“Can machines think?” The missing history of the Turing test

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Abstract

Turing’s much debated test has just turned 70 and is still fairly controversial. His seminal 1950 paper is seen as a complex and multi-layered text and key questions are yet to be answered. Why did Turing refer to “can machines think?” as a question that was “too meaningless to deserve discussion” and yet spent the largest section (over 40%) of his text discussing it? Why did he spend several years working with chess-playing as a task to illustrate and test machine intelligence only to trade it off for conversational question-answering in his 1950 test? Why did Turing refer to gender imitation in a test for machine intelligence? In this paper I shall address these questions directly by unveiling social, historical and epistemological roots of Turing’s 1950 test. I will show that it came out of a controversy over the cognitive capabilities of digital computers, most notably with physicist and computer pioneer Douglas Hartree, chemist and philosopher Michael Polanyi, and neurosurgeon Geoffrey Jefferson. Turing’s 1950 paper is essentially a reply to a series of challenges posed to him by these thinkers against the view that machines can think. My goal is to improve the intelligibility of Turing’s test and contribute to ground it in its history.

Keywords: Alan Turing, Can machines think?, The imitation game, The Turing test, History of artificial intelligence, Mind-machine controversy

1. Preliminaries

Robin Gandy (1919-1995) was one of Turing’s best friends and his only doctorate student. He received Turing’s mathematical books and papers when Turing died in 1954, and took over from Max Newman in 1963 the task of editing the papers for publication (cf. Moschovakis & Yates [1996, p. 367-8]). Regarding Turing’s purpose in writing his 1950 paper and sending it for publication, Gandy offered a testimony previously brought forth by Jack Copeland (2004, p. 433) which has not yet been commented about:

It was intended not so much as a penetrating contribution to philosophy but as propaganda. Turing thought the time had come for philosophers and mathematicians and scientists to take seriously the fact that computers were not

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merely calculating engines but were capable of behaviour which must be accounted as intelligent; he sought to persuade people that this was so. He wrote this paper unlike his mathematical papers quickly and with enjoyment. I can remember him reading aloud to me some of the passages always with a smile, sometimes with a giggle. (Gandy, 1996, p. 125)

I shall refer to this as Gandy’s anecdote on the purpose of the Turing test. It think it is intriguing, for one thing, because it diverges from the widely shared view of Turing’s paper as the proposal of a decisive experiment for machine intelligence. But more than that, it suggests that Turing was engaged in a dialogue with “philosophers and mathematicians and scientists” on the capabilities of (digital) computers. Now, what debate was this? Who were these interlocutors that Turing sought to persuade? While “the Turing test” is widely known in philosophy, there is a huge gap of scholarly studies on its history.

2. The problem

Seventy years have passed since Turing’s famous (1950) proposal of an imitation game or test for machine intelligence, and its available interpretations are still conflicting.

At a first level of discussion, interpreters disagree on whether or not Turing proposed an experiment to decide for machine intelligence. On the one side, philosophers such as Daniel Dennett (1984), James Moor (1976; 2001) and Jack Copeland (2000) all provided support for viewing Turing’s test as such experiment. Dennett wrote that “the Turing test, conceived as he conceived it, is (as he thought) plenty strong enough as a test of thinking,” and added “I defy anyone to improve upon it” (p. 297). This class of interpreters found in Turing’s 1950 paper an epic species test in neglect of any gender test whatsoever, and posited that the preferable machine-imitates-human test stands as the best experiment to decide whether or not machines have achieved human-level intelligence. On the other side, scientists such as Patrick Hayes and Kenneth Ford (1995) and Drew McDermott (2014), with further support from Marcus et al. (2016), although less certain about what Turing tried to do in his paper, also tried to take his 1950 proposal of an experiment for machine intelligence seriously and yet found no philosophical and/or scientific substance in it. This class of readers complained about the quality of Turing’s experiment description and design, be it for a gender or a species test. McDermott wrote that “[c]onsidering the importance Turing’s Imitation Game has assumed in the philosophy-of-mind literature of the last fifty years, it is a pity he was not clearer about what the game was exactly.”

Furthermore there are those who rejected that Turing’s test addresses an empirical question. Noam Chomsky wrote in (1995) that ‘can machines think?’ “is not a question of fact” but one of language (p. 9), and that Turing himself observed that the question is “too meaningless to deserve discussion.” Blay Whitby (1996) acknowledged the role played by Turing’s 1950 proposal in the early 1950’s to inspire or drive research. But he claimed that soon later it became a distraction, for Turing’s test rather measures the human reaction to a performative machine and this is not a problem in artificial intelligence research. Marvin Minsky said in (2013) that Turing suggested his test “as one way to evaluate a machine but
he had never intended it as the way to decide whether a machine was really intelligent.” So much for these representative classes of interpretation of Turing’s 1950 proposal, we shall now be ready to proceed. A comprehensive survey was given by Saygin et al. (2000). The reader may also seek a report on “the Turing test” as a concept in analytic philosophy with its loose ties to Turing’s historical proposal (Oppy & Dowe, 2003).

Now, in face of this sheer heterogeneity in the secondary literature on the Turing test, one may wonder that some structural exegesis and well-sourced historiography of Turing’s 1950 proposal must be helpful. Nonetheless, there is still much room in Turing scholarship for broad yet close exegetical and historical analyses. Andrew Hodges offered an account of the test and pointed to the Turing-Polanyi connection (§4.2) in (2009), writing that Polanyi “encouraged [Turing] to publish his views” (p. 13, no source is given). In Hodges’ most comprehensive Turing biography (1983), several valuable primary and secondary sources can be found, and yet Hodges often struggles with Turing’s text in favor of his own essayistic drives. For instance, he wrote that Turing’s “sexual guessing game” was “in fact a a red herring, and one of the few passages of the paper that was not expressed with perfect lucidity” (p. 415). Jonathan Swinton’s (2019) Turing biography provided plenty of new valuable sources. Regarding Turing’s test, Swinton emphasized in his turn the Turing-Jefferson connection (§4.3). He pointed that “it was Jefferson’s obtuseness that provoked Turing into developing this vivid image [the Turing test]” (p. 93, no source is given). Turing scholar Diane Proudfoot contributed in (2013) a philosophical interpretation of Turing’s 1950 proposal centered on a specific aspect of Turing’s concept of machine intelligence, namely, Turing’s (1948) observation that “the idea of ‘intelligence’ is itself emotional” (p. 411). More broadly, Proudfoot concurs with Copeland’s (2000) defense of the test as a decisive experiment for artificial intelligence. I shall refer later to Darren Abramson’s (2011) location of material evidence that Turing read and annotated Jefferson’s 1949 citations of René Descartes. In any case, my point is that there is a need to connect specific findings such as this to the whole towards a more historically grounded interpretation of Turing’s 1950 test. I shall call this gap in the secondary literature the problem of the missing history of the Turing test, whose illustration can be given by the general obliviousness on what is brought forward in Gandy’s anecdote but also by key related exegetical and historical questions which still appear to be largely unanswered:

- If Turing’s goal was rather the proposal of a decisive experiment in avoidance of a “meaningless” discussion, why did he spend the largest section (over 40%) of his text addressing objections to the possibility of machine intelligence?

