

## Thought Leadership

### Differences in modern Artificial Intelligence systems



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All well-known A.I. systems today (IBM Watson, Google Deep Mind, Microsoft Cognitive Services/C, Cycorp's Cyc, et al) are actually only "partial" A.I.-capable systems. None of these systems possesses all of the various characteristics of a true, human-like intelligent brain. Thus, none are (as of yet) true "Artificially Intelligence" if that term is meant to describe a computing system capable of mimicking in a continuous behavior all of the cognitive attributes going on minute-by-minute, day-by-day in an actual human brain

Instead, each of these *partial* A.I. systems is architecturally different from the others, wherein each has been designed and built to focus on solving various different types of problems and/or capabilities which are part of human cognition. These "cognitive-like" problems and capabilities include such attributes as: autonomous discovery (self-learning), automated cognitive focus (continual guided awareness), deep statistical analysis (mathematical/algorithmic discovery), remembrance/knowing (stored reusable "Knowledge"), and other similarly important characteristics of human intelligence.

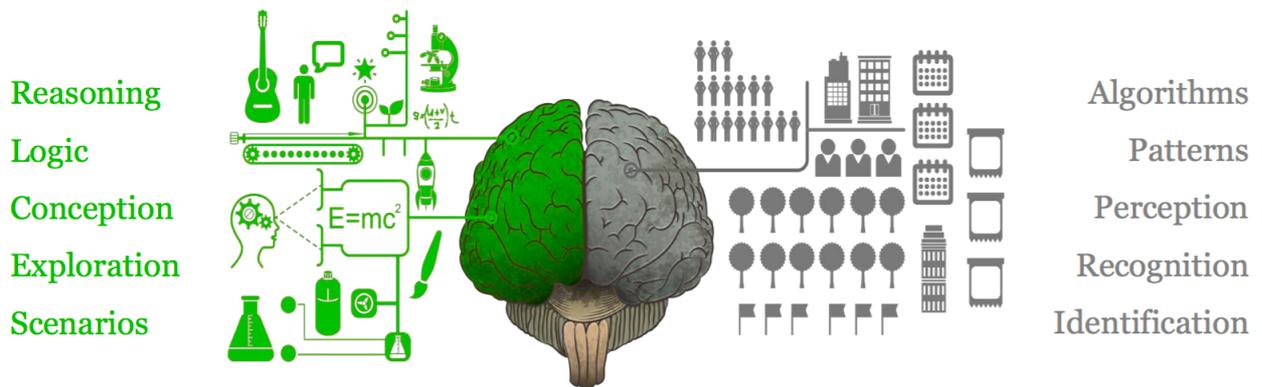
Although none of today's popular AIs do ALL of these things, the fact that each can perform impressive amounts of SOME of these capabilities allows them to be considered "AI". Most of these AIs leverage one or more types of "discovery" or "learning" capabilities called

"machine learning", "neural net", or "autonomous learning". These capabilities are effected by mathematical algorithms autonomously applied to large datasets to *discover* interesting patterns in the data, such as valuable types of trends, inflections, correlations, and other statistically-derivable understandings that could not have been readily discoverable without the aid of those autonomous systems.

These types of AI (IBM's Watson, Deep Mind, Cortana, et al) are loosely referred to as being "right- brain" pattern-istic replicas of humans' (and many other species') abilities to *perceive* and *delineate* patterns in large data sets which we need in order to better understand our realities. Because these AI systems mimic how human minds *perceive* such patterns or trends, but do so autonomously against far larger datasets than humans can cognize, they are said to be artificially-like human intelligence... thus...AI.

But...and this is a very important BUT...these types of so-called "right-brained systems" have several key drawbacks. They create very valuable findings by overcoming human cognitive limitations; discovering valuable patterns in data in autonomous ways, but they lack many other human - intelligence capabilities. They are only partially AI.

## Causal Reasoning + Machine Learning = Strong AI



**Logical / Causal Reasoning and Relevance**  
**Cyc = “What”, “Why” and “So What”**

**Algorithmic Pattern Matching**  
**“What”**

These Machine Learning/Neural-type of AI systems:

- do not actually KNOW what they are studying in any classical sense...meaning they aren't actually leveraging any sort of *conception* of pre-assembled underlying knowledge and/or logic structures to guide their statistical interrogations (humans instead have to use their conceptual reasoning powers to “train” these statistical approaches up-front);
- nor are they storing any of their self-discovered new-knowledge *concepts* into any sort of combined Knowledge-structure or “Knowing repository” (building a ‘brain’);
- nor are they able to “infer” with inferencing-powers (reasoning) lots of other Knowledge that might not have been in the data at all but could have been “non-statistically derivable” (obtained by using reasoning) from the data via the powers of inference/reasoning,
- nor can they “explain” their findings in any logics-based format. Instead, they are relying only on the statistical interrogation of the data to create the “veneer” of Intelligence (think of Siri on a phone as

*seeming* to be “smart” while not actually being Intelligent at all). Essentially, these systems fake being smart while not knowing anything.

These right-brain types of AI systems like Watson and Deep Mind are looking to answer the question of “WHAT is interesting” to find hidden within the data (correlations, trends, inflections, patterns etc.), but they are not built to answer “WHY” such findings might or might not occur (Causation of the phenomenon).

