What is ‘undone computer science’?

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Abstract: The concept of ‘undone science’ emerged in the 2010s in research in social sciences at the intersection of studies on social movements and of science and technology studies. It refers to research questions that are neglected, ignored, or left unfunded, even though they deserve to be explored. The aim of this special issue is to apply this concept to computer science, by examining whether the way this discipline is structured (including its sociological, economic, and political dimensions), as well as the paradigms that shape it, make it possible to identify epistemological and ethical questions that are crucial for its development and conception.

1 Introduction. From undone science to undone computer science

The expression ‘undone computer science’ selected for the title of this special issue may seem somewhat unusual and does indeed bring up a number of questions such as: Where does it come from? What does it actually designate? Why should this be the object of epistemological thought? This introduction to the special issue aims to provide some answers to questions of this kind and discuss the emergence of a broader debate about the status and specificity of computer science as a scientific discipline.

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The idea of 'undone computer science' stems from the attempt made to apply the concept of 'undone science' to the field of computer science. According to Hess (2016), this concept has emerged over the last fifteen years in social science research carried out at the intersection of social movement studies and science and technology studies.

The starting point for this research was the observation that the dynamics of scientific production cannot be entirely explained at the microsocial level, or by applying an internal perspective specific to each scientific community (for example, by studying interactions within research laboratories[1] and considering the scientific community to be relatively autonomous from a social standpoint). When taking these dynamics into account, it is also necessary to consider factors that are external to scientific institutions and to adopt a macrosociological approach in which political, economic and industrial dimensions are integrated to contribute to the identification, development and structuring of knowledge.

And yet, certain social movements can give rise to forms of protest with epistemic implications when they are in opposition to decisions taken by political institutions or the agendas of industrial stakeholders. For example, movements of this kind may challenge the distribution or marketing of certain products or technologies by calling for more detailed study of their effects, the aim being, in this case, to demonstrate that they could be dangerous (as in the case of campaigns against GMOs or the use of certain products in the agri-food industry). In this way, some movements actually go so far as to posit alternative scientific or technological approaches to those adopted by political institutions or industrial actors, particularly in the framework of ecological transitions.

In this context, the term 'undone science' refers to "areas of research identified by social movements and other civil society organizations as having potentially broad social benefits that are left unfunded, incomplete, or generally ignored." (Frickel, Gibbon et al. 2009, p. 445.) Indeed, studies devoted to 'undone science' aim to understand the emergence of potential subjects for scientific study, which can provide responses to certain objectives or values which may be ethical, social or health-related, for example, but remain overlooked for various reasons.

This may be because the subjects have yet to be clearly identified before protest movements draw attention to them.[2] Another possibility is that such subjects may be identifiable and have already been taken up by certain researchers, but have been deliberately marginalised by political, economic or industrial institutions, notably through a lack of funding or recognition (Frickel, Gibbon et al. 2009, pp. 447–448).

[1] *Cf.* what is sometimes referred to as the "sociology of laboratory life" (see Latour and Woolgar 1979; Woolgar 1984).

[2] Conversely, there may also be attempts by certain protest movements to prevent certain research from being carried out.

However, one particularly important aspect of the concept of 'undone science' is its capacity to enable us to address several crucial philosophy of science questions. These are epistemological questions like the relationship between ignorance and knowledge and the transition from one to the other and also questions linked to scientific practice, such as the distinction to be made between what is recognised as being scientific and what is not, or the relationship between scientific research and value systems. In this way, the notion of 'undone science' appears as a prism through which certain classic themes of the philosophy of science can be re-examined, one example being Kuhn's theme of research paradigms (Kuhn 1970).[3]

This issue introduces the task of engaging in a somewhat different and, in some ways, more specific exercise, namely to apply the concept of 'undone science' to a particular discipline – computer science. The aim is to highlight epistemological and ethical thought about this field, and, in this way, potentially bring to light sociological, political, anthropological, economic, and other such forms of thought. In reality, it is not entirely surprising that one might wish to apply the concept of 'undone science' to computer science because, in the space of just a few decades, the products of computer science have become deeply embedded in many aspects of our everyday life – in technology, work, social and institutional relations, media, culture, and so on. Although computer science is a relatively young discipline, it has thus come to encompass economic, social and political dimensions over time. It is therefore natural that one may expect to find dynamics typical of undone science within this field, particularly in terms of industrial, economic and institutional biases in their different and diverse forms.

