Toward Antiformalist Computer Science

Steve Meyer - Pragmatic C Software Corp State Street, Suite 700, Boston, MA USA Email: sjmeyer@pragmatic-c.com Web Site: www.pragmatic-c.com

Attached are the foils from my ECAP-2005 philosophy of computer science conference talk. The conference was held in Vasteras Sweden, June 2-4, 2005. An extended abstract and a detailed list of references is attached after the foils. Please email any comments or criticism since I am working on the full paper.

The AHQP quotations are included with permission from the Niels Bohr archive.

A copy of these slides is available at:

www.pragmatic-c.com/docs/anti-form-cs.foils.pdf

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What is Antiformalist CS?

Lighthill's View:

[Computer theories] may have quite as much value as in physics and chemistry for stimulating understanding and suggesting new kinds of experiment - provided only that the theoretical work takes proper account of available observational data.

(Ref: "Lighthill Report", British Science Research Council, 1972, p. 5.) Polyani's Definition:

For the impossibility of formalizing mathematical heuristics is, of course, but one instance of the same impossibility which extends to every kind of knowledge, whether empirical, mechanical or mathematical, and to all stages of knowledge from its dawn in discovery, to it petrification in textbooks.

(Ref. Lakatos Archive 13/731 - item 3 - letter from Polyani Aug. 14, 1961)

Felix Bloch's View:

And I chose Utrect--I think that was partly also Pauli's influence, maybe also partly Heisenberg's. Both were somewhat critical of Goettingen spirit; that is, Born's school and approach were considered highly formal and mathematical.

Ref: Bloch AHQP interview transcript p. 29 - describing 1930 decision.

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- 12. Discussion of various formalist CS examples and anomalies.

Overview

- This talk attempts to explain and extend the argument given in the paper's published extended abstract. References on these foils are given only informally. These foils along with a list of references will be available on my web site.
- Goal is to establish that formalist CS is a degenerating research programme and needs to be replaced by CS as experimental natural philosophy -- the antiformalist CS research programme.
- Following the science as natural philosophy idea, the terms CS and the philosophy of CS are not distinguished in this paper. The word philosophy instead of CS is sometimes used when discussing methodology. The correct term in a given situation is a testable question.

Science as Natural Philosophy

- The most successful scientists since Isaac Newton have studied philosophy and history as part of their scientific studies.
- Theories were explicitly evaluated in philosophical and historical terms starting with Albert Einstein and Max Planck.
- The research programmes of Faraday (ref. Agassi's Faraday biography) and Darwin probably used explicit (intentional and conscious) study of history and philosophy earlier.
- Scientists formulate theories as competing research programmes.
- The use of competing research programmes culminated in the early 20th century scientific revolutions in physics in which long established proven truth was overthrown by relativity and quantum mechanics.

Lakatos-Feyerabend-Kuhn (LFK) Methodology of Scientific Research Programmes.

- LFK theory of research programmes codifies the methods of modern science. It is both descriptive and prescriptive and can itself be tested.
- Science may be rational or not rational, but it is still possible to study scientific research programmes. Is a programme degenerating? What is a programmes' core tenets? What is its protective belt? Has a paradigm shift occurred? Can it predict new knowledge? Is quasi-empirical heuristic mathematics involved?
- Best Introductory reference: *Falsification and the Methodology of Scientific Research Programmes*, eds. Lakatos, I. and Musgrave, A.
- The LFK programme continues science as natural philosophy connection to history. Here is Lakatos' paraphrasing of Kant (Lakatos, *Phil. Papers, Vol. I*, p. 102):

'Philosophy of science without history of science is empty; history of science without philosophy of science is blind.'

THE CENTER FOR AUSTRIAN STUDIES PRESENTS

THE VIENNA CIRCLE'S SUCCESSORS IN MINNESOTA AND AMERICA THE LAKATOS-FEYERABEND-KUHN PROGRAM



STEVEN MEYER PRAGMATIC C SOFTWARE CORP.

