

Artificial Life  
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# What is Artificial Life (AL)?

- A simulation of life characterized by its organization, relations and behavior, NOT its physical form.
- "All reality is a simulation" – Jeff Luty in Postsingular by Rudy Rucker



# What is Artificial Life?

- AL is studied from the bottom-up, not top-down, as in real life.
  - In biology, we work down from ecologies, organisms, organs, cells, down to molecules.
  - AL creates “life forms” and studies their emergent, complex behavior and interactions.
  - “Locusts have no king, yet they advance together in ranks.” Proverbs 30:27

# What is Artificial Life?

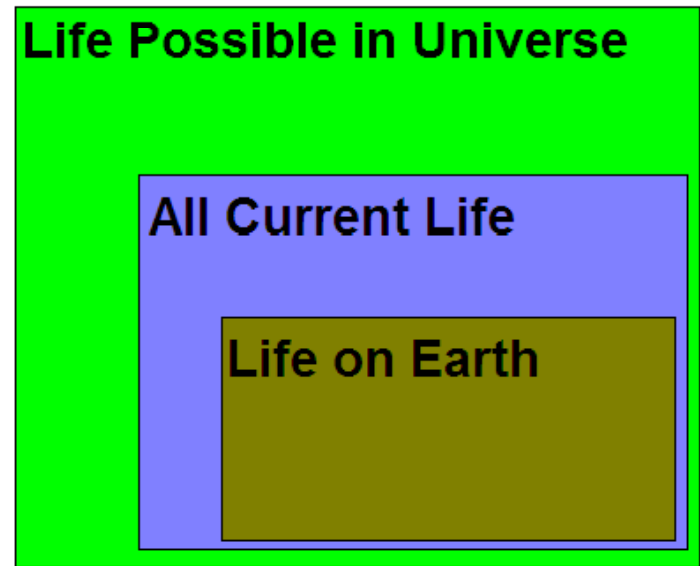
- “Locates **life-as-we-know-it** within the larger picture of **life-as-it-could-be**.”
- This is huge!

**All Possible Life**

**Life Possible in Universe**

**All Current Life**

**Life on Earth**



# What is Artificial Life?

- Does not necessarily seek to arrive at some sort of solution to a problem (although this can be done!) but simulates and studies the processes and interactions between the components.
- The life forms run in parallel. Also, the system is **nonlinear**, that is, it is greater than the sum of its parts. Things here can't be considered separately!

# Cellular Automata (CA)

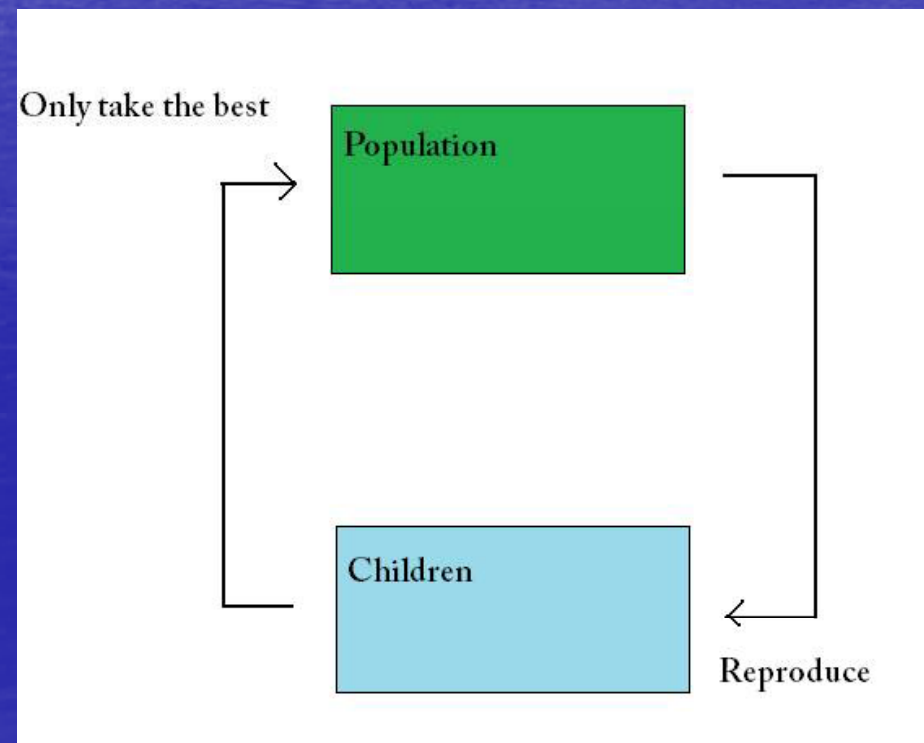
- CA are simply cells that change their state according to what their own and other cell's states are (it follows a set of rules).
- Very complex behavior can emerge from simple rules, and predicting it is not that simple!

# CA-Conway's Game of Life

- A square grid of black (living) and white (empty) cells that starts with an initial population.
- Rules:
  - If a live cell has less than 2 neighbors, it dies
  - A live cell with more than 3 neighbors dies
  - A live cell with 2 or 3 neighbors survives
  - Any empty cell with 3 neighbors comes to life
- <http://www.bitstorm.org/gameoflife/>
- Self-replication!

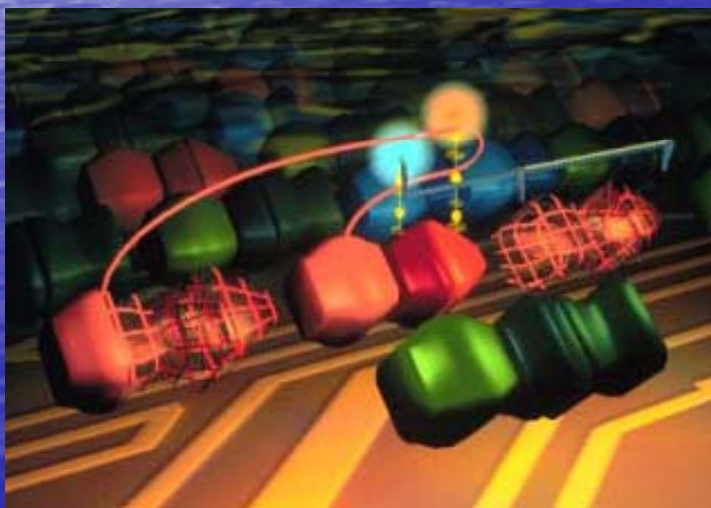
# Genotype, Phenotype, Evolution

- AL has a genotype and phenotype like real life.
- The life-forms can undergo evolution.
  - Genetic algorithms
  - Genetic programming



# Evolution Example--Tierra

- Little programs in memory grow and evolve. Their behavior changes with time.
- Phenotype IS the genotype here!
- <http://life.ou.edu/pubs/images/>



# Computer Animation

- Can also tie into evolution.
- <http://www.youtube.com/watch?v=d4BGLp0wcdE&feature=PlayList&p=214FFB9255CB41FD&index=0&playnext=1>