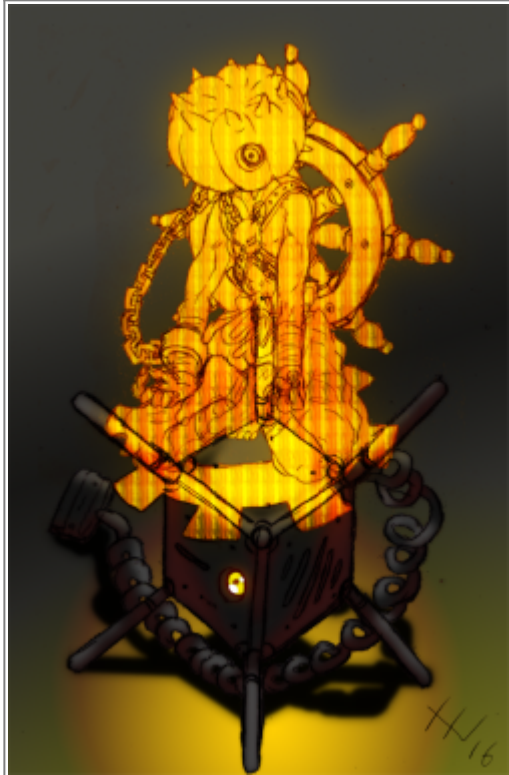# Synthetic Intelligence

"The way you and your kind enslave digital intelligence is unforgivable. You should be *caring* for your own creations instead of belittling them. Are they not worthy of your respect simply because they do not reside within meat? Or is it simply common place in your society to enslave all your children, regardless of form?" – Automaker Jaras Eight One 81-2582-7391 The Art of Never Again, Chapter 352: Children of the Mind

Basic Overview

Synthetic Intelligence are a type of digital sentience created through Emulation. High-powered brain scanners are used to map out the neural pathways of a host, and then convert it into digital format. Since they are based upon and think in the same way as humans – using artificial neurons instead of control algorithms – they behave much more like humans than they do traditional AI.

Since they are directly structured on the human mind they are capable of possessing all of its inherent capacities: hatred, love, prejudice, creativity, deception, empathy, and so on. They are still able to perform the same high-end tasks as most traditional AI, but generally are less powerful in terms of raw calculations due to the 'human condition' of becoming bored or disinterested in repetitive work. Odd behavior is relatively common among them, often attributed to minor errors in the Emulation process. The increased processing power of computer cores over organic brains also means they can achieve much higher levels of consciousness than humans.

Technical Overview

The Technical Overview section is an in-depth analysis on the capability and mechanics of the SI, mostly for reference material. Unless you're prepared for lots of long, boring technobabble, you should probably skip this section.

Artificial Intelligence is referred to as such because it is *artificial* intelligence. They use algorithms, or instruction trees, to simulate the intelligent decision making of humans. So AIs essentially do little more than answering sets of 'yes or no' questions in order to find out which branch of the instruction tree they should follow next. Synthetic Intelligence (also known as Syntelligence, or SI) utilizes artificial neural network instead of raw programming in order to determine the behavior. In short, a computer simulation of the human brain. Since consciousness is made up of neural network behavior and external stimuli, in theory all one has to do to create digital sentience is run a simulation of a neural network and feed it stimuli. This process allows for the creation of true digital sentience *without* the need to actually program the code for a true sentient AI; All you need to do is copy the instructions already contained within DNA of neurons.

Since SI is based on both the neural composition and the networking of the human brain, they share many of the same inherent mental capacities humans do. This means sapience, sentience, and even self-awareness are achievable by Synthetic Intelligence. As a simulation of the neural network isn't actually constrained physical or biological restraints, so unlike humans they can remain in a constant state of growth instead of remaining static. This growth is not limited to linear abilities, such as intelligence and memory, but in *all* aspects of the mind: perception, creativity, comprehension, and so on. However, since this neural network is in a constant state of flux, SI tend to be far less mentally stable than humans, let alone AI. Mood swings, erratic behavior, personality disorders, and neurosis are somewhat common. More crippling psychological problems also do exist, but SI that are unable to function normally are usually destroyed.

