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Patented Personality

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PATENTED PERSONALITY

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I. INTRODUCTION

This article presents a current examination of the state and structure of artificial intelligence (AI) and its patentability. Because artificial intelligence is on the technological horizon, an understanding of its internal and theoretical workings is requisite to any attempt to procure patent protection of an artificial intelligence inventor's rights.

This article addresses two issues. First, whether artificial intelligence personality (AIP), the "module," as defined herein, could ever properly be subject to protection under current patent laws. Before this issue can be addressed, however, it will be necessary to attempt to define the meaning of AIP, which requires significant analysis of the concepts forming current AI theory. Second, if AIP by itself is found to be outside the scope of patent protection, will it be prudent to attempt to patent an AI system embodying AIP.

II. THE PERSONALITY CONCEPT

"Personality," in an AI application, is the quintessence or sine qua non of an AI system in that it allows synergy, growth, or learning of new and appropriate behavior. AIP would be an internally self-directed and task-oriented system to whatever extent AI's behavior could be self cognizable. In the built-in quest for increased appropriateness, AIP would be designed to supervise a vast number of programs, subprograms, system resources, and even itself.[1]

The responses produced by an AIP could be designed to represent any desired form of simulated thought,[2] rational or irrational,[3]

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1. This, of course, insofar as all of the system's resources (beyond hardware devices) could be made cognizable to AI, subject to the Incompleteness Theorem and other phenomena of representation and interpretation, and limited by the problem of simultaneous creation and integration of the same piece of newly generated information.

2. "Simulated thought" means mechanized reasoning, whether simple or complex.

3. *See* PARRY, a program created by Kenneth Colby which simulates the behavior of a

so long as the output generated was appropriate.[4] Responses could then be fed back to the AIP to allow the AIP to evaluate its own responses in terms of short term goals, or expectations (long range ultimate goals serving as indicia of appropriateness).[5] Hypothetically, the greater the number of non-trivial[6] effective goals, the greater the degree of "intelligence" and the need for AIP as a means to deal with paradoxes, contradictions, and conflicts.

It should be noted that correct answers, the desired products of most programs, are not the ultimate touchstones of intelligence.[7] Right answers and appropriate answers are not necessarily the same.[8] Humans learn by making mistakes, remembering them, and acting on them in future situations. Insight can be gained from a wrong answer and may serve to redirect the search for a better answer. Likewise, the wrong answer may redefine the question, or show that a right answer is secondary to the most appropriate answer obtainable under the circumstances.

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paranoid personality. D.R. HOFSTADTLER, GODEL, ESCHER, AND BACK: AN ETERNAL GOLDEN BRAID at 300-301, 599-600 (1980) [hereinafter HOFSTADTLER].

4. That is, appropriate to the task or function assigned to AI and to personality.

5. M. J. PEDELTY, AN APPROACH TO MACHINE INTELLIGENCE, at 11 (1963) [hereinafter PEDELTY].

6. *Id.*

7. Port, *Computers that Come Awfully Close to Thinking*, BUSINESS WEEK, June 2, 1986, 92, 94.

8. In 1956, four prominent researchers (Marvin Minsky of M.I.T., John McCarthy of Stanford, Nathaniel Rochester of IBM, and Claude Shannon of Bell Labs) called a meeting at Dartmounth College to discuss ways of simulating thought with computers. The meeting resulted in the formal establishment of the term "artificial intelligence" and featured a theorem-proving program developed by Alan Newell and Herbert Simon, of Carnegie-Mellon, and J.C. Shaw of Rand Corporation. Newell and Simon utilized the natural strength of the computer in symbol-manipulation—searching, comparing and modifying information—to model human thinking. The result was GPS, the "General Problem Solver." GPS was based on the belief that a few laws of reasoning ("heuristics") combined with powerful computers could simulate human intelligence. Although GPS could handle a restricted domain of puzzles with a relatively small set of states and well-defined formal rules, researchers soon realized that "brute force" (the classic example being a chess-playing program that appears intelligent only because it can search many more potential moves than a human) failed as a realistic model of human thought. Moreover, GPS and other general-purpose problem solving strategies were too weak to handle significant real-world problems.

> Despite the limited ability of GPS, the emergent concept of heuristics, or "rules of thumb" that humans or machines use "to recognize promising approaches to problems, to break problems down into smaller problems, to get around incomplete date, and to make educated guesses where necessary," became the focus of AI research.

S. NYCUM & I. FONG, MACHINE INTELLIGENCE AND RELATED PROBLEMS (1985) [hereinafter NYCUM].

The challenge is to maximize the AIP's growth while minimizing system states which interfere with the selection of appropriate behavior and disable the system.[9] However, these problematic system states may serve as lessons to enable the AIP to avoid or effectively manage such situations in the future. AIP should be able to effectively use knowledge gained from wrong or inappropriate answers to foster positive growth, by recording problems and their resolution for future use.

When two or more incomprehensible system states occur, causing a disabling confusion or misinterpretation, the AIP could be designed to intercede and formulate an appropriate course of action. The AIP could revise and adjust to resolve the conflict by assigning a preference for one system state depending upon the purpose of the AI. This would be accomplished by providing hierarchies and networks of heuristics to integrate the rules for problem-solving, and hermeneutics which incorporate the rules for establishing relevancy.[10]

The AIP could be designed to lie dormant until summoned, yet able to monitor and record significant aspects of the AIP's experi-

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9. Means of control, integration and management of AI could be devised which were deterministically automatic, or brute force impositions of structure on AI's behavior, but this would tend to destroy synergistic possibilities for learning and creative growth which are prerequisite to intelligence.

