Conference:

Refresh / First International Conference on the Histories of Media, Art, Science and Technology, Banff New Media Institute, Canada
September 28 – October 1st, 2005

Session:

IV. Image, Science, and 'Representation': From a Cognitive Point of View

Paper:

Computation, Aesthetics, and Representation: A Critical Examination of the "The Thesis of Computational Sufficiency & Explanation" and the Incorporation of "The Argument from {Human} Creativity

Tim Clark

Associate Professor
Faculty of Fine Arts
Concordia University
1455 DeMaissoneuve
Montréal, Québec
Canada
H3G 1M8

Tel: 514-848-4620
E-mail: clarkk@videotron.ca

In the 1996 issue of the Australian Journal *Psyche,* the English physicist and mathematician Roger Penrose published an essay in response to a series of review articles criticizing two of his earlier monographs, *The Emperors's New Mind* and *Shadows of the Mind*. These latter works had attempted to mount what, for Penrose, would have been a decisive blow against one of the most influential, and controversial set of theoretical and philosophical proposals ever to emerge during the 20th century with respect to the nature of mind – the metaphysical thesis that computationalism provides both a necessary, and sufficient explanatory framework to account for mind and consciousness within context of the physics of the world. The American philosopher John Searle, in his own published attack on the work of the AI researcher Roger Schank and company at Yale, *Minds, Brains and Programs*, had formulated the Thesis as "The Strong Theory of Artificial Intelligence." By strong AI Searle referred to the presumption that the computer was more than a mere implement to be used to study mind, but rather, the much stronger, metaphysical claim that it is "*really is a mind, in the sense that given the right programs the computer can be literally be said to understand and have other cognitive states* ".

The rise of the thesis of Strong AI during the 20th century is hardly surprising given a situation where the only exemplar for "intelligence" was human cognitive experience. As such, it was virtually axiomatic that the pioneering groups of mathematicians and engineers working on the development of computational systems equivocated the internal cognitive processes underlying mind with the internal hardware structure and algorithmic processes of computational systems.

A seminal example of this process of equivocation can be found in the opening paragraph of the document, *A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence*, that was submitted in 1955 to the Rockefeller Foundation requesting the required funding to set up the conference. The document announces, "*The study will proceed on the basis of the conjecture that intelligence (which is reserved for humans) can in principal be so precisely described that a machine can be made to simulate it*." [1]

Although the Dartmouth Conference is an important social event in the history of AI ***the*** consequential milestone was the publication, 1936-37 and 1950 of two papers, *On Computable Numbers with an application to the Entscheidungsproblem* and *Computing Machinery and Intelligence*. Written by the English mathematician Alan Mathison Turing, these papers investigated

[1] **McCarthy, J., M.L. Minsky, N. Rochester,** & **C.E. Shannon.** A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence. John McCarthy, Department of Mathematics, Dartmouth College, Hanover, NewHampshire,1.
This "conjecture" is now known as the "physical symbol system hypothesis."

the nature and limitations of computability of effective procedures and, as Turing himself remarked, whether "*machines will eventually compete with men in all purely intellectual fields*". In particular, Turing had, as early as 1936 begun to address what, for many, would later become ***the*** fundamental question. As the Cambridge mathematician Andrew Hodges recently observed, "*everyone agrees that today the basic question is whether human minds are super-mechanical*."

Notwithstanding the monistic character of the "question," it is possible to divide the issues of mechanical/supermechanical it into a sub-set of two questions. In a 2003 paper by the philosopher and computer scientist Selmer Bringsjord and Konstantine Arkoudas titled, *The Modal Argument for Hypercomputating Minds,* they ask, "*one of the things that we don't know is whether the human mind hypercomputes, or merely computes – this despite informal arguments from Godel, Lucas, Penrose and others – for the view that, in light of the incompleteness theorem, the human mind has powers exceeding those of Turing Machines and their equivalents*." In what appears, at first read, to be a different question the computer scientist and bio-computationalist Hava {Eve} Siegelmann pointed out in the introduction to her 1995 paper, "Computation Beyond the Turing Limit," that there have been ". . . *Numerous efforts to build machines that simulate the world or communicate with it*. *The computational power and dynamic behavior of such machines is a central question for mathematicians, computer scientists, and occasionally, physicists*."

I stress on "first read" because these questions are, I would argue, constrained by a conceptual framework of at least five *contentious*, baseline philosophical premises. In the first case, there is the metaphysical doctrine of materialism-physicalism, which argues that at its most fundamental level, any lawful claim concerning empirical features of the world will assert, and only assert, either truth claims about facts pertaining to the physics of the material world or, about facts that are, themselves, dependent on that physics. The second constraint is the "modeling," or formalization thesis which refers to the development of sets of axioms and rules of deduction that interpretatively map features of the physical world. The third constraint is the correspondence, or isomorphic theory of truth. Perhaps the most famous post 2nd WW formulation of correspondence is Alfred Tarski's "The Semantic Conception of Truth."[2] It states that any propositional locution containing the terms "true" or "false" is a 2nd order assertion about a 1st order locution about a given state of affairs. For example, "It is true that it is raining outside right now" if, and only if "It is raining outside right now." [3]The fourth constraint is the Argument from the First Person, or the Primacy of the Epistemic

---

[2] **Tarski, Alfred.** "The semantic conception of truth," in *Philosophy and Phenomenological Research* **4**, 1944, 13-47.

