

# Thinking Colours and/or Machines

*Friedrich Kittler*

## Editors' Notes

THIS ARTICLE – published originally in 1996 as *Farben und/oder Maschinen denken* – directs a challenge to cultural studies and the humanities by suggesting that these should become ‘part of media theory’. This provocation, which is typical of Friedrich Kittler’s work, is the outcome of a wide-ranging critique of hermeneutics and of the wider attempt to separate philosophy from mathematics. For Kittler, hermeneutic philosophy and social science are founded upon an ‘anthropocentric illusion’ in so far as they project humanness onto technologies and machines. Instead of this, Kittler argues precisely the reverse: that meaning is not intrinsic or prior to technology but rather made possible and directed by technology itself. This approach, which Kittler sometimes terms ‘information-theoretical materialism’, draws heavily on the work of information theorists such as Claude Shannon, Norbert Wiener and others who refuse to separate questions of the *meaning* of communication from the technical or *mathematical* problem of how communication takes place. In the present article – *Thinking Colours and/or Machines* – what frustrates Kittler is that the anthropocentric illusion of hermeneutics today lives on in cultural studies analyses of digital media such as the personal computer. In such readings, the computer is treated as a tool rather than as a medium, and this means that the humanities are ‘free to go about their business as usual’ because tools are defined from the point of view of their human users. It is this basic presumption that humans define machines that is questioned in this article. More specifically, Kittler asks what consequences ‘the global conquest of computers’ might have for the humanities by raising two questions. The first is: ‘How and why did post-Kantian philosophy separate philosophy from mathematics, and the humanities from computation?’ And the second: ‘What caused philosophers to draw a distinction between humans and machines, or more precisely, between humans and technological media?’ In *Thinking Colours and/or Machines*, Kittler spends more time addressing the former, but this in turn enables him to question why it is that machines still tend to be treated as tools that are defined by their human usages and applications. Kittler answers this question historically by tracing the displacement of mathematics and media by the so-called ‘life-world’ in the writings of Hegel, Husserl and Heidegger. At the same time, however, Kittler finds an alternative trajectory of thinking in Gustav Fechner’s psychophysics, which attempted to conceive of all

cultural data as scientific data. The attraction of such an approach to Kittler is that it resists the temptation to privilege natural language and meanings over real numbers, hence also his interest in cybernetics and information science. Alongside this, Kittler is also fascinated by the breakdowns or ‘disturbances’ of everyday life which, contrary to the early Heidegger, are as inevitable as they are indispensable, and which remind us that we are never as in control of our technological objects as we would like to think. Kittler finishes with a modern-day example of this: the ways in which the formal languages of computer source code distort ‘the insights and intentions’ of those who use them, and thereby introduce a feedback loop ‘from the machine to the programmer rather than the other way round’. The conclusion Kittler draws from this is that ‘computers cannot be classified as tools’. This, in turn, informs his basic point of attack against humanistic readings of new media technologies: machines cannot simply be defined from the point of view of humans.

### Thinking Colours and/or Machines

There is not, and cannot be, number as such. There are several number-worlds as there are several Cultures. (Spengler, 1926: 59)

My topic is the question of what consequences the global conquest of computers has for the humanities, that is, for those quaint but no longer very functional disciplines that should rather be called cultural studies or, even more preferably, become part of media theory.

Remarkably, computer science itself – that mathematical discipline which in Germany goes by the name of *Informatik* – has already raised this question. Even more remarkably, the great American programmer Terry Winograd, with whom I had the honour of discussing this paper, familiarized himself with Martin Heidegger in order to gain an initial understanding of what the humanities, and humans in their language-bound everyday existence, are all about.<sup>1</sup> The result, in short, is that in principle the interminably open horizon of human existence does not allow for any computerization, but that computers can be helpful tools (in the sense of *Being and Time*) since they, like humans, exist on the basis of language. Conceptualizing the most complex technological medium as a tool, however, is so common and comforting that the humanities are free to continue their business as usual. Given that tools are always defined from the point of view of their user, there is no need to question the old approach that defines machines from the point of view of humans; and subsequently there is no need to consider the possibility that, conversely, humans are defined by machines. But it is imperative to critique this notion. The first question, then, must be why parts of computer science forfeited their mathematical rigour and instead became indebted to a philosophy that was able to provide a concept of tools. The second, historically older and therefore more urgent question is what caused philosophers to draw a distinction between humans and machines, or more precisely, between humans and technological media.