THURSDAY, JANUARY 27, 3:30 P.M. Ford Room, 710 Social Sciences Building (WB)

College of Liberal Arts

UNIVERSITY OF MINNESOTA

Lakatos Criticism of Feyerabend:

[...] On studying your Against Method I am increasingly worried. To my mind you have a basic weakness in your position which is at least as bad as mine. If you were consistent you would have the courage to be a sceptic. For the first time to my knowledge, you now say that epistemological anarchism cannot be equated with scepticism. If so, I shall prove that epistemological anarchism is double faced. One face is the face of a sceptic, the other is the face of a Kuhnian authoritarian. I am terribly sorry about this, but you either return to complete scepticism or I shall show that you are inconsistent. All that I can promise is that I shall do it with a light touch so that you will be killed and most people will believe that you are being praised ... The word paradigm has entered popular culture and no longer has any meaning (For and Against Method, p. 323).

Feyerabend Criticism of Lakatos:

So--forget about rationality and find out what it was that made everyone accept Einstein's research programme and abandon Lorentz's. 'Everyone,' this means a few big shots in England, Germany, France, for the rest are content with the Lorentz transformations and E equals mc² tacked onto it; that is, they are content with some purely formal tricks and would not even know the difference between Einstein and Lorentz. That Lorentz turns out to be not ad hoc at all, but progressive, pleases me very much and cheers me up on an otherwise rainy day (*For and Against Method*, p. 317).

Question: What are the Properties of Formalist CS Research Programmes?

- Formalist CS Artifi cial Intelligence (AI) Variant
 - Core: computers embody intelligence and will soon surpass human intellectual capacity.
 - Protective belt: engineering success in building intelligent machines (new engineering methods replace failed ones).
 - Positive heuristic: time within x years robots will be unimaginably intelligent, or the combinatorial explosion of brute force search can be overcome by better algorithms, or maybe there is a short step from a babies' block world to AI.

Formalist CS - Hilbert Knowledge (Truth) as Logic Variant

- Core: truth and mathematical proofs are identical.
- Protective belt: computer's revolutionary ability to evaluate logic formulas (new and usually more complex types of logic replace failed ones).
- Positive heuristic: intellectual integrity requires formal proofs.

Question: What are the Properties of Antiformalist CS Research Programmes?

- Antiformalist CS as Natural Philosophy (Lighthill's Definition?)
 - Core: observe and test within competing research programmes, phenomenological interpretations of experiments is good, treat CS style discrete mathematics as a quasiempirical experimental science, avoid probability, and do not confuse large numbers with the phenomenological concept of infi nity.
 - Protective belt: experiments (replace research programs that are degenerating using quasi-empirical experimentation).
 - Positive Heuristic: apply LFK research programme theory to eliminate degenerating programmes, be sceptical, use experiments to evaluate algorithms, do not assume any formal input data distribution, criticize formalism, and rely on the cunning of human reason.

Background Problem - is Formalist CS Pseudo Science?

- Analyzing CS as science is difficult due to various problems involving bad faith and continual change to avoid disproof. This paper treats it as a science but the background problems make scientific argument difficult.
- Many CS formalist do not believe in science and refuse to specify theories in a concrete way. There is continual drift in theoretic claims to prevent disproof.
- Computer science is now studied by departments isolated from the checks and balances of scientific review. CS has degenerated into engineering and information technology (IT) so anti-intellectual that it is only suited to running a business. Papers are often rejected on the grounds that they are not consistent with the current largest market share holding company's theory.

• Formalist CS has not been funded using open grant competition. Here is how Lighthill describes the problem in his report (p. 19):

[^] Research on AI in some other countries may be funded by military agencies (DARPA in the USA) or by other mission-oriented public bodies. With this type of funding it is common for scientists to 'close their ranks' and avoid public disagreement among themselves, in the hope that the total funds available for science may thus be enhanced to an extend that may outweigh any harmful results of a distribution of those funds determined on the basis of insufficient scientific discussion.'

• Formalist CS is politicized (at least in the US). Here is how physicist Werner Heisenberg described the problem (*Physics and Philosophy*, p. 167).