[3] The correspondence theory of truth is, philosophically, a highly contentious position. In arguing that it is a

Subject. The fifth, and perhaps most important constraint, is that "intelligence" is both thoeretically explainable and, reproducible. Notwithstanding the up front objective of AI has always been the formulation of a "true" theory of intelligence, it is somewhat less than apparent that this goal has always been primarily directed towards the reproducibility of human intelligence as an *artificial* process.

Accordingly, in the case of the position of Bringsjord and Arkoudas, the question of mechanical-supermechanical relates specifically to the formulation of a "true" theory of mind and intelligence while, in Hava Siegelmann's case, the aim is the construction of an *artificial*, machine based entity capable of intelligent interaction with the world. Although both positions are parasitic on how we may understand the nature of mind it does *not* follow that, whereas we may never develop a true theory of {Human} mind and intelligence, that we will not be in a position to creat a form of machine intelligence that can, as Siegelmann notes, *simulate the world or communicate with it*.

If, in light of these five constraints, we examine, for example, the work of the influential computational theory of the "*Conscious Mind"* developed by the Australian philosopher David Chalmers, then this theory accepts that the first constraint forms a warranted baseline presupposition. But, as a computationalist position, it is a functionalist-representationalist theory of the mental properties of mind. As such, the relation between these properties and the biochemical-neurological structure of mind must be reformulated in non-reductionist terms. Consequently, mental properties, though dependent on the biochemical-neurological substrate are, as David Chalmers argues, "supervenient"[4] upon the substrate of mind insofar as they are not reducible to this substrate. At base, computationalism then asserts property dualism, a representationalist theory of mind, token physicalism, and substrate independence or, what is known as the "multiple-realizablity" thesis.

---

constraint my point is that most, if not all the adherents of the the computationalist thesis espouse, for want of a better phrase, a form of naïve realism. This is the assumption that the objective of scientific practice is the establishment of sets of theoretical models that assert truth claims about a *mind independent*, objective reality.

4 **Chalmers, David J.** The Conscious Mind: In Search of a Fundamental Theory. Oxford: Oxford University, Press, 1996.
Chalmers points out that although the principle of supervenience was first considered by the English philosopher G.E.Moore in 1930's both the term, and its first articulated formulation was by English and American philosophers David Hare and Donald Davidson. By "supervient" we mean that once the physical facts with respect to, for example, the biochemical and molecular foundations of the neurological structure of the human mind are established, then the facts about neurology are *locked in*.

As the cognitive scientist Mel W. Bartlett forcibly notes,

> The need for modeling in neuroscience is particularly intense because what most neuroscientists ultimately want to know about the brain *is* the model—that is, the laws governing the brain's information processing functions. The brain as an electrical system, or a chemical system, is simply not the point. In general, the model as a research tool is more important when the system under study is more complex. In the extreme case of the brain, the most complicated machine known, the importance of gathering more facts *about* the brain through empirical studies must give way to efforts to relate brain facts to each other, which requires models matched to the complexity of the brain itself.[5]

It is important to underscore the possible implications of the applicative scope of the thesis of "Computational Sufficiency & Explanation." The "Thesis," when formulated as a strong interpretation of the principle of explanatory sufficiency, maximizes the claims of necessity for computationalism to cover *all* phenomena in the Universe. In this strong form the "Thesis" is, ontologically, a functionalist, or a formistic description of the universe. Known as the Zuse-Fredkin Thesis after the work of Howard Fredkin and Konrad Zuse, it proposes that the universe is, by definition, a "unineversal cellular automation" or a universal computational system. As the mathematician and theoretical physicist Petrov Plamen notes,

> If the Universe is a universal cellular automaton (UCA)3, anything that is going on within that UCA, obviously, is some sort of a computational process, and then we *ourselves* (together with our "mathematical thoughts") are nothing more than *algorithms* taking place in some specific region of space/time of the automaton.[6]

I am not arguing that anyone who advocates some variant of computationalism necessarily accepts the Thesis in its strong form. Rather, the bedrock metaphysical constraint on computationalism is that the universe is a causally closed, physical system – a position that each proponent will have to contend with. It is precisely at this point that a fundamental question arises concerning the explanatory status of the mind and, of Humanity's position within this universe. Furthermore, it is also here that The Argument from Human Creativity comes into play insofar as it provides a sixth boundary constraint that computationalism will have to contend with inasmuch as it may, or may not provide a further necessary, component of the computationalism. As Bringsjord and Arkoudas point out **if,** "*in light* of" a strong interpretation "*of the incompleteness theorem*", then "*the human*

---

5 **Bartlett, W, Mel.** "In the Brain, the Model is the Goal". *Nature Neuroscience Supplement,* 3:1183, November 2000, 1.

