

# ***Marvin Minsky: An autobiography***

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## **Introduction:**

Marvin Minsky is widely regarded as one of the 20th Centuries most influential software engineers. He specialised in the field on Artificial Intelligence and within this field was a jack of all trades, although in this case was very much a leader in the field in everything he tried his hand at. From developing new technology to better examine the brain and the cells of the brain, to developing the first physical artificial neural network as well as being a leading theorist in the field of artificial intelligence.

## **Early Life and Education:**

Marvin Minsky was born in New York in August 1927 to an eye surgeon and a Zionist activist. He initially attended a private Jewish school, before transferring to the Bronx High School of Science, which is an elite public high school. He served in the US Navy in World War II before pursuing his intellectual interests in Harvard University. He was invited to become a fellow at harvard and he graduated with a B.A. in mathematics in 1950 at the age of 23 and received his Ph. D in Mathematics from Princeton University four years later. He met the *Father of Artificial Intelligence* in Dartmouth university and from there they co-founded the MIT Artificial Intelligence Lab in 1959 where Minsky remained for until his death. [1]

## **His Work/ Contributions:**

### *1. Confocal Microscope*

Confocal microscopy has many advantages over conventional optical microscopy “including the ability to control depth of field, elimination or reduction of background information away from the focal plane (that leads to image degradation).”[2] Minsky himself said “I studied everything available about the physiology, anatomy, and embryology of the nervous system. But there simply were too many gaps; nothing was known about how brains learn.” He was determined to figure this out and thereby reverse engineer this and incorporate it into computers. In his time as a fellow where he was “bound only by a simple oath to seek whatever seems the truth”[3] he focused his time away from artificial intelligence into creating a machine that would allow him to study the nerves of the brain and learn how our brains learn. His goal was accomplished when he created the first confocal microscope in 1955

### *Implications*

His confocal microscope was built upon and improved using lasers and has been improved since he invented it. These microscopes allowed other scientists to better examine and therefore build a better understanding of cell biology as a whole.

Nowadays, Confocal microscopy is used in the evaluation of eye diseases and particularly important in the analysis of the cornea. It is also used to control the quality and uniformity of the drug distribution in the pharmaceutical industry.[4]

## *2. SNARC*

SNARC stands for Stochastic Neural Analog Reinforcement Calculator and is a neural net machine designed by Minsky just after his doctorate in Princeton before he co-founded the MIT AI Lab with the help of a student Dean Edmunds which simulated a rat finding its way through a maze. Minsky simulated the brain by creating an interconnected grid of mechanical neurons connected by a series of synapses. The 'rat' moved through the maze based on the memory stored in the neurons finding his way to the 'food'. Interestingly, there was a design fault that allowed a second rat to be introduced. It was found that the 'rats' interacted together. After various attempts the 'rats' began thinking on a logical basis powered by reinforcement of correct choices resulting in more advanced 'rats' (those who had done the maze more) and less advanced 'rats' (those that were relatively new to the maze).[6]

### *Implications*

This was a huge step forward in the pursuit of Artificial Intelligence as it mimicked the brain in a rather simple way. It set the base for all further research in neural networks that have been key to the further Artificial intelligence advances since.

## *3. Perceptrons*

In 1969, together with Seymour Papert, who was an expert on learning, wrote *Perceptrons*. A perceptron was a neural net developed by psychologist Frank Rosenblatt in 1958 [7] and was one of the most famous machines of the period. This book highlighted a range of problems with nascent neural networks. This book, as Minsky argued did not say that neural networks were not useful but that the model of purely "connectionist" neural networks would not lead to genuine machine intelligence.[8]

### *Implications*

*Perceptrons* is a highly criticised book and is blamed hugely for what is termed the "AI winter". This term is used to describe a period that lasted most of the 70's and early 80's where there was greatly reduced funding and less interest in artificial intelligence research. During this period, "neural net researchers continued smaller projects outside the mainstream, while symbolic AI research saw explosive growth." [9] Minsky compared *Perceptrons* to the fictional book *Necronomicon* in H. P. Lovecraft's tales, a book known to many, but read only by a few. Minsky released

an expanded edition in 1987 which contained a chapter to counter criticisms of the book made during the AI winter. Nowadays, many AI researchers, “including those who have pioneered work in deep learning, are increasingly embracing this same vision” [9] that Minsky shared in *Perceptrons*.

#### *4. Society of the Mind Theory*

In the early 70's as per his message in *Perceptrons* he moved away from “building robots and inventing gadgets” [11] and instead began developing theories of learning in the MIT AI lab. Throughout these years he developed 100's of small theories and “trying to fit them together.” [11] This all culminated with the publishing of “The society of the mind theory” of human cognition in 1986. [10] “What is the human mind and how does it work? This is the question that Marvin Minsky asks in *The Society of Mind*”

Ultimately, Minsky touches on virtually every important question one might ask about human cognition. The book contains 270 different theories, which deal with processes such as “language, memory, and learning work, and also covers concepts such as consciousness, the sense of self, and free will.” *The society of the Mind* suggested that intelligence emerges not from one system but from the interactions of numerous simple components, or “agents.”

#### **Other Notable contributions:**

##### *1. Head mounted graphical display*

Marvin Minsky invented the first ever head mounted graphical display in 1963. This technology has come a long way since its inception and over 50 years later it has reached the mainstream. Head-mounted displays now have range of applications especially popular in the virtual reality sphere of gaming. Oculus rift is a VR product that uses a head mounted display.

##### *2. The 7,4 Turing machine*

Marvin Minsky came up with a 7,4 Turing machine in 1962 which was known to be the simplest turing machine in the world for 40 years until in 2002 Stephen Wolfram published a 2,5 turing machine in his book, *A new kind of science*.

##### *3. The Emotion Machine*

In the *Emotion Machine*, published in 2006, Minsky reorganises, elaborates and expands upon the ideas presented in *The Society Of the Mind* as well as adding in “new higher level ideas” [12]

#### 4. Legacy as a Professor

Marvin Minsky does not only have his vast physical contributions to artificial Intelligence. He also has the doctoral students he taught, mentored. Some notable students of Marvin Minsky are:

- *Manuel Blum*, who is a Venezuelan computer scientist who received the Turing Award in 1995 "In recognition of his contributions to the foundations of computational complexity theory and its application to cryptography and program checking".
- *Daniel Bobrow*, who was the President of the American Association for Artificial Intelligence(AAAI),
- *Ivan Edward Sutherland*, who is an American computer scientist and Internet pioneer, widely regarded as the "father of computer graphics". He received turing award in 1988 for the invention of sketchpad.

#### Recognition and Awards:

- Turing award in 1969
- Japan Prize in 1990
- Benjamin Franklin Medal in 2001
- Inducted as a fellow of the Computer History Museum for co-founding the field of artificial intelligence, creating early neural networks and robots, and developing theories of human and machine cognition."
- In 2011, Minsky was inducted into IEEE Intelligent Systems' AI Hall of Fame for the "significant contributions to the field of AI and intelligent systems".
- In 2014, Minsky won the Dan David Prize for "Artificial Intelligence, the Digital Mind".

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