- If Turing was decided about conversational performance as the best intellectual task to illustrate, develop and test machine intelligence, why did he worked for several years ever since his wartime service in 1941 up to his 1950 paper with chess-playing as such task, having even reconsidered it at the end of his 1950 paper?

- If Turing really proposed in 1950 a species test for machine intelligence in neglect of a gender test, why did he clearly refer to gender imitation in the same source?

I shall start by addressing the first question through a contextualized exegesis of Turing’s 1950 text (§3). Next I shall present crucial historical events in the year of 1949 that shall
explain Gandy’s anecdote and answer the three questions altogether (§4). My goal is to improve the intelligibility of the Turing test and contribute to ground it in its history.

3. An interpretive basis for Turing’s 1950 text

Turing’s (1950) text is often said to be accessible for a general readership and yet to be complex, multi-layered and too ambiguous for scientific and philosophical interpretation if not even contradictory. So I shall start by addressing its structure as explicitly as possible in view of improving its intelligibility (§3.1). Then I shall explain his famous and controverted reference to the question “can machines think?” as “too meaningless to deserve discussion” (§3.2). Finally I shall present evidence of a method that he used to elaborate his text (§3.3).

3.1. The logical structure of Turing’s 1950 text

Let Turing’s 1950 text be read according to these logical steps:

- (The proposal, §§§1, 2, 3). His new proposal on how best to discuss the question, “can machines can think?” One possibility, he argues, is to have the discussion on the basis of commonsense notions of machine back then (say, a steam engine) and thinking (say, what humans and humans only do). But this, he observes, would render the question paradoxical from the start and, in effect, absurd. He poses the imitation game as an idealized scenario that he designed to be a sensible and proper substitute for what he sees as obsolete commonsense. He comments on the appeal and the settings of his proposed idealization; in particular, why blind conversational question-answering makes sense as an intellectual task to empirically evaluate the cognitive capabilities of digital computers (new machines then existing) to perform something that, if done by a human being, one ought to call “thinking.” He thus proposes the imitation game as a vivid and picturesque image that carried inside an (epistemological) “criterion for thinking.” Based on the imitation game, he suggests two variants (a man-imitates-woman version and a machine-imitates-woman version) of the new question in replacement to the original one, and he continues to suggest yet other variations of it as he proceeds into the next logical steps of his text.

- (The science, §§4, 5). His teaching of what a digital computer is, in language widely accessible for readers in philosophy, mathematics and science, if not the general public altogether. He makes it clear that his proposal (the first logical step) is a philosophical reflection upon a science, namely, his 1936 mathematical science of computing. This science is now combined with the technology of stored-program computing that has been developed (early since the war years at Bletchley Park in Britain, but this he cannot reveal; and) in the postwar years. This combination was not casual, but fine-tuned by him and colleagues in order to make digital computers behave or perform as universal computing machines. His proposal, it should be clear at the end of his §5, is not about any sensible imaginary scenario but one that is informed and constrained by the science and technology of digital computers.
• (The discussion, §§6, 7). His negative and positive argumentation — by means of the
science-informed proposal — against a series of nine objections to a positive answer
to the original question (“can machines think?”). As preliminaries, Turing explains
his beliefs and views. For him, the scientific status of the question is in the open.
His own belief is that the answer for the question is positive, but would rather avoid
saying it directly for the very reason why he outlined the proposal in the first place,
namely, to provide a basis for the discussion not to be meaningless. Then proceeding
to the discussion itself he engages into each objection formulated, and systematically
refers to the imitation game in his rebuttal. This was his negative argumentation.
He then advances to present a tentative research agenda for the development of
“learning machines” that could be made to play the imitation game well. These,
once provided with the required storage capacity and a suitable program, would be
able to learn for themselves. In analogy with the education of a human child, his
suggested approach was to find a “child program” that would have initially little
structure and learn from experience so as to eventually exhibit intelligence of its own
in the imitation game. This was his positive argumentation. Both the negative and
the positive argumentation were systematically based on the imitation game.

Now, it is important to emphasize key elements of Turing’s rationale. Without the proposal,
the discussion of the original question (“can machines think?”) would be grounded on
commonsense notions of “machine” and “thinking” back then. From the point of view of
Turing’s goal of proposing conceptual change over the meaning of these words based on a
new science, this would be absurd indeed. And without introducing or teaching the new
science, the proposal might be understood as some silly intellectual exercise in fiction or
fantasy. But given such elemental premises, Turing reasoned, the discussion could finally
unfold. It would then have an empirical basis on his proposed (epistemological) “criterion
for ‘thinking,’” which was at the same time embedded in a sensible idealized scenario (the
imitation game) to keep an appeal to commonsense.

3.2. Turing’s proposal of conceptual change on the meanings of words

Turing’s reference to “meaningless” has been largely understood as affiliation to positivism,
operationalism or behaviorism. Turing scholars such as Copeland (2000, p. 526) and
Proudfoot (2017) denied it. But then, if the emergence of behaviorism in the early 1950’s
and Gilbert Ryle’s editorship of Mind back then happens to be a coincidence, why would
Turing have referred to the original question as “meaningless”? We shall now examine it.