6 **Petrov, Plamen.** "The Church-Turing Thesis as an Immature Form of the Zuse-Fredkin Thesis (More Arguments in Support of the "Universe as a Cellular Automaton" Idea)," in *Series of Brief Articles about Digital Physics, 2003* Faculty of Mathematics and Informatics, Sofia University, Bulgaria, 2.

mind has powers exceeding those of Turing Machines." The Argument from Creativity[7] then becomes the assertion that the *"human mind has powers exceeding those of the Turing Machine*"[8] which, ***if*** it were established would, in turn, provide us with a canonical ***re***fomulation[9] of human creativity.

Part of the difficulty here is that it is a controversial question as to whether one could actually develop a strong reading of Kurt Godel's "incompleteness theorem" and, the coextensive arguments Alan Turing and his doctoral advisor at Princeton, Alonzo Church. Each of these positions were

---

[7] The *locus classicus* formulation of the Argument from Human Creativity is found in Immanuel Kant's 1790 work *The Critique of the Power of Judgement.* In particular, the section of the Critique titled *The Faculties of the Mind which Constitute Genius*,

> The imagination {as a productive faculty of cognition} is a powerful agent for creating, as it were, a second nature out of the material supplied to it by actual nature. It affords us entertainment where experience proves too commonplace; and we even use it to remodel experience, always following, no doubt, laws that are based on analogy . . By this means we get a sense of our {ethical-political} freedom from the law of association' {which attaches to the empirical employment of the imagination}.

Kant reasoned that, as a consequence of a subject's disinterested, perceptual {phenomenal} encounter with the beauty of nature and the works of art of genius, we are provided with "a sense," or a symbol of humanity's moral freedom. In so arguing he established a distinction that would form a canonical component for the *Argument from Human Creativity* – the difference between what comes into existence as a function of the empirical laws of causality that structure the natural world and, what comes into existence as a function of a different form of causality – the causality of free human action. Thus creativity, is free causality because it is not constrained by the causality of nature. At base, his central philosophical concern was to understand how nature and freedom intersected in our socio-phenomological world. As Kant remarked, "all human intervention in the natural order", not just Fine Art inasmuch as all forms of human productive activity were a functional consequence of the teleological nature of human intentionality grounded in the casualty of our free social action.

[8] This conclusion is hardly surprising given that Bringsjord is one of the principal supporters of the Argument from Human Creativity working today {In particular, read < **Bringsjord, Selmer & Ferrucci, David**. Artificial Intelligence and Literary Creativity Inside the Mind of Brutus, a Storytelling Machine, 1999}. In addition, Bringsjord and Arkouda's position is that, notwithstanding the Luas-Penrose position, John Searle presents the far more compelling case against computationalist argument. Thus, although the computationalist position collapses this, however, does not preclude that theoretically mind, at least in part, hypercomputes **-** hypercomputation, or super-recursive computation being computation beyond theTuring Limit. Certainly of greater interest for us is that Turing also felt that Godel's theorem simply underscored the fact that the human intellect was not constrained by the theorem. As Turing remarked in his paper *Computing Machinery and Intelligence*,

> The short answer to this argument is that although it is established that there are limitations to the powers of any particular machine, it has only been stated, without any sort of proof, that no such limitations apply to the human intellect. But I do not think this view can be dismissed quite so lightly. {11}

[9] If Bringsjord and Arkoudas prove to be correct then a subsequent reformulation of mind as a hypercomputational system would represent an absolutely momentous event insofar as we would be in a position to argue that mind was "super-mechanical". Consequently, Kant's use the Argument from Human Creativity to argue that human socio-cognitive activity is a function of *free* Human action collapses inasmuch as that "socio-cognitive activity" would now be supervient on the physics of the world. As Douglas Hoftstadter noted, freedom would finally "bottom out".

developed in response to the German mathematician, David Hilbert's question concerning the "*Entscheidungsproblem"* or the "decision problem". As Andrew Hodges explains, "*Was there a formal method {in the mathematical meaning of mechanical method}, for any given mathematical proposition by which it could be decided whether or not it was provable?"* Church, Godel, Emil Post, and Turing all responded that there is no mechanical method available.[10]

Godel's "Incompleteness Theorem" states that, *For any formal theory in which basic arithmetical facts are provable, it's possible to construct an arithmetical statement which, if the theory is consistent, is true but not provable or refutable in the theory*." A further, informal interpretation that historically has been appended to the "Theorem" is that although "*an arithmetical statement*" is unprovable within a formal theory, the mathematician "intuitively" recognizes the truth of "statement". In its strong form the "Incompleteness Theorem" is then interpreted as stating that, with respect to the axiomatization of the world, the theorem constrains ***any*** theoretical model covering ***every*** event phenomenon. This conclusion directly leads to the question whether mind is "super-mechanical". This question may be answered in the affirmative if, in fact, "*the human mind has powers exceeding those of the Turing Machine*."