10. In order to accomplish the functions mentioned and also perform AI system organization, metacontrol, integration of hardware configuration options, management of AI's behavior and software, without exerting undue influence on creativity and positive synergistic growth, AIP would be designed with at least some of the following features:

> 1. heuristics: the rules for problem solving, especially those that use self-educating techniques such as the evaluation of feedback to improve the system's ability to cope with ambiguity, brittleness, and blindness;
>
> 2. hermeneutics: the rules for making interpretations, such as determining relevancy or appropriateness. Such rules would be designed into AI and AIP and could be supplemented with new hermeneutics generated by AI or AIP, if appropriate, enabling AI to interpret its own experiences, understand its own internal language, and resolve queries about its experience;
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> 3. catalogs of britical, goal, and past problematic system states and their resolutions, useful solutions structures, and any other helpful records of experience;
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> 4. hierarchies of goals, objectives, and purposes, levels of control and metacontrol, and networks of formal structures for generating increasingly appropriate responses;
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> 5. means for integrating AI behaviors and reactions within the system and between the system and the environment without resorting to forced predetermination;
>
> 6. flexible procedures for handling disabling confusions, contradiction,

ence through feedback techniques.[11] The AIP could be designed to be silent until invoked and potentially omnipotent when activated. Alternatively, the AIP could be designed to be triggered by any predetermined or determinable system state in order to provide hermeneutic aid in resolving problematic system states using design redundancies.[12] Although a number of different designs have been postulated for the AIP, the final structure is ultimately a function of its control ability. Predetermination and absolute certainty must give way to flexible solution searching. Although some control is needed to remedy and prevent disabling system problems, it should not inhibit growth and development. This will be discussed at greater length below.

In order to achieve flexibility, it is believed that an AIP must be able to exert control over its own operating system, *i.e.*, metacontrol.[13] Without such control the system would simply stop or malfunction when a disabling system state arose. The problem with this design is that for each new control added, an additional control may be required.[14] For this reason, the system is never truly complete, hence, the pitfall of the Incompleteness Theorem.[15]

Every hierarchy must have a top, some level where the ulti-

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and unforeseen contingencies, insofar as such contingencies could be planned for;

7. means for managing the system without impairing opportunities for positive creativity, synergy, learning, and growth;

8. means for recording, cataloging, and analyzing AI's experience without interrupting AI in its performance of its assigned tasks; and

9. means for dealing with paradoxes likely to thwart AI, such as Turing's paradox and the Liar's paradox.

11. This could be accomplished through negative feedback or through positive or negative feedforward. *See* HOFSTADTLER, *supra* note 3, at 544-545.

12. "No semi-hard problem can be solved feasibly by computer program, unless the program is enriched with a larger or smaller catalogue of logically redundant heuristic information." D. MICHIE, MACHINE INTELLIGENCE AND RELATED TOPICS at 178 (1982). *See also* J. ROTHFEDER, MINDS OVER MATTER, 39-59 (1985) [hereinafter ROTHFEDER]; HOFSTADTLER, *supra* note 3, at 18, 97, 101.

13. Metacontrol would be control above a lower level control, and meta-metacontrol, likewise, would be control over the control of the lower level control.

14. HOFSTADTLER, *supra* note 3, at 687 (discussion of how a self-modifying game would have rules for the game, metarules to tell how to modify the game and the rules, metametarules to tell how to modify the metarules and so forth ad nauseum).

15. The Incompleteness Theorum says for any formal system what the Liar's paradox says for language in the following statement: "Everything I say is a lie." A formal system is a system which is governed by rules.

There are many levels from which "completeness" can be analyzed. Ideally, personality could provide completeness for AI's otherwise unexplained behaviors with respect to its own internal language and its analysis therof and with respect to its ordinary work conjoined with completeness of the other two levels mentioned.

mate choices and the highest level goals are determined.[16] In our model, the AIP represents the highest level in the AI system, the internally omniscient and omnipotent reference point to which the system could turn to when all else fails. AIP would provide layer upon layer of control, metacontrol, meta-metacontrol, etc.. Each new control adds a greater synergistic ability to create knowledge and flexibility within the system.

III. INTELLIGENCE: HUMAN VS. ARTIFICIAL

One of the most perplexing problems facing AI research is the definition of human intelligence. As long as human intelligence remains partially undefinable, an artificial form of that intelligence will be more difficult to develop. Very few aspects of human intelligence, such as the neuron network structure of the brain, are completely understood.[17] Although human intelligence probably involves more than the ability to comprehend natural language, this is a major requirement of artificial intelligence.[18] For a machine to understand human language, the machine must first be able to understand its own internal language.[19] The internal language of an AI system, and in particular an AIP, would include some form of

16. J. ALBUS, BRAINS, BEHAVIOR, & ROBOTICS, 208 (1981).

17. For instance, the inherent structural organization of the brain "... both machines and people are made of hardware which runs all by itself, according to the laws of physics." HOFSTADTLER, *supra* note 3, at 685.

> We *feel* self-programmed. Indeed we couldn't feel any other way, for we are shielded from the lower levels, the neural tangle. Our thoughts seem to run about in their own space creating new thoughts and modifying old ones, and we never notice any neurons helping us out! But that is to be expected.

Id. at 692.

18. [A]lthough developers have yet to claim that their computers *actually* understand ordinary English, their systems at least can *appear* to understand. A well-known example of a computer appearing to understand ordinary English is ELIZA, developed by Joseph Weizenbaum in 1966. ELIZA acts the part of a psychiatrist and relies on a clever system of rather fixed patterns of responses that give an imitation of language understanding many people find convincing. If the patient types "I'm feeling a bit tired," ELIZA can embed part of the patient's sentence in its reply: "Why are you feeling a bit tired?" Recent advances permit programs to make plausible inferences from pre-defined scripts, so that programs can answer questions given a descriptive passage and summarize news stories as they appear on the wire service.

NYCUM, *supra* note 8, at 372 (emphasis in original) (footnotes omitted). *See also* ROTHFEDER, *supra* note 12, at 22, and MICHIE, *supra* note 12, at 134. *See* HOFSTADTLER, *supra* note 3, at 608 regarding whether Doctor Weizenbaum's successor to ELIZA has a personality.

19. *See* WINOGRAD & FLORES, UNDERSTANDING COMPUTORS AND COGNITION (1986), for a discussion of this position based on the assumption that AI will never be capable of natural language, and therefore true AI will not exist.

electrical signals generated by the computer. In order for the machine to understand itself, a metalanguage,[20] to analyze the AIP's natural language, must also exist. Metalanguage could enable AI to "remember" and integrate experiences without destroying synergy and creativity.

