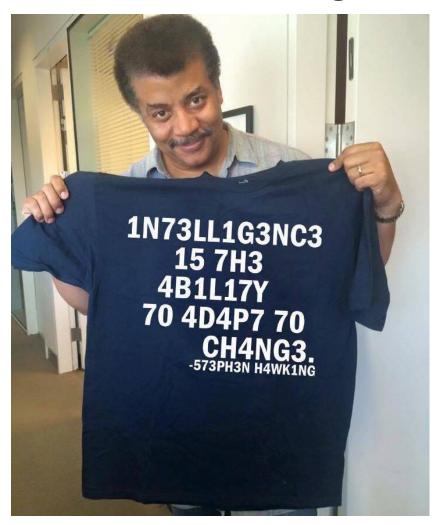
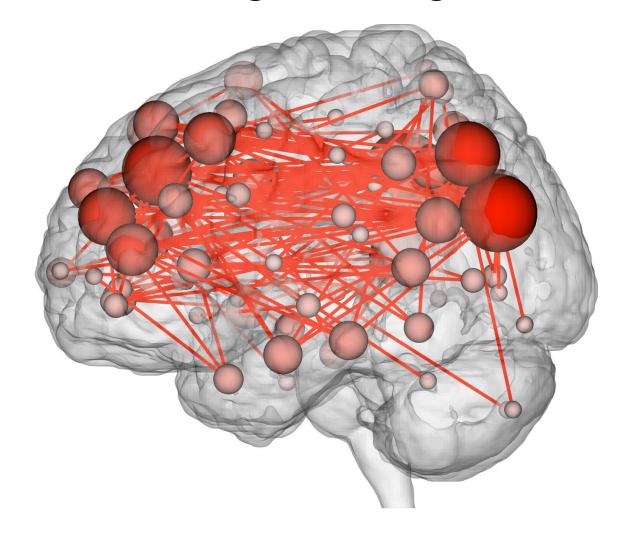


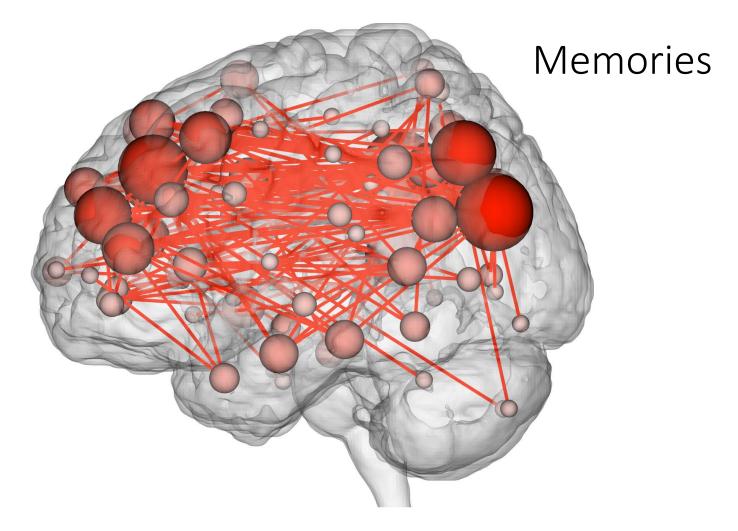
#### Konstantinos Sgantzos

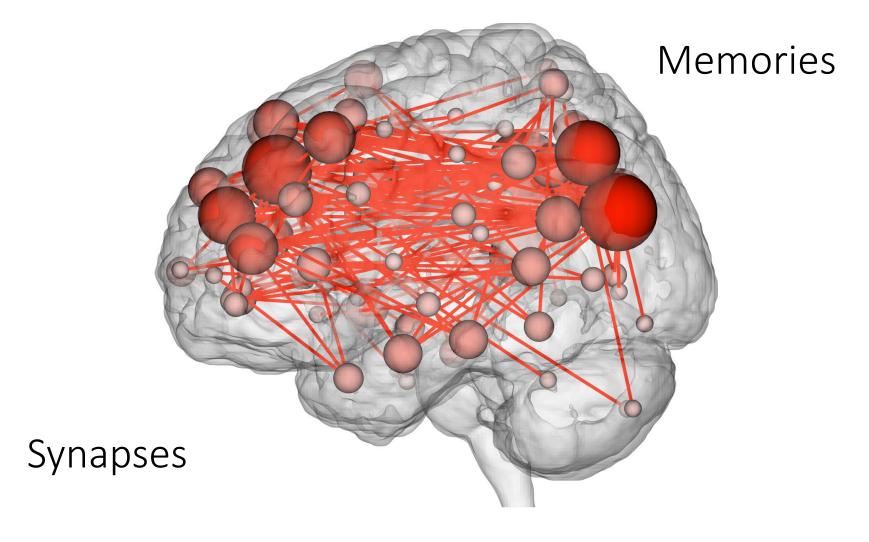
Software Engineer, Physicist - Biochemist, MSc in Bioinformatics 2017, University of Thessaly