In order to cut a long story short, I will tell it as a fairy tale. Like all fairy tales, it begins with a state of perfection. Once there was a time when hard sciences such as physics and astronomy found their unquestioned academic place within the faculty of philosophy; and the fact that this

faculty was ranked far below the other three may explain why there were no squabbles about possible differences between spirit and nature or man and machine. When Immanuel Kant set out to revise the foundations of epistemology, he in many instances still relied on contemporary mathematics. In his theory of art he even tried to integrate the theory of the frequency of light and sound, as it had been formulated by the great mathematician Leonhard Euler. But that was precisely why Kant was under no pressure to consider any scientific analysis of these processes; with unabashed philosophical arrogance his concept of apperception claimed to bring about the transformation of something that Kant himself already referred to as naked ‘data’ into the structured objects of an inner imagination.

This old European state of affairs changed, at least in Germany, shortly after 1800. Based on the new foundations laid by Kant, philosophy claimed to be able to interpret all cultural data. This claim had the institutional effect of forging a new alliance between the state and a faculty of philosophy that just a short time earlier had almost been abolished due to its social irrelevance. Which is why the leading philosophers urged that in turn all the natural and bread-and-butter sciences be excluded – at least from a faculty of philosophy that by virtue of this manoeuvre rose to the rank of top faculty. And at the top of the top there resided philosophy and philology, or, in other words, the natural language of thought and the thought of natural languages.

Hence the very reform that facilitated the global career of the humanities in the 19th century also served to sever their knowledge from all types of computation. In striking contrast to Kant, Hegel had nothing more than a scornful laugh for the ‘wholly awkward and factually completely erroneous application of numerical relationships to tones’ (Hegel, 1959: 237), an application that, according to him, Newton had made to colours. As a result, Hegel’s own philosophical theory of colours could do no more than repeat and deepen what natural languages said about colours in the first place. Philosophy, in other words, turned into interpretation. Thus, Karl Marx was slightly off target when he accused philosophy in general and his master Hegel in particular of only interpreting rather than changing the world . . .

Fortunately, the intended exclusion of all hard sciences from German universities did not take place, but the mere threat had a remarkable side effect. Out of revenge, as it were, completely new forms of knowledge came into being. At the very moment that philosophy set out to interpret or conceive of all cultural data, psychophysics, as it was named by its founder Gustav Theodor Fechner,<sup>2</sup> began to decipher the same cultural data as scientific data. Fechner in Leipzig and his successors in Berlin, especially Hermann Ferdinand von Helmholtz, succeeded in giving a mathematical expression to the data stream of sensual perception. What Heinz von Förster has called order from chaos no longer originates in a synthesis accomplished by Kant’s transcendental ego; it is by virtue of the electric potentials and logarithmic transfer functions of the nervous system that the order of perception attains its subconscious existence.

But in order to discover hard facts such as Fechner's basic law of psychophysics, humans had to be divested of all their humanity. First, the few psychophysical founding heroes and later their countless guinea pigs were subjected to rigorous test procedures which right from the start excluded the use of natural language. Instead the test subjects were forced to listen to artificially produced noise or to stare straight into the sun. Otherwise it would not have been possible to isolate the subconscious mechanisms responsible for the construction of psychophysical reality from the cultural – that is, language-dependent – functions responsible for concept formation.

This experimental quantification of so-called man had two effects: one related to the history of technology and the other to the history of science. It was only after processes of perception had been examined in such cold and inhuman fashion as if they were technological media that nothing stood in the way of the construction of real media that deceived and/or simulated that perception. Edison's phonograph, the precursor of the gramophone, is as much an offspring of Helmholtz's acoustic experiments as Bell's telephone.