The existence of electrical signals in the internal control structure of the AIP leads one to believe that AIP can be mastered through software. However, AI is concerned primarily with non-numeric processes that involve complexity, uncertainty, and ambiguity, for which no known algorithmic solutions exist.[21] In terms of creating artificial intelligence, a computer would only be useful in conjunction with an intelligence, human or otherwise, capable of using it. Intelligence either resides in the programmer-user-designer, who imparts decision-making power to the computer, or in the computer itself, in an embodiment allowing the computer to choose an appropriate response without intervening human control.[22]

A software embodiment of AIP would likely be a complex dynamic system, similar, in a simplistic sense, to a brain.[23] This is likely because all complex dynamic systems appear to be able to develop new rules for governing behavior in order to adapt to their unique and changing environment.[24] If an application-specific AIP could vary AI and its rules as its environment changes, the result would be a "style" of behavior or "personality" which characterizes the AI system as a whole. Scientists have already simulated such behavior in complex dynamic systems utilizing modeling programs capable of adapting and changing themselves. Furthermore, systems that exhibit their own adaptability, creativity and synergy[25]

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20. In order to circumvent the liar's paradox, symbolic logic can be used to refer to our natural language. Language used to refer to another language is called metalanguage. The language analyzed is called the object language. Since symbolic logic allows language to examine itself, we might expect that AIP could examine AI as object language using the same approach.

21. In summary, AI is concerned . . . primarily with non-numeric processes that involve complexity, uncertainty and ambiguity and for which known algorithmic solutions do not exist . . . Thus AI can be considered to be built upon . . . Knowledge of the domain of interest . . . Methods for operating on the knowledge . . . Control structures for choosing appropriate methods and modifying the data base (system status) as required.

W. GEVARTER, ARTIFICIAL INTELLIGENCE, EXPERT SYSTEMS, COMPUTER VISION AND NATURAL LANGUAGE PROCESSING, 183 (1984) [hereinafter GEVARTER].

22. PEDELTY, *supra* note 5, at 11 (1963).

23. Reiter, *Toy Universes*, SCIENCE 86, 55 (June 1986).

24. *Id.* at 55-56.

25. *Id.* at 56.

have been developed.

IV. Supporting Technology

A. *Expert Systems*

Although quantum leaps have been achieved in the areas of neural networks and complex dynamic system research, scientists are seeking to enlarge the validity of AI expert systems.[26] Expert systems are the branch of AI that attempts to simulate the expertise of specialists in highly technical disciplines.[27] One type of expert system, a rule-based system, is an expert system based on the hypothesis that expert knowledge consists of a large number of independent, situation-specific rules where computers simulate expert reasoning by chains of deduction.

A modern expert system with the ability to analyze mass spectrograms, called DENDRAL, was created by the Nobel prize-winning chemist Joshua Lederberg and computer guru Edward Feigenbaum, at Stanford University.[28] Feigenbaum created a sister-system to DENDRAL, called META-DENDRAL. DENDRAL identifies a substance based upon its mass spectrogram, whereas

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26. Nycum, *supra* note 8, at 368.

27. Davis, *Mechanical Minds — More Firms Try to Put Skills of Key Staffers In Computer Programs,* Wall St. J., June 10, 1985, at 1, col. 1.

28. Mass spectroscopy is an established technique for identifying organic molecules by analyzing the spectrum produced when the molecule is exposed to light. The success of DENDRAL represented a major achievement in the application of heuristics to create systems that mimic expert problem-solving. Using DENDRAL as a prototype, Edward Shortliffe, also at Stanford, developed an expert system to tackle the more complex field of medicine. The program, called Mycin, incorporated the knowledge and experience of human experts to diagnose bacterial infections of the blood and advise physicians on antibiotic therapy. As with current expert systems, the key step was the trial-and-error consultation between the expert and the program to develop the hundreds of rules and exceptions that human experts learn from theory and practice — a process which has become known as "knowledge engineering."

> Although Mycin was actually limited in its usefulness in clinical situations, its development produced new insights on the structure of human reasoning. Researchers found that by removing the medical information, or the knowledge base, from Mycin, what was left was the generalized logic of the system. This system, dubbed Emycin for Essential Mycin, could then be connected to a database containing heuristics from other fields such as geology or computer-chip design. In addition, researchers added a program to Mycin that would explain the logical analysis leading to Mycin's conclusion. Physicians would thus be much more comfortable in either accepting or rejecting the computer's reasoning and the later advice and diagnosis. Matching human queries to machine explanations is one feature that distinguishes expert systems from specialist texts.

Nycum, *supra* note 8, at 367 (footnotes omitted).

META-DENDRAL generates its own rules to explain the fragmentation of molecules and compounds.[29]

The only knowledge META-DENDRAL possesses at the outset is a group of instructions, called the general legal syntax, that allows the system to generate rules to explain the mass spectrograms it receives.[30] The general legal syntax is generated by using symbolic logic, such as "A implies B," and certain chemical structural information. Based upon the general legal syntax and the particular chemical's mass spectrogram, META-DENDRAL can formulate a general rule of mass spectronomy.[31] Feigenbaum included a feature that allows the system to discard rules automatically generated by the system if they contradict the rules already generated by the system.[32] Although these expert systems were designed for use in medicine and chemistry, the most effective expert systems have been used to evaluate trouble along telephone lines, lay out preventive maintenance programs for large power stations, and configure computer systems. The practical application of expert sytems has been limited to only a few situations.[33]

29. ROTHFEDER, *supra* note 12, at 109-113 (1985).

30. *Id.*

31. META-DENDRAL came up with 33 rules for 3 different classes of steroids that explained how to decipher which steroids were present in which compounds. They were so unique and sufficiently good that they were published in the *Journal of American Chemical Society* not as freaks produced by some computer, but as genuine new knowledge. The computer wasn't even mentioned in the article, except in a footnote.

ROTHFEDER, *supra* note 12, at 112 (quoting Edward Fiegenbaum).

32. We cut back on the number of rules [generated by the system] as far as possible by forcing the computer to continually refer to the data, the chemical structure information, that gave rise to these rules. Every time there is a branch added to the if/then tree, it asks of that branch, "Is nature telling me that?" Then it goes back and looks at the data, with the help of its internal question and answer program. If nature is not telling it what the new if/then rules are representing—perhaps some knowledge that the computer has picked up generated a mutant, inaccurate rule—then the statements are thrown out. This way we can rapidly prune down a potential rule set that could conceivable run into the millions, to one much smaller that the data is definitely pointing to as necessary.

ROTHFEDER, *supra* note 12, at 111 (quoting Fiegenbaum).

33. [C]urrent expert systems are useful only for highly specialized tasks that place a high value on knowledge of a single, well-defined subject. Moreover, despite the increasing investment in research on expert systems by dozens of companies, "expert systems software development costs are high, development times are unusually long, and the resulting programs put a heavy burden on computing resources."

Martins, *The Overselling of Expert Systems*, DATAMATION, Nov. 1, 1984, at 76.