In the very opening of his text, Turing argued about the dispensability of a definition
for words “machine” and “think” according to commonsense back then. He wrote:

I PROPOSE to consider the question, ‘Can machines think?’ This should begin
with definitions of the meaning of the terms ‘machine’ and ‘think’. The defini-
tions might be framed so as to reflect so far as possible the normal use of the
words, but this attitude is dangerous. If the meaning of the words ‘machine’ and
‘think’ are to be found by examining how they are commonly used it is difficult
to escape the conclusion that the meaning and the answer to the question, ‘Can machines think?’ is to be sought in a statistical survey such as a Gallup poll. But this is absurd. (Turing, 1950, p. 433)

Turing thus addressed directly the issue of the paradoxical aspect of the combining words “machine” and “think.” Later in the same text he even reiterated this observation in connection to the notion of “learning.” He wrote: “[t]he idea of a learning machine may appear paradoxical to some readers” (1950, p. 458).

Turing’s caveats, however, do not seem to have received enough attention. Wolfe Mays, for example, who was then a young philosopher and a contemporary of Turing at the University of Manchester, was asked by Ryle whether he would write Turing a reply (2001). His contribution ended up appearing elsewhere and was one of the earliest received views on Turing’s paper (1952). Mays went to the Oxford English Dictionary to promptly show that Turing had just instilled nonsense. He read from entry “machine” back then:

[A] combination of parts moving mechanically as contrasted with a being having life, consciousness and will. Hence applied to a person who acts merely from habit or obedience to a rule, without intelligence, or to one whose actions have the undeviating precision and uniformity of a machine.

(Mays, 1952, p. 149, as retrieved from the O.E.D. as of 1952)

The sourced dictionary entry proves that reacting to the original question as “meaningless” or “absurd” was then a standard intellectual attitude based on culture and commonsense. Mays overlooked that Turing’s goal was exactly to propose a science-informed conceptual change on the meaning of words “machine” and “think.” Turing had been at least since early 1947 explicitly challenging the conventional wisdom caught in common phrases such as “acting like a machine” (1947, p. 393), “purely mechanical behaviour” (1948, p. 410). The fact that Mays, writing after Turing’s 1950 paper, yet disregarded his opening plea for a suspension of judgement on the issue seems to explain very well why Turing felt the need to acknowledge that he understood all too well that the original question (“can machines think?”) would sound absurd (or “meaningless”), and why he resorted to the imitation game as an attempt to provide a new frame of discussion hopefully towards shaking up people’s intuitions on the original question.

So far we have gained depth into the issue by examining the cultural background against which Turing posed his famous phrase about the question to be “meaningless.” Now, let us look back at the internal logic of the (1950) text. In preparation to reach that passage, Turing pondered: “[w]e cannot altogether abandon the original form of the problem, for opinions will differ as to the appropriateness of the substitution” (p. 442). He then proceeded to outline two predictions, the first based on the imitation game, or “the more accurate form of the question,” and the second based on his suggested conceptual change over the combination of the two words, and here is where he referred to “meaningless:”
The original question, ‘Can machines think?’ I believe to be too meaningless to deserve discussion. Nevertheless I believe that at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted. (Turing [1950] p. 442)

The order of exposition is striking. After his reference to “meaningless,” the next sentence refers to what he expects will happen with the combination of words “machine” and “think” in society and culture in the future. That is, Turing was conceding that combining the two words could sound meaningless indeed. The following passage is evidence of his intention to ground the discussion on the imitation game.

Those who hold to the mathematical argument would, I think, mostly be willing to accept the imitation game as a basis for discussion. Those who believe in the two previous objections would probably not be interested in any criteria. (Turing [1950] p. 445, emphasis added)

This explains the two first logical steps of Turing’s 1950 text (the proposal and the science).

In fact, Turing’s discussion (the third logical step of his 1950 paper) turns out to have taken 19 out of 28 pages of it (nearly 70%). There should be little doubt that it was the very focus of his paper. I shall next present evidence that Turing’s “discussion” was no casual initiative of his and no vacuous rhetorics. Rather he seems to have felt compelled to follow a well-known method in the history of philosophy, with a clear goal in mind.

3.3. Turing, reader of Bertrand Russell

Turing made it explicit in his (1950) discussion of the theological objection (p. 443) that he was a reader of Bertrand Russell’s History (1945), which had appeared only five years before his 1950 paper and is one of the few pieces in its bibliography. I am not aware of any commentary on the secondary literature taking notice of this, and yet, I find it to be a valuable exegetical element to make sense of his 1950 text. Turing turned to Russell’s book as his chosen reference on the history of western philosophy. I shall take a moment to examine this by quoting in depth stepwise from Russell, who thus introduced the method:

Dialectic, that is to say, the method of seeking knowledge by question and answer, was not invented by Socrates. [...] But there is every reason to suppose that Socrates practised and developed the method. [...] Certainly, if he practised dialectic in the way described in the Apology, the hostility to him is easily explained: all the humbugs in Athens would combine against him. (Russell, [1945] p. 92)

If there was hostility to Socrates in Athens, there was hostility to Turing in postwar Britain as well. For instance, in connection to §4.3 below, in (1949) Jefferson wrote that “the concept of thinking like machines lends itself to certain political dogmas inimical to man’s happiness [and] erodes religious beliefs that have been mainstays of social conduct” (p. 1107).
Moreover, the platonic figure of Socrates, as known, was a master of irony. And irony was one of Turing's preferred tools in debating the conventional wisdom about machines.

Russell remarked that the socratic dialectic method, as it turns out, was the one used by Galileo in his dialogues to advocate his theories and overcome prejudice. And Russell pondered about the limits of the method, as exemplified with excellence by Galileo. This passage may have contributed for Turing to discover Galileo as a hero, as portrayed in the end of his rebuttal to the theological objection (1950, p. 443-4), and later in his 1951 BBC radio lecture “Intelligent machinery, a heretical theory” (1951b, p. 475). Russell wrote:

The dialectic method is suitable for some questions, and unsuitable for others. [...] Some matters are obviously unsuitable for treatment in this way — empirical science, for example. It is true that Galileo used dialogues to advocate his theories, but that was only in order to overcome prejudice — the positive grounds for his discoveries could not be inserted in a dialogue without great artificiality. Socrates, in Plato’s works, always pretends that he is only eliciting knowledge already possessed by the man he is questioning; on this ground, he compares himself to a midwife. (Russell 1945, p. 92-3)

The connection of this passage with Turing’s argumentative approach as exhibited in the third logical step of his 1950 text (“the discussion”) is striking. Russell discouraged one to purport to establish any positive grounds for discoveries by means of a discussion. And along these lines, Turing wrote: “[t]he reader will have anticipated that I have no very convincing arguments of a positive nature to support my views.” With a tone of irony, he completed: “[i]f I had I should not have taken such pains to point out the fallacies in contrary views.” Via Russell, as it seems, Turing reproduced Socrates’ approach in his negative dialectic (§6 of his 1950 text), while respecting the boundaries suggested by Galileo’s in his positive dialectic (§7 of his text) towards the development of learning machines.