' [...] the scientific problems have finally become connected with political issues, and some scientists have taken recourse to political methods to carry their views through.' There has been some bad faith behavior. For example, when one searches for "lighthill.ps" on the web, the only Google match is John McCarthy's response named lighthill.ps. When one searches for "lighthill report", the only matches are discussions from advocates of AI. For some reason when "lighthill.ps" is entered from the US using the British google URL address, the Lighthill Report match is found, but when entered from the English URL is entered from England or Scandinavia, the only the McCarthy match is returned.

Formalist CS has avoided disproof by trivializing and redefining language

- Lighthill's report is especially interesting because AI's meaning shifts are avoided.
- Changed the concept of paradigm defined by Kuhn to identify research programmes to mean the 'latest fad'.
- The Kuhnian concept's of paradigm shift and scientific revolution have been unconsciously shifted to disconnect formalist CS from history and from any possibility of testing or disproof.
- Redefi ned 'learning' to mean 'Bayesian inference'. (See criticism of probability below).
- Changes Polya's concept of Heuristic as quasiempirical mathematics to 'programs that do not always work'.
- Language use is similar to Azandi magic. By giving something a name, the object takes on the properties of the name - examples: 'intelligent agent' - instead of naming a program for what it computes, 'neural network algorithm' - hope program will behave like the human brain, 'learning program' - phrase without content.

If formalist CS is pseudo-science, analysis along the lines of Cioffi 's criticism of Freudianism might be required:

It is characteristic of a pseudo-science that the hypotheses which compromise it stand in an asymmetrical relation to the expectations they generate, being permitted to guide them and be vindicated by their fulfi llment but not to be discredited by their disappointment. One way in which it achieves this is by contriving to have these hypotheses understood in a narrow and determinate sense before the event but a broader and hazier one after it on those occasions on which they are not borne out. Such hypotheses thus lead a double life--a subdued and restrained form in the vicinity of counter-observations and another less inhibited and more exuberant one when remote from them. ... If we want to determine whether the role played by these assertions is a genuinely empirical one it is necessary to discover what their proponents are prepared to call disconfi rmatory evidence, not what we do.

Ref. Cioffi , F. in *Explanation in the Behavioral Sciences.* **1974, p. 474.**

Some Definitions:

Hilbert's Programme:

Mathematical research program aimed at formalizing all knowledge using mathematical logic. Criticised by Goedel, Wittgenstein, Tarksi, etc. resulting in programme's degeneration.

Phenomenology:

Method of physics in which interpretation of facts depends on a scientific theory. Pickering's modern example: Bubble chamber tracks are meaningless until 'constructed' by the quark theory of particle physics.

Logical Positivism:

The name adopted by the Vienna Circle (including Rudolf Carnap and Alfred Ayer) for their philosophical position, most famous for introducing the verifi cation principle as a criterion for meaning of synthetic propositions, and for dismissing metaphysics as meaningless. It Attempted to save Hilbert's programme but was eliminated by Nazism before it could make progress. Intended to save a much weakened form of Hilbert's programme.

Internal Versus External Criticism:

Internal criticism criticizes the core and protective belt of of research programmes using either results or theoretical arguments. External criticism criticizes using extra scientific reasons such as psychological reasons.

Lighthill Report Shows 50 years of Formalist CS Programme Degeneration

Lighthill Report was written by then Newton (Lucasian) professor of applied mathematics at Cambridge university. Although written in 1972, Lighthill had astounding ability to see into the future. It is available on the web: (www.inf.ed.ac.uk/teaching/courses/irm/lighthill.ps.gz)

Lighthill Report Overview:

- It used arguments from natural philosophy to convince the British Science Research Council not to fund AI research. After 50 years of more degeneration, antiformalist CS is needed.
- Defi nes the AI part of formalist CS as 'a rather broad fi eld with mathematical, engineering and biological aspects' (p. 1).
- Lighthill's uses the language of natural philosophy: 'new theoretical concepts' (p. 6), 'hard facts of neurobiological observation' (p. 6), 'warrant completely separate treatment in respect to research support' (p. 7), 'traditional academic department organization' (p. 9), and 'problem domains' (p. 10).
- Lighthill's term **'Conventional programming methods'** (p. 9) is a better expression for the non AI part of antiformalist CS that replaces object oriented programming.