Of course, the role played by economic interests is a focus in the field of undone science given that this concept has been mobilised in the context of health and the environment (Hess 2016). Indeed, Abdalla and Abdalla (2021) have stated that the actions of 'Big Tech' – the major global technology companies – are reminiscent of the tactics deployed by 'Big Tobacco' – the major global tobacco companies – from the 1950s onwards to manipulate public opinion and academic discourse. Such actions have been analysed in terms of 'undone science' as capable of producing an 'epistemic rift', in which the flow of scientific knowledge into the political sphere no longer occurs (Hess 2016, pp. 55–56). For example, this kind of process is reportedly at work within 'tech ethics', which is said to be "absorbed by corporate logic and incentives", and serves as a form of 'ethics-washing' for the technology industry in Green's view (2021).

One strong point of the concept of 'undone science' is that it can be applied in areas beyond extreme situations of this kind. For example, Hooker (2021) describes an industrial bias, which leads to certain research projects becoming somewhat like "lotteries" because of the existing hardware and software

[3] The reference to Kuhn is, moreover, explicit in Frickel, Gibbon et al. (2009) and in Hess (2016).

constraints at the time of the experiments involved. Constraints of this kind have sometimes played a decisive role in determining which ideas have 'won' and which 'lost'. Instrumentation bias is a classic topic in the Kuhnian tradition, but Hooker more specifically describes the industrial conditions that mean hardware development tends to favour existing commercial applications over serving as a testing ground for research ideas.[4] This phenomenon has notably entrenched a division between research in algorithms and software and research in hardware. Hooker posits that it is therefore necessary to develop methods and techniques to break down barriers of this kind.

Finally, Maraninchi (2022) considers that the value the discipline places on the optimisation of software and hardware is contrasted with 'rebound effects' that lead to the expected gains being offset or even outweighed by increases in usage triggered directly or indirectly by optimisation. These rebound effects are encouraged by "a promise and a deliberate hypothesis" incorporated in many forms into the design of computer systems and by which "resources grow as needed" (Maraninchi 2022, p. 37). The potential incorporation of the concept of 'limits' in this field – or, in other terms, the absence of such promises and hypotheses – is then described as a 'paradigm shift' that, in turn, paves the way for new research avenues.

2 The contributions to this special issue

In this issue, we present contributions on topics drawn from computer science practice that display characteristics of 'undone science', which means they can be studied through the prism of this concept, and thereby become genuine examples of 'undone computer science'. The overall aim is to analyse the methodological, epistemological, ethical, social, economic and political issues that these topics shed light upon. We also aim to bring out problems and questions that may interest other computer science researchers by encouraging other, possibly transdisciplinary, questions to be raised that could prove important for a given field of research but which have tended to be relegated to informal 'hallway track' discussions at conferences, because they were not considered legitimate according to that research field's own standards.

As we have seen, there are already examples of research in the literature that is moving in this direction. Furthermore, at least one piece of work is explicitly presented as a case study of 'undone science', namely the article by Nafus (2018), which considers alternative ways of exploring databases.[5] Instead of systematically automating the extraction of information from collected data,

[4]For example, graphical processing units (GPUs) that were developed over a long period for the video game and computer graphics markets before their actual usefulness was demonstrated for a broader range of applications involving inherently parallel computations and including deep learning (Hooker 2021).

[5]It is worth noting that Maraninchi (2022) also mentions the concept of 'undone science', even if she does not explicitly situate her work within this tradition.

this work suggests that a 'hand made' analysis should be carried out by human subjects who are directly concerned by these data.[6] It goes on to demonstrate that this type of analysis not only enables more effective 'cleaning' of the data in question through the elimination of irrelevant parts and noise, but also provides insights into the links between these data and their value to the implied subjects,[7] independently of the implementation of a computer programme designed to detect certain critical situations.[8]

This special issue also presents three articles that follow a similar direction to the work of Nafus (2018), in that they examine alternative ways of thinking about computing objects and methods. These papers demonstrate how these alternatives might transform our conception of computing work from both an epistemological and a social perspective.