Russell resumed to consolidate his observation about the proper use of “the method of question and answer” by delimiting that it does not apply to empirical problems such as, say, “the spread of diseases by bacteria.” Then he explicitly suggested the platonic-socratic method for questions about the meaning and usage of words:

The matters that are suitable for treatment by the socratic method are those as to which we have already enough knowledge to come to a right conclusion, but have failed, through confusion of thought or lack of analysis, to make the best logical use of what we know. A question such as “what is justice?” is eminently suited for discussion in a Platonic dialogue. We all freely use the words “just” and “unjust,” and, by examining the ways in which we use them, we can arrive inductively at the definition that will best suit with usage. All that is needed is knowledge of how the words in question are used. But when our inquiry is concluded, we have made only a linguistic discovery, not a discovery in ethics. (Russell 1945, p. 93)
Now, the meaning and common usage of words, namely, “machine” and “thinking,” were just the central topic of Turing’s 1950 paper. Nonetheless, again in line with Russell’s point that no positive discovery could come out of an application of the socratic method, as we have just seen, Turing emphasized that he did not expect to have very convincing arguments of a positive nature to support his views. He rather declared that “[t]he only really satisfactory support that can be given for the view expressed at the beginning of §6” (viz., his prediction about a machine being able to play well a simplified form of the imitation game) “will be that provided by waiting for the end of the century and then doing the experiment described” (p. 455). So, because Turing was in agreement with Russell’s empiricist guidelines, he was compelled to acknowledge that it was only experiment that could provide satisfactory support for his views on the original question.

Also along the lines of Russell’s exposition, Turing seems to have made a very specific use of the dialectic method. His goal was “to point out the fallacies in contrary views” to his hypothesis that machines can think. It is worth to highlight Russell’s point about the function of this method to elicit truth after fixing “[l]ogical errors:”

We can, however, apply the method profitably to a somewhat larger class of cases. Wherever what is being debated is logical rather than factual, discussion is a good method of eliciting truth. Suppose some one maintains, for example, that democracy is good, but persons holding certain opinions should not be allowed to vote, we may convict him of inconsistency, and prove to him that at least one of his two assertions must be more or less erroneous. Logical errors are, I think, of greater practical importance than many people believe; they enable their perpetrators to hold the comfortable opinion on every subject in turn. Any logically coherent body of doctrine is sure to be in part painful and contrary to current prejudices. The dialectic method [...] tends to promote logical consistency, and is in this way useful. But it is quite unavailing when the object is to discover new facts. (Russell, 1945, p. 93)

In fact, Russell proposed the dialectic method to debate philosophical questions. And it was this method that Turing decided to use in his 1950 paper against his opponents on the question whether machines can think. Also, he clearly acknowledged that he did not expect to settle the matter by a philosophical discussion. He rather insisted on the open status of the question from an empirical point of view. He seems also to have considered, though, that “logical errors” were the core obstacles in the way of the requisite scientific research that would lead, in the future, to the actual demonstration of machine intelligence. He addressed such logical errors in his discussion by referring to “the imitation game” or his test “as a basis” (1950, p. 445). We shall see next (§4) just what logical errors he addressed.

We have thus learned about what kind of discussion Turing offered in the third logical step of his 1950 text. In short, it was a socratic dialectic discussion that respected the empiricist boundaries indicated by Russell to have been exemplified by Galileo.
4. 1949, the crucial year

In June, computer pioneer Douglas Hartree published his Calculating instruments and machines (1949). Described in detail in the book, the new electronic computing machines could do a lot and yet should be seen as nothing but calculation engines (§4.1). Also in June, distinguished neurosurgeon Geoffrey Jefferson had given his Lister Oration along the same lines and pushed it further with strong demands to accept that “machine equals brain” (§4.3). Asked by a reporter from The Times, Turing rebutted to Jefferson sharply, in wit. This indirect exchange with Jefferson, however, would only make an actual impact on Turing’s views from October to December 1949 after two editions of a seminar, “Mind and computing machine,” in the Department of Philosophy of their university. These seminars were co-chaired by Michael Polanyi, who also engaged in contention with Turing (§4.2). These three conservative thinkers, all endowed with fellowships of the Royal Society and more prestigious university professorships while Turing was Reader at the University of Manchester's Department of Mathematics, tried to establish boundaries to Turing's views on machine intelligence. From June to December 1949 their provocations would resonate in Turing’s thought and crucially lead to his famous 1950 paper, as we shall now see.

4.1. Turing provoked by Douglas Hartree

Douglas Hartree (1897-1958), Fellow of the Royal Society since 1932 (Darwin, 1958), then Plummer Professor of Mathematical Physics and member of the Cavendish Laboratory at the University of Cambridge had given his “short series of lectures” in the early fall of 1948 at the University of Illinois. His related Calculating instruments and machines came out in about June (1949). Hartree had cited in his May 1949 preface (p. v) the Manchester “Baby” computer, which had recently been “put into operation.” (Earlier, in February 1946 Hartree had been a key figure for Newman’s Computing Laboratory in Manchester to be granted funding from the Royal Society, cf. Rope, 2010.) And he kept pushing his public criticism on the term “electronic brain” (1949, p. 70) as he had been doing ever since his note on The Times in early November of 1946. It was after Hartree’s 1949 book that Turing cited and discussed “Lady Lovelace’s objection” (1950, p. 450) or “dictum” (1951a, p. 485). Hartree drew attention to her views:

Some of her [Lady Lovelace’s] comments sound remarkably modern. One is very appropriate to a discussion there was in England which arose from a tendency, even in the more responsible press, to use the term “electronic brain” for equipment such as electronic calculating machines, automatic pilots for aircraft, etc. I considered it necessary to protest against this usage [Hartree, D. R. The Times (London), Nov. 7, 1946.], as the term would suggest to the layman that equipment of this kind could “think for itself,” whereas this is just what it cannot do; all the thinking has to be done beforehand by the designer and by the operator who provides the operating instructions for the particular problem; all the machine can do is to follow these instructions exactly, and this is true even though they involve the faculty of “judgment.” I found afterwards that over a hundred years ago Lady Lovelace had put the point firmly and concisely (C, p.
44): “The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform” (her italics). (Hartree 1949 p. 70)