Lighthill divides AI into 3 research programme categories (p. 2):

- Category A (pp. 3-4, 9) advanced automation
- Category C (pp. 5-7) computer study of the central nervous system (the term brain research is avoided). This paper does not consider C since it falls into the Neurobiology not CS area.
- Category B bridge category (pp. 5-7) also called B for building robots

Importance of Category B:

- Category B is probably the most interesting since formalist AI is still making grandiose claims.
- The actual robot building area is discussed along with category C progress is improvements in combined analog and digital advanced automation.
- Lighthill's predictions of the promise of using computers as glorifi ed calculators (in the sense of Macsyma or Matlab) for brute force search have come true.
- Lighthill's conclusion is still true (p. 7):

There are much greater diffi culties in any attempt at clear identifi cation of good reasons for putting resources into those researches.

AI's Major Claimed Successes:

- Chess playing programs have beaten the world champion.
 - It is true but the circumstances provide strong motivation for the world's best chess players to lose because it is hard to make money in chess and the excitement of rematches leads to large purses and rematches for the loser.
 - It is too early to tell if future human chess champions will learn to adapt to computer chess programs.
 - Also, chess is a fi nite solved game (the move tree for all chess games is fi nite albeit exponentially large in the number of chess pieces). Brute force computer searching is suited for rapid searching just as mechanical cranes are perfectly suited for lifting.
 - It is not impossible to imagine solving chess within the antiformalist research programme where a mathematician uses the computer tool as a fancy calculating machine to prove say black can always draw.

- New mathematical discoveries made by programs.
 - It has been claimed that mathematical robots have 'discovered' new mathematical theorems that the best 20th century mathematicians (Robinson and Tarski?) were unable to solve.
 - This actually proves formalist CS degeneration because human computer program users unconsciously used the specialized symbolic calculator to help with brute force search of formulas from logic.
 - The mathematical calculator programs specialized in one area - MAGMA combinational group theory program is another example.
 - The best evidence for AI programme degeneration is some recent solutions (claimed solutions?) of some of Hilbert's famous ten problems by unknown Midwestern mathematicians who probably wrote assembly language programs to search for solutions.
 - Computers are tools for antiformalist CS rivaling spectrometers in atomic physics.

Lighthill's antiformalist view of advanced automation is more true now:

- Recognition of printed characters (p. 3).
- Recognition of hand written language (p. 3).
- Speech recognition (p. 3).

Area unusual in that it is now worse than 1972 in the sense that third world outsourced employees are replacing advanced automation AI.

- Manufacturing automation (p. 3) triumph of sold state physics.
- Cryptography (pp. 3,10) philosophy of antiformalist CS versus the complexity of combinational explosion.
- Mathematics (pp. 4, 10-11) better symbolic calculators.

- Mathematics (pp. 4, 10-11) better symbolic calculators
- Information retrieval (p. 4) failure of formalist 'one size fi ts all' well structure knowledge bases (fi le structure not 'of crucial importance').
- Economic planning and decision making (p. 4) Actually the 1998 failure of Long Term capital Management (LTCM) may be unexplained anomaly in entire formalist research programme (exposed uncomprehended structural flaw in mathematical theory of option pricing).
- Artifi cial thinking (p. 4) is human thinking obsolete?
- Machine Translation (pp. 5-7)

Web browser dictionary look up (the simpler the better) good into one's native language but useless out of one's native language.

Case Studies:

• Three competing computational complexity research programmes

P=NP?, Kolmogorov-Chaitin program size complexity, Krohn-Rhodes semigroup complexity (should memory cost be included?). The Formalist Turing recursive function model may be wrong. Abandoning formalist CS justified just to allow studying this problem.

• Formalist CS trivialization of Polya's mathematical heuristics.

Modern book: *How to solve it: Modern Heuristics* by M. Zbigniew and B. Fogel does not even discuss Polya's complex quasi-empiricist mathematical research programme or reference his "Plausible Reasoning" studies. Also, Shockley's introductory heuristic text book ignored.

• Probability theory is wrong.

Misunderstanding of very large but fi nite versus infi nite. P(anything) = 0. Informal statistics makes sense for studying approximate data.

