Popperian Falsification of AI Revisited

(Submitted to 2024 IACAP Feb. 1, 2024)

Abstract:

Paper revisits the argument in my paper "A Popperian Falsification of AI - Lighthill Defended" presented at IACAP 2019. It argues that recent events in AI make Lighthill's arguments even more persuasive. The conclusion of the paper is that development of sophisticated computer application programs is good, but the activity should be called application program development not AI and developed by traditional institutions. A recent video by Leslie Lamport giving in my view incorrect assumptions about computer science used to justify AI method is analyzed. Four problems are discussed: 1) failure to understand that the human brain and computer are fundamentally different artifacts, 2) that programming is coding human knowledge into computer not mathematics, 3) socially detrimental use of large language models that is not really AI but is being used to force university presidents to resign and 4) characterization of computer science as mathematics removes the crucial connection to history needed to develop good applications programs. Recent develops in game playing application programs is discussed. Paper calls for support to develop various competing protein folding application programs.

1. Introduction

I presented a paper at the 2019 IACAP conference "A Popperian Falsification of AI - Lighthill's Argument Defended". A preprint is available on the arXiv archive (Meyer[2019]). Since that Paper was presented, I believe AI and the social and game playing responses to AI have made Lighthill's analysis and conclusions even more persuasive.

The conclusion of this paper is that development of computer applications is positive, but is should be treated and implemented by the traditional organization of scientific disciplines and human activities. This matches Lighthill's conclusion that British Research proposals should continue to be performed by the traditional scientific agencies (Lighthill[1973]). If the term Artificial Intelligence continues to be used it should be just a synonym for application computer program development.

2. Progressive Biology versus Degenerating AI - Paul Nurse's Popper Lecture

An important part of Popperian falsification methodology is that research programmes need to be evaluated in light of their progressiveness and degeneration. 2001 Nobel Physiology or Medicine prize winner Paul Nurse's 2016 Popper memorial lecture (Nurse[2016]) shows why biology is a progressive research programme. At first Nurse's mechanism for cell division was not believed. He used falsification to criticize and improve his own theory and criticize rival theories. Many explanations of cell division were proposed. Nurse explains his Popperian falsification method in his lecture.

In contract, for AI there is one chosen method at any given time (currently ML). Over the years the chosen method has changed among heuristics, expert systems, machine learning and primitive automata. In AI one particular method is claimed to be the method used by human intelligence (the holy grail of making the human brain obsolete). This is a statement very hard to falsify because lack of progress is defended by claiming there will be ultimate success. This

property and lack of alternative theories subject to falsification would cause it to be called pseudo science by Karl Popper.

3. Incorrect Assumptions - Why AI Has Not Been Falsified

See Leslie Lamport's short video interview (Lamport[2022]) in which he expresses what I claim are the incorrect assumptions used to theoretically justify AI. Lamport's assumptions are important because he is a central member of the current computer science establishment. Possibly much of the confusion would be avoided if Peter Naur's term "dataology" were used for studying computation (Naur[2007]). Also, if Lamport's argument that computer science is best studied in industry is accepted, it will be even more difficult to falsify AI theories because debate of computing methodologies requires academia. Computer Science was created mostly by John von Neumann at the academic Princeton Institute for Advanced Study (Aspray[1990]).

1. **The computer and the the human brain are two completely different kinds of artifacts.**
   It is wrongly assumed that neural network computer ML artifact process is the same as brain problem solving. One example of the difference is that computer artifact requires well ordered time, but brain artifact does not. Lamport is incorrect is stating the main property of special relativity is well ordered time. The main property is constant speed of light that is the same in all inertial frames. There are interesting cosmological theories that only require a partial ordering of time (see Einstein protege Hans Reichenbach's books for a discussion of the philosophy of modern physics).

