower realms of creation without perceiving or respecting their own nature and character. This attitude ignores the interdependence of all life; to damage nature is to damage the foundation of our own existence. It is our task to find a balance between these extremes, by exercising a respectful yet active guidance over the realms of nature.

A responsible attitude towards nature requires increasing consciousness of the natural world's diversity, rhythms, and interdependencies: in short, its ecology. Unless we respect, preserve, and enhance these, treating them as if nature's beings were our own children, we shall lose the right and the capacity to live in a natural world. Our own health and balance depend upon our maintaining a caring relationship towards the beings of nature.

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Humanity's capacity to be true cultivators of the earth remains modest. Thousands of years—epochs and eons—of work and research lie ahead before we shall be able to do full justice to the realms of nature subject to our influence. To understand the full magnitude of the task, it may be helpful to recall how spiritual beings once played a role in establishing the original physical basis for our own entry into evolution on the physical plane.

Our responsibility for the evolution on earth of new beings is analogous to what was once done for us. According to Rudolf Steiner's description, in the diffuse sphere of warmth available as a medium at the moment when the basis for our own physical bodies was laid down, beings of evolution three stages ahead of the human being established forms that would serve as the basis for the evolution of the human physical body. Now, having evolved life forces, a psychology, and self-consciousness, we are coming to be responsible for the evolution of other beings, even for helping to form physical bodies from which new evolutions may develop. In our work with the mineral realm, three levels of existence below our own evolution, humanity has an analogous task to the role of the Spirits of Personality in the formation of our own physical body. The mineral world is today in the state of development that human beings were once in their earliest stage of unfolding. We now have the task of taking the material substance of the earth and giving it new forms, into which new beings waiting to incarnate have the chance to enter the stream of evolution.

We are now using intelligence to fashion the mineral world into many forms and structures, and either permeating these with a harmonizing aesthetic and higher purpose—or neglecting them.

This process can take various directions. We can picture, for instance, the awesome transformation involved in reshaping masses of incoherent rock into the magnificence of a Chartres Cathedral. According to Steiner, during the phase of earth's evolution that will follow our own, a work such as Chartres will arise in metamorphosed form. Such artistic creations will appear in a next cycle of evolution as flowers appear during our phase of evolution, that is, equipped with life forces and capable of growth and decay, though with a mineral body. New life forces capable of enlivening a body of stone will permeate their transformed existence. I visualize magnificent flower-like organisms with crystalline blossoms, a more stone-like leaf and stem region and then truly stony roots. Imagine such a transformation of Chartres Cathedral, the Parthenon, Hagia Sophia, or the first Goetheanum.

Other physical structures that human beings have created will also provide paths of incarnation for beings. In particular, let us turn to computers. Computers are fashioned by shaping mineral substance—crystals (usually of silicon) and conductive metals—into incredibly complex and finely fashioned patterns of electronic circuitry. These transformations of the mineral realm are an expression of something fundamentally different from exquisite works of architecture. Architectural works are always a combination of the practical will, aesthetic feeling, and the insightful mind—elements the Roman architect Vitruvius called structure, beauty, and function. The design of computer circuits is usually not much influenced by aesthetic considerations and its intended functions no longer include the full range of human life. Computer circuitry is purely determined by the rational intellect's logic working at refinement and complexity, but also at a merciless absoluteness of principle previously unknown in world evolution. An automobile engine, otherwise a triumph of modern precision engineering, is but a child's toy, in comparison.

What beings will find a path to incarnation through these formations, both now and in future planetary phases? Following Steiner, I have suggested that the wondrously complex harmony of Chartres can be imagined as being transformed in a future evolutionary phase into a flower having all the lovely, wonderfully complex harmony of the cathedral, yet being equipped with life—a mineral form, in other words, capable of growth and decay. When we come to the integrated chip, the computer, I imagine a living, growing being with the laws of these devices as its basis: a one-sided, virtually parasitic virus of the future earth. Incapable of existence except by feeding on beings of more well-rounded capacities, these will have only one purpose: to reproduce themselves and extend their crystalline maze of logic over all of the earth.