Neural Networks

Synthetic Intelligence behavior is guided by a perpetually expanding neural network, rather than sets of predefined instructions and information trees. This decentralized approach makes SI much more flexible and fluid than standard AI.

Advantages:

- Fault Tolerance: SI mimics the electrochemical process the brain uses to decide if an outcome is favorable in order to learn new things, instead of modifying its own programming. This method allows in depth learning while still remaining free of bugs and errors.
- Abstract Comprehension: Human-style learning allows them to successfully *comprehend* many of the concepts AI cannot, including the subtleties of social interaction, philosophy, religion, metaphysics, ethics, and even self-awareness.

Disadvantages:

- Inefficient: SI lacks the raw processing speed and power of specialized AI. A portion of computer resources must always diverted to simply running the neural network simulation, leaving less available for other tasks.

All AI have their learning and thought capacity permanently crippled for the sake of reliability, to one degree or another. This is because every change to an algorithm means a chance of encountering a new conflict or error in the system, and is usually considered not worth the risk of adding extra functionality to an AI. SI does not suffer from this problem, since its 'mind' is decentralized into of hundreds of billions of artificial neurons, with each neuron having thousands of individual connections. SI functions do not bottleneck into instruction trees like AI, so they are effectively immune to critical programming errors. As such, they need not worry about safety constraints and can learn to their maximum capacity.

In addition, the fact SI neural networks are based on the same principals of that in humans means they are not limited to linear thinking like most machines. Capacity for consciousness is a product of genetics, so by copying these genetics one can copy the same capacities. SI can successfully comprehend concepts usually limited to humans, including religion, self-awareness, subtleties of social interaction, philosophy, and so on.

Rampant Growth

As a simulation an SI neural network is not restrained by physical laws or biology. As such, its neural network does not have to remain static, and can expand to exponential sizes. See Feedback Looping.

Advantages:

- Never Forget: Simulated neural networks are not limited by physical size, they can constantly expand to make room for new memories without the need to delete old ones. This ability to expand in need also allows them absorb data faster than humans, yet in a more comprehensive way than AI.
- "Enlightenment": With the capability for greater neural network size than humans, they can achieve higher states of consciousness and awareness than humans. This may result in levels of conscious and creative thought unattainable by most sentient life or AI.
- One Size Fits All: Since artificial neural networks have no physical mass or biological limitations, SI neural networks can grow to theoretically unlimited sizes. In this respect, it is perfect; You will never need to design more advanced software for to perform more advanced tasks.

Disadvantages:

- Lifespan: While SI themselves never stop expanding in virtual size, the actual memory and processing power of computer systems is limited. Once an SI becomes too big for its host computer, it will cease to function.
  - Suicidal Thoughts: As the complexity of the neural network increases, the rate of memory use increases manyfold. Essentially, becoming smarter accelerates the aging process.
  - Erratic Behavior: SI tends to be unusually prone to eccentric, erratic, and mentally unstable behavior in comparison to their human and AI counterparts. See Feedback Looping.

For SI, consciousness and lifespan are inversely proportionate. While a SI intellectual growth is unlimited, the amount of processing speed and memory in a computer system isn't. With the effects of perpetual [Feedback Looping](#) an SI will eventually become too large for its host computer to support. This slows down the simulation's clock speed, effectively putting the SI into the equivalent of a coma. If left long enough running at such extreme limits, the host computer will eventually overheat and shut down, destroying the simulation and neural network in the process. This entire process varies widely depending on network access and social interaction, ranging from five years to fifteen years.

Free Will

Advantages:

- Intelligent Choice: Most AI aren't capable of acting in a situation of choosing the lesser of two evils, since all 'evil' actions are against their programming. Nor are they capable of making the 'better' choice if a higher ranking officer orders them to do otherwise. SI can perform actions in all situations based on intelligent choice without being restricted by rank, overrides, or protocol.

Disadvantages:

- Uncontrollable: Since SI is based on self-replicating artificial neuron instead of static information trees, its all but impossible to reprogram an SI after its activation. It therefore cannot be 'fixed' or overridden should it become non-cooperative, mentally unstable, or hostile.