Hartree further resumed it in a way that conceded a window for machine learning research:

This does not imply that it may not be possible to construct electronic equipment which will “think for itself,” or in which, in biological terms, one could set up a conditioned reflex, which would serve as a basis for “learning.” Whether this is possible in principle or not is a stimulating and exciting question suggested by some of these recent developments [...]. But it did not seem that the machines constructed or projected at the time had this property. (Hartree 1949 p. 70)

This passage would be quoted and discussed by Turing at length (1950 pp. 450, 454, 459). Turing was decided to pursue machine learning beyond “reflexes” and “the action of the lower centres” of the brain at least since his c. November 1946 letter to Ross Ashby (1946). In fact, as we will now see, in 1949 Hartree was himself writing in reply to Turing.

Back in November 1946, Hartree had been interviewed alongside Turing about the machine (or “brain”) under construction at the National Physical Laboratory near London, the so-called Automatic Computing Engine (ACE). (After the Second World War, Turing was hired to lead the design of the ACE as an implementation of his (1936) universal machine, while Hartree had been collaborating with Maurice Wilkes on the EDSAC machine at the University of Cambridge.) On 7 November The Daily Telegraph reported “ACE’ will speed jet flying,” an account based on their interviews but whose headline centered on Hartree’s views. He would have said: “[t]he implications of the machine are so vast that we cannot conceive how they will affect our civilisation.” But Hartree meant practical applications of scientific computing. Turing would have gone his own way: “Dr Turing, who conceived the idea of [ACE], said that he foresaw the time, possibly in 30 years, when it would be as easy to ask the machine a question as to ask a man.” The contrast between Hartree’s view and Turing’s view was marked. Hartree has also been reported to have said in that 1946 interview, in line with his future citations of Lady Lovelace, that “the machine would always require a great deal of thought on the part of the operator.” And he would have denied “any notion that Ace could ever be a complete substitute for the human brain.” This was postwar Britain, and Hartree saw a connection between Turing’s projection for the machine and authoritarian regimes. He added: “[t]he fashion which sprung up in the last 20 years to decry human reason is a path which leads straight to Nazism.” This was in spite of the fact that, as known, Turing served his country bravely in the war and using computing machines helped to defeat Nazism (Copeland 2012).

Disregarding Hartree’s play of the Nazi card, Turing must have felt compelled to respond to what was in essence, say, the Lovelace-Hartree thesis. Soon after their November 1946 interviews, it seems that Turing had already defined what would be his line of response. Accepting a premise of the thesis but questioning its conclusion, in February 1947 in his lecture on the ACE to the London Mathematical Society, Turing asked:
It has been said that computing machines can only carry out the processes that they are instructed to do. This is certainly true in the sense that if they do something other than what they were instructed then they have just made some mistake. It is also true that the intention in constructing these machines in the first instance is to treat them as slaves, giving them only jobs which have been thought out in detail, jobs such that the user of the machine fully understands what in principle is going on all the time. Up till the present machines have only been used in this way. But is it necessary that they should always be used in such a manner? (Turing, 1947, p. 392-3)

Turing seems to have observed that the objection raised by the Lovelace-Hartree thesis was strong and could only be met if machines were made to learn for themselves by experience, with no need to redesign. He said: “[w]hat we want is a machine that can learn from experience.” And completed: “[t]he possibility of letting the machine alter its own instructions provides the mechanism for this” (1947, p. 393). So, when Hartree wrote the above passage in (1949, p. 70) denying that “the machines constructed or projected at the time had this property” (of learning to think for themselves), he was already responding to Turing (February 1947) and perhaps also to Norbert Wiener’s Cybernetics (October 1948) after Turing. Wiener reported to have met Turing in the spring of 1947. Among other generous mentions of Turing, Wiener referred to Turing’s results from his 1936 paper (1948, p. 125-6) to conclude that “the logic of the machine resembles human logic, and, following Turing, we may employ it to throw light on human logic.” From that passage, Wiener proceeded to answer positively to the possibility of the machine to have even “a more eminently human characteristic,” namely, “the ability to learn.” Wiener made it public thereby that he shared Turing’s non-obvious view that machines could be made to learn for themselves. As we shall see shortly (§4.3), Wiener’s Cybernetics did not pass unnoticed in Britain and may have contributed to stir Hartree’s reactions.

4.2. Turing provoked by Michael Polanyi

Michael Polanyi (1913-1976), born Hungarian, left Nazi Germany to England to become Fellow of the Royal Society in 1944 (Wigner & Hodgkin, 1977). In 1948, associated with the Department of Philosophy and with some support from Professor of Philosophy Dorothy Emmet, he was granted a new chair of Social Studies at the University of Manchester. (Emmet, as an Alfred Whitehead scholar, was interested in science and had religious affinities with Polanyi. Jonathan Swinton presented her profile in 2019, p. 87-90). Emmet and Polanyi were interested in the postwar public discussion about science and society, and payed attention to the debate around the new computing machines or “electronic brains.” So they invited Turing, Newman, Jefferson and others to a seminar on “the mind and the computing machine,” to be held on 27 October 1949 at the Philosophy Department. This would be a crucial event. We know of it mostly from minute notes that survived (Turing et al., 1949). Here I will cover Polanyi’s key interventions that challenged Turing.

The seminar had two sessions. The first session was led by Polanyi, who read a text, entitled “Can the mind be represented by a machine? Notes for discussion on 27th October
1949,” which he had prepared and circulated to Newman and Turing several weeks before
the meeting. Essentially, Polanyi claimed that humans can solve problems that machines
cannot. He vindicated support from Gödel’s incompleteness theorems. Polanyi scholar Paul
Blum found at the Polanyi archive at the University of Chicago a printed copy of that text
containing a few critical annotations by hand (2010, p. 52), which indeed seem to have
been made by Turing. In what survived of the first session of the seminar, we read:

NEWMAN TO POLANYI: The Gödel extra-system instances are produced ac-
cording to a definite rule, and so can be produced by a machine. The mind/machine
problem cannot be solved logically; it must rest on a belief that a machine can-
not do anything radically new, to be worked on experimentally. The interesting
thing to ask is whether a machine could produce the original Gödel paper, which
seems to require an original set of syntheses.