• Quantum computing and quantum cryptography claims are nonsense (Star Trek's 'beam me up Scotty' applies) (see QC foils below).

• Objection that computer languages are in some sense formal.

One objection to my antiformalist argument is that CS must be formalist because computer language are formal (as opposed to natural languages). The answer is that programming language are just notations for people to describe their intentions. If the objection were correct, messages in morse code would be 'formal' because the language is binary.

• Problem with formalist simple algorithm complexity.

Algorithm efficiency proof analysis is the only allowed formalist method for discovering algorithms (Ref. Lakatos, I. *Proofs and Refutations*). Too often assumed input data distribution is chosen to simplify the combinatorics.

• Structured and objected oriented programming are pyschological Preferences.

Formalist anomalies with Dutch National Flag problem (Ref. S. Meyer, "Structured versus Pragmatic Computer Programming" on my web page). Also Linux OS couldn't exist if formalist CS were correct since it could never have been developed by one undergraduate in C. Antiformalist CS would allow designing opposite of C++ style languages for people who dislike operator overloading and prefer gotos.

- Genetic algorithms always worse than operations research algorithms (using natural philosophy experimental analysis).
- Simulated annealing failed attempt to supersede physics as natural philosophy research programme.
- Noyes' discrete mathematics describes the universe natural philosophy theory eliminates the formalist CS research programme.

Ref: Noyes, H. P. (van der Berg, J. ed.) *Bit-String Physics - A Finite and Discrete Approach to Natural Philosophy*, 2001.

- DNA computers imputing computing same as a child's bubble blower computes 'minimum energy surface'.
- Digital electronic synthesis circuit designers should be allowed to vote on antiformalist tools and methods (computers could be even more valuable combinatorial calculators).

Quantum Cryptography/Computing as Pseudo Science:

- There are constant published claims announcing cryptographic and computing devices using quantum physics.
- Popular science journals are fi lled with science fi ction like predictions such as 'quantum computers (QC) will make cryptography obsolete'.
- Theoretical physicists do not believe the claimed QP/QC observations are real or can be explained without using quantum mechanics (such as classical electrodynamics) and in fact are now studying physics as discrete mathematics.
- This is a puzzle that needs explaining.
- It is possible that the various claims for quantum cryptography (QC) and QP are actually just proposals for studying the mathematics of imagined oracles with interesting properties.
- Maybe since theoretical physics is moving toward discrete combinatorial group theory, it may make sense for cryptographers to study group theoretic crypto systems (i.e. not connected to topology).
- Why not imagine an oracle that solves problems in NP in constant time and study it.

Contrast Schiff's QM Textbook versus Quantum Computer Building

- Schiff's 1949 graduate quantum mechanics (QM) textbook created modern physics. CS blind faith and announcements of success building a quantum computer realizing mathematical properties of Von Neumann's Hilbert space formalization of QM is disproven by Schiff experimental science.
- Von Neumann is only mentioned in two footnotes (pp. 122, 126) as inventing one possible formalization of QM - quantum matrix mechanics. Schiff references a purely mathematical theorem in matrix theory - not related to physical theory.
- On page 1, Schiff writes:

[^] The need for quantitative comparison with observation, which is the ultimate test of any physical theory, in this case led to the formalism and only later to its interpretation in physical terms.[^]

• QM's range of applicability is limited to approximating the behavior of the atom (p. 267).

• Also on page 1:

' We shall try to make the theoretical development seem plausible rather than unique. The justification for the theory, then, will rest on the agreement between deductions made from it and experiments, and on the simplicity (in principle more than practice) and consistency of the formalism.'

- Schiff does not assume any formalism but uses mathematics to produce predictions to compare with measurements. Statistics is used because measurements are approximate and equations are only approximately solvable (p. 271 fi rst edition). Probability is never mentioned.
- QM would still be true if particular formal mathematical theories were disproven.
- There is not one mathematical description but many. Schiff's description of the extension to relativistic wave equations is:

[^] This extension can be made in many ways, each of which is consistent with the Lorentz transformation equations of the the special theory of relativity' (p. 306, fi rst edition).

The Antiformalist future: CS and the physical and Biological Universes Described by Combinatorial Group Theory?