Also, they cannot extrapolate the “So-What” of their findings, knowing why those findings might be important or not to the Users’ needs (Relevance). Causation and Relevance are essential bedrocks, not only of human-like Intelligence, but also of ensuring that AI is at its most useful to users.

Essentially, they are required to take information about a User’s data to the next level, and can tell the User about that information in Natural Language and how the information was derived. **This capability would offer the *transparency* of an AI which is called for in, for example, the European “General Data Protection Regulation” 2016.**

Such Causation and Relevance capabilities in AI systems require a completely different type of system-architecture than using algorithms to discover correlations.

The ability of an AI system to be able to derive accurate understandings of Causation and Relevance about its findings requires a huge amount of "Prior Knowledge" and also "Subject-specific Knowledge", leveraged by various forms of "Reasoning and Inferencing" capabilities about that Knowledge in order for the system to "cognize" those causal/relevant understandings. Causation and Relevance, and the ability for the system to be able to explain what it knows to the User, are powerful, knowledge-based/reasoning-based capabilities which those right-brained forms of AI are not yet architected to try to solve.

A simple example helps explain these concepts, so consider two short fact-sentences of data:

1. Michael stole Tom's car.
2. After being paroled, Michael went on to have a good life.

Without any intervening additional data or facts, existing right-brained statistical AIs like Watson or Deep Mind could trivially correlate to high accuracy that Michael stole the car, that he earned parole, and that he went on to have a good life (given that these were definitively stated facts). Even if hidden within huge piles of data, these systems could find and report these facts with high accuracy.

BUT, most all the world's existing AIs (apart from the Cyc Technologies) could not further INFER that Michael not only got caught, but that he also had a trial or he pled guilty in lieu of one, that there was a judge and likely a jury at that trial, that the judge likely had a black robe and kept order with a gavel, that the trial happened in a courtroom possibly with a bailiff, that Michael actually lost the trial and was found

guilty, that he went to jail and served more than a few days on his sentence of jail-time, that he likely ate terrible food and had cold and dangerous showers while there in jail, and much more.

Humans can infer hundreds of thousands or maybe even millions of inference-able facts or truths about those two sentences which were NOT written at all anywhere in the data, by reasoning about prior knowledge that is somehow applicable to these facts.

*The power of human-like inferencing to know facts or truths which are NOT included in the data is enormously valuable, creating the most leverage possible from users of AIs.*

Cyc is the only existing deeply-"Causal type" of Knowledge and Inference-Reasoning-based, *commonsense* A.I. which can answer the original statistical correlations correctly from those two sentences just like other AIs, but which can also INFER all of those additional facts or truths from those sentences.

- Moreover, Cyc would explain WHY it knows all of those other facts or truths to be true, and in which perspectives or circumstances they might be true or not true (thinking about temporal, geographic, circumstantial, and/or hundreds of other constraints/perspectives).
- Furthermore, Cyc could likely infer thousands or tens of thousands of other facts which humans might have forgotten or not thought through completely. And, Cyc can offer detailed knowledge and reasoning to support each one of its findings, explaining also the Relevance of the findings, and doing so in plain Natural Language English to the User.

Like other AI systems, Cyc also has to be "taught" new Knowledge about any new processes it's being focused upon. However, Cyc has already been taught in its 35+ years a

huge amount of core underlying “commonsense” (literally the massive amounts of “sense” i.e. knowledge that is “common” among all humans to “make sense of” the world).

## “Cyc is the only commonsense A.I.”

Thus, much like a generally smart human, Cyc can be rapidly taught new Knowledge about new things in short timeframes to create new

Applications. This App-construction process now typically takes less than 3/4 months to reach a successful POC, and less than 9/12 months to reach V1.0...with ongoing learning by the App and *only marginal additional investments needing to be made by the User to own a hyper-intelligent process App which transcends human capabilities and continuously improves.*

In fact, in more than 100+ documented applications of Cyc, all have overcome that initial cost/benefit justification hurdle needed to justify any such capital investment.

In each of those applications, Users were typically adding much less than 2% of new Knowledge into Cyc to build each new App because of how much Cyc knew about the world

in general and about their industry/processes prior to engaging in the App building process.

Currently, work is underway to make Cyc autonomous; this capability will enable Cyc to intelligently and autonomously “logically unify” new knowledge and “dynamically-orchestrate” disparate, heterogeneous computing systems for global corporations as if they were one unified, common system. We know HOW to do so, we specialize in doing large “pieces” of such engagements already via Cyc’s Semantic Knowledge Source Integration (SKSI) capabilities, and these progresses are expected to emerge in the coming year or two at most.

While all other forms of AI on Earth have only required thousands of hours to research, build, and deploy, The Cyc Technology is now more than 35 years old, encompassing far more than 2 million hours of creation and ontological work by employees with PhD level qualifications to enable its singularly unique commonsensical, causal reasoning capabilities.

***Note:** We use the simplistic ‘left/right’ brain analogy to help readers understand AI while recognizing that modern cognitive scientists see this explanation of the human brain as a fallacious characterization of how our brains actually work.*

**About the author:** *Michael E. Stewart is the Chairman, CEO and a Founder of Lucid. He has a long career as an entrepreneur and innovator. As a partner in the Torii Group (2005 to 2009), Mr. Stewart performed consulting services in business change management, enterprise risk management and IT systems for the commercial real estate and insurance industries.*

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