Artificial Intelligence

by

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A Brief History of AI

5th century BC
Aristotle invents syllogistic logic, the first formal deductive reasoning system.

16th century AD
Rabbi Loew supposedly invents the Golem, an artificial man made out of clay
17th century
Descartes proposes animals are machines and founds a scientific paradigm that will dominate for 250 years.
Pascal creates the first mechanical calculator in 1642

18th century
19th century

George Boole creates a binary algebra to represent “laws of thought”

Charles Babbage and Lady Lovelace develop sophisticated programmable mechanical computers, precursor to modern electronic computers.
20th century

Karel Capek writes “Rossum’s Universal Robots”, coining the English word “robot”

Warren McCulloch and Walter Pitts lay partial groundwork for neural networks

Turing writes “Computing Machinery and Intelligence” – proposal of Turing test
1956: John McCarthy coins phrase “artificial intelligence”

1952-62: Arthur Samuel writes the first AI game program to challenge a world champion, in part due to learning.

1950’s-60’s: Masterman et. al at Cambridge create semantic nets that do machine translation.
1961: James Slagle writes first symbolic integrator, SAINT, to solve calculus problems.

1963: Thomas Evan’s writes ANALOGY, which solves analogy problems like the ones on IQ tests.

1965: J. A. Robinson invents Resolution Method using formal logic as its representation language.
1965: Joseph Weizenbaum creates ELIZA, one of the earliest “chatterbots”

1967: Feigenbaum et. al create Dendral, the first useful knowledge-based agent that interpreted mass spectrographs.

1969: Shakey the robot combines movement, perception and problem solving.
1971: Terry Winograd demonstrates a program that can understand English commands in the word of blocks.

1972: Alain Colmerauer writes Prolog

1974: Ted Shortliffe creates MYCIN, the first expert system which showed the effectiveness of rule-based knowledge representation for medical diagnosis.
1978: Herb Simon wins Nobel Prize for theory of bounded rationality

1983: James Allen creates Interval Calculus as a formal representation for events in time.

1985: ALVINN, “an autonomous land vehicle in a neural network” navigates across the country (2800 miles).

Early 1990’s: Gerry Tesauro creates TD-Gammon, a learning backgammon agent that vies with championship players

1997: Deep Blue defeats Garry Kasparov
Modern Times (post-Cartesian)

Robopets
Widespread viruses, security holes aplenty
AI-powered CRM
Faster—and many more—computers
A word about paradigms...

AI will force a dualistic view of life to change because the environment will be inseparable from it. Axiological shifts will occur in defining life, causing society to expand current definitions of life (e.g. requirement of a body). Also, the connectedness of the local environment to AI will force science away from a reductionist view of this new life and into a more complex view of interactions causing life to arise.

On the other hand, most scientists would be happy to view the brain as a vast but complex machine. As such it should then be possible to purely replicate the brain using artificial neurons. This has already been done for very simple life forms such as insects which only have a few thousand neurons in their brains. In principle, it would not be necessary to have a full scientific understanding of how the brain works. One would just build a copy of one using artificial materials and see how it behaves.
ETHICAL CONSIDERATIONS

Utilitarianism supports the development of AI, but only because of the Christian value of dominion over the environment. AI promises to increase control over life, thus suffering can be reduced. Yet, if AI is developed and not forced into particular tasks, Utilitarianism may not apply.

Artificial life may be viewed as more expendable than human life, so AI will be used as cheap labor, or perhaps slaves, thus increasing profits for corporations.

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- Rights Based Ethics
- Once AI programs achieve a modicum of sentience, should they be given rights on par with other animals?
- Two sides of the argument:
  1) No, because sentience is impossible to determine.
  2) Yes, because sentience can be proven beyond a reasonable doubt.
Duty ethics

Consequence of developing AI is not at issue. What obligations do we have to our biological children? Once AL is created, are they to be a Frankenstein’s monster and cast off without help, or are they to be guided by their creator, like Adam & Eve in Eden.

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Do we have a responsibility to our biological children similar to AI? Are the two exactly the same?

What rules should we use as categorical imperatives? AI should contain a set of rules that most people share, like “do not kill, unless in self-defense” or “do not lie, unless the suffering caused by honesty is large”.
Confucianism

- Confucianism is, in part, similar to Kant’s duty ethics: “don't do to others what you would not want yourself” (reciprocity)
- Yì, not Lì: actions should be based on righteousness, duty and morality, not on gain or profit.
- Rén: “benevolence, charity, humanity, love, and kindness”
But AI is also an advance in civilization; it makes it possible for everyone to live more comfortable lives.