With regard to the history of science, the crucial point was that philosophy could no longer claim to be compatible with psychophysical laboratory findings or technological media. As far as I can tell, Edmund Husserl's phenomenology was the first attempt to successfully circumvent this new problem. Philosophy could no longer afford to flatly deny, as Hegel's freestyle had done, the correctness of mathematical and psychophysical descriptions, but since acknowledging them would have condemned all thought to pure redundancy, Husserl invented his so-called life-world as a philosophically autonomous realm.

Within this life-world, which we allegedly all inhabit, there are no psychophysical facts. All cultural techniques – from simple perception all the way to memory and thinking itself – are one with their appearance or phenomenality; that is to say, they arise from self-observation. And whenever scientific findings contradict such insights, the sciences have to learn from phenomenology that they too are, or at least at one point had been, part of the life-world. For no matter how the psychophysical descriptions of human perception may turn out, each such experiment had as its point of departure a phenomenological perception, simply because the experimenter himself could not but inhabit our common life-world. 'The natural scientist may even say,' Husserl remarked in his lectures on 'Thing and Space',

'This piece of platinum is in truth an atomic complex of such and such a nature, endowed with these or those states of motion, etc.,' yet in speaking this way he is always determining that thing there, the one he sees, holds in his hand, lays on the pan of the scale, etc. (Husserl, 1997: 6–7)

Heidegger's writings prior to his so-called turn drew the harshest consequences from this reduction of science to the life-world. According to

Heidegger, in 1927, the year *Being and Time* was published, it had finally become possible to question science as such simply because

the discipline which is seemingly the strictest and most securely structured, mathematics, has experienced ‘a crisis in its foundations’. The controversy between formalism and intuitionism centers on obtaining and securing primary access to what should be the proper object of this science. (Heidegger, 1996: 8)

In other words, the debate – the very personal debate – between David Hilbert and Luitzen Brouwer<sup>3</sup> allowed philosophy for the first time to turn mathematics into one of its objects of investigation, thus terminating the very basis of its millennia-old alliance with the sciences. Heidegger even went so far as to sacrifice the basic self-definition of philosophy that had been in place since the days of Parmenides, its perennially victorious campaign against the blindness of everyday life and non-philosophers, by replacing the old alliance with the sciences with a new union involving thinkers and craftsmen, masters of the pen and masters of the hammer. Yet in order to achieve this goal, which explicitly divulged its claim to power in his rectorial address, Heidegger was forced to equip every worker and inhabitant of the life-world with the hermeneutic skills that hitherto had been the guarded privilege of the humanities. Thus, the famous crisis of the humanities was not brought about by evil media or technocrats; the crisis, in fact, is self-inflicted to the extent that philosophy downgraded all its distinctive features by turning them into mere local implementations of a universal, or rather existential, basic faculty called understanding.

With this, however, the life-world is no longer restricted, as Husserl would have it, to contemplation and thus to theory in the Greek sense of the word. On the contrary, what Heidegger called the facticity of *Dasein* was designed to emphasize the precedence of craftsmanship over all theoretic abstinence. This shift from perception to action, from the sensory to the motoric, was explicitly designed to launch a counterattack against the psychophysical explanations of sensations and perceptions. Just like Husserl, Heidegger could no longer deny the hard facts that the experiments on humans had brought to light, but he reduced those facts to variables of life-world experiences. To quote a statement from ‘The Origin of the Work of Art’ that has significant consequences for Heidegger’s whole theory of art:

We never really first perceive a throng of sensations, e.g., tones and noises, in the appearance of things . . . ; rather we hear the storm whistling in the chimney, we hear the three-motored plane, we hear the Mercedes in immediate distinction from the Volkswagen. Much closer to us than all sensations are the things themselves. We hear the door shut in the house and never hear acoustical sensations or even mere sounds. In order to hear a bare sound we have to listen away from things, divert our ear from them, i.e., listen abstractly. (Heidegger, 1993: 151–2)

According to Heidegger, the ears of the life-world are born interpreters not only of human or natural languages but also of advertisements. In the case of the Mercedes and the Volkswagen – in the American translation, the ‘Volkswagen’ anachronistically replaces the *Adlerwagen* of the German original – these ears are not so much hearing ‘the things as such’ but rather their brand names. In ways which threaten to render all media theory obsolete, all possible transportation and communication systems – from airplanes and cars to radio – arrive directly at their users, who in turn are practical enough to immediately decode the noise level as a recognition signal. As a result, it appears to have become impossible for the psychophysically exact concept of noise – pure white noise – to ever reach the ears of the existential life-world.