For many commentators the greatest figure with regards to machine intelligence is, without question, Alan Turing. In an introduction to an edited collection of essays published after a 2004 conference held on the work of Alan Turing at the Logic Systems Laboratory of the Swiss Federal Institute of technology, the American computer scientist Douglas Hoftstadter poses the rhetorical question as to whether Turing actually thought machine intelligence would come to compete with or equal human intelligence.[11] This is the question that Turing attempted address in what must be one of the most debated papers ever to be published in the 20th century.

Following the lead of Alonzo Church's formulation of "effective calculability" and his demonstration that there were "undecidable problems" Turing redrafted the David Hilbert's question in terms of the computability of effective procedures[12], or algorithms using his Turing

---

[10] **Hodges, Andrew**. "What Would Alan Turing Have Done After 1954? ", in *Alan Turing: Life and Legacy of a Great Thinker*. Teuscher, Christof (ed) Berlin: Springer-Verlag, 2004, 50.

[11] **Hoftstader, Douglas.** "Inroduction", in *Alan Turing: Life and Legacy of a Great Thinker*.Teuscher, Christof (ed Berlin: Springer-Verlag, 2004.

[12] Or, calculable by finite means.

Machine. Turing's work {may} have demonstrated that all existing, and *possibly* all future, discrete state computer systems are subject to the constraints of a *Turing Machine*[13]. This conclusion is also referred to as the Turing Limit with regards what can, and cannot be computed. The question is how does this conclusion square with Turing's hope that sometime in the near future machine intelligence will match human intelligence. Turing's response to this question was presented in his 1939 and 1950 papers *Systems of Logic based on Ordinals* and *Computing Machinery and Intelligence*, Turing proposed to address the issue "can computers think."[14]

> 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. I believe further that no useful purpose is served by concealing these beliefs.

In his 1950 paper he addresses a number of what he called *Contrary Views on the Main Question* of machine intelligence. Five of these "Views" constute a core set postulates that underwrite *The Argument from {Human} Creativity*. The first postualte is the "Lady Lovelace Objection." In this case, the *Argument from the Generation of New, Original Solutions*. These are the now famous remarks of the 19th century English mathematician Augusta Ada Byron concerning Charles Babbage's "Analytical Engine". She remarked that the "*Engine*" has "*no pretensions to originate anything"* and that *"It can do whatever we order it to perform*"[15]. Historically, the "Lovelace Objection" is the first use of the "Argument" to define what a computational system cannot do, as opposed to we humans can do. Interestingly, any survey of ***all*** of post 2nd WW literature in the disciplines of AI systems development and psychology would reveal that "the generation of new, original solutions" will appear in almost all of the standard formulations of creativity[16].

---

13 Turing himself considered that both analog, and digital computers as being subject to TM. However, like many of the issues with surrounding the Turing-Godel-Church thesis this claim is controversial. For example, B. Jack Copeland and Richrad Sylvan in their paper "Beyond the Universal Turin Machine" argue, flat out, that the UTM Thesis is false, while Aaron Sloman dismissses it as irrelevant - "The Irrelevance of the Turing Test (and maybe to computers as we know them)". *School of Computer Science Theory Seminar*, The University of Birmingham, 2003.

14 **Turing, Alan M**. "Computing Machinery and Intelligence", *Mind*, Vol. LlX, 236, (1950), 433-60, 1.

15 Ibid, 9.

16 A typical formulation is found in the paper by Rob Saunders & John S. Gero, "Artificial Creativity: Emergent Notions of Creativity in Artificial Societies of Curious Agents", *The Key Centre of Design Computing and Cognition*, The University of Sydney, 2005,

> What is creativity? Generally, artefacts are labelled as creative if they are both novel and appropriate;

Postulate two is the *Argument from A Posteriori Experience*, or what Turing calls "The Argument from the Informality of Behavior." As a position with respect to the behavior of human beings, it argues that it is not possible to provide a set of rules prescribing our behavior in all possible situations. The third postulate is "The Argument from Consciousness" or, *The Argument from Phenomenological Experience*. In this case, Turing quotes George Jefferson who, in his Lister Oration for 1949 argues that "*Not until a machine can write a sonnet or compose a concerto that represents thoughts and the emotions felt, and not by the chance fall of symbols, nor could we agree that machine equals brain - that is, not only write a sonnet, but knows that it had written it*[17]". This is *the* traditional, canonical formulation of the Argument from Human Creativity insofar as it combines the creation of works of art with the reflectivity of *self*-consciousness. As a form of anthropomorphism it is also a version of the doctrine of Special Creation, or The Argument from Design[18]. The fourth postulate of the "Human Creativity" position does not appear in his 1950 paper but rather in Turing's letters where describes his work on randomization to produce nonpredicable outputs. As Turing states concerning his designing of "*a small program . . that I defy anyone … to be able to predict any replies to untried values.*[19]" Given his description of this postulate we may

---

individuals are regarded as creative if they produce creative works [1]. More specific definitions of creativity vary greatly in the details of what makes someone or something creative. Some definitions require that creative products must be the result of some creative mental processes, effectively ruling out the possibility of computationally modelling creativity until these processes are understood. Many computational models of creativity have been developed to gain this understanding by simulating mental processes thought to play an important role in creative thinking, e.g. Simon [2], Hofstadter et al. [3].