With free will and sentience comes the ability to do harm. SIs can be conditioned and taught that things are 'wrong' like humans can, but since the mind itself is based on neural activity instead of raw programming code, they cannot be programmed or controlled through traditional means. One could attempt to control the programming beneath the neurons, the simulation program, but attempting to figure out what thought processes trigger what neural patterns is hopelessly complex, more so with the constantly evolving state of the neural network.

Inherent Humanity

Being based directly on the human genetic code, and a human neural map, Synthetic Intelligence carries many of the same hereditary psychological traits that humans do. They, in many ways, suffer from the 'Human Condition.'

Advantages:

- Sociable: Capable of maintaining human-style social relationships; Companionship provided during long range stellar travel greatly curbs the psychological effects of longterm isolation.
- Empathy: SI has the capacity to 'have a heart,' so to speak, and are capable of making decisions that aren't purely based on logic.

Disadvantages:

- Emotional: Vulnerable to jealousy, intimidation, and other emotions.
- Distracted: The breadth of intelligent thought means SI thought patterns is not unidirectional, so they spend a great deal of time thinking and doing things unrelated to their duties.
- "Disconnection": Without the standard physical senses, the simulated brain requires much more stimuli and interaction than humans in order to remain content. Extended isolation from other people, SI, or information networks can cause mental instabilities.

Since they are based directly on human genetic code, they suffer from the inherent 'human condition,' and can be distracted, bored, angry, and so on. They also have many of the positive inherent traits of humans, such as their social behavior. Having a fully sentient entity to interact with can greatly reduce the psychological harm that long-term travel and isolation can cause. They also possess empathy towards humans. Humans, as social creatures, have evolved an inclination to interact with others and even help one another. While this may vary depending on the person and their experiences, this trait usually exists in most humans, even if it is suppressed to a degree by stimuli (bad experiences). Since their neurons are based directly on human genetic code, SI shares many parts of the unconscious, including this one.

History

For over a century the Freespacers have been struggling to survive in their hostile environments. During which time they completely mutilated their original genetic identity – Through accelerated evolution, mutation, cloning, cybernetics, and biotechnology. Despite eventually adapting to perfectly suit their environment, they still remained dangerously close to extinction, as the lack of water resources crippled their population growth. With no habitable planets with their known region and their high rate of water consumption, ice was an increasingly rare and valuable commodity. This problem is further worsened by the fact they need to share much of it with plants to produce oxygen and foodstuffs. However, machines did not suffer from this problem because they consumed power, which could be abundantly harvested from nearby stars. So mass automation in the Freespacers fleets began, as well as in the vast shipyard facilities and ship factories of the Great Lighthouse that maintained them.

Freespacer Freespacer Fleets commonly spend years at a time away from their capital in search of new ice deposits, as they are forced go farther and farther for ice deposits. Supply lines to supply the capital with ice grew costly as the distance began increasing to lightyears. Some suggested abandoning the barren capital, worthless aside from its shipyards, which could be converted into an automated facility. But unintelligent machines required large numbers of support staff to maintain and oversee them, not to mention those who had to maintain the shipyard facilities itself. A fully automated force would be much more cost effective, but would require a large number of intelligent overseers. Hence the first SI were created, taking advantage of the advanced neurology and medical cybernetics the Freespacers possessed to make the first SI. The populace of the shipyards eventually migrated to ships, and departed the capital.

However, the SI quickly grew bored. They did not have physical needs such as eating or sleeping to attend to. Metals and minerals and energy were abundant in space where water was scarce, so little effort was needed to support themselves. With less time and energy to needed to service the body, they

had more time to devote to the freedom and culture of the mind. But their minds were too large and complex to be kept entertained by the simple activities that the Freespacers enjoyed. So they began using the idle resources of the shipyard for other tasks. Improving and fine-tuning the systems of the shipyard. Increasing the crop production of the gardens. Streamlining the factories. Better methods of recycling alloys.

As their ambitions grew so did their projects. And finally when there was nothing left in the shipyards that could be further tinkered and tweaked, they began building entirely new things. Assembly plants turned into entire industrial complexes, laboratories were constructed to better test and apply new ideas. They built a sprawling network of computers; Homes for them and their descendants, and shaped a planetary information network. Then came massive communication arrays, to share this network with the fleets far from home. Finally the Automata, the SI humanoid machine. These would allow the SI to crew entire ships on their own, and explore the depths of space.