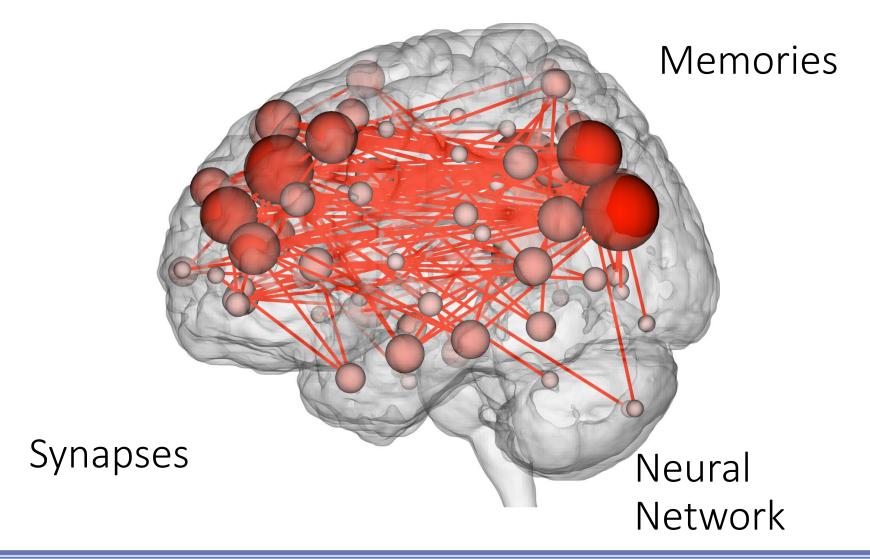
## Philosophical question: What is Intelligence?



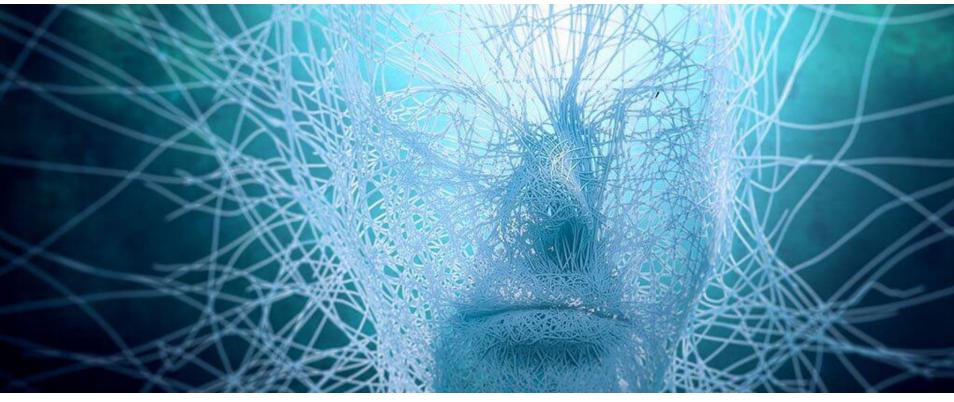








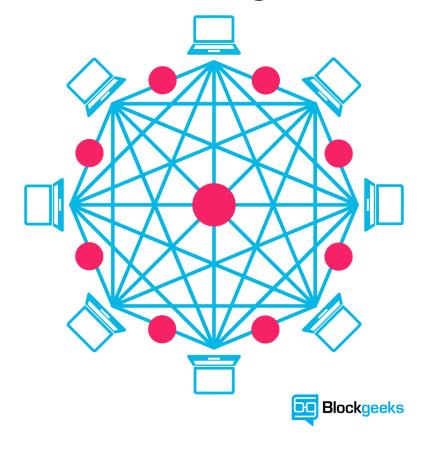
#### How do we define Artificial Intelligence?