The work of Pierre Saint-Germier, Benjamin Matuszewski and Frédéric Bevilacqua[9] focuses on machine learning and describes alternatives to deep learning methods promoted widely by Big Tech that are particularly costly in terms of data and computational resources. Saint-Germier, Matuszewski & Bevilacqua are particularly interested in techniques known as 'shallow learning' and highlight their epistemological value. Indeed, such methods are posited as allowing for a form of understanding of learning models based on the interaction between users and the models themselves (the authors discuss a machine learning application that enables users to define correspondences between sounds and gestures).

Sophie Quinton and Jean-Bernard Stefani,[10] for their part, present a research programme focused on the design and development of computing tools that respect the principle that Ivan Illich calls 'conviviality' (Illich 1973). They demonstrate how, from a normative standpoint, this approach is accompanied by guiding principles for the design of digital systems, notably by providing guidelines for integrating computer technologies into a degrowth scenario.

Pierre Depaz[11] begins by remarking that commercial considerations in the field of software engineering particularly lead to the focus mainly being placed

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[6]One of the examples discussed in this article concerns data on the work of people who care for their family members, like the number of hours of sleep, the ambient noise level in the environment of both caregivers and those cared for, and so forth.

[7]For example, once a caregiver is made aware that a lack of sleep is affecting their work, they may then decide to hire someone else to provide night-time care.

[8]For example, a programme that identifies "the areas when health and social systems fail caregivers" – which could, incidentally, cause stress for them – "as opposed to making caregivers individually responsible for their own stress relief every time that stress is inferred" (Nafus 2018, p. 371).

[9]Pierre Saint-Germier, Benjamin Matuszewski and Frédéric Bevilacqua (2026). 'Machine Learning, Understanding, and Interaction'. In: *Philosophia Scientiae* 30-2, pp. 17–39. DOI: 10.4000/16953.

[10]Sophie Quinton and Jean-Bernard Stefani (2026). 'Conviviality for Digital Degrowth'. In: *Philosophia Scientiae* 30-2, pp. 41–63. DOI: 10.4000/16954.

[11]Pierre Depaz (2026). 'Global and Local Implications of Computational Artifacts'. In: *Philosophia Scientiae* 30-2, pp. 65–79. DOI: 10.4000/16955.

on designing software whose structure and functionality remain stable when scaled up, particularly as the volume of input data, the number of concurrent users, or the number of interconnected computing resources increases. Conversely, there has not been sufficient research into the transition to a smaller scale when working locally with limited and specific amounts of data without pooled computing resources or databases. This perspective enables Pierre Depaz to consider situations aimed at limiting energy expenditure, but also gives him the opportunity to bring up epistemological questions concerning the concept of scale, which he views as closely linked to the construction of computational artefacts, rather than as something that is accepted *a priori*.

However, a second meaning can be attached to the idea of 'undone computer science', namely thought about its own epistemological status. Currently, the focus on the uses of computer science, and on study of the effects thereof in the economic and social spheres, has left this issue unresolved, or even unfinished. In other words, is it possible to consider computer science as a science in its own right and, if so, what kind of science is it – theoretical or applied? Does computer science possess its own disciplinary autonomy (and, if so, on what grounds?) or should it be viewed as a branch of engineering (as is often the case in the United States, for example, where computer science departments are frequently integrated into engineering schools)? And finally, is computer science, as a *science*, completely independent of the humanities and social sciences?

This special issue also aims to explore these questions, particularly by examining whether certain philosophical approaches to computer science tend to neglect certain aspects that are nonetheless central to its practice – such as its anthropological and social dimensions – and also essential to understanding the status of such a discipline. This issue's fourth article, by Felienne Hermans,[12] is situated within this framework. In this paper, she demonstrates that, when conceptual reflection on computer science takes place, it is all too often conceptualised as a science that considers objects or processes (computation, algorithms, as well as their implementation and verification) that derive from mathematics, engineering or the natural sciences, and neglects the human dimension and social interactions, which do, however, play a crucial role in these practices.

So, whilst the notion of 'undone computer science' may just seem a form of specialisation or a specific case of 'undone science', reflecting on computer science helps broaden the very concept of 'undone science', beyond the more restricted meaning deriving from studies of social movements. In this way, thought about computer science as a discipline encompasses certain parts or subjects that have yet to be studied in the sense discussed above, or, in other

[12] Felienne Hermans (2026). 'How The Social Construction of Disciplinary Boundaries and Disciplinary Hierarchies Shapes What Computer Science Gets Done'. In: *Philosophia Scientiae* 30-2, pp. 81–108. DOI: 10.4000/16956

terms, are themselves ‘undone’. In this sense, this discipline could be considered as possessing a status that has yet to be fully established and therefore remains open to change and evolution.