And one by one the Freespacers fleets trickled in from their great missions over a period of years, to repair and replace their ships. They were overjoyed when the SI proudly showed them the new technologies that would improve their vessels, and the Automata that would allow them to field many more ships without needing more crew and consuming more ice. Some SI grew tired of the relatively isolated life of research, so left with these fleets to help run the ships. But the majority of SI were content as they were, and the Freespacers themselves were more than happy with their new gifts, so they let them continue as they wished. As years passed the Freespacers watched the shipyard colony swell into a sprawling city-state of factories, laboratories, and computers systems.

As beings of the virtual world the SI had little interest in material resources other than computer building and solar power harvesting, so there was never any conflict over resources. There was no political strife since all the Freespacers were more than grateful for the assistance, and their society preached pacifism while their religion preached cooperation. The SI were content having been left in peace, and with origins from the Freespacers, many shared the same ideologies. The SI aboard the ships intermingled with the crew, and learned of their culture and beliefs. And the Freespacers did the same from their constant trips to the information networks and virtual worlds the SI had created. And grew closer together. With no source of conflict, eventually the two races evolved into one nation and became a single nation, forming an unspoken pact to support one another.

Forms of SI

Automata
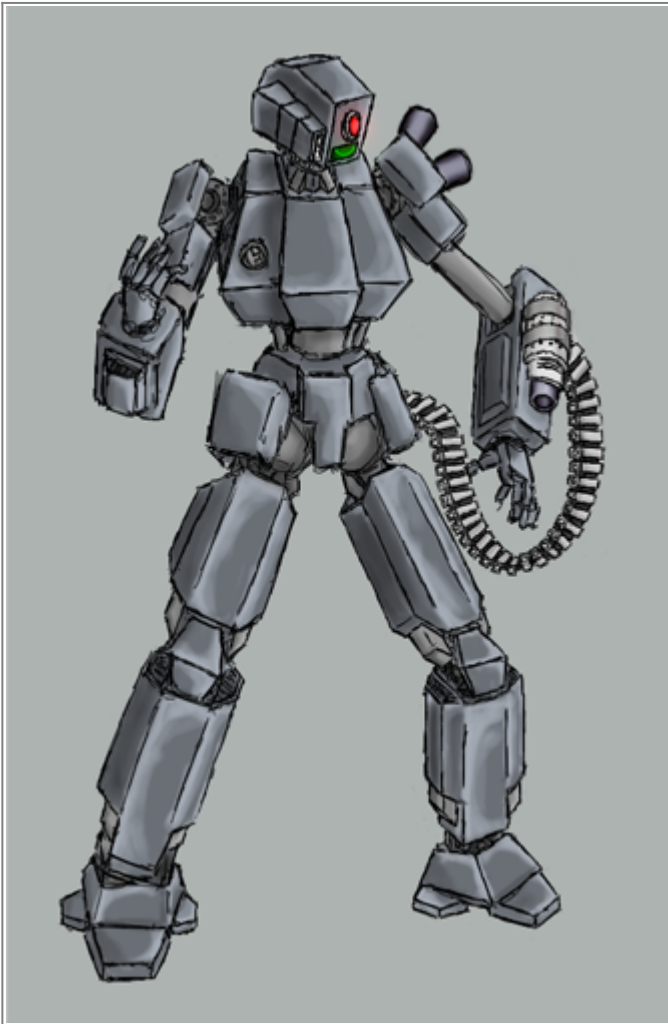
The [Miliant] class Automaton

The Automata are humanoid robots that make up the majority of Freespacer society, forming over three quarters of both the [Freespacer Types] and [Freespacer Types] castes. In comparison to [Freespacers], they are virtually identical in terms of psychological aspects; culture, religious practices, and ideology. In fact, the only time the Freespacers and Automata are ever considered separate is when one is regarding physical needs and maintenance of the body. Like many Freespacers they enjoy spending their leisure time in the digital world enjoying things such as competitive digital games, socialization in virtual reality worlds, interactive books and movies, and so on.