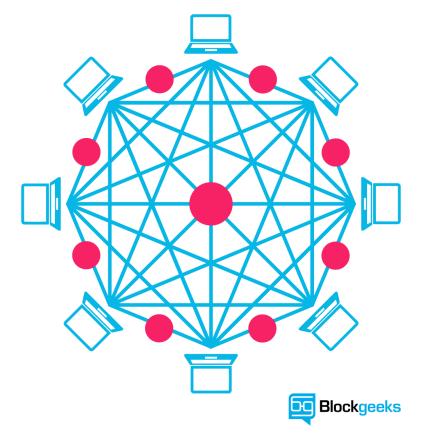


October 19, 2017:

Google's Latest Self-Learning Al Is Like an "Alien Civilisation Inventing Its Own Mathematics"

https://www.sciencealert.com/new-self-learning-ai-is-like-an-alien-civilisation-inventing-its-own-mathematics





Nodes

Collaborating **Blockgeeks** 

Nodes

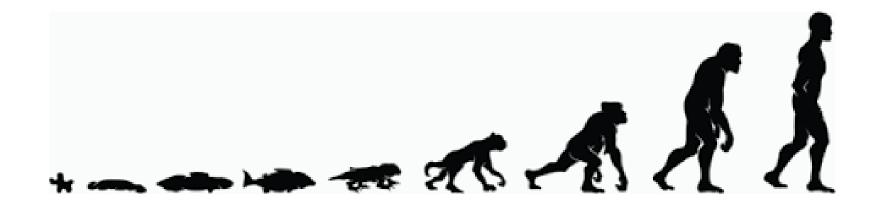
Algorithms

Nodes **Blockgeeks** 

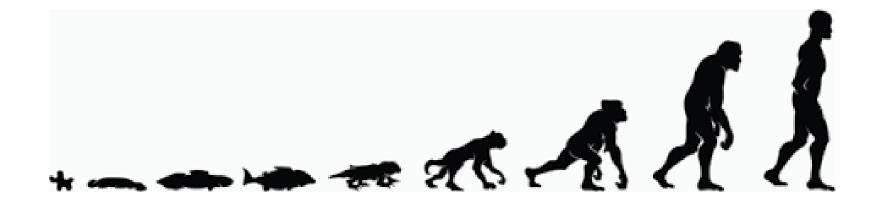
Collaborating Algorithms

Neural Network

#### Biology: How did we evolve?

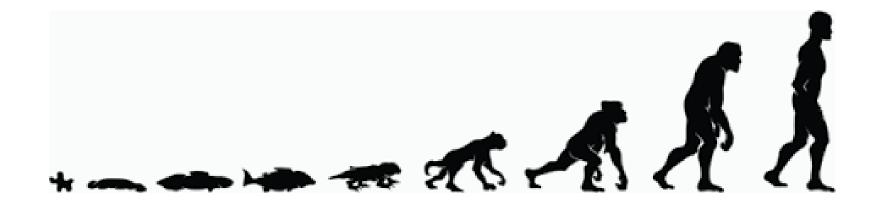


### Biology: Nature evolves "Randomly"



We need to simulate Nature's way

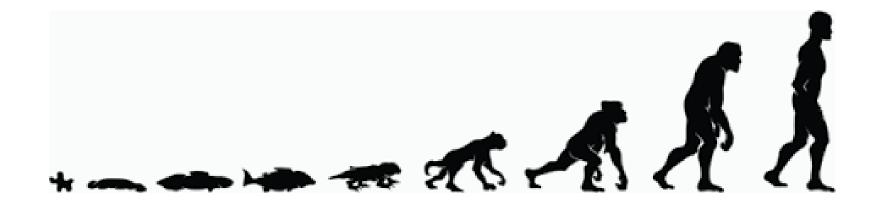
### Biology: Nature evolves "Randomly"



We need to simulate Nature's way

The key element is "Randomness"

### Biology: Nature evolves "Randomly"



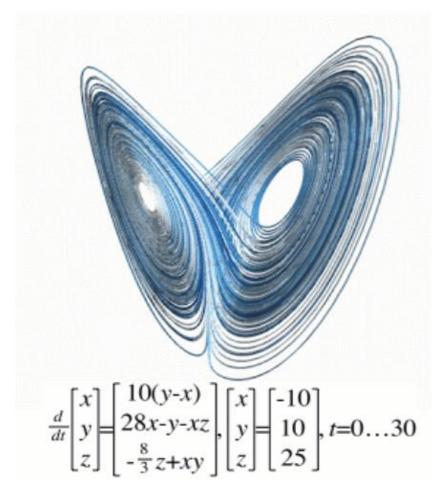
...but what "Random" means?