2. **Programming is human knowledge coding into computers rather than mathematical proving.**
   Lamport says "An algorithm without a mathematical proof is a conjecture not a theorem." Following applied mathematician George Polya's more accurate characterization, mathematics is heuristic and empirical requiring experimentation. See my Lakatos Centennial Conference talk that shows development of Polya-Lakatos philosophy of mathematics (Meyer[2022]). An example is Paul Finslers proof that the continuum hypothesis is true versus Dana Scott's proof of independence (Finsler[1969]). Only the human brain artifact can evaluate this.

   In the area of digital electronic design, there are two methods for evaluating 3 state logic. One method is local so for example an if statement conditional that is x causes all logic (called RTL) assignments in the if statement "then" and "else" to also be unknown. Another is global (called X propagation) where each if statement unknown conditional needs to be evaluated as both 0 and 1. The results then are combined. Only the human brain artifact can evaluate and combine the different methods each of which has advantages and disadvantages. Also, modern digital circuits are so complicated only the computer artifact can simulate digital electronics.

3. **Not really AI large language models (LLM) are being used to the detriment of society.**
   Both the university president's of Stanford and Harvard have recently been forced to resign. The conflicts were political but the mechanism that forced the resignations were justified by LLM application programs. I am assuming the program that was used to criticize Tessier-Lavigne's neurophysiology paper images used visual shape 'large language model' type rules. See recent newspaper article in which the accuser of former Harvard President Gay was accused of committing similar so called plagiarism when the LLM pattern analysis program was run (Roe[2024]).

This misuse of an application computer program especially by mislabeling it AI in the sense that programs that generate human language are by their nature somehow 'intelligent' is troubling and almost certainly anticipated by Lighthill's recommendation against funding AI. For Gay's sociological papers, the issues are that there are only so many ways to express academic ideas. Also the refereeing system works because it is historical and realizes that it is unfair to require a reference to cite a paper that expresses a view contrary to the one advocated in the paper.

For Tessier-Lavigne's supposed altered images, all images in neurophysiology are processed in some sense by at least microscope artifacts but also various type of processing and staining. It is important for the growth of science for referees to encourage scientists to publish papers advocating theories. In Tessier-Lavigne's case, his co authors continued to claim their papers and images were good science. At the very least such criticism by application programs need to have the programs validated and a consensus among scientists reached that the computation is valid.

4. **Human Intelligence requires historical study - AI as mathematics is ahistorical**
One major problem with the mathematical assumptions justifying AI is that mathematics is ahistorical. Progress in the growth of knowledge requires the study of history. Lakatos describes the lack of history problem as scientific progress is blind without history. Donald Gillies eloquently argues that historicism is crucial to science in his Popperian podcast interview (Gillies[2023]). Lamport's claim that algorithms (programs are like typing) whether machine artifact or human brain artifact created are ahistorical mathematics is incorrect. Intelligence requires historical context.

4. Game playing AI has become applications for experts and data search

Recent cheating accusations in Chess show human response to computer program game playing. There has been no public matches between humans and computers since Kasparov's 1996 Deep Blue match. Since that match, human chess players have reacted to computer analysis of chess positions by developing chess position analysis application programs designed for use by chess experts. This computer analysis has changed the game of chess. It creates a new type of cheating where during a match, a cheater can receive instructions from a collaborator who runs an analysis program on the position (Schribner[2022]). I think the cheating method actually involved using the collaborator to run a program that searches all opponents games looking for same or similar positions and giving the cheater guesses of what the opponent's likely move will be. The human Chess player is playing against oneself.

It is not surprising that AI advocates would respond to better computer application position analysis with improved chess data base searching. Since once expert chess players have a way to analyze complex positions, Chess programs are back to losing because they run into combinatorial explosion that the human brain artifact does not. Problem is that for chess masters every game they played is coded and stored in data bases. Result is that humans and AI chess program developers can not agree on rules for a match. Humans want no rebooting, no changing algorithm during matches, no world wide web connection and no stored games data bases.

Defeat of one of the best AI GO computer programs by an amateur shows a similar pattern (Waters[2023]). The amateur developed a GO position analysis program to find a flaw in the ML programs that played many games against themselves. Then used the flaw in the search algorithm (found a combinatorial explosion barrier the program ran into) to defeat the program in a match. I claim the response by AI of even more game playing by the ML algorithm will not help.