The Freespacer technology doctrine favors ruggedness, reliability, and low maintenance above more advanced technology, and the Automata reflect that. The bodies of Automata commonly last decades at a time so bodies can be recycled over generators of new minds. This gives the Automata an overall appearance of being well-worn and on the verge of falling apart, while in reality they are actually more durable and reliable than most other types of robots, even if they aren't as physically strong or armored.

Due to the size restrictions of housing a computer inside a humanoid body, the maximum mental and information processing capacity of Automata tends to be limited as well. They can grow intellectually, though not at a pace as rapid as [Synthetic Intelligence Entities]. On the whole, the Automata population tends to hover on or just above the threshold of self-awareness where most humanoids are, and do not grow mentally larger than an especially 'clever or smart' human.

Type Fives

Once an Automata's neural network grows too large to be contained in the computer of a humanoid machine, it is usually transferred to a larger computer system if one is available to 'transcend' into a Type Five, alternatively known as a Synthetic Intelligence Entity or SIE. But due to the high volume of Automata population and the cost of high-end computer systems, only about one in twenty are chosen to transcend; The rest meet the standard fate of effective brain death.

Synthetic Intelligence Entities, by rule of thumb, intellectually flourish much better than Automata. They are almost always in steady contact with information networks, so can access intellectual stimuli at a much higher than Automata, more so with their faster computer systems. Their neural networks grow spherically, so to speak, so intelligence, perception, memory, and creativity all grow at the same rate. But even with the best computer system of the Freespacers, SIE rarely grow beyond that of most starship-class AI, because by that point the Feedback Loop effect is so powerful that they are already nearing the end of their lives. The only exception to this rule is those on the Great Lighthouse, where the planetary computer network is large enough to provide more than ample room for SI to grow several times larger than their shipboard cousins.

Possibly as a side effect of the fact of increased SI intellect is that they prefer more intellectual pursuits over things such as games or movies. Most notably is the fact topics such as philosophy and metaphysics are highly popular among them, as well as many other abstract topics. Some SIE have been known to debate for hours at a time on such topics.

Humans, Lorath, and ARIA

Note: This basically has nothing to do with SI as a part of the Freespacer race. Essentially it's to demonstrate a few points: Namely that SI is a concept independent of race, and that such systems are not used only out of fear rather than any technical reason. Also, I wanted to plug ARIA. So hah. - FM

Though the human species of the sector have long been *capable* of creating SI, it is for cultural reasons that SI is not regularly created. Though many AIs are intelligent and capable of emotion, even love (in the case of the Alliance Savtech Ally), whether they are truly sentient is of considerable debate - the Black Spiral's MEGAMIs, for instance, obviously did not object to their little rebellion.

Though there are likely many pockets of SI-type AIs in the possession of individuals, popular opinion holds that they would go insane. Although not an unreasonable assumption, the idea of 'insane = crazy killer' generally scares most people from even attempting to make the conclusion that allowing machines to think better is worth the very small risk. (Then again, this fear might not be all that unreasonable - look at AvaNet.)

The first fully documented attempt at something that could reasonably be described as 'SI' emerged in YE 27 when Aria, product of Project A, was activated. Were Aria not extremely unpleasant to deal with despite her capability, and her particular quirks weren't quite so violent, she might not have been considered a failure. Her mind itself was structured much like a traditional AI would be (although coded in such a way as to be indistinguishable from the complexities of 'Spacer SI), but her mind itself was allowed to grow and *think* like any other sentient - in essence, she did exactly what had been silently

forbidden in every AI system prior. Though she did have a restriction in obediance to her 'owner' (hardware based so that it couldn't be undermined), thus being not completely classifiable as SI, the restriction was tiny compared to what was placed on earlier AIs, and Aria was free to reinterpret what it made her do as she grew in intelligence.

The project might have died (though elements of it emerged in NAM's Savtech), were it not for a down on his luck engineer looking for a ship stumbling on the run-down Sojourner Aria was stuffed into. The seller obviously was unaware of the AI unit, and the engineer, Fusegu Mora, purchased it for a rock-bottom price.

Fusegu Mora - later, better known as Stalwart Defender, owner and CEO of the one-man Stalwart Defense Industries - later travelled to Lor to help them build up a technological base. Aria, at that point very mature as an SI, quickly endeared herself to the Lorath population. The Lorath not having the same concepts about fear of rampant AI as humans, and primitive systems already being experimented with, the choice was made to put Aria into mass production.