Other researchers consider the details of an individual's creative process to be less important and consider the socio-cultural environment to have a significant effect on the production of creative works. Csikszentmihalyi [4] proposed that the processes essential to creativity are not only to be found in the minds of creators but also in the interactions between individuals and their socio-cultural environment.

[17] Ibid, 11.

[18] The claim that creation cannot occur through the "chance fall of symbols" is the classic element of the Argument from Design. A perfect example is found in William Paley's 1802 work *Natural Theology*, "Since watches are the products of intelligent design, and living things are like watches in having complicated mechanisms which serve a purpose {e.g., having eyeballs to enable sight}, living things are probably the products of intelligent design as well."

[19] Historically, there are two broad sources for the "*Contrary Views"* that Turing attacks. The first is the appearance in the UK and the United States, during the early 19th century, of empirical studies that investigate creativity in humans. The first such study being George W. Bethune's, *Genius,* which was published in 1837 in Philadelphia. As Bethune describes the works of genius, it is "*to engender or create, because it has the quality of originating new combinations of thought, and of presenting them with great clearness and force."* The other source is far more well known. This is the emergence, during the late 17th, and 18th centuries of Enlightenment aesthetics and German, proto-Romantic anthropology, a process that culminates with the publication of Immanuel Kant's *Critique of*

call it T*he Argument from Unpredicatablity, or the Generation of Unforseen Surprises*. [20]

The final postulate is a function of Turing's formulation of the "imitation game"[21] or what has now come to be known as the "Turing Test". This, the postulate of *The Argument from a Socio-Linguistic Interaction,* is fundamental because it represents a "third person" criteria for deciding whether a machine is as intelligent as a human being. Turing's position was that the appeal to the internal operational structure of mind – i.e. the problem of "other minds"- was a non-starter[22] when it came to establishing acceptable criteria for just how we are to decide whether a human level of intelligence has been achieved by a machine or not. The background assumption for the "Test" being that if a machine were to pass the "Test" then that would imply that it must be as "creatively" intelligent as the human in answering the interrogator's questions.[23]

Turing, prior to the 1950's paper had, during his work on his Ph.D under the direction of Church at Princeton, already begun to approach the issue of creativity when he began to consider the theoretical possibility of "uncomputables". There is a brief discussion in his 1939 paper[24] about a entity that he rather dramatically named the "Oracle Machine". This train of thought occurred when

---

Judgment in 1790, and his *Anthropology from a Pragmatic Point of View* in 1798.

20 **Hodges, Andrew**. "What Would Alan Turing Have Done After 1954? ", in *Alan Turing: Life and Legacy of a Great Thinker*. Teuscher, Christof (ed) Berlin: Springer-Verlag, 2004, 50.

21 **Turing, Alan M**. "Computing Machinery and Intelligence", *Mind*, Vol. LlX, 236, (1950), 433-60, 1.

22 It is interesting to note that Turing and Wittgenstein were well aware of each other's work. Both Wittgenstein's game theory of language and Turing's criteria of sociolinguistic interaction are quasi behavorial in nature. It would be a interest to know if Turing took into account Wittgenstein's argument against "Private Language" {problem ofother minds} when he formulated the "Imitation Game".

Hodges points to another source for Turing's decision not to focus on the criteria of 3rd person observability as opposed to what is going on in the mind of the human participant in the Turing test – the work of the English philosopher Gilbert Ryle. Ryle's arguments against Cartesian dualism were well known as was his stress on 3rd person observability when describing the behavior of human beings.

23 This is clearly an intepretative move on my part. The point is that the whole thrust of Turing's attack on the various "Contrary Views" was that these arguments were false – that a machine's answers will, in due time and, under certain strict testing protocols, be as intelligent as human responses.

Of equal interest, in assuming that machine intelligence would, in the future, equal human intelligence did this imply that there was whether Turing was talking about the scope of machine computability or about what human's do when they "calculate". Gualtiero Piccinini in his paper, "Alan Turing and The Mathematical Objection", is unequivical on this point, "In this latter paper {"Intelligent Machinery"}, far from describing Turing machines as being humans who calculate, Turing described human beings as being universal digital computers".{P. 14}

24 **Turing, Alan**."Systems of Logic based on Ordinals." *Proceedings of the London Mathematical Society,* 45 (3) (1939): 161-228,

he began to consider what it would involve for the human mind to operationally move from a following a rule, to a human mind not following a rule. In particular, what constitutes, as Turing notes, the "activity of the intuition"[25] or, as M. H. A. Newman noted, what is meant by a mathematician "having an idea."[26] This concern represents the root source of the question about solving *non*-computable problems using *non*-algorithmic procedures. Turing remarked, *in re* Godel's "Incompleteness Theorem", that there are "*formulae, seen intuitively to be correct, but which the Gödel theorem shows are unprovable in the original system.*"[27] Thus the "Oracle" is an added element **-** a black box- to the Turing Machine insofar as the T-Machine can ask of the "oracle" a relative question, with respect to a specific computational sequence, in order for the T-Machine to make an uncomputable step during the computational process. That is, make "*intuitive*" decisions or, as Marvin Minsky states, make "*innovative*" decision leaps.