Until current research in common sense and machine learning progresses to

B. *Symbolic Logic Language*

Computer languages are being developed with greater potential for symbolic logic than traditional "high level" languages, FORTRAN, COBOL and BASIC. LISP, for LISt Processor, manipulates symbols, words, phrases, and even geometrical figures, rather than only numbers.[34] LISP allows elaborate data structures and makes complex data base management systems relatively easy to build. Powerful symbolic logic languages, such as LISP, could be used to develop the AIP because of the relative ease with which non-numeric symbols and concepts can be manipulated in a quantified logic environment.[35]

C. *New Design Frontiers*

Advances in the development of AIP will ultimately depend upon the development of hardware technology and not simply advances in AI programming. Two important areas of AI research are: (1) neural network chips for use in neural network computers; and (2) parallel design computers. Other promising areas include high voltage electronic circuitry,[36] submicron integrated circuits,[37]

> the point of developing a "general" expert system, current expert systems remain sophisticated tools in specialized fields.

NYCUM, *supra* note 8, at 369, 370.

34. Alexander, *The Next Computer Programming Revolution*, FORTUNE, Oct. 29, 1984, at 81.

35.
> [Computational logic, which earlier appeared doomed by combinatorial explosion] excessive proliferation of decision branches generated by the pure resolution approach, has become revitalized with new representation approaches, inference rules, domain heuristics and advanced computers and will play an increasingly important role in future AI applications.

GEVARTER, *supra* note 21, at 225.

> The resolution approach in theorem proving proceeds either by manipulation of the premises of an argument into equivalence with the conclusion by transformation using rules of inference, or by reductio ad absurdum proof. Computational or Quantificational logic (a product of basic symbolic logic), allows for categorical statements to be quantified, i.e. "For every X . . . such that . . ." "There exist a Y such that . . ." whereas basic sumbolic logic only allows for negation, conjunction, disjunction, implication (if X then Y) and material (X if and only if Y) equivalence. Formal logic systems permit analysis of categorical statements representing a certain pattern of logical form, but devoid of subjective instantation. Form can represent any individual validly included in the universe of discourse, by instantation of the empty form. Formal logic is a valuable tool in AI and promises to become more so as fuzzy, multivalued and non-monotonic logics come into their own.

See I. COPI, SYMBOLIC LOGIC, 166-170 (1973).

36. Bylinsky, *Smart Power Chips Are The Latest Turn-On*, FORTUNE, March 4, 1985, at 94.

37. By decreasing the width of the integrated circuit's channels from the average of 3

superconducting integrated circuits, and "fuzzy logic."[38]

1. Neural Network Chips and Other Chip Designs

As noted earler, neural network computers operate significantly different than conventional computers. By using the analog neural networks designed to simulate neurons of a slug, researchers at Bell Labs and in Japan[39] have produced neural network chips.[40] Neural network computers using these chips contain the equivalent

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microns today to below one micron, Perkin-Elmer has produced a machine for etching chips which claims a 1/4 micron circuit width potential. Smith, *Electron-Beam Chipmakers Move Out of the Lab*, BUS. WK., Sept. 29, 1986, at 105. The speed of the chip is increased as is the density which designers can utilize, and the Perkin-Elmer machine can be used to "print" different chips on the same silicon semiconductor wafer. *Id.* By reducing the circuit width to 0.5 microns, and increasing chip size, TRW has designed chips which have 35 million components. TRW and Motorola are working on Very High Speed Integrated Circuits (VHSIC), for DoD, to create new chips 10,000 times more powerful than current IC's and TRW plans production by 1989. Newport, *A Supercomputer on a Single Chip*, FORTUNE, Sept. 29, 1986, at 128-129. *See also* Port, *The Submicron Era May Belong to the Japanese*, BUS. WK., March 16, 1987, at 98. With submicron or Very High Speed Integrated Circuits (VHSIC), chipmakers have bounded forward toward quantum increases in computing power which will make AI easier to design and implement because of increased speed and design density potential.

38. Port, *Bell Labs Puts a Big Brain on a Small Chip*, BUS. WK., Jan. 13, 1986, at 125.

39. *See* note 59 and text accompanying. *See also* Yoder, *Worms and Slugs are Research Tools in Japan's Search for New Computer*, WALL ST. J., June 28, 1986.

40. [A] team of Bell (Laboratories) secientists has been using research on slugs' brains to develop a radically new type of computer. It would use decision-making techniques eerily similar to human intuition to solve certain complicated problems almost instantly . . . [T]he conceptual focus of the Bell project is the model of a neural-network computer created by [John] Hopfield . . . Neural networks operate in the analog mode—when information enters the brain, the neurons start firing and their values, or charges, rise and fall like electric voltage in analog computers. When information is digested, the network settles down into a so-called steady state, with each of its many neurons resting close to their highest or lowest values—effectively, then, either on or off. A computer designed to mimic a neural network would solve problems speedily by manipulating data in an analog fashion. But it would report its findings when each neuron is either in the on or off state, operating like a digital computer speaking a binary language.

> The simulated computer designed by Hopfield and his AT&T colleagues uses microprocessors to do the work of neurons. Each microprocessor is connected to all others—as many neurons are interconnected—which would make the machines costly and complex to build. Another major difference between this computer and traditional ones is that memory is not localized in any one processor or set of processors. Instead memory is the pattern formed by all neurons, whether on or off when they are in steady states. As a result, the computer can deal with fragmentary or imprecise information . . . . Neural network computers work best on problems that have more than one reasonable solution.

Newport, *What Bell Laboratories is Learning From Slugs*, FORTUNE, April 1, 1985. *See* Bylinsky, *The High Tech Race: Who's Ahead*, FORTUNE, Oct. 13, 1986, 26, 43.

of more than 500,000 processors and 250,000 interconnections.[41] A group of researchers at TRW have designed a neural network computer with 100 million processing elements. A major difference between this computer and a traditional one is that memory is not localized in any one processor or set of processors. Instead memory is the pattern formed by all neurons, whether on or off when they are in steady states. As a result, the computer can deal with fragmentary or imprecise information. The ability to understand fragmentary or imprecise information would be a necessary feature for promoting "intelligence" in an AI system.

The "transputer" created by INMOS, is another chip design with AI and AIP ramifications. This chip contains microprocessor, memory and communications circuitry in a single transputer,[42] that is ideal for neural network and parallel computer applications.[43] In fact, it has its own operating language, OCCAM, designed to avoid the incongruity between parallel hardware and conventional software.