Thus, Confucianism seems to encourage development and application of (non-sentient) AI, so long as it does not endanger others.

If the AI is sentient, however, it would have to be treated humanely without exploitation, and could not be created out of individual or corporate greed.

Though Confucianism can be seen as a religion, it is also a code of ethics, which suggests that it would be more open to considering AI to be alive and deserving rights than other spiritual mythologies.
Virtue ethics

Difficult to predict what virtues to give Artificial life because it is a complex technology. Unable to see the results of these virtues may be a problem because there are risks involved with some virtues overpowering others.

What preprogrammed “virtues” should computers have to allow them to be morally right? Can virtues make an AI entity behave morally at all?

Wisdom, compassion, courage, strength, obedience, carefulness...?
Artificial Intelligence / Life

- Establishing Artificial Creature is that Artificial Life and Artificial Intelligence

  - **Artificial Life**:
    Human-made systems that possess some of the key properties of natural life. It has self-preservation through changeable environment.

  - **Artificial Intelligence**:
    Science and engineering of making intelligent machines in which behaviors maximize the chances for self-preservation of that system in a particular environment.

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Conceptual Diagram

- **Science**: Physics, Chemistry, Biology, Ecology, Ethology, Meteorology, Medical Science, Engineering, Philosophy, Logic, Cognitive Science, Psychology
- **Models**: Evolution, Computing, Neural network, Fuzzy System, Cellular automata, Nonlinear dynamics, Autonomous agents, Immune System
- **Emergence**: Complexity, Robustness, Homeostasis, Open chaos
- **Realization**: Software, Hardware, Wetware, Philosophy
- **Intelligence**: Life Simulation, Game algorithm, Information Processing, Computer Graphics, Virtual Creature, Entertainment, Explorer, Autonomous robot, Meme agent, Micro robot, Evolutionary hardware, Biological robotics, Gene manipulation
- **Agent Cell**: Sense, Actuation, Environment

- Both Engineering and Scientific Viewpoint
ADVANTAGES (Factual Changes)

Smarter artificial intelligence promises to replace human jobs, freeing people for other pursuits by automating manufacturing and transportations.

Self-modifying, self-writing, and learning software relieves programmers of the burdensome task of specifying the whole of a program’s functionality—now we can just create the framework and have the program itself fill in the rest (example: real-time strategy game artificial intelligence run by a neural network that acts based on experience instead of an explicit decision tree).

Self-replicating applications can make deployment easier and less resource-intensive.

AI can see relationships in enormous or diverse bodies of data that a human could not.
Intelligent Transport Systems

- Web-Based Traveler Guide System
- Traffic Flow Analyzing System

Test Area

Gang-Nam, Seoul, Korea
5X4 network

3D Navigation Screen
Front direction board
Site Map
2D path / Present position
Turning direction indication
Animation control key

TOD (Time Of Day) Signal Control

Although there are no moving cars, unnecessary display lasts for 25 seconds. (Signal periods are independently uniformed with the existence of vehicles on standby)

Adaptive Signal Control

If there are no cars between minimum and maximum time, screen will show the next display. (Signal periods vary with the existence of vehicles on standby)
Realization

Cost
Low
- Entertainment
  - Avata
  - Robot soccer
  - I-Robo
  - Aibo
- Human Aide
  - Secretary
  - Fault monitoring
- Automation
  - Autonomous Driving
  - Home Automation
- Industrial
  - Mining Machinery
- Exploration
  - Rover Sojourner
  - Bathy-scaphe

Necessity
High
Reliability

Implementation

- Autonomous Mobile Agent (Robot Car Race)
  - Intelligence in Competing Environment with Real time
  - Multiple Agent with Changing Environment

System Architecture

Acquisition of Environment → Sensor → Recognition → Decision → Actuation → Motor → Effect on Environment

Environment: Track, Cars, Obstacles

Sensor: Position, Border, Obstacles

Recognition: Trajectory, Overtake, Avoid

Decision: Prediction, Constraints, Safety Rule

Prediction: Learning, Effect of action, Obstacle moving

Constraints: Evolution, Best choice, Goal, Plan, Strategy

Experience: Sequence of action, Database

Bias

Motor: Acceleration, Brake, Steering
Disadvantages (Risks)

- Potential for malevolent programs, “cold war” between two countries, unforeseen impacts because it is complex technology, environmental consequences will most likely be minimal.
- Self-modifying, when combined with self-replicating, can lead to dangerous, unexpected results, such as a new and frequently mutating computer virus.
- As computers get faster and more numerous, the possibility of randomly creating an artificial intelligence becomes real.
- Military robots may make it possible for a country to indiscriminately attack less-advanced countries with few, if any, human casualties.
- Rapid advances in AI could mean massive structural unemployment.
- AI utilizing non-transparent learning (i.e. neural networks) is never completely predictable.
Mythological Considerations