TURING: emphasises the importance of the universal machine, capable of turn-
ing itself into any other machine.

POLANYI: emphasises the Semantic Function, as outside the formalisable sys-
tem. [Turing et al. (1949)]

This gives evidence that Newman considered, just like Turing, that “the mind/machine
problem” can be decided empirically and only empirically. That is, for Newman as well,
it is not merely a language problem as is sometimes suggested. But more than that, New-
man shifted the discussion around Polanyi’s Gödelian argument to the Lovelace-Hartree
thesis. So Turing and Newman seem to have tried to extract some philosophical meat from
Polanyi’s point. Specifically, Newman had cast the problem of “producing the original
Gödel paper” as an instance of Lady Lovelace’s objection (the question whether a machine
can “do anything radically new”). And this had been suggested by Turing himself ever
since his February (1947) lecture, when he connected his response to (then yet unnamed)
Lady Lovelace’s objection (p. 392-3) — machine learning — with his response to Gödel’s
argument or the mathematical objection (p. 393-4).

Polanyi’s appeal to a “Semantic Function” would be extended into the second session
of the seminar, chaired by Dorothy Emmet, and lead to new exchanges with Turing. At some
point, we see that Turing would have presented a distinction, to which Polanyi replied:

TURING: declares he will try to get back to the point: he was thinking of the
kind of machine which takes problems as objectives, and the rules by which it
deals with the problems are different from the objective. Cf. Polanyi’s distinc-
tion between mechanically following rules about which you know nothing, and
rules about which you know.

POLANYI: tries to identify rules of the logical system with the rules which deter-
mine our own behaviour, and these are quite different things. [Turing et al. (1949)]

Here lies the motivation for Turing’s (1950) formulation and rebuttal of the “argument from
informality of behaviour” (p. 452). Now, writing nine years after the October 1949 seminar
in Manchester, Polanyi gave this even more valuable piece of historical information:
A. M. Turing has shown [Polanyi’s note: in a communication to a Symposium held on “Mind and Machine” at Manchester University in October, 1949. This is foreshadowed in ‘Systems of Logic based on Ordinals’, Proc. London Math.
Soc., Series 2, 45, 1938-9, pp. 161-228.] that it is possible to devise a machine which will both construct and assert as new axioms an indefinite sequence of Gödelian sentences. Any heuristic process of a routine character — for which in the deductive sciences the Gödelian process is an example — could likewise be carried out automatically. A routine game of chess can be played automatically by a machine, and indeed, all arts can be performed automatically to the extent to which the rules of the art can be specified. [Polanyi, 1958, p. 261].

I take two key historical facts related by Polanyi here. The first is that, beyond what Turing discussed in “the mathematical objection” with a more general audience in mind (1950, p. 444), in the October seminar he had presented a more technical response to it was based on his (1936) and (1938) papers as we have seen him saying in the quotation above, “the universal machine, capable of turning itself into any other machine.” The second and most important fact for my purpose here is that, as of late October 1949 Turing, was still referring to the game of chess as intellectual task to illustrate and test machine intelligence. Nevertheless, we see that Polanyi had classed chess as an art that “can be performed automatically” because its rules “can be specified.” So Turing had just seen his well-established reference to machine chess-playing to sound unimpressive to philosophers.

We can now revisit the question: why did Turing make the move of replacing chess-playing by conversational question-answering as intellectual task to illustrate, develop and test machine intelligence? Because he noticed that chess-playing would not suit to his goal, namely — recall from Gandy’s anecdote (§1) —, to persuade “philosophers and mathematicians and scientists to take seriously the fact that computers were not merely calculating engines but were capable of behaviour which must be accounted as intelligent.”

In fact, in his (1948) Intelligent machinery report Turing had discussed a tradeoff between most convenient and most impressive intellectual fields:

Of the above possible fields [including “various games e.g. chess”] the learning of languages would be the most impressive, since it is the most human of these activities. This field seems however to depend rather too much on sense organs and locomotion to be feasible. (Turing, 1948, p. 421)

And indeed Turing presented at the end of his 1948 report an imitation test for machine intelligence based on the game of chess. He thus had kept his choice for chess-playing, which dated from as early as his wartime service in 1941 (cf. Copeland & Prinz, 2017, p. 329) and went through late (1945) when Turing asked in his problem 10 “Can the machine play chess?” (p. 389) and his February lecture (1947, p. 393) and his 1948 report until the Manchester seminar in October 1949 as related by Polanyi. Now, while in his 1950 paper Turing proposed, as known, conversational question-answering as intellectual task (within the field of the learning of languages), he reconsidered it at the end:
We may hope that machines will eventually compete with men in all purely intellectual fields. But which are the best ones to start with? Even this is a difficult decision. Many people think that a very abstract activity, like the playing of chess, would be best. It can also be maintained that it is best to provide the machine with the best sense organs that money can buy, and then teach it to understand and speak English. This process could follow the normal teaching of a child. Things would be pointed out and named, etc. Again I do not know what the right answer is, but I think both approaches should be tried. (Turing, 1950, p. 460)

In further discussions with essentially the same interlocutors, Turing reassured his proposal of various forms of *viva-voce* examination to test machine intelligence (1951a, p. 484; 1952, p. 495), and in the turn from late 1952 to early (1953, p. 569) he reconsidered chess again. Clearly, chess was more convenient to experiment with at the early 1950’s, while conversational question-answering was still an imaginary experiment yet preferable for persuasion. But Turing never determined one single and special form of (species) test to be a decisive experiment for human-level machine intelligence. He rather acknowledged the existence of “my” [his] several “imitation tests” (1952, p. 503). In short, I suggest, Turing felt compelled to shift to linguistic performance for illustrating, developing and testing machine intelligence, if for nothing else, after Polanyi’s criticism that chess was an art that “can be performed automatically” because its rules “can be specified.”

So far we have seen that in his 1950 paper Turing responded to criticisms from Hartree (November 1946 and June 1949), and from Polanyi (October 1949). And yet it was Jefferson who became Turing’s primary antagonist, as we shall now see.