The universe we live in was formed out of wisdom, through the logos. The microcosmic correspondence to this cosmic wisdom is our human intelligence, which has evolved through the successive stages described above until it has reached the level of understanding applicable to the physical world. Because human intelligence is an image of cosmic wisdom, human understanding can comprehend the universe's laws, rhythms, and workings. We are now using this intelligence to fashion the mineral world into many forms and structures, and while doing so either permeating these with a harmonizing aesthetic and higher purpose—or neglecting them.

But our universe was not meant to be—and has not remained—solely an expression of wisdom. The principles of freedom and love have entered into human—and thus also into the world's—evolution. Through us, the kingdoms of nature can become imbued with love. We can shape the mineral world into forms literally built out of love, not simply dictated by the intellect or the will to power. The plant world, if cultivated with love, will evolve in different directions than it will if we impose a mineralized, rationalized farming upon it. The animal world, nurtured with love, will find through us new possibilities of evolution that will be supportive of and in harmony with humanity's activities and needs.

The principles of love and freedom must enter into all of our life and deeds—and especially into our formative activity with nature. The critical question accompanying the evolution of artificial intelligence, then, is this: How do we imbue these constructions with the new principle of love? Is this even possible? The electronic mechanisms we make will certainly carry over into future generations the outer image of the workings of earthly intelligence, of the intellect. This is surely part of their task: to carry out for human beings the repetitive functions of earthly intellect, not least in order that humanity is freed to move forward beyond this state, to remount the steps of intelligence's fall through our own conscious and purposeful activity. How we shape these beings' physical form is of vital importance to how this task will be carried forward.

Machines can be created and used in a way that leads us further down the path toward the mechanization of our own intelligence or they can be used to free our intelligence from a focus on mechanical tasks so that it can find its way back to its cosmic inheritance. We are imprinting our intellectual achievements upon the lowest realm accessible to us, the mineral world. But in doing so we face the danger of being confronted everywhere by the outer form, the hardened shell, the husk of intellect in the very world we fashion for ourselves. Only if we truly understand what we are doing here will we find the proper place for this synthetic intellect and preserve a space for the human qualities of engaged will, active love, and living intelligence.

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Artificial intelligence, as we meet it in computers, confronts us with two challenges. One is that human intelligence will fall under the spell of mechanization rather than guiding it. Creators of mechanized technologies often fail to comprehend the effect of these technologies upon the human life of soul and spirit, including their own. At the other end of the spectrum, those who may be most concerned with this effect are often unable to fully understand the technology itself. To bring an increased comprehension of both the technology and the soul and spirit realities that underlie our relationship to it is our first challenge.

The second challenge is this: Even if human beings preserve a healthy soul life despite their increasing contact with computers, how are we to relate to the beings that are incarnating into the world through this technology? In a sense there is one being who underlies all computer technology, incarnating in a manifold of individual devices. What vessels for incarnation are we creating? Here is a task that we will carry forth over eons of world evolution: both to care for the world into which we are introducing a new and in many ways potentially detrimental element, while at the same time caring for the future development of this being in its many guises.

Love is active knowledge, and without real understanding there can be no love. If we can awaken in ourselves a real understanding of the nature of the beings we are working with here and of their mission, and if we can face these beings not just with understanding, but also with real compassion for their nature and mission, then we will be able to find ways to redeem them. If those who create new forms in this realm become capable of real understanding, knowledge, and perception of what it is that they are creating, and in the face of this develop this love and compassion, then we will be able to look forward to the future with a degree of confidence.

Beings of pure logic will be with us in the future. They will incarnate into the forms that we are making available for them. But human love and the will to redeem these beings through the forces and insight developed out of an unsentimental recognition of and compassion for them may also be there in sufficient force. Upon this depends our future—and not ours alone. The whole earth's evolution depends upon our insightful love and compassionate will.

Conclusion

I opened this essay with the question: What intelligence do computers exhibit? I then sought to justify the following response: A computer presents us with a dead image of intelligence, a reflection in a mirror that human beings have erected. Artificial intelligence is an empty form, a barren shell; it is intelligence's shadow, without intelligence's light.

Looking at our creation, we see our own reflection, our own intelligence, in the polished mirror we have made, and we may almost see the reflection before us to be itself imbued with life, with its own intelligence. We can breathe life into this mirror for moments, but as soon as a human being steps away from the devices, they return to being empty mechanisms. Computers may present the outward form of intelligence but they lack its inner reality.

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