



## Is There an AI Cosmology?

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In the past fifteen years artificial intelligence has changed from being the preoccupation of a handful of scientists to a thriving enterprise that has captured the imagination of world leaders and ordinary citizens alike.

This is a quote taken from the article “Artificial Intelligence in Transition” written by Peter E. Hart published in *AI Magazine* Volume 5 Number 3 over 30 years ago in 1984. The first paragraph of the article states:

THE FIELD OF ARTIFICIAL INTELLIGENCE is in the midst of a deep and irreversible structure change. The older research institutions that were almost alone on the AI landscape (at least in North America) in the late 60s and early 70s have been joined by a host of newer ones; new products based on the fruits of AI research have begun to appear and the public at large is beginning to believe that “intelligence” can be put in machines.

Something about that paragraph has a familiar ring. *AI Magazine* was not alone in helping to clarify the status and progress of Artificial Intelligence. Two years earlier, the ACM's *SIGART Bulletin*, a somewhat progenitor of our own *AI-Matters* newsletter, published in Issue 79, January 1982 an article entitled “DIRECTIONS FOR AI IN THE EIGHTIES”. The article starts off with the following paragraph:

The 1980s will be an exciting decade for artificial intelligence, one in which we can expect to see considerable progress on scientific questions, widespread application of AI techniques to programs of practical significance, and major changes in the social political and economic structure of the field. I will attempt to identify some of the commercial, scientific and sociological considerations that I think will be important in coming years. In particular, I will in-

roduce the metaphor of deep versus surface systems, and pose some challenges arising from the recognition of this distinction.

The article goes on to explain some of the short comings of AI efforts in the 70s and why things will be different this time for the AI technologies and techniques of the 80s. Both articles are contextualized at a time when there was an intense fervor, anticipation and excitement for all things AI. At the time there was incredible hype for latest AI technology. The technical media and many business journals were virtually intoxicated with AI's flagship technology, “Expert Systems,” which were everywhere and being touted as the smart panaceas for almost everything from sports predictions to some of societies largest challenges. Over 30 years later, the AI community, the tech media, business journals, and pop culture no longer have the zeal for, or infatuation with the promise of endless applications of the “Expert System”.

But if we could indulge ourselves (just for a moment) in a little time travel, we would see striking parallels between the frenzy over Artificial Intelligence's Expert Systems Era and the current frenzy over Artificial Intelligence's Machine Learning Era. The listing shows the domain and range of some of the more notable expert systems from the 70s and 80s and some of the current applications of machine learning. Paul Harmon and David King in their landmark book “Expert Systems Artificial Intelligence In Business” published in 1985 portray AI's transformation of business and industry at that time as being imminent. The inevitable magnanimous impact of each of the expert systems from the listing is detailed in Harmon and King's book. The impending transformation of our society by AI technologies in the form of Expert Systems was over 30 years ago.

*70s - 80s EXPERT SYSTEMS*

- **MYCIN** consulted and advised on meningitis.
- **DENDRAL** performed spectroscopic analysis on unknown molecules.
- **HEARSAY I and II** performed signal and speech processing.
- **PUFF** interpreted measurements from respiratory tests administered to patients in pulmonary lung function laboratory.
- **GENESIS** consulted on the nature of DNA molecules.
- **Drilling Advisor** assist Oil rig supervisors in resolving problems relating to the drilling process.

*CURRENT MACHINE LEARNING APPLICATIONS*

- **InnerEye** helps radiologists identify and analyze 3-D images of cancerous tumors.
- **FingerID** learns to predict molecular fingerprints from a large collection of MS/MS spectra then retrieves and rank candidate molecules from a given large molecular database.
- **Apple's ResearchKit** is used in the treatment of Parkinson's disease and Asperger's Syndrome by allowing users to access facial recognition apps that assess their conditions over time; their use of the app feeds ongoing progress data into an anonymous pool for future study.
- **Chatbots** speech recognition capability is used to identify patterns in patient symptoms to form a potential diagnosis, prevent disease and/or recommend an appropriate course of action.
- **Deep Learning** is used to train algorithms to recognize cancerous tissue at a level comparable to trained physicians.
- **Machine Learning** used to help optimize drilling operations and facility/well management as well as investment decisions in exploration and production.

It would seem the quest for the promises of AI undergoes these periodic hype-frenzy-transformation-adaptation cycles. It appears we are riding the crest of one of these cycles now with the machine learning + big data

phenomenon. There was certainly one in the 80s. There was one in the 40s even though it did not have the designation "Artificial Intelligence". In the 40s and 50s similar goals were pursued under the auspices of Cybernetics but that's the subject for another article.

Fast forward to today, and we have pronouncements by prominent researchers, venture capitalists, futurists, government agencies, and some multinational corporations about the impending transformation of our society at the hands of AI technologies. It is a fact that Expert Systems were transformative but for all their applications they didnt fulfill the promise AI. In fact in 2018, the fervor, hype and frenzy that Expert Systems brought society has all but been forgotten. It's almost as though AI is only just now starting to return dividends. For example on May 3, 2016, Ed Felton who was Deputy U. S. Chief Technology Officer in his "Preparing for the Future of Artificial Intelligence" letter wrote:

There is a lot of excitement about Artificial Intelligence (AI) and how to create computers capable of intelligent behavior. After years of steady but slow progress on making computers "smarter" at everyday tasks, a series of breakthrough in the research community and industry have recently spurred momentum and investment in the development of this field.