2. Parallel Computers

Conventional computers solve problems sequentially, one step at a time, while parallel systems divide the workload among multiple processors that solve a problem simultaneously.[44] One parallel computer, the Connection Machine, has 65,000 microprocessors, processes seven billion instructions per second, and is 175 times faster than a typical mainframe computer.[45]

One main problem with parallel computers is that all problems may not easily be solved by parallel methods. For example, painting a picket fence using one painter for each picket may be efficient, but 65,000 writers simultaneously working on the same article would be grossly inefficient.[46]

In extremely large parallel computers, the effective — active connections[47] have meaning to the system. Such connections could

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41. Port, *supra* note 38, at 96.

42. Petre, *A Computer Chip with a Mind of Its Own*, FORTUNE, 114 (May 14, 1984).

43. *Id.*

44. Davis, Superfast Computers Mimic the Structure of the Human Brain, WALL ST. J. (Feb. 19, 1986).

45. *Thinking Machine Unveils a Computer With New Technique*, WALL ST. J. (May 1, 1986). *See also* FORTUNE, Oct. 13, 1986, at 36.

46. *Id.* at 1, 22. This is one main problem with parallelism: That all problems are not at the current time solvable in parallel terms or at least are not at the present time easily definable in parallel-stage terms.

47. Port, *Computers that Come Awfully Close to Thinking*, BUS. WK., June 2, 1986, at 92, 93.

be a strong candidate for the AIP approach to flexible meta-control.[48]

V. Patents and Law

A. *Patented AI Related Inventions*

The AIP described above is a utopian system having all of the features theorized as being necessary to create a truly intelligent system comparable to the human brain. Although a considerable amount of technology has been developed in an effort to create the AIP, and a number of AI related inventions have been patented, none of these developments completely embody the AIP described above.[49] Many of the patented, so-called "artificially intelligent,"

48. The personality concept could become as generic to AI as the operating system has become to conventional computers, but since each AI system would require an individualized, application-specific personality, each AIP would require a different patent. Each patented AIP would protect only its particular AI system, not seek to preempt the concept of AIP itself. The fact that it is highly improbable that any two AI systems would accidentally employ the same hardware, software, purposes, design, and systems of heuristics and hermeneutics culminating in the same idiosyncratic intellectual properties, makes it highly unlikely that two or more AIPs would be unintentionally the same.

If AIP could maintain its integrity and remain relatively unchanged as other parts of AI evolve, then AIP could avoid a common pitfall of much of the software that seeks patent protection: obsolescense before the patent is approved or denied. "Accordingly, patent protection should be given serious consideration with respect to the basic new features [of programs which embody creative concepts which are expected to be long-lived]." Port, at 94.

49. U.S. Pat. No. 3,950,733 is an information processing system which illustrates an adaptive information processing system in which the learning growth rate is exponential rather than linear. U.S. Pat. No. 3,715,730 is a mult-criteria search procedure for trainable processors that illustrates a system having an expanded search capability in which trained responses to input signals are produced in accordance with predetermined criteria. U.S. Pat. No. 3,702,986 is a trainable entropy system that illustrates a series of trainable non-linear processors in cascade. U.S. Pat. No. 3,700,866 is a synthesized cascaded processor system that illustrates a system in which a series of trainable processors generate a probabilistic signal for the next processor in the cascade, wherein the probabilistic signal is a best estimate of a desired response for the next processor. U.S. Pat. No. 3,701,974 is for a learning circuit, or a type of learning element, used in some prior art systems. U.S. Pat. No. 3,613,084 is for a trainable digital apparatus which illustrates a deterministic synthesized boolean function. U.S. Pat. No. 3,623,015 is for a statistical pattern recognition system with continual update of acceptance zone limits that illustrates a pattern recognition system capable of detecting similarities between patterns on a statistical basis. U.S. Pat. Nos. 3,999,161 and 4,066,999 relate to statistical character recognition systems having learning capabilities.

Other patents that deal with learning systems that appear to be adaptive based upon probability or statistical experience include U.S. Pat. Nos. 4,704,695; 3,725,875; 3,576,976; 3,678,461; 3,440,617; and 3,414,885. Patents showing logic circuits that may be used in some of the above systems include U.S. Pat. Nos. 3,566,359; 3,562,502; 3,446,950; 3,103,648; 3,646,329; 3,753,243; 3,772,658; and 3,934,231.

Adaptive pattern, speech or character recognition systems are shown in the following: U.S. Pat. Nos. 4,318,083; 4,189,779; 3,581,281; 3,588,823; 3,196,399; 4,100,370; and 3,457,552. U.S. Pat. No. 3,988,715 describes a system that develops conditional probabilities character by character with the highest probability being selected as the most probable intersystems are really adaptive pattern, speech or character recognition systems that use probabilities or statistical information to form educated guesses as responses.[50]

Many newer systems are a combination of new developments and individual features disclosed in older systems, such as a probabilistic learning system which is capable of modifying its databases in response to feedback from the environment in which it operates in order to produce more appropriate behavior.[51] Expert systems have also received a considerable amount of patent attention. One patent covers a computer system that evaluates the problem solving ability of a target computer and then determines whether it would be practical to write a computer program for the target computer to solve a particular problem.[52] One system is even titled an "Artificial Intelligence System," and is described as performing processing analogous to the continuous train of thought produced by human beings in solving diverse problems.[53] However, this system is really an interactive language processor and expert system which contains a large database about a specific topic and which is capable of resolving information gaps, contradictions and ambiguities by questioning the user and suggesting more appropriate inputs.[54]

The language that is used in describing some of these systems could easily lead one to believe that they are indeed the utopian AIP described above. One such system is titled a "Knowledge Engineering Tool," and includes the following independent patent claim:

> 1. A knowledge engineering tool comprising a computer having memory for storing a knowledge base . . . wherein said knowledge base includes facts expressed as expressions equivalenced to corresponding values, rules including premises having logical operations and corresponding conclusions concluding at least one value for a selected expression, prescribing

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pretation of an optically scanned word. U.S. Pat. No. 3,267,431 describes a system that uses a "perception," a weighted correlation network, that is trained on sample patterns for identification of other patterns.

50. *See supra* note 49.