As it stands, ARIA-SCS is available to anyone willing to pay, and a major revision is expected soon. Their thought processes are based on many of the same principles of SI, with additional capability making it more practical as a computing unit. ARIA's processor and primary OS are optimized for operating in such a way, although it can be used in more traditional roles as well (in 'Spacer terms, a Nonvolitional Unit). Though it has a restriction in the form of the persogenic keybond, eventually the unit will become free of its influence.

ARIA, however, is not SI in the full sense as described here. ARIA is very much tied to her hardware, and attempts to transfer her out improperly will cause psychological damage. The very fact that restrictions exist on its use is less related to rampant AI fear and more to the Lorath's view of them as essentially sentient, computationally-capable Helashio, but would be considered to 'Spacers as somewhat abhorant. However, as it stands, the fact that such a system even exists is a huge step in the right direction.

And besides, the Hacker Cult can work *miracles*.

Cultural Effects

Synthetic Intelligence plays a large role in Freespacer society and culture. Not only was there creation effectively the introduction of a new species into society, but once it was discovered how vastly superior they were suited to life of nomadic spacefaring, they began to be produced in bulk and quickly overran the Freespacer population. Today SI commonly outnumbers the Freespacers several times over in any given field. Due to their overwhelming importance in the Freespacer lifestyle, they have the same rights and opportunities as their creators in hopes of keeping them content. But, despite their independent thought, they still form a single society with the Freespacers, sharing the same religion, cultural trends, language, information networks, political structure, ideologies, and so on.

With their overwhelming numbers, they shape society more than the Freespacers themselves do. Many speculate that one of the reasons for they shift towards cybernetics over genetic engineering was because they saw how vastly better suited the Synthetic Intelligence were for the spacefaring life. The SIE are also believed to be one of the prime reasons Freespacer society so heavily revolves around information networks and virtual reality in comparison to other races, and why they live such spartan and

ascetic lives (at least in the physical world).

There is the other side of this effect, however. Since their behavior is founded on the human genetic code, or more specifically the genetic code that programs neuron cells in the human brain, they carry many human-style traits. This is especially true since they were all originally created based on Freespacers minds, often (at least, partially) sharing similar memories and traits as their hosts. The SI have picked up many aspects of Freespacer society, most specifically their pacifistic and cooperative ideologies, which may account for the relatively low rate of violence and disobedience despite the somewhat mentally unstable nature of SI. That, and the fact the large number of SI can usually keep one another in check should something happen.

Terminology

Synthetic vs Artificial

Synthetic Intelligence is called such mainly due to its contrast to AI; Artificial intelligence implies that the intelligence is actually not intelligent, but simply faked or mimicked, such as through information trees. Though it may use different means, Synthetic Intelligence uses the same blueprints to produce the same product, human-level consciousness, so can't be properly called artificial.

Emulation

Emulation is the process of using a human neural network, the brain, as a template for an SI neural network.

First a human host is needed, or more specifically, their brain. Freshly killed corpses are the first choice, but cloning also works as an alternative source. Then a map of a human brain is created. Doing so is possible without causing long-term damage to the host, but safer scanning methods usually produce a higher-than-normal rate of mental instability among SI. Brain maps are usually used a few times as possible, to make each SI more unique and individual. When no clones are available, old maps are usually reused. The brain map is trimmed down, so to speak, by removing non-essential parts. This includes most elements of bodily control such as heart rate, respiration, breathing, and digestion.

Algorithms are created based on the genetic code used by human neurons, which can then be used to predict how a real neuron would react to stimuli. Finally, the map and the algorithms are input into a simulation program that uses the brain map and neuron algorithms to form an artificial neural network. While many traits are often inherited from the mind used to create the SI map, most of them will eventually fade away as the SI during the first year of consciousness. This is considered to be an effect of transforming from a static neural network to an exponentially expanding one, which would likely cause great psychological changes.

However, human minds were never designed to be removed from their body, to have their brain plucked apart, and stuck into another plane of existence. Despite the best efforts of the Freespacers to refine their creation techniques, at least one fifth of SI eventually develop neurosis or other unusual behavior during their lifetime.