But it only appears so, for as soon as the clear statement, ‘we never hear mere noises’, has made its philosophical noise, it is retracted. Unlike Kant, whose transcendental perception could not but spirit away naked sensory data by way of synthesis, Heidegger has to accept the proven possibility that mere noises are perceived. But this obligation is immediately relegated to those who undergo the exertion of listening to the noise of matter rather than to things. But these people can only be the inmates of psychophysical laboratories.

In other, summarizing words: Heidegger turns what prior to his philosophy had been a rather theoretical dualism between spirit and nature into a gory drama. All of culture lands on our existentially burdened shoulders, while all of nature is consigned to scientific experiments. Following this clinical separation, however, the new and perplexing question arises as to how, despite the immeasurable primacy of the life-world, science came about in the first place. At the end of all its labours the hermeneutics of existence is faced with the self-wrought necessity to understand, if not explain, how its direct opposite, scientific explanation, can take place.

*Being and Time* provides half the answer – not to be confused with that of the later Heidegger – by focusing on the phenomenon of so-called unhandiness [*Unzuhandenheit*], which Winograd’s information-theoretical take on Heidegger translates far more elegantly as ‘breakdowns’. If and only if daily *Dasein* comes across broken tools, missing links or illegible signs, will its genuine blindness yield to a certain theoretical perception that, in the final analysis, may lead to things that are neither tools nor equipment (as Heidegger puts it) but objects under the control of science, test procedures, or media technologies. Much as in the case of Husserl, disturbing the practical interconnectedness of an environment turns into the origin of theory. But nowhere does Heidegger write, as his information-theoretical interpreters would have it, that objects and their qualities only come about when a breakdown occurs that turns their handiness into the mere objectivity of objects. Such a statement would proclaim once and for all that science and technology are legitimate domains of *Dasein*. But Heidegger formulates and simultaneously retracts this statement, with the result that, much like a wandering spirit, science and technology are kept outside the

boundaries of existence. According to Heidegger, when breakdowns do occur '[w]hat is at hand is not thereby *observed* and stared at simply as something objectively present. The character of objective presence making itself known is still bound to the handiness of useful things' (1993: 69, emphasis not in original). In other words, the disturbances of everyday life make up a series that approximates the objectivity of objects but never converges in it. In *Being and Time*, science and its original concerns are themselves the breakdown with which Heidegger tries to understand and explain their origin.

Indeed, for psychophysics – the enemy at which all the arguments are aimed – breakdowns were as inevitable as they were indispensable. Fechner's temporary blindness led to the discovery of the regularities of visual perception, while the deafness of Mrs Mabel Bell prompted her husband to replace human hearing with telephony. If, contrary to all previous philosophy, Heidegger's concept of tools and even that of signs has its roots in disturbed rather than functioning everyday life, then the hermeneutics of *Dasein* is once again indebted to its enemy. Heidegger's praise of handiwork simply inverts the praise of handicaps that had stood at the beginning of all media technology.