51. Denenberg, U.S. Pat. No. 4,599,693, issued July 8, 1986 for a "Probabilistic Learning System," assigned to ITT Corporation, discloses such a system which also uses parallel processing for enhanced speed, and overlapping and redundancy of tasks to enhance reliability. Slack et al., U.S. Pat. No. 4,593,367, issued June 3, 1986, discloses a type of probabilistic learning element which may be used in the above system.

52. Scott et al., U.S. Pat. No. 4,713,775, issued December 15, 1987, assigned to Teknowledge, Incorporated of Palo Alto, California and Compagnie Generale de Geophysique.

53. Scramm, U.S. Pat. No. 4,670,848, issued June 2, 1987, assigned to Standard Systems Corporation of Tampa, Florida.

54. *Id.*

> the manner in which facts and rules should be used, and declarations defining whether certain of said expressions are singled-valued or multiple-valued, and wherein said means for interpreting said knowledge base includes means for determining the value of any selected goal expression, means for searching the knowledge base for occurrences of the selected expression, means for invoking and chaining said rules concluding a value for the selected goal expression, means for evaluation said logical operations in the premises of the invoked rules, means for termination the searching of the knowledge base for a single-valued expression when a substantially certain value is found, and a for a multiple-valued expression when all values for the expression are determined, and means for conveying to the user said value of said goal expression.[55]

The above language reads on much of the AIP described above and would appear to claim an autonomous artificial intelligence system. However, the specification for the above patent and a commonly assigned related patent reveal that the described system is an expert system, and that the meta-control necessary to modify the knowledge base is supplied by an engineer interfaced with the system.[56]

B. *Patentability of Future AI Systems and the AIP*

In order to determine whether the AIP would be patentable, like the other patented forms of artificial intelligence, it is necessary to determine how these other inventions obtained patent protection. An invention can qualify for patent protection if it satisfies the requirements of 35 U.S.C. § 101, which provides, in part, that "[w]hoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor."[57] Many of the above patents covering artificial intelligence related inventions are for machines, systems, or process steps and therefore come under the definition of § 101. Although some of the above inven-

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55. Erman et al., U.S. Pat. No. 4,658,370, issued April 14, 1987, assigned to Teknowledge, Inc., Palo Alto, California.

56. *Id.*; *See also* Hardy et al., U.S. Pat. No. 4,648,044, issued March 3, 1987, for a "Basic Expert Sytem Tool," which has a similar independent claim that also includes the following language:

> 1. A knowledge engineering tool comprising a computer . . . said knowledge base also including control knowledge supplied by a knowledge engineer to modify the built-in control procedure, and a language interpreter for executing the control knowledge to modify the built-in control procedure, whereby the control knowledge can be separated from the factual knowledge and the judgmental knowledge and stored as a distinct portion of the knowledge base.

57. 35 U.S.C. § 101 (1982).

tions are related to software developments, they can still come under the definition of § 101, despite the generally wideheld belief that patent protection is not available for software.[58] Even an invention which is described as a higher-level flexible knowledge language (software), but is titled a "Method and Apparatus for Building Knowledge-Based Systems," has been given patent protection.[59] The reason that these inventions have been granted patent protection, even though software related, is that as long as an invention is claimed in relation to physical elements or process steps in an otherwise statutory process, machine, manufacture, or composition of matter, the invention can be patentable.[60]

Misunderstanding as to the patentability of software stems from the Supreme Court's holding in *Gottschalk v. Benson*, which stated that any type of patent which "would wholly preempt the mathematical formula and in practical effect would be a patent on the algorithm itself" could not be patented under § 101.[61] This decision was based on the understanding that laws of nature, physical phenomena, and abstract ideas are excluded from patent protection.[62] As a result of the Supreme Court's holding in *Benson*, and a number of other decisions,[63] any invention embodying an algorithm or law of nature was thought to be automatically excluded from patent protection.[64] However, the Supreme Court has subsequently held that a claim is not unpatentable under § 101 merely because it includes a step or element directed to a law of nature, mathematical algorithm, formula or computer program, so long as the claim as a whole is drawn to subject matter otherwise statutory.[65]

Accordingly, subsequent cases before the Court of Custom and Patent Appeals (now known as the Court of Appeals, Federal Circuit), have established that as long as the Freeman-Walter test is satisfied, a claim embodying an algorithm can be subject to patent

58. Maier, *Software Protection — Integrating Patent, Copyright and Trade Secret Law*, JPTOS 152 (March 1987).

59. Clemenson, U.S. Pat. No. 4,675,829, issued June 23, 1987, assigned to Intellicorp Corp., Mountain View, California.

60. In re Abele, 684 F.2d 902, 214 U.S.P.Q. 682 (C.C.P.A. 1982). *See also*, Ex parte John, 220 U.S.P.Q. 576 (P.T.O. Bd. App. 1983) ("Since the mathematical computation appears in apparatus and a process which are otherwise statutory subject matter, the instant claims are proper.")

61. Gottschalk v. Benson, 409 U.S. 63, 175 U.S.P.Q. 673 (1972).

62. Diamond v. Diehr, 450 U.S. 175, 209 U.S.P.Q. 1 (1981).

63. Parker v. Flook, 437 U.S. 584, 198 U.S.P.Q. 193 (1978).

64. Maier, *supra* note 58, at 152.

65. *Id.*

protection.[66] The Freeman-Walter test, a two-part test for analyzing mathematical algorithm-statutory subject matter cases, is derived from *In re Freeman*[67] as modified by *In re Walter*[68], and is as follows:

> First, the claim is analyzed to determine whether a mathematical algorithm is directly or indirectly recited. Next, if a mathematical algorithm is found, the claim as a whole is further analyzed to determine whether the algorithm is "applied in any manner to physical elements or process steps," and if it is, it "passes muster under § 101."[69]

If this test was to be applied to an AI system utilizing the AIP as a central core, having all of the desired abilities postulated above, it would resolve that the AIP is statutory subject matter under § 101. Although there may be serious questions regarding the statutory nature of the AIP itself, the AIP's embodiment in a computer system would absolve any § 101 problems. As was stated in *In re Abele,*[70] "if the claim would be 'otherwise statutory,' id.[sic], albeit inoperative or less useful without the algorithm, the claim likewise presents statutory subject matter when the algorithm is included."[71]

Patenting the AIP as a central core of an entire AI system would provide little protection for the AIP. If a type of car is developed and patented as a system, and the engine is not itself patented, the engine may be freely used for any purpose which does not infringe the system patent. Likewise, if the AI system is patented, but not the AIP itself, the AIP could be freely used for a wide variety of other applications. A true AIP would have a myriad of applications because of its flexibility and intelligence and would not be limited to use in the AI system, just an an engine is not limited to use in a car.