### Mapping randomness in Nature



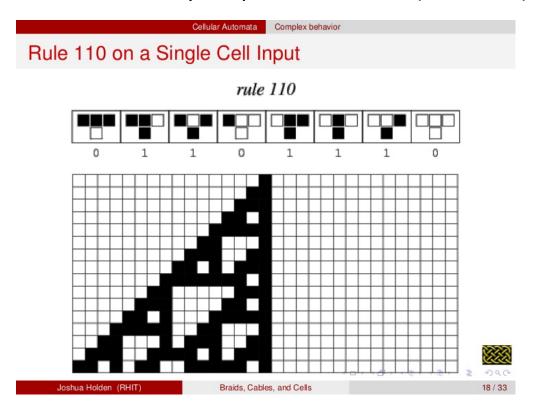
Edward Norton Lorenz 1917 - 2008

### Randomness in nature: Lorenz Attractor



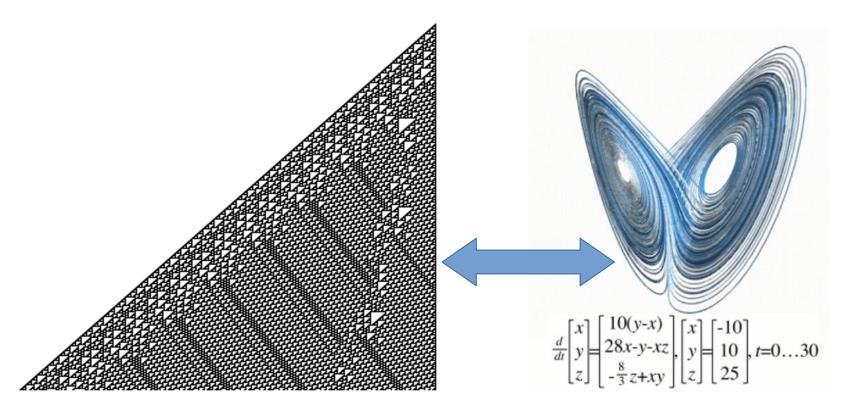
### Rule 110 Cellular Automaton Another "Natural" Randomness

In computability theory, a Cellular Automaton can be **Turing Complete**, if it can be used to simulate any **single-taped Turing Machine**. Such an automaton is described by Wolphram's Rule 110 (or Rule 30).

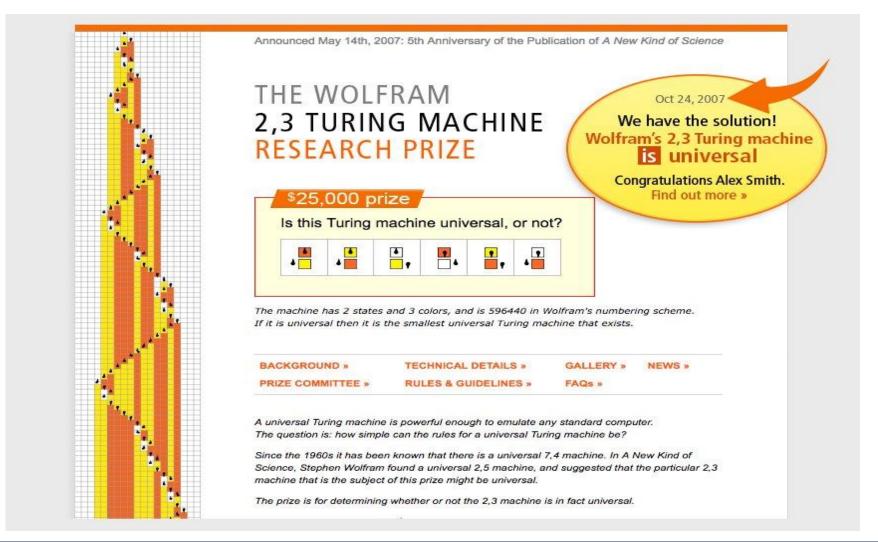


### Rule 110 Cellular Automaton Another "Natural" Randomness

Such a Cellular Automaton after a certain period of time can provide a **mathematically modeled deterministic Chaos**, similar to those that describe chaotic phenomena like a tropical storm or the formation of clouds.



## Wolfram's simplest Cellular Automaton (2 state 3 color) is Universal!



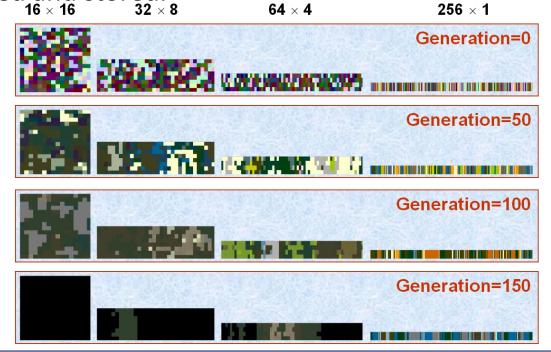
## A Turing Complete Cellular Automaton (The Timeline so far)