This is why media technologies are also banned from and frowned upon by Heidegger's rather sensory work of art. 'A stone,' he writes in the 'Origin of the Work of Art':

presses downward and manifests its heaviness. But while this heaviness exerts an opposing pressure upon us it denies us any penetration into it. If we attempt such a penetration by breaking open the rock, it still does not display in its fragments anything inward that has been opened up . . . If we try to lay hold of the stone's heaviness in another way, by placing the stone on a balance, we merely bring the heaviness into the form of a calculated weight. This perhaps very precise determination of the stone remains a number, but the weight's burden has escaped us. Colour shines and only wants to shine. When we analyze it in rational terms by measuring its wavelengths, it is gone. It shows itself only when it remains undisclosed and unexplained. Earth thus shatters every attempt to penetrate it. (Heidegger, 1993: 172)

It appears that Mother Earth herself has taken over the philosophical counter-attack that Heidegger had to conduct as a solitary thinker in *Being and Time*. Yet despite the inflection, her enemy is not masculine but numerical. There once was a time when Kant, though surely not without a philosopher's scruples, attempted to ascribe the aesthetic pleasure of colours to an intellect that, unlike Euler, would have been capable not only of casting their frequency in a formula but also of counting them in a few trillionths of a second. And there once was a time when Hegel, protected by Goethe's formidable firepower, was allowed to heap philosophical scorn on the very idea of colour frequencies. In the time of hermeneutics, however, it is a matter of simultaneously accepting and banishing the facts provided or (in the strict mathematical sense of the word) distributed by measuring weights

and colours. Heidegger can move on to his late work and reflect upon ‘language as language’ simply because he excluded the body of real numbers.

All this took place in 1935 at what was in all likelihood the very last moment. Nowadays we all know that the frequency spectrum of colours can be seen and noises can be heard without any experimental feats. Thanks to solid-state physics, the basis for silicon and laser technologies, chip technology can penetrate miniaturized stones up to a point where they start shining from within. Semiconductor lasers, light-emitting diodes and transistors are a completely different origin of the work.

In view of this particular light, the phenomenological circumvention of science and technology exhibits two major weaknesses. First, its attempt at refutation was focused solely on the analysis and measurement of data, not on their synthesis and simulation. Second, it attacked a headquarters that the enemy had just vacated in favour of another.

Norbert Wiener, master of mathematical calculus and thus also of real numbers, is reputed to have said of his most prominent World War II colleague: ‘Shannon is quite simply crazy. He even thinks in the binary system.’ As far as I can tell, despite Husserl’s early relations to Gottlob Frege, phenomenology never grasped this crucial point. Its attempt to separate philosophy from calculus and all its applications, including the Fourier analysis of frequency ranges, came just a little too late. In 1937, Alan Turing had just shown that every conceivable program can run on a digital machine that has been fed with the mere description of another digital machine. Turing’s new concept of description hinges on the subtle but decisive difference between that which the machine refers to and that which it can perform without the danger of running on indefinitely. On the one hand, the machine can by virtue of its sensors and effectors refer to portions of a nature that probably corresponds to the body of real numbers. On the other hand, the programmed descriptions have to be selected from a finite number of syntactic elements in order to be determinable. Which is why the machine can only compute numbers in as far as their cardinality (or *Mächtigkeit*, as defined by Cantor) is aleph nought.

This price – one that all digital technology has to pay for the programmability of its machines – only affects their computing power when it comes to problems, the mere explanation of which is far beyond the scope of this essay. On the contrary, digital machines really come into their own when engaging in number crunching that is beyond the lifespan of all human computers, for instance, in frequency analyses and spectrograms. Hence our great paradox that only combinatorial or digital machines can seriously measure, simulate or manipulate a nature that in all likelihood is analog rather than digital. With the noteworthy exception of Turing’s Colossus, all computers of the founding generation computed ballistic trajectories, explosions and other penetrations of Mother Earth, who shatters every attempt at penetration or, as Heidegger adds with acerbic precision, ‘causes every merely calculating importunity to turn into a destruction’ (Heidegger, 1993: 172).



To be sure, the introduction of desktop machines, the splendid PCs, has resulted in a great variety of applications. While the number crunchers among the machines continue to compute and determine our daily lives, for instance, by virtue of their simple ability to predict the weather, their desk-tied peers remain confined to printing out such meteorological texts. In other words: In the interest of the well-being of so-called ‘end users’ these machines have very consciously been restricted to applications that work with a finite number of elements. One hundred and twenty-eight letters are enough for America, 265 for the European polyglossia. But, as Winograd has shown so clearly, this is precisely why all the attempts by AI researchers to extend the automatization of natural languages beyond the finite numbers of letters and phonemes to the virtually infinite numbers of their semantics are doomed to failure. Obviously, the installation of personal computers on the desks of humanists – when questioned, almost all my colleagues swear that they use them ‘only as an improved typewriter’ – has not healed the breach between nature and culture; and presumably even the fact that they have found their way into the methods and databases of the humanities won’t change anything.