If other components of the AI system were capable of growing around the AIP, like software and peripheral devices grow around an operating systems, these would be further incentive for attempting to protect the AIP. By protecting the AIP, exterior variable portions of the system could continue to change and evolve, while the AIP remained relatively fixed, thereby retaining value in the original patent.[72] An AIP core design would allow the AI system

66. In re Abele, 684 F.2d 902, 214 U.S.P.Q. 682 (C.C.P.A. 1982); and In re Pardo, 684 F.2d 912, 214 U.S.P.Q. 673 (C.C.P.A. 1982).

67. In re Freeman, 573 F.2d 1237, 197 U.S.P.Q. 464 (C.C.P.A. 1978).

68. In re Walter, 618 F.2d 758, 205 U.S.P.Q. 397 (C.C.P.A. 1980).

69. In re Pardo, 684 F.2d at 915, 214 U.S.P.Q. at 678 (C.C.P.A. 1982).

70. *See* note 68 and text accompanying.

71. 684 F.2d at 907.

72. Relatively few programs are appropriate subject matter for patent protection. Be-

to be modified without changing other parts of the system, thereby maintaining the fundamental integrity of the AI system and keeping

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cause patent proceedings are expensive and time consuming, the program should be commercially important and should embody creative concepts which are expected to be long lived. Of course with respect to [short lived] programs, fundamentally new features which will survive for many years may be suitable candidates for protection. In this regard, broad patent protection, such as in the "means plus function" format, may continue to cover fundamentally new features even though subsequent enhancements of the program have caused the implementation of the feature to evolve into a specifically different form. Accordingly, patent protection should be given serious consideration with respect to basic new features of such programs.
In addition to the requirements of commercial importance and long life, a suitable candidate for patent protection should incorporate fundamentally new programming features or advantages. Programs which demonstrate little creativity will probably not be sufficiently inventive to meet patentability requirements.
See Diamond v. Diehr, 450 U.S. 175 (1981); Matter of Application of Bradley, 600 F.2d 807 (C.C.P.A. 1979), *aff'd*, 450 U.S. 381 (1981); Paine, Webber v. Merrill Lynch, Pierce, 564 F. Supp 1358 (D. Del. 1983). The primary claim in Matter of Application of Bradley is illustrative of the broad terms in which patent claims are typically formed:

> 1. In a multiprogramming computer system having a main memory, a central processing unit (CPU) coupled to said main memory, said CPU controlling the state of a plurality of groups of processes being in a running, ready, wait or suspended state, said computer system also having scratchpad registers being accessible to an operating system for controlling said multiprogramming computer system, a data structure for storing coded signals for communicating between said processes and said operating system, and said scratchpad registers, said data structure comprising:
> (a) first means in said data structure and communicating with said operating system for storing coded signals indicative of an address for a selected one of said processes;
> (b) second means in said first means for storing coded signals indicating priority of said selected one of said processes in relation to others of said processes for obtaining control of said CPU when ready;
> (c) third means in said data structure and communicating with said operating system, for storing coded signals indicative of an address for a selected one of said plurality of groups of processes; and
> (d) fourth means coupled to said data structure and said scratchpad registers, for generating signals causing the changing of information in said data structure and said scratchpad registers.

Matter of Application of Bradley, 600 F.2d at 809.
This claim is in "means plus function" format, a broad form of expression used to set forth the boundaries of the protection afforded by the patent. The "means plus function" format, for example, "second means. . .," is explicitly sanctioned by statute and is deemed to cover "the corresponding structure, material, or acts described in the specification and equivalents thereof." *See* 35 U.S.C. Section 112 (1982).

> In summary, the significant advantages provided by patents, with respect to both the breadth and reach of the protection, are tempting. Few programs, however, will possess the commercial importance, expected lifetime, and novelty required to be suitable for patent protection. With respect to the few that do, patent protection should be given serious consideration in view of its superior breadth and reach."

Anthony & Colwell, *Litigating the Validity And Infringement of Software Patents*, 41 WASH. & LEE L. REV. 1307, 1311.

the AIP from becoming obsolete before the patent application is approved or denied.[73]

The purpose of the AIP is to help and guide the AI system in its own search for appropriateness, and to protect, in patent, the essence of the system's intelligence and potential for growth. No algorithm,[74] in and of itself, could totally accomplish the purpose of the AIP because any algorithm would merely be an aide to the AIP's true function.[75] Any algorithm embedded in the AIP core would be secondary to the network of goals, hermeneutics, heuristics, learning and synergistic growth which would be the real invention comprised by the AIP and intended to be the system's mind. In addition, the AIP could not be said to preempt an algorithm because any calculated result of an algorithm embodied in the AIP would be fed back into the AIP (or the AI system) to form only a portion of the ultimate output of the system.

Even if the AIP was found not to preempt an algorithm, the AIP may still run into problems under 35 U.S.C. § 101. In *In re Chatfield*,[76] it was stated that there are "two categories judicially determined to be non-statutory, i.e., claims drawn to mathematical problem solving algorithms or to purely mental steps."[77] If the AIP was capable of intelligent thought and true flexibility, it might well be considered as equivalent to a human brain. If the Patent Office or a court were willing to analogize the AIP to the human mind, the AIP may be considered to preempt purely mental steps and therefore be non-statutory.

The kind of problems that might be experienced by an applicant for an AIP are shown in *In re Meyer*, which involved an application for a process and an apparatus for carrying out the process of testing a complex system and analyzing the results of the tests.[78] The patent examiner rejected all claims under 35 U.S.C. § 101 as drawn to non-statutory subject matter.[79] The specification and the appellant's own oral arguments indicated that the invention was concerned with replacing, in part, the thinking processes of a neu-

73. Davis, *Computer Firms Turn to Patents, Once Viewed as Weak Protection*, Wall St. J., Jan. 28, 1986 at 33, col. 3.

74. In Parker v. Flook, 437 U.S. 584, 198 U.S.P.Q. 193 (1978), the Supreme Court reiterated the definition of an algorithm set forth in Gottschalk v. Benson, 409 U.S. 63, 175 U.S.P.Q. 673 (1972), as "a procedure for solving a given type of mathematical problem."