One of the important, ongoing controversies surrounding Turing's work on uncomputables has to do with the actual nature of the O-Machine.[28] A number of points should be underscored when attempting to understand how Turing conceived of this "Machine". There is, as Hodges notes, the source of the name "Oracle". This is, of course, the Delphic Oracle of Greek antiquity who, when asked a question submitted to her, will provide an answer in the form of an interpretable riddle. Additionally, the "Oracle Machine" is, in theory, capable of answering any relative question, that is, it has infinite capabilities[29]. Therefore, it must be a strictly theoretical entity that cannot be equated with machine, or human intelligence since it surpasses the abilities of the human mind, and more

---

[25] Ibid, 214.
Copeland argues that after the war Turing " the term 'intuition' drops from view and what comes to the foreis the closely related idea of learning—in the sense of devising or discovering—new methods of proof. When a human mathematician is confronted by a problem that he or she is unable to solve, the mathematician would searcharound and /nd new methods of proof' [52, p. 123]."

[26] **Newman, M. H. A**. "Alan Mathison Turing", *Biographical memoirs of the Royal Society (1955):* 253-263.

[27] **Hodges, Andrew**. "Alan Turing", in *Stanford Encyclopedia of Philosophy*, 2002, http://plato.stanford.edu/entries/turing/ . P. 8.

[28] In particular, the debate between Jack Copland, Diane Proudfoot and Andrew Hodges over whether Turing actually was pointing to an constructible machine – in this case both Copland and Proudfoot argue that Turing's work implied the possible development of hypercomputation. On the issue of whether Turing was talking about an actual machine, I am in agreement with Hodges that Copland and Proudfoot have misunderstand the philosophical significance of the O-machine.

[29] **Hodges, Andrew.** "Alan Turing", in *Stanford Encyclopedia of Philosophy*, 2002, http://plato.stanford.edu/entries/turing/ . 9.

importantly, of any other *existing*, or future intelligent entity A further, final point that Turing was very clear about was that the "Oracle" could not be a machine. If we accept this formulation then we are faced with an theoretic entity insofar as it forms a limiting case on all possible fromulations of machine intelligence.

Turing, like virtually everyone else, had assumed that Human beings has the apparent cognitive ability to act creatively in the world. We may infer this, albeit weakly, from his informal reading of Godel's Incompleteness Theorem and, more strongly, from the concerted attack that he directed against the "Contrary Views" in his 1950 paper. Does this mean that Turing believed that the Turing Limit can be breached insofar as one could actually build a Super Turing Machine? The answer I think is no.[30] The "Oracle Machine" is a philosophical proposal with respect to the inherent limitations on creative intelligence inasmuch as it is theocentreic[31] proposal that forms a theoretically absolute constraint on both machine and human or, if you like, it is the converse, or "super" version of the Turing Limit.

There is, I believe, a precedent for his proposal. One of the essential philosophical characteristics of the Primacy of the Epistemic Subject are the epistemological limitations placed on First Person experiences. This problem is virtually axiomatic insofar as the accumulation of empirical knowledge of the world is a historically constrained, diachronic-synchronic process. Consequently, the epistemological relationship between our *relative position* within totality of hypothetical laws rules out any possibility of our actually knowing whether the specfic knowledge we acquire over time is, in fact, true knowledge. This situation is a function of methodological role that scepticism

30 Ibid 12.
Hodges make the point by the time of Turing's 1950 paper he had dropped any discussion of the 0-machine and had concluded that "How could the *intelligent* arise from operations which were themselves totally *routine and mindless* — 'entirely without intelligence'? This is the core of the problem Turing faced, and the same problem faces Artificial Intelligence research today. Turing's underlying argument was that the human brain must somehow be organised for intelligence, and that the organisation of the brain must be realisable as a finite discrete-state machine."

31 Descartes, Leibniz, Malebranche, and Spinoza all adhered to some form of the Theocentric, or Argument from God's Eye P erspective. This position was proposed in order to address the realization that monadic experience is limited by both the potential fallibility of the epistemic subject's cognitive abilities and, its relative, epistemological location within the universe. Descartes, for example, noted that whereas we can never know that what we experience is not, in actuality, grounded in the dream like imaginings of subjective experience, we must assume that God does know.[30]Thus, the God's Eye Perspective provides a form of pre-established, ontological harmony between the knowledge claims of the monadic subject in relation to an objective totality.

plays within scientific practice. Scientific practices must function sceptically, and at the same time, act on the assumption that our relative knowledge claims are, in fact, grounded in unified theory of the nature of the universe. This presumption is, of course, a metaphysical claim, thus it is, in principle, unprovable. As a consequence, any metaphysical claims are really belief assumptions that have value as heuristic devices only. Turing's formulation of the O-Machine then functions *as if* it were a Theocentric proposal *only* insofar as the "Oracle Machine" *may* be premised upon the metaphysical assumption that the universe is, in principle, explainable algorithmically – that is, any relative question ought, in principle, to be answerable.[32]

In light of Turing's hope that machines will, in time, equal human intelligence what then of the present situation with respect the status of research work on *thinking* machines? The English logician and philosopher Diane Proudfoot points out that today a growing number of AI researcher's aim is "*to produce, not thinking and understanding machines, but high-performance advanced information processing systems*." Thus, we may be witnessing the slow death of the great, post 1950's romantic period of AI research when researchers dreamed of creating an anthropomorhized, mechanical form of AI.