And yet. Natural language, that unique territory or domain that the Humanities claim by rights to be theirs, does not remain unaffected by the global emergence of computers, since Turing’s proof that formal languages exist as technologies and no longer merely as mathematical theorems. In Hilbert’s time, which after all was also the time of *Being and Time*, the entire foundational crisis of mathematics boiled down to the question whether numbers ‘exist in the human mind’, as the poor Brouwer believed, or ‘on paper’, as his enemy Hilbert was able to convince his contemporaries and posterity.

Hilbert’s cold-blooded reduction of mathematics to its mechanics could also have been undertaken by Heidegger. With unforgettable debunking, *Being and Time* refuted the self-wrought illusion that breakdowns in everyday life could on their own turn into the origins of theory: ‘But even the most “abstract” working out of problems and refining what has been gained, uses, for example, writing materials. As “uninteresting” and “obvious” as these components of scientific investigation may be, they are by no means ontologically indifferent’ (Heidegger, 1996: 328). Exactly the same argument had almost at the same time been applied by Hilbert to all essential components of mathematics, that is, to numbers, operators and tools. Everything that Plato and his innumerable successors had located in the highest heaven came crashing down to earth – or rather, on to paper – in order to form figures that (in Hilbert’s words) have to be clearly present to us. While platonic figures and bodies in their ideational heaven were essences that could be described by mathematical means (for the Greeks, this involved numbers rather than operators), Hilbert, much like Heidegger, turned the mathematical signs themselves into the ontological foundation of his science. Both looked at the world with the eyes of an engineer, as Gadamer is reputed to have said of Heidegger. Which in the case of Hilbert

is all the more paradoxical, since as a young acting chair he once informed the assembled German engineers with utmost geniality that there was no discord whatsoever between technology and mathematics – but only because they had absolutely nothing to do with each other.

And yet the same argument unfortunately had very different effects in mathematics and philosophy. The late Heidegger arrived at the conclusion that the essence of technology is nothing technological; Hilbert's separation between paperware and wetware, numbers and the human spirit, cleared the way for Turing's abstract machine whose principal target was Hilbert himself. As an 'Application to Hilbert's *Entscheidungsproblem*', to quote the excessively modest subtitle of Turing's dissertation, his primal computer was able to prove the undecidability of Hilbert's favourite assumption. Ever since the days of psychophysics, the decisive steps of modern science lead over the corpses of crippled or contradicted professors.

The technical implementation of Turing's skeleton diagram, first in electron valves, later in transistors, and finally in integrated circuits or chips, mechanizes for the first time in history language itself, which is why computers, despite Winograd, are no useful things or tools, not even the ontologically so indifferent writing tools. For hardly any tools have to do with cultural technologies, that is, with the processing, storing and transmission of information; rather, tools and machines are mainly involved in the processing, storing and transmission of natural energy. But the mechanized formal languages simultaneously running through the many self-similar hierarchical computer levels thwart this very distinction. They process information that in the form of computable real numbers can refer to information just as well as to energy. For instance, the specific difference of the European writing system – that is, the fact that letters and numbers no longer coincide as they once did in Greek and Roman antiquity – is beginning to vanish. And as long as the dreams of a couple of physicists of reconfigurable analog computers do not result in adequate materials or feasible computer designs, the power of this alphanumerical implosion can hardly be exaggerated.