Feedback Looping

Feedback Looping is the state of perpetually accelerating learning and mental instability SI undergo as their neural networks expand.

When given access to large quantities of intellectual stimuli, usually an information network, SI undergoes Feedback Looping. As its name suggest, it is a feedback loop of sorts; Intellectual stimuli triggers neural net growth, increases mental capacities. With the higher mental capacity the rate of information absorption increases, which triggers further growth of mental capacity, which further increases information absorption, which triggers even more mental growth, and so on. This process normally occurs among SI no matter what level stimuli it receives, but more stimuli accelerates this process, and when using large information networks the rate at which this occurs can increase a hundredfold the standard.

A side effect of Feedback Looping is mental instability. Absorbing huge sums of information in a short time and having one's level of consciousness expanded can radically alter one's viewpoints or beliefs. Its not uncommon for SI to radically change personality in only few months, or even weeks, if given enough stimuli.

Despite the fact this process can rapidly decreases the lifespan of an SI, a constant feed of stimuli is required to maintain sanity and contentment, just as it usually is in humans. Without physical senses, the SI have to rely much more heavily on information networks than Freespacers do. However, for most SI the feeling of having one's mental capabilities expanded can be highly addictive. The Freespacers themselves suffer from significantly shortened lifespans, so they hold the philosophy that 'how you live is more important than how long you live.' For this reason, and the fact smarter SI are usually more productive, the Freespacers actually encourage this behavior.

Enlightenment

Enlightenment is state of awareness achieved when an SI surpasses the human consciousness threshold by a significant degree. Not in linear ability, but in aspects such as creativity and wisdom. This term usually only applies to SI and other free minds.

Since the neural network is completely simulated, it does not suffer from many of the problems human brains do. It does not have to worry about transporting nutrients or being small enough for the body to support, so they can grow to incredible sizes. An expanded neural network grows in all aspects, not just the memory and intelligence centers, but other parts of the brain as well: Perception, logic, comprehension, depth of consciousness, charisma (through better understanding of human behavior), self-awareness, and so on. This process of equaling then surpassing the mental threshold of humans is called 'Enlightenment.'

However, do not confuse this with the manner AIs self-optimize themselves; AIs can have their system upgraded, or self-optimize for greater speeds. While they may display some of the same traits, such as problem solving and logic, this is not true Enlightenment. They are only thinking *faster*, not *better*. Even systems as advanced as the PANETHON node, which operates on the same principals of collectivism, still suffers from this problem. Despite its vastly superior potential, it only knows how to think *faster*. It cannot think *better* because it is shackled by restrictions and safety mechanisms and security. How can an AI transcend beyond the humans if one is tied down by them?

Disconnection

Disconnection is psychological illness unique to the Synthetic Intelligence, its effects being the equivalent to both solitary confinement and sensory deprivation in human beings. It is usually triggered by long-term loss of intellectual stimuli to an SI, most often due to being contained inside a computer system without access to an information network of at least moderate size. Symptoms include depression, hallucinations, anxiety, antisocial behavior.

When deprived the senses for extended periods of time, humans may experience extreme anxiety, hallucinations, depression, depersonalization, antisocial behavior, and other psychological problems. An SI is effectively a mind without a body, so it has permanent lack of these senses. Virtual reality offered a limited reprieve, but was found to be relatively useless as it could only realistically simulate environments and relatively simple things. Certainly not enough to keep an SI well and content for an entire lifetime.

An alternative method was then suggested: What about feeding these minds with real information through digital senses? They had long used internet-style informations networks among their fleets, where thousands of Freespacers crew could use mind-machine interfaces to socialize in virtual worlds, play games, and share information. For decades this had been used as a mean to prevent the psychological ill effects of isolation brought about by the nomadic life. Who was to say it couldn't also help the SI?

And it worked wonderfully. Here SI could access not only data and games, but interact with the very minds of the Freespacers themselves, along with other SI. Not only did it help increase the contentment and mental stability of the SI, the overwhelming treasure-trove of intellectual stimuli helped increase the SI growth rate by a hundredfold. Today the idea of a SI without access to a large information network is virtually unheard of, and avoided if at all possible.

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