

Introduction to Artificial Life

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What is life?

- Definition of life: State of a functional activity and continual change, before death (defined complimentarily as *end-of-life*).
- *Characterized* by the capability to:
 - *Act autonomously*
 - *Adapt to an environment in a quest for survival*
 - *Reproduce*
- **Biology is the scientific study of natural life on Earth based on Carbon-chain chemistry.**
- **However, nothing restricts the study of properties of life to carbon-chain chemistry; it is merely the *only* form of life so far available for study.**
- **Is natural life, a special case of life?**

A-life: life as it could be

- Further motivation to study life as a *generic concept* comes from the hypothesis that we are perhaps just one possible atom combination that makes this life possible. We haven't met other examples (Aliens).
- Lack of any available non-carbon based life-forms motivates us to create an artificial environment and a set of rules for life to evolve.
- Artificial Life, or ALife or AL is the study of *non-organic organisms*, beyond the creations of nature, that possess the *essential properties of life* as we understand it, and whose environment is artificially created in an alternative media, which very often is a logical device like the computer.

A-life vs. AI

Artificial Life	Artificial Intelligence
Concept : Late 1980s	Concept : 1960s
Grounded in Biology, Physics, Chemistry, Mathematics, Comp. Sci.	Grounded in philosophy of mind/language, Cognitive sciences, Psychology and Comp. Sci.
Studies Intelligence as part of Life itself. Focus on group <u>behavior</u> .	Focus on individual Intelligent <u>Behavior</u> (sometime isolated)
Bottom-Up approach - study synthesis	Top-Down approach - focus is on results
Views life-as-it-could-be	Views intelligence-as-it-could-be

A-life: life as it could be

- Rather than being an analytical study of “natural” life, A-Life is a *Synthesis* approach to studying any form of *Life*.
- An a-life system is usually executing in an artificially-created *environment* (usually within computers),
- The system design is usually more or less derived from the *one* example we have of life - *Natural life*.
- Often, the focus is on *Emergent property*: *emergence occur when* something becomes more than sum of its parts. For example:
 - Ants' foraging activity.
 - Neurons in the brain (or in an ANN)

A-life as a domain

- Topics of interests:
 - Mathematical, Philosophical, Biological foundations, Social and Ethical implications of A-Life.
 - Cellular Automata
 - Neural Networks
 - Genetic Algorithms
 - Evolutionary / Adaptive Dynamics
 - Self-organization, Repair and Replication
 - Autonomous, Adaptive and Evolving Robots
 - Software Agents (good/evil)
 - Emergent Collective Behaviors, Swarms.
 - Synthetic / Artificial Chemistry / Biology / Materials
 - Applications: Finance, Economics, Gaming, metacreation, ...
- There is quite a lot of overlap with AI and Machine Learning.



And in the end, it's not the years in your life that count.
It's the life in your years.

Abraham Lincoln