3 For legitimising computer scientists’ reflections about their own discipline

The fact that computer science does not seem to fit into the traditional classification of the sciences contributes to making it a *sui generis* discipline, the boundaries of which are difficult to define clearly and unambiguously. As Gilles Dowek has noted, from the perspective of the classification inherited from (particularly logical) positivism, mathematics deals with *a priori* analytical truth, whereas the natural sciences deal with *a posteriori* synthetic truths.[13] However, computer science occupies an entirely unique position, which Gilles Dowek calls *a posteriori* analytical knowledge, stating that “it is both analytical and *a posteriori.*[14] It is analytical in the sense that the properties of an algorithm, for example, are intrinsic (independent of the laws of nature). But it is also *a posteriori* in the sense that their validation requires interaction with a physical system (the machine), which is a form of experimentation in some ways.”[15]

However, a machine like a computer is not merely a physical and logical system (a set of electronic circuits and programmes). It is also a technological tool that enables certain actions to be carried out automatically, which, in turn, constitute infrastructures, networks and ecosystems that then enable forms of interaction and intervention in the real world. In other terms, as technological instruments, computers are means by which humans interact

[13] See the interview published in volume 431 of ‘Cahiers de l’INRIA–La Recherche’ in June 2009: https://inria.hal.science/inria-00527531v1.

[14] Gilles Dowek redefines these terms in a non-Kantian manner. Without wishing to carry out a detailed analysis of the terminology Dowek uses, it is possible to posit that he refers to what Kant calls ‘a priori’ and ‘a posteriori’ as being ‘analytic’ and ‘synthetic’ respectively. On the other hand, what Dowek calls “a priori” and “a posteriori” are closer to the Kantian distinction between “rational knowledge” and “historical knowledge” (Critique of Pure Reason, A836/B864–A837/B865). In this sense, what Dowek calls “a posteriori analytical knowledge” might be close to what Kant refers to as historically acquired a priori knowledge, that is, knowledge which does not depend on experience in itself, but can nevertheless be acquired by from empirical data (*ex datis*). For example, although the truth of the Pythagorean theorem does not itself depend on sensory experience, a schoolchild could learn it by heart when they begin school, without being able to prove it. We would like to thank Baptiste Mélès for drawing our attention to these distinctions.

[15] *Translated from the original French.* This extract can be interpreted in two ways. On the one hand, this refers to calculability as illustrated by the halting problem, insofar as only the result of an experiment generally enables us to find out whether a Turing machine halts, even though halting is entirely and systematically determined by the machine’s mathematical definition. On the other hand, it refers back to complexity. An effective physical implementation of the Turing machine is generally required to observe whether it halts and then to determine its final state (if this is even possible within a human timescale).

with other agents, or which help shape social and institutional relationships, work and other aspects of life.

The unique nature of computer science therefore appears to stem from its combination of theoretical concepts (the construction of formal languages, the design of algorithms, the mathematisation of the concept of information) and technical objects (computers and their constituent components along with those specific components that enable computers to be connected to and communicate with each another). However, although the theoretical model of the Turing machine remains a paradigm in computer science,[16] technical and social developments have, of course, marked computer science's brief history. These include, for example, processing speed (with the miniaturisation of chips from the 1960s onwards), data storage (which shifted within a few years from punch cards to data centres) or, finally, access to information (with the emergence of the consumer internet in the 1990s and the commercialisation of touchscreen handheld devices that began in the 2010s). The latest significant milestone in this history came with the recent popularisation of generative artificial intelligence systems. Technological developments of this kind have been supported by theoretical work aimed at devising the most suitable ways of exploiting and optimising the technologies concerned.