For the complete letter, see:

[obamawhitehouse.archives.gov/blog/2016/05/03/preparing-future-artificial-intelligence](http://obamawhitehouse.archives.gov/blog/2016/05/03/preparing-future-artificial-intelligence)

The letter goes on to talk about the impending impact of AI on the medical field and other areas. It introduces an entirely new set of enthusiasms for AI. The consortium Partnership on AI formed in 2016 consisting of a wide range of companies and organizations such as Amazon, Facebook, IBM, Apple, Google, Deep Mind, AAI, ACLU, ACM, and Microsoft has announced:

"We are at an inflection point in the development and application of AI technologies. The upswing in AI competencies, fueled by data, computation, and advances in algorithms for machine learning, perception, planning, and natural language, promise great value to people and society". With organizations such as

these behind this kind of statement one is compelled to believe that very significant benefits are in the cards for people and society at the hands of AI technologies. The 100 year study on Artificial Intelligence<sup>1</sup> delves in great detail about the status and potential promise of AI. The AI 100 report is informative. But so was so many of the reports and reporting from the Expert System era of the 1980s. How do we separate fact from fiction? How do we separate promising results from the hype that so often follows the publishing of those results? What is it about research into Artificial Intelligence that seems to lead to an almost periodic cycle of promising results, hype, frenzy, and then adaptation?

Simon Natale and Andrea Ballatore in their paper “Imagining the thinking machine: Technological Myths and the Rise of Artificial Intelligence” posits the notion that the rise of Artificial Intelligence was accompanied by a powerful creation myth:

“the creation of a thinking machine, which would be able to perfectly simulate the cognitive faculties of the human mind ...”

Natale and Ballatore go on to challenge and expose many of the phenomena associated with the rise then fall and then rise again of various incantations of Artificial Intelligence. We strongly recommend a thorough read of Natale and Ballatores work for anyone that may want a more sober or different interpretation of what’s going on with this AI stuff.

So what is a dutiful researcher, practitioner, student or interested onlooker supposed to make of the AI landscape? How should they interpret the hype-frenzy cycles, the conflicting information and definitions, the legitimate results, the exaggerated results, the real impacts, the promising futures, the feared and dreaded disappointing futures, the thousands of disparate blogs and advertisements all simultaneously claiming to refer to Artificial Intelligence?

### Is There a Need for an AI Cosmology?

It was these considerations (and a few more) that lead of to the question of whether there is a true Cosmology for Artificial Intelligence and whether one is needed. Typically, the term

<sup>1</sup>[ai100.stanford.edu/2016-report](http://ai100.stanford.edu/2016-report)

‘Cosmology’ is used in conjunction with the study of the Universe. One convenient definition for Cosmology “is the study, origin, evolution and the eventual fate of the Universe”. It is important to note that there are various theological, mythical, and scientific cosmologies for our Universe. But could we apply the concept to the notion of “An Artificial Intelligence Universe”? Is there a cosmology of Artificial Intelligence? Can we talk about the study, origin, evolution and the eventual fate of Artificial Intelligence? If there is a cosmology for AI, what would it look like? If there are multiple cosmologies for AI, what would be the justification for more than one? How would they differ?

Any valid AI Cosmology would force us to define its origin. And in defining its origin, we would have to be very specific in uncovering the goals of AI and the meaning of the term “Artificial Intelligence”. Does it refer human reasoning, memory, imagination, creativity, or other cognitive, or neurological capabilities? What is it’s structure? How is it evolving? What is it’s fate? Is AI an intersection of other areas of study? For example, Figure 1 shows a simplistic venn diagram of what might represent what we call AI.

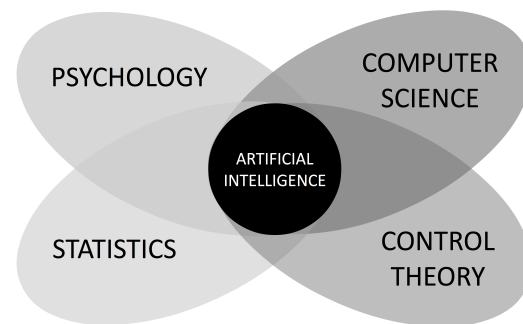


Figure 1: Venn diagram of AI.

We would be able to examine the major structures and processes at work in its evolution. An AI Cosmology would allow us to predict the vector of its fate. An AI Cosmology would depend on taxonomy. Figure 2 is a very simply but interesting starting point for a discussion on AI taxonomy.

A taxonomy for AI will help on the development of an ontology for AI or vice versa. A valid AI Cosmology would ultimately give us a discrete story for AI having a beginning, mid-

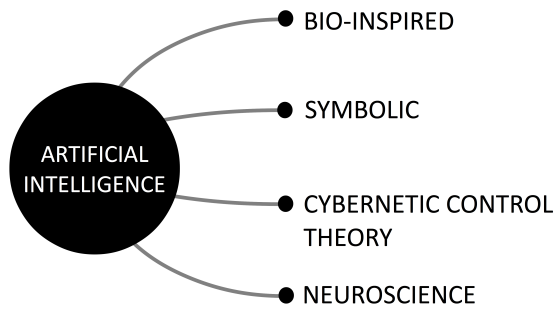


Figure 2: Stem of an AI taxonomy.

dle and end, allowing us to:

- Evaluate hype-frenzy cycles and predictions concerning AI
- Contextualize AI innovations
- Inform our moral and ethical discussion

But first things first. Just as our Big Bang Cosmology attempts to give us the true picture of the origins of the Universe, an AI Cosmology should attempt to give us a true picture of the origins of Artificial Intelligence.

*We would like to dedicate a column in AI Matters to the discussion and possible developmental beginnings for an AI Cosmology, beginning with identifying the true origins of Artificial Intelligence.*



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