4.3. Turing provoked by Geoffrey Jefferson

Geoffrey Jefferson (1886–1961), then Professor of Neurosurgery at the University of Manchester and Fellow of the Royal Society since 1947 [Walshe (1961), had given on 9 June 1949 in London his Lister Oration when he issued criteria and demands to “agree that machine equals brain” published later in the *British Medical Journal* (1949, p. 1110). Jefferson had entitled his talk “The mind of mechanical man” in response to Norbert Wiener’s (1948) *Cybernetics* and to the several digital-computer projects in the UK and the US, notably the one Turing was engaged in hosted at his University of Manchester. A reporter from *The London Times* covered Jefferson’s talk and emphasized one of his strong observations, which was thus quoted the next day (10 June 1949) “No mind for mechanical man” (1949b):

[N]ot until a machine can write a sonnet or a concerto because of thoughts and emotions felt, and not by the chance fall of symbols, could we agree that machine equals brain — that is, not only write it but know that it had written it. No mechanism could feel (and not merely artificially signal, an easy contrivance) pleasure at its successes, grief when its valves fuse, be warmed by flattery, be made miserable by its mistakes, be charmed by sex, be angry or miserable when it cannot get what it wants. (Jefferson, 1949, p. 1110)
These words of Jefferson’s would be quoted in full by Turing in his discussion of “argument from consciousness” (1950, p. 445). The reporter from The Times looked for Turing’s lab at the University of Manchester to get a reply to Jefferson’s claims. Once asked, Turing replied sharply in wit and with his usual touch of humor. On the next day (11 June 1949), Turing was thus cited in the newspaper under headline “Calculus to Sonnet”:

Mr. Turing said yesterday: “This is only a foretaste of what is to come, and only the shadow of what is going to be. We have to have some experience with the machine before we really know its capabilities. It may take years before we settle down to the new possibilities, but I do not see why it should not enter any one of the fields normally covered by the human intellect, and eventually compete on equal terms”. “I do not think you can even draw the line about sonnets, though the comparison is perhaps a little bit unfair because a sonnet written by a machine will be better appreciated by another machine”. Mr. Turing added that the University was really interested in the investigation of the possibilities of machines for their own sake. Their research would be directed to finding the degree of intellectual activity of which a machine was capable, and to what extent it could think for itself. News of the experiments was disclosed by Professor Jefferson in the Lister Oration reported in The Times yesterday. (Times, 1949a)

From this day on a mind-machine controversy was established in England. Two weeks later when Jefferson’s Lister Oration was published by the BMJ (25 June), Turing did not escape a warning note from the editorial that opened the edition:

Mr. A. W. Turing [sic], who is one of the mathematicians in charge of the Manchester “mechanical brain,” said in an interview with The Times (June 11) that he did not exclude the possibility that a machine might produce a sonnet, though it might require another machine to appreciate it. Probably he did not mean this to be taken too seriously [...]. (BMJ, 1949)

Turing would push back. It turns out that a sonnet-writing machine is just what presented in his 1950 paper. This is evidence that not only Polanyi’s negative point about chess but also Jefferson’s positive demand about sonnets influenced Turing to drop chess for conversation. Turing quoted Jefferson’s demands and addressed Jefferson directly:

I am sure that Professor Jefferson does not wish to adopt the extreme [...] point of view. Probably he would be quite willing to accept the imitation game as a test. The game (with the player B omitted) is frequently used in practice under the name of viva voce to discover whether some one really understands something or has ‘learnt it parrot fashion’. (Turing, 1950, p. 446)

Jefferson’s (1949) Lister Oration, in fact, had posed a bold critique of the Turing-Wiener analogy between the new electronic computing machines and the human brain. He spoke
out against the idea that machines could think and even tied it to “political” and “religious” issues. He urged that “the concept of thinking like machines lends itself to certain political dogmas inimical to man’s happiness [and] erodes religious beliefs that have been mainstays of social conduct” (p. 1107). The influence of Jefferson’s text on Turing’s 1950 paper is material and enormous, as described next.

Very recent evidence suggests that another edition of the seminar took place in December 1949. Jonathan Swinton located a Christmas Eve postcard sent to cybernetician Warren McCulloch then in Chicago by a Jules Bogue, an industrialist in the chemical sector and neighbor of Max Newman that found his way into the meeting:

I wish you [McCulloch] had been with us a few days ago we had an amusing evening discussion with Thuring [sic], Wiliams [sic], Max Newman, Polanyi, Jefferson, JZ Young & myself. An electronic analyser and a digital computer (universal type) might have sorted the arguments out a bit. Bogue (1949)

Some chaos was noted in the arguments during the discussion in December 1949, which may explain Turing’s will to propose the imitation game “as a basis for discussion.” (Recall that Turing was acquainted with Russell’s History and probably came across Russell’s suggestion of the socratic dialectic method for cleaning up logical errors, cf. §3.3).

Now, I have observed that this finding of Swinton’s correlates with what Jefferson related in a letter after Turing’s death. Jefferson described an event when Turing would have come to his house to talk to Professor J.Z. Young and him over dinner after a meeting in the Philosophy Department. The key information that Jefferson gave was that after midnight Turing went off to ride home on his bicycle “through the same winter’s rain” (Irvine, 1959, p. xx). So that meeting cannot have been the seminar held on 27 October 1949 (in the fall), and must have taken place in late December (in the winter) near Christmas eve. In effect, given that the minute notes of the October (1949) edition do not show any exchange between Jefferson and Turing, it must have been in this December meeting (extended into late night at Jefferson’s house) that they had their most lively exchanges, and must have been when Jefferson drew Turing’s attention to his Lister Oration.

We know that Turing possessed and annotated an offprint of Jefferson’s Lister Oration at the time he was writing his own in January 1950. It has been delivered to the King’s College Archive at the University of Cambridge after Turing’s death, and the Archive’s catalog entry (AMT/B/44) describes it as having “annotations by AMT (Alan Turing).” Darren Abramson drew attention to that in (2011). He located two heavy markings in the offprint, which gives material evidence that Turing read and annotated Jefferson’s text. Turing marked in pencil two passages: Jefferson’s demands that appeared in The Times as we have seen above, and Jefferson’s exposition (p. 1106) of René Descartes’s (1637) Discourse on method, Part V. The latter presented the sensible image proposed by Descartes, as known, of a viva-voce examination to distinguish human beings from machines and other animals however good their imitation of human behavior could look at a first glance. Towards the end of his (1949) text Jefferson returned to Descartes to suggest speech as the most distinctive intellectual faculty of “man” as opposed to “the highest animal” (p. 1109),
and further required that thinking machines should be able to write a sonnet “because of thoughts and emotions felt” (p. 1110). So by imagining a machine being questioned about a sonnet composed by itself in his (1950) imitation game or test (p. 446), Turing addressed Jefferson’s demands — say, writing a sonnet and passing a *viva-voce* test about it — both at once. And there is another move of Jefferson’s that to my knowledge has never been observed in the secondary literature and yet is crucial for the intelligibility of Turing’s test.