It is barely 50 years ago that computers only knew numbers. Their input and output consisted of nothing but binary numbers, a fact that filled founding heroes such as Turing, who were able to read this number salad, with concealed pride. In deference to the venerable alphabetical and decimal conventions, later operating systems such as UNIX expanded this zero-dimensional bit surface by a single, one-dimensional command line. Another decade later, the world-wide copier fees invested by the Xerox Company in the outskirts of Palo Alto gave birth to the currently prevailing man-machine interface, the two-dimensional user surface, which also resulted in a first compatibility of numbers and figures. And today, following the saturation of the world's offices with 2D computers, the electronics industry is investing billions in multi-media projects that, first, invite the acquisition of a new generation of computers and, second, are to bring about a new compatibility of pictures and sounds. Theoretically, this could go on

forever from one dimension to the next, if the virtual reality of human senses were not restricted to the four dimensions of time and space. What is certain, however, is that this explosion of computer interfaces and their dimensions will lead to the implosion of all other entertainment media, and not only them, in the supermedium of the computer.

The effects of this explosion, however, are not restricted to the technological and commercial spheres. Because cultures, the business of the Humanities, do not depend on individual intentions but on all the media that become possible on the basis of natural languages, their limits do not become visible until viewed in the alphanumeric light of modern machines. One hundred and twenty years ago, when the Californian railroad king and governor Leland Stanford senior ordered the famous experiment combining horse's legs and high-speed cameras which was to lead to the establishment of cinematography, the epoch's greatest horse and battle painter had to admit the failure of his art. These days, media technologies constructed on the basis of formal languages move the boundary between the possible and the impossible, the thinkable and the unthinkable. Those who have tried to pour the fuzzy logic of their insights and intentions into computer source code know from bitter experience how drastically the formal language of these codes distorts those insights and intentions. And because these feedback loops tend to lead from the machine to the programmer rather than the other way round, computers cannot be classified as tools, which is why the later Heidegger is more relevant when it comes to understanding universal machines than the Heidegger of *Being and Time*. His lecture 'The Question Concerning Technology' concedes that with regard to everyday activities, 'the current conception of technology, according to which it is a means and a human activity' is 'correct' (Heidegger, 1993: 312). But unlike the argument put forward in *Being and Time*, Heidegger immediately revokes this concession by pointing out that technology is not a mere means 'but a mode of revealing' (1993: 319). That means in practical terms that 'the energy concealed in nature is unlocked, what is unlocked is transformed, what is transformed is stored up, what is stored up is distributed, and what is distributed is switched about ever anew' (1993: 322). At which point, Heidegger, as if he had just invented the closed circuit, concludes that 'unlocking, transforming, storing, distributing, and switching are ways of revealing' (1993: 322). What Wiener called Shannon's madness must have been precisely this discovery.

As a young student at MIT, Shannon is said to have built the simplest, most elegant and most useless of all digital machines. It boasted one single ON/OFF switch. Whenever Shannon's friends came to visit, the machine was on OFF. Sometimes, when they were in a playful mood, the visitors switched it to ON. Whereupon the lid of the machine opened, a hand appeared, fumbled around for the switch, put it on OFF again and disappeared under the closing lid . . .

(Translated from the German: Geoffrey Winthrop-Young)

*Translator's Notes*

1. See Winograd and Flores (1986), esp. pp. 70–9.
2. Gustav Theodor Fechner (1801–1887), experimental psychologist and founder of psychophysics. His insights into the close relationship between the operations of consciousness and bodily facts (rephrased here in terms of cultural and scientific data) are crucial for the foundation of what Kittler terms the ‘Discourse Network 1900’. See Kittler (1990: 207–28).
3. Kittler is referring to the *Grundlagenstreit* or foundational debate that pitted the ‘intuitionism’ – that is, the notion that mathematics amounts to the formulation of mental constructions governed by self-evident laws – of Dutch mathematician, Luitzen Egbertus Jan Brouwer (1881–1966) against the formalist approach of his German counterpart, David Hilbert (1862–1942). As Kittler notes later in the article, the basic issue was whether numbers exist in our mind (Brouwer) or on paper, that is, inextricably linked to signs (Hilbert). If the latter is the case (in other words, if the human mind is removed from the equation), then the possibility arises that the manipulation of said signs can be effected by a machine that is itself programmed by signs – the Turing machine.

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