Felix Bloch's enigmatic comment in his AHQP interview (conducted by Thomas Kuhn) may point toward a discrete future where CS and other sciences that apply mathematics are based on combinatorial group theory (transcript p. 34, paragraph 6 - describing 1929-1931 work):

' I had the impression that group theory is something tremendously import. Later on, I didn't think so much of it any more, but at the time I did.'

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Toward Anti-Formalist Computer Science - Extended Abstract

1. Introduction

Since the founders of modern physics explicitly studied philosophy as part of their scientific research in the first half of the twentieth century, the study of science has required the study of philosophy and history of science.¹ The roots of formalist philosophy of computer science go back to Hilbert's program that attempted to formalize all human knowledge. The program degenerated starting with Russell's paradox discovered in 1901 in London and was abandoned after the success of quantum physics and its phenomenological philosophy of science that occurred primarily in Copenhagen and Berlin during the 1920s.² The Vienna Circle in the early 1930s attempted to save the Hilbert program in a weaker sense but disappeared because of political suppression before progress could be made.³ Most members of the Vienna Circle emigrated to the US and England. The modern successor to the failed Hilbert formalism of knowledge program and the Vienna Circle is the Lakatos-Feyerabend-Kuhn methodology of scientific research programme theory (abbreviated LFK programme).⁴ The theory studies science and scientific method in terms of research programmes and claims that philosophy can not be studied without detailed analysis of research programme's and historical examples. The LFK programme provides a 'quasi-empirical' experimental system for disproving formalist philosophy of computer science.

This paper is relevant to the ECAP-2005 conference because Colton and Pease presented an invited lecture 'Modeling Lakatos's Philosophy of Mathematics' at last years ECAP conference.⁵ Colton and Pease use Lakatos' work to advocate solving the engineering problem of automating reason by using 'a multi-agent approach to automating Lakatos style techniques'⁶ The use of this Lakatos (and Kuhn) work to justify a formalist philosophy of knowledge so mis-interprets the anti-formalist LFK programme that it is equivalent to interpreting Einstein's theory of relativity as proof for the Lorentzian ether theory and then going so far as to claim that application of Lorentz's theory improves Einstein's relativity theory.

- 1. The best justification for this claim is: Heisenberg, H, *Physics and Philosophy*. Prometheus books, 1958. Lakatos' short justification is: 'Philosophy of science without history of science is empty; history of science without philosophy of science is blind' (Lakatos, I. *Philosophical Papers Vol. I*, Cambridge, 1978, p. 102).
- 2. Phenomenology is best defined by Pickering's modern example in which the interpretation of bubble chamber tracks requires a particular theory of high energy particles. Pickering, A. *Constructing Quarks: A Sociological History*. Chicago, 1984.
- 3. Stadler, F. *The Vienna Circle Studies in the Origins, Development, and influence of Logical Empiricism.* Springer, 2001.
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6. Colton, S. and Pease, A. 'Lakatos-style Methods in Automated Reasoning', 18th International Conference on Artificial Intelligence, 2003. Paper available on Simon Pease's home page. Also see 'Lakatos and Machine Creativity' presented in 2002 at the same conference.

^{5.} URL: http://iacap.org/programs/2004-ECAPpavia.htm

2. Applying the LFK Programme to Disprove the Core of Formalist Computer Science

Using LFK research programme analysis,⁷ this paper shows that formalist computer science, which assumes without scepticism the the claims the artificial intelligence (AI), has been degenerating since its inception. AI has been marked by a pattern of continual grandiose predictions that in every case proved to be incorrect. Starting in the 1950s, AI conjectured that intelligence was nothing more than theorem proving using the predicate logic resolution proving method. Then when that turned out to be false, other methods such as dependency networks were proposed. Each new ad hoc claim has failed just as predicted for a degenerating research programme. Recently, the AI programme has started claiming that its value is not its scientific progress but rather the great spin off technology it has created. Another inventive ad hoc AI claim is that although the scientific part of the research programme is degenerating, a machine embodying intelligence will soon be built and therefore the scientific disproof should be ignored.⁸

Application of the LFK programme disproves the following core claims of formalist philosophy of computer science. In fact it can even remedy the current situation in which computer science research has degenerated to such a state that it is nothing more than engineering development of business products.