- Do sentient programs have a soul?
- Christianity says no because a soul is imparted by God alone, and not by Computer Scientists, yet Christianity does dictate that we control the environment around us, thus if cyberspace is part of our environment, would AI allow us to control it?
- Buddhism and Taoism take a different stance.
Buddhism and Taoism

The Hua-Yen school of Buddhism offers as the metaphor for the world an infinite net, at each intersection of which lies a jewel in which exists every other jewel and where every part of the net depends for its existence on dynamic awareness of every other part. This is in line with the axiological shift that would likely result from developing Artificial Life; environment and individual life are one.

Buddhism and Taoism value life above all else, so AI would be valued just as highly as all other life, once developed. Creation of AI would be opposed because AI does not share the tenets of the 8-fold path.
Christianity, Islam, Judaism

Oh my!

- Christianity, Islam, and Judaism are (at least in relation to AI) very similar: they all state God created man in his own image
- So:
  - How can man create artificial life if God is the creator of life? (“Say unto them, O Muhammad: Allah gives life to you, then causes you to die, then gathers you unto the day of resurrection...”)
  - If AI programs are sentient and as smart or smarter than humans, is man still the highest of worldly life?
  - Does sentient AI have a soul? Does it ascend to heaven when it is deleted? Or when it stops running temporarily (and then is reborn)? How do you baptize software? And so on...
Because they will not accept AI as life, Judaism, Christianity and Islam do not care about the rights and treatment of any AI.

Instead, they will focus on the dangers to humans.

Christianity concerned with orthodoxy (correct belief), while Islam and Judaism concerned with orthopraxy (correct action)

Should you release (potentially dangerous) AI software if you have tested it to your satisfaction or if you have applied a set testing protocol?
- Judaism and Christianity hold that man has free will; however, Islam is more slanted toward predestination (“By no means can anything befall us but what God has destined for us”).
- Digital AI doesn’t appear to have free will: all inputs and outputs to an AI program are discreet and reproducible, as are the AI program’s state and execution (its “memory” and “thought”). Given the same conditions and the same input, digital AI software will always produce the same output.
- Notice, however, that this could be true for humans as well, but is unverifiable because our inputs, outputs, memories and thoughts are not easily accessible or reproducible.
- Bottom line: in most ways, sentient AI doesn’t make sense in the context of these religions, and, in some cases, is contrary to their beliefs.
- And thus Christianity, Islam, and Judaism would not accept any AI as sentient, and probably not even as life.
Applied Ethicist’s Stance

- Macroethics-current societal values is dominated by Utilitarianism, thus AI is likely to continue.

- Microethics-depending on a person’s spirituality, this may influence the codes of conduct designed into artificial life.

- Mesoethics-if a company develops AI, it will produce a utilitarian creature. If research institutes develop AI, then it may contain various ethical standpoints depending on who is doing the research and development.
The Future?

- Idea of Artificial Intelligence is being replaced by Artificial life, or anything with a form or body.

- The consensus among scientists is that a requirement for life is that it has an embodiment in some physical form, but this will change. Programs may not fit this requirement for life yet.
Should we start caring yet?

- Very sophisticated—perhaps even sentient—AI may not be far off; with sufficient computation power (such as that offered by quantum computers) it is possible to “evolve” AI without much programming effort.

- Today, concerns include mutating viruses and the reliability of AI (you don’t want software directing your car into a tree).
What should happen

- When programs that appear to demonstrate sentience appear (intelligence and awareness), a panel of scientists could be assembled to determine if a particular program is sentient or not.
- If sentient, it will be given rights, so, in general, companies will try to avoid developing sentient AI since they would not be able to indiscriminately exploit it.
- Software companies should be made legally responsible for failings of software that result in damage to third parties despite good-faith attempts at control by the user.
- AI and robotics have the potentially to truly revolutionize the economy by replacing labor with capital, allowing greater production—it deserves a corresponding share of research funding!
And what is going to happen...

- Most people are willing to torture and kill intelligent animals like cows just for a tastier lunch—why would they hesitate to exploit artificial life?
- This is further compounded mainstream religious beliefs
- Even with laws, any individual with sufficient computing power could “evolve” AI without much programming.
- Licensing agreements will continue to allow careless companies to often escape responsibility for faulty software.
- Bottom line: ethical considerations will be ignored; reform—if it happens—will only take place when the economic costs become too high.