It turns out that Jefferson offered a second image to Turing, and this one was no less striking. Jefferson referred to “sex hormones” as a distinctive feature of the behavior of “animals” and “men,” as opposed to “modern automata” (1949, p. 1107). In this connection, he referred to the iconic electromechanical tortoises of Grey Walter:

> [...] it should be possible to construct a simple animal such as a tortoise (as Grey Walter ingeniously proposed) that would show by its movements that it disliked bright lights, cold, and damp, and be apparently frightened by loud noises, moving towards or away from such stimuli as its receptors were capable of responding to. In a favourable situation the behaviour of such a toy could appear to be very lifelike — so much so that a good demonstrator might cause the credulous to exclaim “This is indeed a tortoise.” I imagine, however, that another tortoise would quickly find it a puzzling companion and a disappointing mate. (Jefferson, 1949, p. 1107)

Jefferson remarked that “neither animals nor men can be explained by studying nervous mechanics in isolation, so complicated are they by endocrines, so coloured is thought by emotion.” He then completed: “[s]ex hormones introduce peculiarities of behaviour often as inexplicable as they are impressive” (p. 1107). In short, Jefferson suggested that machines could not exhibit enough peculiarities of behavior to be able to imitate the actions of animals or “men” because they have no sex hormones. A machine would give itself away and be found to be “a puzzling companion and a disappointing mate.” So, one may say, Jefferson committed to an *a priori* assumption that the physiology of sex hormones is causally related with gendered behavior.

In Jefferson’s passage quoted by *The Times* in June 1949, it is notable his demand that for machines to think they should be able to have emotional reactions in general, and be capable of being “charmed by sex” in particular. In (1950), Turing addressed this in his discussion of objection (5) “Arguments from various disabilities” (p. 447). Among other non-obvious things, he considered “fall in love” and “make someone fall in love with it” as capabilities that *do are* within the reach of machines. Jefferson’s tortoise challenge, however, Turing did not respond explicitly. One may note though that for a machine not to be a puzzling companion and a disappointing mate in the sense of Jefferson, it must be able to learn and imitate gender. That is, Turing addressed the tortoise challenge in the very design of the imitation game. He modified the *viva-voce* examination proposed by Descartes in (1637) in a few key aspects, one of which was the inclusion of an additional gendered player B sitting side by side with player A to serve as a baseline model of gender performance in the unrestricted conversation conducted by the examiner. If player A can
imitate well the required gender, then it will showcase not only human intelligence in general but also the “peculiarities of behaviour” that according to Jefferson would be rendered by specific (male and female) “sex hormones.”

5. Summary

Turing’s 1950 proposal of a test for machine intelligence is still fairly controversial. His seminal paper is often said to be accessible for a general readership and yet to be complex, multi-layered and too ambiguous for scientific and philosophical interpretation if not even contradictory. In this paper I have provided original answers to key exegetical and historical questions that have been largely unaddressed so far.

I proposed to read Turing’s 1950 text in three logical steps and found that his reference to his question “can machines think?” as “too meaningless to deserve discussion,” rather than an affiliation to behaviorism, was an acknowledgement of the cultural background back then. The standard intellectual attitude towards a combination of words “machines” and “think” — as recorded then in the Oxford English Dictionary’s entry for “machine” — was to take it as meaningless or absurd. Indeed, the logical structure of Turing’s 1950 paper is tailored for his discussion of that question (§§6, 7 which took nearly 70% of the text) by means of his proposal of an imitation game or test for machine intelligence. I have also explained what kind of discussion was that, namely, a socratic dialectic discussion that respected the empiricist boundaries indicated by Russell in his (1945) History to have been exemplified by Galileo.

Indeed, Turing spent several years – from c. 1941 to late 1949 — working with chess-playing as a task to illustrate, develop and test machine intelligence. At least since his indirect controversy with Hartree in interpreting the cognitive capabilities of the ACE in late 1946 Turing was already thinking of making a machine to play chess by learning from experience. This would establish a concept of machine intelligence that should be enough to refute the Lovelace-Hartree thesis. But in October 1949 his argument based on chess received criticism from Polanyi, who was unimpressed and posed that chess was an art that “can be performed automatically,” for its rules “can be specified.” Not less importantly, late that year Jefferson drew Turing’s attention to his Lister Oration. In Jefferson’s text, Descartes’s proposal of a *viva-voce* examination to distinguish humans from machines and other animals was appreciated, and speech in general was pointed out as the highest form of human intelligence — so much so that the climax of the text was to require that thinking machines should be able to write a sonnet “because of thoughts and emotions felt.” Also in his Lister Oration, Jefferson had pointed to Grey Walter’s iconic electromechanical tortoises and suggested that machines could not exhibit enough peculiarities of behavior to be able to imitate the actions of animals or “men” because they have no sex hormones. A machine would give itself away and be found to be “a puzzling companion and a disappointing mate.” In doing so, Jefferson committed to an *a priori* assumption that the physiology of sex hormones is causally related with gendered behavior, which Turing challenged through an irreverent adaptation of Descartes’ test.

Altogether, I have explained Robin Gandy’s anecdote on the purpose of the Turing
test, and singled out Turing’s most notable interlocutors — the “philosophers and mathematicians and scientists” that Turing “sought to persuade” about the cognitive capabilities of digital computers. Turing’s direct and indirect discussion with these three thinkers — Hartree, Polanyi and Jefferson —, I claim, is key for any exegesis of Turing’s 1950 paper and to an understanding of the conceptual problems he tried to solve in his 1950 test and/or in his various “imitation tests” (1948-1952). My hope is that this shall improve the intelligibility of “the Turing test” and contribute to ground it in its history.

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