5. Competition Among Protein Folding Application Programs

Instead of constant press releases on how machine learning AI has solved the protein folding problem, a better approach would be to encourage and finance development of many different and competing protein folding programs. There are already a number of such programs (Wikipedia[2024]). This would allow various types of algorithms to compete using not just the currently in favor ML neural network algorithm but also more traditional chemistry calculation algorithms. This current missing historical aspect is that programs are really just finding arrangement already discovered by Xray crystallography.

6. References

Aspray[1990] Aspray, W. *John Von Neumann and The Origins of Modern Computing.* MIT Press, 1990.

Finsler[1969] Finsler, P. Ueber die Unabhaengigkeit der Continuumshypothese. *Dialectica 23*, 1969, 67-78.

Finsler[1996] Finsler, P. *Finsler set theory: platonism and circularity.* D. Booth and R. Ziegler eds. Birkhauser.

Gillies[2023] Gillies, D. Popperian Podcast. Lea-Henry, J. Host, March 26, 2023, URL Jan. 2024: https://www.youtube.com/watch?v=4pl9TPdxCbc

Kasparov[2017] Kasparov, G. *Deep Thinking: Where Machine Intelligence Ends and Human Creativity Begins.* Public Affairs, 2017.

Lamport[2022] Lamport, L. The Man Who Revolutionized Computer Science with Math. *Quanta Magazine,*, May 17, 2022, URL Jan. 2024: https://www.youtube.com/watch?v=rkZzg7Vowao

Lighthill[1973] Lighthill, J. "Artificial Intelligence: A General Survey" in *Artificial Intelligence: a paper symposium.* UK Science Research Council, 1973. URL March 2023: www.math.snu.ac.kr/~hichoi/infomath/Articles/Lighthill%20Report.pdf

Meyer[2019] Meyer, S. A Popperian Falsification of AI - Lighthill's Argument Defended, *arXiv:1704.08111v3 [cs.AI],*, 2019. URL March 2023: https://arxiv.org/abs/1704.08111

Meyer[2022] Meyer, S. George Polya's Contribution to Lakatos Philosophy of Mathematics. Lakatos Centennial Conference, London School of Economics, Nov. 2022, slides with document images on LSE philosophy YouTube channel, URL Jan. 2024: https://www.youtube.com/watch?v=3roa2Jt-nes For faster access: http://www.tdl.com/~smeyer/docs/polya-contrib-lak-phil-math.pdf

Naur[2007] Naur, P. Computing versus human thinking. Turing Award Lecture, *comm. ACM 50, 1(2007),* 85-94.

Nurse[2016] "Nurse, P. How philosophy drives discovery: A scientists view of Popper. *Sir Karl Popper Memorial Lecture.*, London School of Economics, URL March 2023: https://www.lse.ac.uk/philosophy/events/sir-paul-nurse/

Roe[2024] Roe, M. Business Insider Owner Axel Springer to Review Plragiarism Investigation Into Bill Ackman's Wife. Yahoo Finance News, Jan. 7, 2024, URL Jan. 2024: https://ca.finance.yahoo.com/news/business-insider-owner-axel-springer-232950603.html

Schribner[2022] Schribner, H. Chess grandmaster files $100M defamation lawsuit over cheating allegations. Axios news story Oct. 25, 2022, URL March 2023: https://www.axios.com/2022/10/20/ hans-niemann-lawsuit-magnus-carlsen-chess-cheating-

scandal

Waters[2023] Waters, R. Man beats machine at Go in human victory over AI. ars Technica new story, Feb. 19, 2023 7:51AM, URL March 2023: https://arstechnica.com/information-technology/ 2023/02/man-beats-machine-at-go-in-human-victory-over-ai/

Wikipedia[2024] Wikipedia. List of protein structure prediction software. URL Jan. 2024: https://en.wikipedia.org/wiki/List_of_protein_structure_prediction_software