- 1951: The concept of a Cellular Automaton (plural: Cellular Automata) was first introduced by John von Neumann in the Hixon Symposium. It was described as a discrete model that consists of a simple two-state, one dimensional grid of cells that can be either on or off.
- **1971:** A two-state, two-dimensional cellular automaton named "Game of Life" by **John Conway**, became widely known
- 1983: It was Stephen Wolfram who did a systematic study of two-state, one-dimension Cellular Automata, based on a specific set of rules. Wolfram named those "Elementary Cellular Automata"
- 2002: His research assistant Mathew Cook showed that one of these rules is Turing-Complete (Rule 110). Their work has been published in 2002 in the bestselling book "A New Kind of Science".

#### How do we use a CA to compute things?

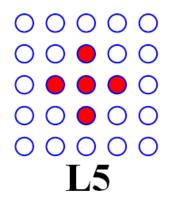
- We need to give it time to produce Chaos
- The produced chaos is directed into a Genetic Algorithm
- •When maximum fitness is due, a Cellular Evolutionary algorithm (cEA) or if you prefer, a **Genetic Algorithm (GA)** is produced and stored.

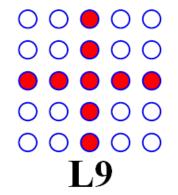
  16 × 16 32 × 8 64 × 4 256 × 1

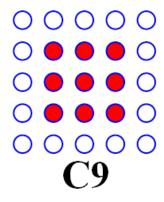


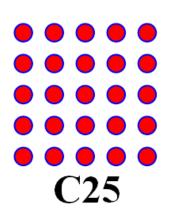
#### Examples

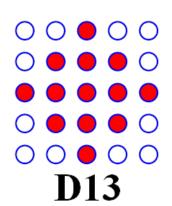
• Example models of neighborhoods in cellular EAs: linear, compact, diamond and... any other!













#### The Math

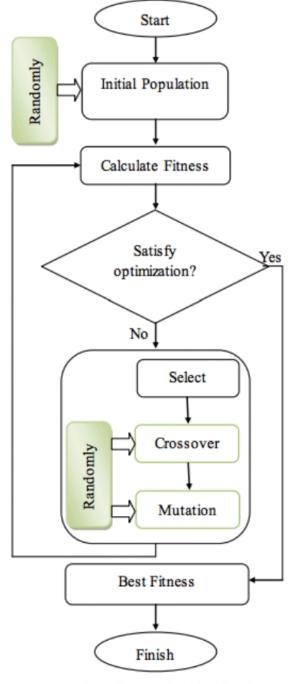
• The ratio between the radii of the neighborhood to the topology defines the exploration/exploitation capability of the cEA. This could be even tuned during the run of the algorithm, giving the researcher a unique mechanism to search in very complex landscapes.

$$rad = \sqrt{\frac{\sum (x_i - \overline{x})^2 + \sum (y_i - \overline{y})^2}{n^*}} \quad \overline{x} = \frac{\sum_{i=1}^{n^*} x_i}{n^*} \quad \overline{y} = \frac{\sum_{i=1}^{n^*} y_i}{n^*}$$

$$ratio_{cGA} = \frac{rad_{neighborhood}}{rad_{grid-topology}}$$

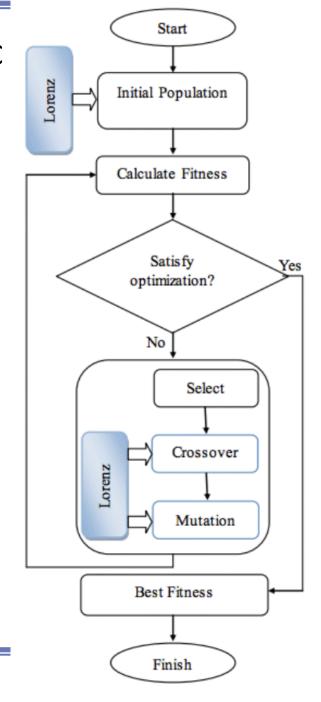
## Graph of a Basic Genetic Algorithm

- Random initial population
- Calculation of Fitness
- Iteration process (hundred times to several Billions of times)
- How sophisticated a GA should become?
- The process is incorporating another Random parameter in the Crossover/Mutation sub-procedure until it reaches Best Fitness.
- Then the GA stores itself.



## Graph of a Chaotic Genetic Algorithm

- A Chaotic GA is using an initial population that instead of a Random parameter now uses a Chaotic one.
- Several studies have showed that if the Random parameter is replaced by Chaos the fitness procedure lasts less and the process finishes earlier.
- Randomness and Chaos are similar but not the same.