Bibliography:

Ashby, W. Ross. *Design for a Brain*. London: Chaapman and Hall, 1952.

Bringsjord, Selmer, and C. Arkoudas. A Refutation of Penrose's Godelian Case Against AI. Department of Philosophy, Pschology & Cognitive Science, Rensselaer Polytechnic Institute, USA, 2000.

The Modal Argument for Hypercomputating Minds, in Theoretical Computer Science, 317 (2004), 167-190.

Bringsjord, Selmer & Ferrucci, David Artificial Intelligence and Literary Creativity Inside the Mind of Brutus, a Storytelling Machine, 1999.

Bartlett, W, Mel. "In the Brain, the Model is the Goal". *Nature Neuroscience Supplement,* 3:1183, November 2000.

[32] As it stands right now this is a stictly interpretative move on my part inasmuch as there is not textual evidence in Turing's writings to directly support this claim.

Chalmers, David J. The Conscious Mind: In Search of a Fundamental Theory. Oxford, Oxford University, Press, 1996.

"A Computational Foundation for the Study of Cognition", Published on *KurzweilAI.* June 4, 2002.

"The Representational Character of Experience." In B. Leitner (ed.) *The Future for Philosophy*: Oxford University Press, 2004.

{with Andy Clark} "The Extended Mind" *Analysis* 58: 1: 1998 p.7-19. Reprinted in The Philosopher's Annual vol XXI-1998 (Ridgeview, 2000) p.59-74.

Church, Alonzo. "An Unsolvable Problem of Elementary Number Theory", *American J. of Math.,* 58 (1936), 345-363.

Copeland, B. Jack. "Narrow versus Wide Mechanisim", in *Minds and Machines.* Edited by Alan Ross Anderson, Englewood Cliffs, New Jersey, 1964.

"Beyond the Universal Turing Machine", in *Australian Journal of Philosophy*, 1998, 1.

"Hypercomputation: Philosophical Issues", in *Theoretical Computer Science,* 317 (2004) 251 – 267

Copeland, B.J. & D. Proudfoot {2000} "What Turing Did After He Invented the Universal Turing Machine. *Journal of Logic, Language, and Information* , 2000, pp. 1-19.

"Alan Turing's Forgotten Ideas in Computer Science". *Scientific American* 280 (April 1999), pp. 99-103

Countess of Lovelace, "Translator's notes to an article on Babbage's Analytical Engine" in *Scientific Memoir* (ed. by R. Taylor), vol. 3 (1842), 691-731.

Dennett, Daniel. *Brainchildren: Essays on Designing Minds*. Cambridge Mass.: MIT Press, 1998.

Dupuy, Jean-Claude. *The Mechanization of the Mind: On the Origins of Cognitive Science*. Trans. M.B. DeBevoise. Princeton: Princeton University Press. 2000

Godel, Kurt. "On Formally Undecidable Propositions in Principia Mathematica and Related Systems *1",*in *Monatshefte fur Mathematick und Physik* 38, (1921): 173-98.

Harnish, Robert M. *Minds, Brains, Computers: An Historical Introduction to the Foundations of Cognitive Science*. Malden Mass.: Blackwell Publishers Inc. 2002.

Heijnoort, Jan van. *From Frege to Godel: Source Book of Mathematical Logic, 1879-1931*. Cambridge Mass.: MIT Press, 1966.

Heims, Steve Joshua. *The Cybernetics Group*. Cambridge Mass.: MIT Press, 1991

Hodges, Andrew, "What Would Alan Turing Have Done After 1954? ", in *Alan Turing: Life and Legacy of a Great Thinker*. Teuscher, Christof (ed) Berlin: Springer-Verlag, 2004.

"Alan Turing", in *Stanford Encyclopedia of Philosophy*, 2002, http://plato.stanford.edu/entries/turing/

Kleene, S. C. "General Recursive Functions of Natural Numbers**.** *American J. of Math.,* 57 (1935), 153-173 and 219-244.

Jefferson, G. "The Mind of Mechanical Man", Lister Oration for 1949 *British Medical Journal,* vol. i (1949), 1105-1121.

Lucas, John.R. "Minds, Machines and Godel", in *Minds and Machines*. Edited by Alan Ross Anderson, Englewood Cliffs, New Jersey, 1964.

A paper read to the Turing Conference at Brighton on April 6th, 1990.

McCarthy, J., M.L. Minsky, N. Rochester, and C.E. Shannon. A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence. John McCarthy, Department of Mathematics, Dartmouth College, Hanover, New Hampshire.

McCulloch, Warren S. & Walter Pitts. *A Logical Calculus of Ideas Immanent in Nervous Activity.* Bulletin of Mathematical Biophysics, 5:115--133, 1943.