1. Formalist computer science assumes probability applies to knowledge.

Lakatos shows that any particular scientific theory or for that matter any formalist theory of knowledge always has zero probability in his lectures on scientific method.⁹ This argument not only criticizes and disproves the various formal mathematical core claims of formalist philosophy of computer science, but it also criticizes current computational complexity methods (particularly uses of random oracles) and criticizes formal discovery methods such as object oriented programming. It is also shown that without the assumptions of AI, quantum computational oracle.

2. **Definition of NP completeness as the only model of computational hardness.** Lakatos' thesis,¹⁰ that Lakatos himself claims was motivated by Polya's antiformalist heuristics,¹¹ shows that mathematics is a quasi-empirical enterprise. Therefore scientific research is needed to determine if Turing machine

^{7.} See Lakatos Philosophical papers Vol. 1, p. 110 for a concise explanation of scientific research programmes.

^{8.} Already in 1972, John Lighthill who was Newton Professor of Physics at Cambridge University prepared a report for the British government that warned that AI did not work and identified its degenerating nature (Lighthill, J. 'The Lighthill Report', British government publication, 1973).

^{9.} Lakatos, I and Feyerabend, P. For and Against Method. Chicago, 1999, pp. 50-51.

^{10.} Lakatos, I. Proofs and Refutations. Cambridge, 1976.

^{11.} AI's borrowing and trivialization of the term 'heuristic' is endemic to degenerating research programmes. Also see the letters from Polya to Lakatos in the LSE Lakatos Archive.

diagonalization style NP completeness is better than alternatives such as Krohn-Rhodes style algebraic semigroup complexity.¹² Another possibility is Kolmogorov program size complexity.¹³

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3. **The 'anything goes' negation of object oriented programming works better.** The author's study that analyzed the Dutch national flag problem, that was used by Dijkstra to justify object oriented programming,¹⁴ shows that formalist design methods do not work and that Feyerabend's 'anything goes' methods are superior. In particular, the formalist claim that the only way to know if a program works is to formally prove its mathematical correctness is shown to be incorrect. One type of LFK style negation establishes that computer programs that are debugged and therefore carefully studied using 'unfettered human reason' work better.

3. Conclusion

It is possible the reason for the acceptance of formalist and AI based philosophy of computer science to the exclusion of any other theory is that AI is really a political theory as described by Heisenberg. 'In both cases the scientific problems have finally become connected with political issues, and some scientists have taken recourse to political methods to carry their views through.'¹⁵ Lakatos' English colleague Cioffi succinctly expressed the main difficulty in establishing anti-formalist philosophy of computer science.

It is characteristic of a pseudo-science that the hypotheses which compromise it stand in an asymmetrical relation to the expectations they generate, being permitted to guide them and be vindicated by their fulfi llment but not to be discredited by their disappointment. One way in which it achieves this is by contriving to have these hypotheses understood in a narrow and determinate sense before the event but a broader and hazier one after it on those occasions on which they are not borne out. Such hypotheses thus lead a double life--a subdued and restrained form in the vicinity of counter-observations and another less inhibited and more exuberant one when remote from them. ... If we want to determine whether the role played by these assertions is a genuinely empirical one it is necessary to discover what their proponents are prepared to call disconfirmatory evidence, not what *we* do.¹⁶

^{12.} Arbib, M. (ed.) Algebraic Theory of Machines, Languages, and Semigroups. Academic Press, 1968.

^{13.} Trakhtenbrot, B. 'A survey of Russian approaches to Perebor (brute force search) algorithms', *Annals of the History of Computing*, 6 (1984), 384-400.

^{14.} Meyer. S, 'Pragmatic versus structured computer programming', unpublished, 1978, pp. 5-11. Available at: www.pragmatic-c.com/docs/structprog.pdf.

^{15.} Ibid. Heisenberg, H, Physics and Philosophy. p. 167.

^{16.} Cioffi, F. in Explanation in the Behavioral Sciences. Cambridge, 1974, p. 474.