#### Turing Machine



A Turing machine consists of 2 elements:

- 1. The computational head
- 2. An **unbounded** long tape.

The head operates roughly as a 'read-write' head on a magnetic tape, and the tape is divided up into an **unbounded** set of boxes, for which on each box a symbol can be written or erased. The Turing machine recognizes and can write down a finite set of symbols, called the Turing machine's alphabet.

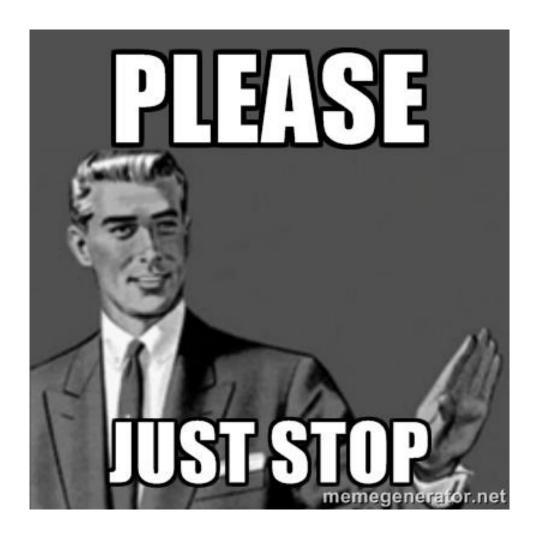
#### Unbounded Single Taped Turing Medium

Blockchain is a representation of a recording cylinder, similar to Edison
 Standard Phonograph



- Transactions are being recorded in blocks, forming a spiral of ellipses, from left to right, whereas the recording is permanent and the cylinder virtually unbounded.
- This concept describes perfectly the theoretical representation of an Unbounded Single Taped Turing Medium.

#### **ENOUGH WITH THE TERMINOLOGY!!!**



#### CA & Blockchain

So Rule 110 Cellular Automaton (CA) is proved to be "Turing Complete" while Blockchain can be considered as an Unbounded Single Taped Turing Medium (which is also Turing Complete).

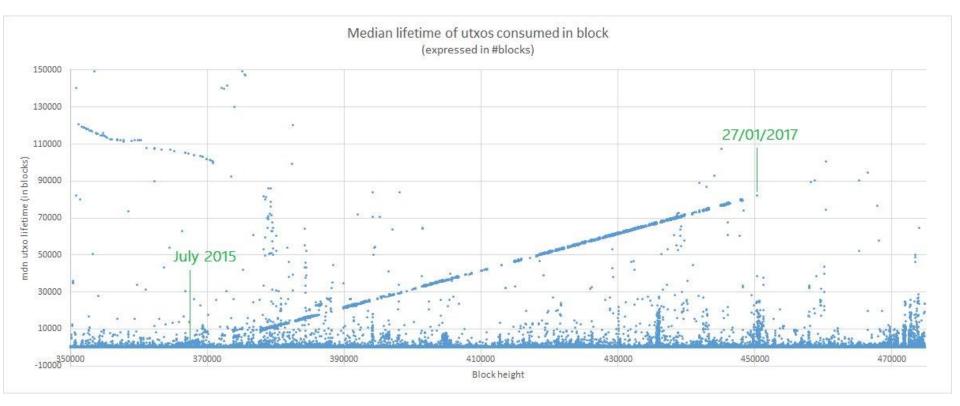
The question is:

### Will it Blend?

#### Tom says...

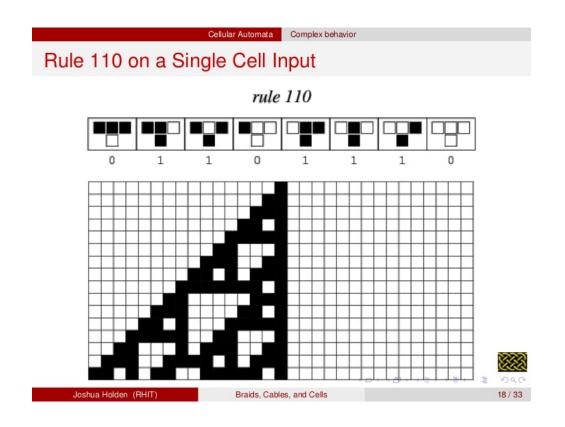


#### Order within Chaos

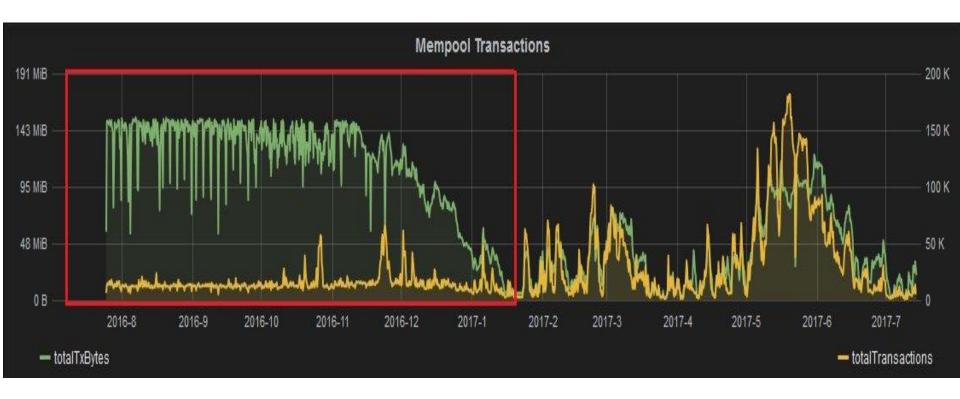


- This is the Median Lifetime of UTXOs consumed in a block on Bitcoin Blockchain (OXT.ME).
- Bitcoin UTXO Lifespan Prediction as shown by Robert Konrad & Stephen Pinto in 2015 is impossible to be modeled mathematically, since it is purely chaotic.
- If this is true, what's this line doing there?

#### Nothing to see here... move along

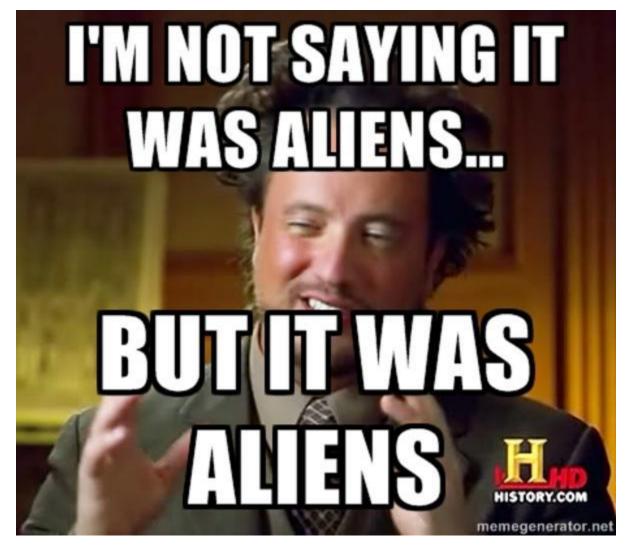


## An Extraordinary Claim requires an Extraordinary Proof!



- This is the Mempool transaction volume in Mb for the same time period (source: OXT.me).
- Total TxBytes is in Green.
- Total Tx is in Yellow.