This proliferation of information technologies has led to emerging issues that are linked to the consequences of their widespread adoption and their control. Issues of this kind have been highlighted in some of the articles mentioned above. For example, Green (2021) cites social and political issues while Maraninchi (2022) discusses environmental concerns. Both of these articles describe the "crisis of conscience" (Green 2021) within the profession over the past decade or so, which is particularly due to the perceived disconnect between the research carried out and the actual consequences that have been observed (Maraninchi 2022). Indeed, although computer science researchers generally believe their work can contribute to the development of their discipline and promote the results of their research for the benefit of society, they are also well particularly placed to develop critical perspectives on the industry and their own discipline. This form of tension has been observed to produce committed, or even militant, stances in defence of certain values among researchers, along with thought about promising research avenues, alternatives or explorations of issues that remain marginal, or have even been totally overlooked. In this respect, approaches of this kind can be considered as falling under the definition of 'undone science'.

In this way, an endogenous dynamic is emerging, in which computer scientists are choosing to carry out multidisciplinary research into the practice of computing itself. Work of this kind considers the uses of computing and the consequences of such uses, along with the study of the theoretical foundations of certain technical developments or specific applications of digital technology.

[16] We use the term 'paradigm' here in the sense of an exemplary past achievement (Kuhn 1970, p. 175).

And yet, this research has not always been viewed as legitimate and particularly lacks recognition within the computer science community itself. Members of this community tend to consider work of this kind as being more suited to researchers from the fields of philosophy, sociology, anthropology, or other humanities disciplines. However, computer scientists are capable of identifying and expressing other limitations within their discipline and drawing further conclusions from these, for example by recognising the technical and theoretical limitations of computing tools. Again, this corresponds to the concept of 'undone computer science' discussed earlier, insofar as this research shows the discipline of computer science to currently lack a fully determined status. This is because computer science can potentially accommodate research by computer scientists into the values, role and boundaries of the discipline itself, and, for example, exploration of its links to the humanities.

4 Conferences on 'Undone Computer Science'

To set up a forum for discussion, exchanges and for researchers to make connections, based on an approach and thinking that are similar to those discussed above, a group of computer scientists working with colleagues from the humanities and social sciences began work on the organisation of a conference that was actually called 'Undone Computer Science' and took place in 2022.[17] One of their aims was to foster the incubation of new ideas and promote cross-disciplinary collaboration, the end goal being for this thought and work to lead to published articles.[18]

The programme committee has invited contributions that involve:[19]

> "[...] any discussion of systematic non-production and non-dissemination of knowledge, whether in a specific area or in computer science in general, either past or present; whether due to limitations of available methodologies, blind spots of dominant paradigms, institutional and industrial biases, lack of social representation, or other factors."

This indeed amounts to an attempt to define the concept of undone (computer) science that corresponds to the generalisation outlined above. The quality and quantity of the abstracts submitted led to the conference being extended by a day.

The seminal article by Frickel, Gibbon et al. (2009) specifically highlighted the "analytical potential of undone computer science". This concept has indeed proven to be a catalyst for thought and offers an open-ended line of inquiry

[17] See https://www.undonecs.org/. The first event was held from February 5th to 7th, 2024, in Nantes (France), followed by a second conference in Esch-sur-Alzette (Luxembourg) from March 23rd to 25th, 2026.

[18] The conference was backed up by a separate call for papers that is open to all, and modelled on the TYPES international conferences.

[19] https://www.undonecs.org/2024/en/page/cfp.html.

capable of addressing multiple aspects of computer science, including its practice and implications. This concept was sufficiently precise, general and significant to enable the first edition of the conference to succeed in bringing together researchers of different nationalities and from varied backgrounds to discuss these ideas about the discipline. Around fifty computer scientists from various subfields attended alongside philosophers, sociologists, linguists, and researchers in public policy and science and technology studies, which clearly proved fertile ground for the exchange of ideas and interdisciplinary dialogue.

Clearly, some may find the term 'undone computer science' somewhat paradoxical when used to define an actual research community. There is no guarantee that a research programme of this kind – for example, one that addresses the ethics or epistemology of computer science in general – might emerge, which could give structure to such a community and ensure its long-term viability because, to put it simplistically but self-evidently, research that has yet to be done stops being non-existent as soon as it is carried out. Apart from transdisciplinary study of and thought about computer science, one of the purposes of this community could be to host research that is destined to slip away from it as soon as a community of researchers manages to embrace it fully. However, the formation, growth, and structuring of a community of researchers of this kind make up an uncertain process that may turn out to be slow in moving forward. In this scenario, 'undone computer science' could be seen as a form of incubator that promotes the emergence of new computer science research questions.

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