McGinn, Colin. The Problem of Consciousness. Oxford: Blackwell Publishers, Reprint, 1995.

Mayr, Otto *Authority, Liberty, and Automatic Machinery in Early Modern Europe* (Baltimore: Johns Hopkins University Press, 1986).

Newman, Maxwell H. A. "Alan Mathison Turing", *Biographical Memoirs of the Royal Society* (1955): 253-263.

Neumann, John von. The Computer and the Brain. New Haven, Conn., Yale University Press, 1958.

Penrose, Roland. "Beyond the doubting of a shadow: a Reply to Commentairies on The Shadows of the Mind", *Psyche* 2 (3). 1996.

The Emperor s New Cloths. Oxford: Oxford University Press, 1989.
The Shadows of the Mind. Oxford: Oxford University Press, 1994

Pereira, Francisco C. & Amilcar Cardoso. "Conceptual Blending and the Quest for the Holy Creative Process." In *Proceedings of the 2nd Workshop on Creative Systems: Approaches to Creativity in AI and Cognitive Science*, ECAI 2002, Lyon, France, 2002.

Petrov, Plamen. The Church-Turing Thesis as an Immature Form of the Zuse-Fredkin Thesis (More Arguments in Support of the "Universe as a Cellular Automaton" Idea)

Piccinini, Gualtiero "Alan Turing and The Mathematical Objection", Department of History and Philosophy of Science, University of Pittsburgh, 1999-2000.

Proudfoot, Diane "Robots and Rule-Following ", in *Alan Turing: Life and Legacy of a Great Thinker*. Teuscher, Christof (ed) Berlin: Springer-Verlag, 2004.

Putman, Hilary. "Minds and Machines", in *Minds and Machines*. Edited by Alan Ross Anderson, Englewood Cliffs, New Jersey, 1964.

Pylyshyn, Zenon Computation and Cognition: Towards a Foundation for Cognitive Science. MIT Press , 1984.

Rosenblueth, Arturo, Norbert Wiener, and Julian Bigelow. "*Behavior, Purpose, Telelogy*." Philosophy of Science 10, no.1 (1943): 18-24.

"Purposeful and Non-Purposeful Behavior," *Philosophy of Science* 17 (1950): 318-326.

Searle, John. "Minds, Brains and Programs", in *The Behavioral and Brain Sciences* , vol. 3., Cambridge University Press, 1980.

Siegelmann, Hava

{Eve} Tova. “Computation beyond the Turing Limit.” *Science,* 268:545–548, 1995.

Stannett, Mike “Hypercomputational Models “, in *Alan Turing: Life and Legacy of a Great Thinker*. Teuscher, Christof (ed) Berlin: Springer-Verlag, 2004.

Sloman, Aaron. “Can we Design a Mind?. Keynote address *Artificial Intelligence in Design Conference, Cambridge University, July 2002.*
The Irrelevance of the Turing Test (and maybe to computers as we know them). *School of Computer Science Theory Seminar*, The University of Birmingham, 2003.

Tarski, Alfred. "The semantic conception of truth", in *Philosophy and Phenomenlological Research* 4, 1944, 13-47.

Taylor, Richard. "Purposeful and Non-Purposeful Behavior: A Rejoinder," *Philosophy of Science* 17 (1950): 327-332.

Turing, Alan M. “On Computable Numbers with an application to the Entscheidungsproblem*”,* London Mathematical Society in *Proceedings of the London Mathematical Society*, Series 2, Vol.42 (1936 - 37) pages 230 to 265

“Computing Machinery and Intelligence”, *Mind*, Vol. LlX, 236, (1950), 433-60.

“Systems of Logic based on Ordinals." *Proceedings of the London Mathematical Society,* 45 (3) (1939): 161-228.

“Intelligent Machinery {1948}”. *National Physical Laboratory Report*, in B. Meltzer and D. Michie (eds) 1969, *Machine Intelligence* 5. Edinburgh: Edinburgh University Press.

“Lecture to the London Mathematical Society on 20 February 1947”, in B.E. Carpenter and R.N. Doran (Editors), *A.M. Turing's ACE Report and Other Related Papers,* Cambridge, MA*:* MIT Press.

Turing, A.M. “Intelligent Machinery, a Heretical Theory” (c.1951), in: B.J. Copeland, *A Lecture and Two Radio Broadcasts on Machine Intelligence by Alan Turing*, in: K. Furukawa, D. Michie, S. Muggleto (Eds.), Machine Intelligence, Vol. 15, Oxford University Press, Oxford, 1999.

et al., “Can Automatic Calculating Machines be Said to Think? (1952), in: B.J. Copeland, *A Lecture and Two Radio Broadcasts on Machine Intelligence by Alan Turing*, in: K. Furukawa, D. Michie, S. Muggleton (Eds.), *Machine Intelligence*, Vol. 15, Oxford University Press, Oxford, 1999.

“Chess”, in: B.V. Bowden (Ed.), *Faster Than Thought* (part of Chapter 25), Sir Isaac Pitman & Sons, London, 1953.