#### Legit Explanation





1. Basic computational functions



1. Basic computational functions

2. Advanced computational functions



1. Basic computational functions

2. Advanced computational functions

3. Universal Computing



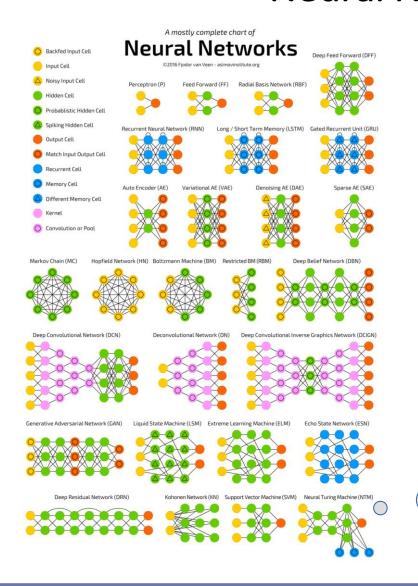
1. Basic computational functions

2. Advanced computational functions

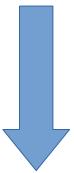
3. Universal Computing

4. Artificial Intelligence

#### **Neural Networks**



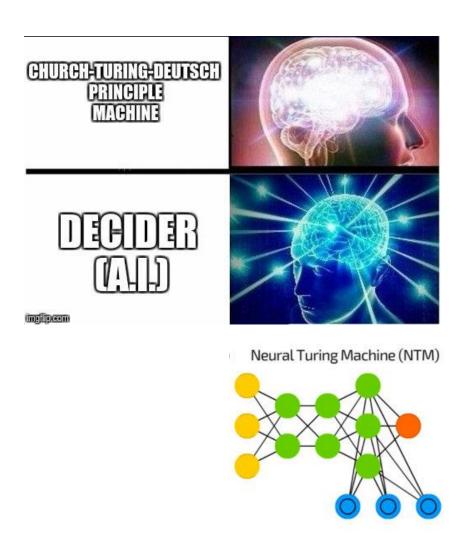
#### **Universal Computing**

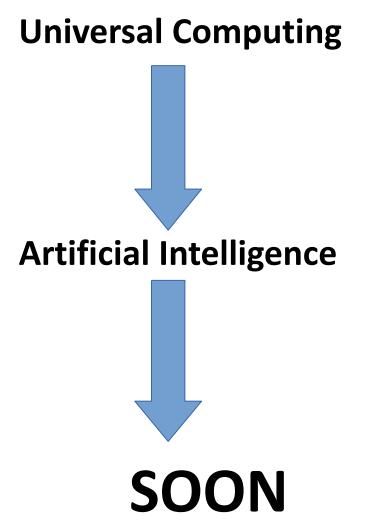


### Artificial Intelligence through Moran Model

Moran model is a simple stochastic process used in biology to describe finite populations.

#### Machine Learning

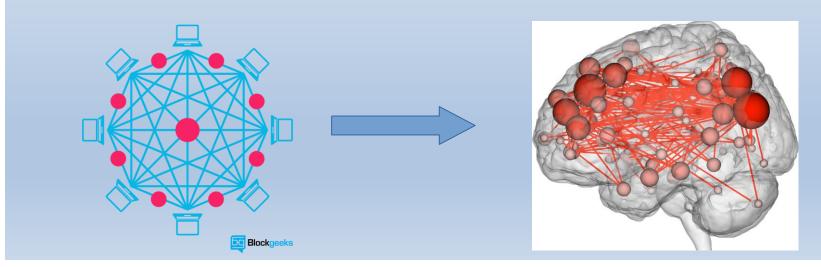




#### Usability

#### Decentralized AI:

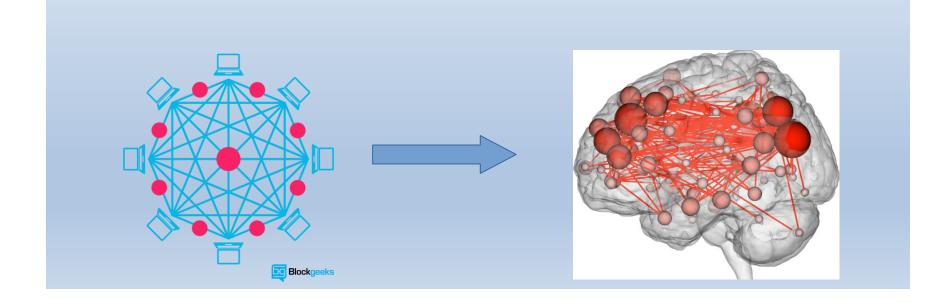
- Big Data Mining
- Monte Carlo based Predictions
- HMM predictions
- Expansion of Human Knowledge
- Protein Folding Prediction
- Future Mutations in Human Genome
- Intrusion Detection of websites
- are only a subset of the fields that could potentially benefit.



#### **Future Uses**

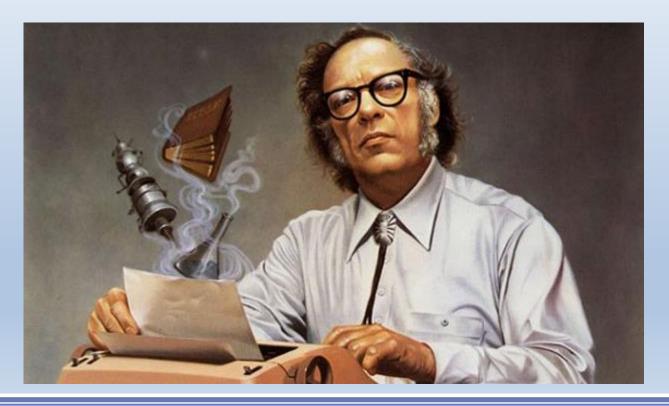
- Analyzing Biological Ontologies
- Provide assistance in cure of Genetic diseases
- Assisted Governance
- Extinction Level Events predictions

...and many more!



#### What next?

- Isaac Asimov, "The Last Question" (November 1956):
- Can this chaos not be reversed into the Universe once more? Can that not be done?



#### Acknowledgements



Athanasios P. Kakarountas



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Ian Grigg



George P. Papageorgiou





Joseph VaughnPerling Vassilis P. Plagiannakos.

#### And of course...

# ALL OF YOU!

Thanks for you time!!!

Questions?