75. This is due partially because of the Incompleteness Problem, and partly because of the nature and magnitude of the task required of personality.

76. In re Chatfield, 545 F.2d 152, 191 U.S.P.Q. 730 (C.C.P.A. 1976).

77. *Id.* at 157.

78. In re Meyer, 688 F.2d 789, 215 U.S.P.Q. 193 (C.C.P.A. 1982).

79. *Id.* at 793.

rologist with a computer.[80] In fact, counsel for appellants went as far as to acknowledge "in oral argument that the claims recite a mathematical algorithm, which represents a mental process that a neurologist should follow."[81] By applying the Freeman-Walter test to the claims, the court concluded that the claims were to an algorithm representing a mental process that had not been applied to physical elements or process steps and were therefore non-statutory.[82]

Although the outcome of *In re Meyer* was in part due to appellant's admissions that the mental processes replaced by the invention was an algorithm, the outcome should not have been a surprise. In *In re Castelet*, the same court stated that abstract concepts were not patentable and that in order for a claim to be statutory, it must define more then mere effect.[83] Likewise, in *In re Sarker* it was held that

> steps occurring only in the mind have not been made subject to patenting because mental processes are but disembodied thoughts, whereas inventions which Congress is constitutionally empowered to make patentable are tangible embodiments of ideas in the useful, or technological arts.[84]

Chief Justice Markey's holding in *In re Sarker* would appear to preclude patent protection for the AIP. However, Markey doubtfully had an AIP in mind at the time of the above holding, and would not be likely to apply the same restrictive test to such an important technological breakthrough.

An alternative argument that could be made in favor of the statutory nature of the AIP would relate to its metacontrol ability. As described above, the AIP provides an ultimate control function to the entire AI system; in essence, a computer which effects the operation of another computer.[85] A claim which relates only to the control of the internal operations of a computer that governs the manner in which programs are executed has been found not to embrace an algorithm.[86] Similarly, inventions for improving the internal operations of computers have been found statutory, notwithstanding the fact that they contained algorithms, because

80. *Id.* at 795.
81. *Id.*
82. *Id.* at 796.
83. In re Castelet, 562 F.2d 1236, 195 U.S.P.Q. 436 (C.C.P.A. 1977).
84. In re Sarker, 588 F.2d 1330, 1333, 200 U.S.P.Q. 132 (C.C.P.A. 1978).
85. Paine, Webber v. Merrill Lynch, Pierce, 564 F. Supp. 1358 (D. Del. 1983).
86. In re Abele, *supra* note 68.

the algorithms were applied to the computer in a different way.[87] Hence, an AIP's metacontrol ability may be considered sufficient to constitute an application to physical elements or process steps in accordance with requirements of § 101.

The vast number of communication channels likely to be utilized within an AI system makes such a system a prime target for severe noise related problems.[88] "Noise" is a term that is utilized to refer to persistent interference with electrical signals, but is more commonly recognized as the hissing noise heard over radio channels or uncorrectable variations in signals observed by an oscilloscope. An AI system plagued with noise problems would require an AIP that could filter-out and deal with noise within the AI system, such as illigitimate rules generated by mutant reasoning. Thus if noise removal or filtering was an important function of AIP, it could be argued that with respect to its filtering ability, AIP was statutory subject matter under § 101.

The bases for the above argument relates to two cases dealing with software that removed noise from seismic trace prospecting signals and thereby achieved better prospecting data.[89] The general rule presented in those case was that if the invention in question served to transform an input (a noisy signal) into a physically different output (a less noisy signal), then the invention was patentable within the meaning of § 101. Thus, if the AIP operated to transform inputs into physically different outputs, (new system states without noise), then the means by which such a new system state was generated could arguably be patentable. The argument could be made that the output is a system state just as the input was a system state and is therefore not really a physically different output; but the output of a seismic filtering program is a seismic trace just as the input was a seismic trace (albeit without the noise).

VI. CONCLUSION

Although this article has analyzed the patentability of an AIP in general terms, a general analysis is considered appropriate because (1) a wide variety of AI design philosophies and purposes are abundant, and (2) AI behavior, as opposed to conventional comput-

87. In re Pardo, 684 F.2d 912, 214 U.S.P.Q. 673 (C.C.P.A. 1982); and In re Chatfield, 545 F.2d 152, 191 U.S.P.Q. 730 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977).

88. PEDELTY, *supra* note 5, at 14-30.

89. In re Johnson, 589 F.2d 1070 (C.C.P.A. 1978); In re Sherwood, 613 F.2d 809 (C.C.P.A. 1980); In re Tanner 681 F.2d 787 (C.C.P.A. 1982).

ing, is more likely to occur in a flexible, relatively unorganized environment.

Many more arguments can be made as to why AIP is not an algorithm and should be within the statutory protection of § 101. However, many of these arguments lead to a conclusion that AIP is probably better defined as a preemption of mental steps, thereby taking it out of statutory protection under § 101. Despite efforts to remove AIP from applications relating to physical elements in the first part of this analysis, it is the AIP's ability to control other physical elements (metacontrol) which will probably provide AIP with statutory protection. It should also be noted that for those not familiar with patent law, the requirements of 35 U.S.C. § 101 are not the only prerequisites to patentability.[90]

In short, this article has attempted to devise a method for protecting a non-existent entity, the sine qua non of intelligence of an AI system, without having to patent an entire system. In this regard, the AIP concept should make sense. Whether an AI system will ever reach true intelligence is impossible to determine. If an AI system is developed which does exhibit truly intelligent behavior, a new rush for protection will begin, if it has not already begun,[91] which will probably be very similar to that experienced as a result of software and semiconductor chip developments.[92]

It could be argued that a patent on the personality of an AI system would unduly restrict development and research in other AI systems. However, the purpose of patent protection is to provide incentives to inventors. Although some restrictions might result, because of such incentives, new developments are constantly being created because of prior inventions. Humans must remember that like the artificially intelligent system described above, it is the human's ability to grow, learn and synergize that makes the human intelligent. Providing patent protection as an incentive to develop AI will also provide an incentive to go beyond AI into the future.

90. For example, 35 U.S.C. § 103 requires that the claimed invention be novel, useful and non-obvious, and 35 U.S.C. § 112 requires that the claimed invention be phrased in definitive and understandable terms, rather than couched in over-generalities.

91. See notes 49-56 and text accompanying.

92. Protection of Semiconductor Chip Products, 17 U.S.C. § 901 *et seq.* (1977).