Computer Viruses, Artificial Life & the Origin of Life
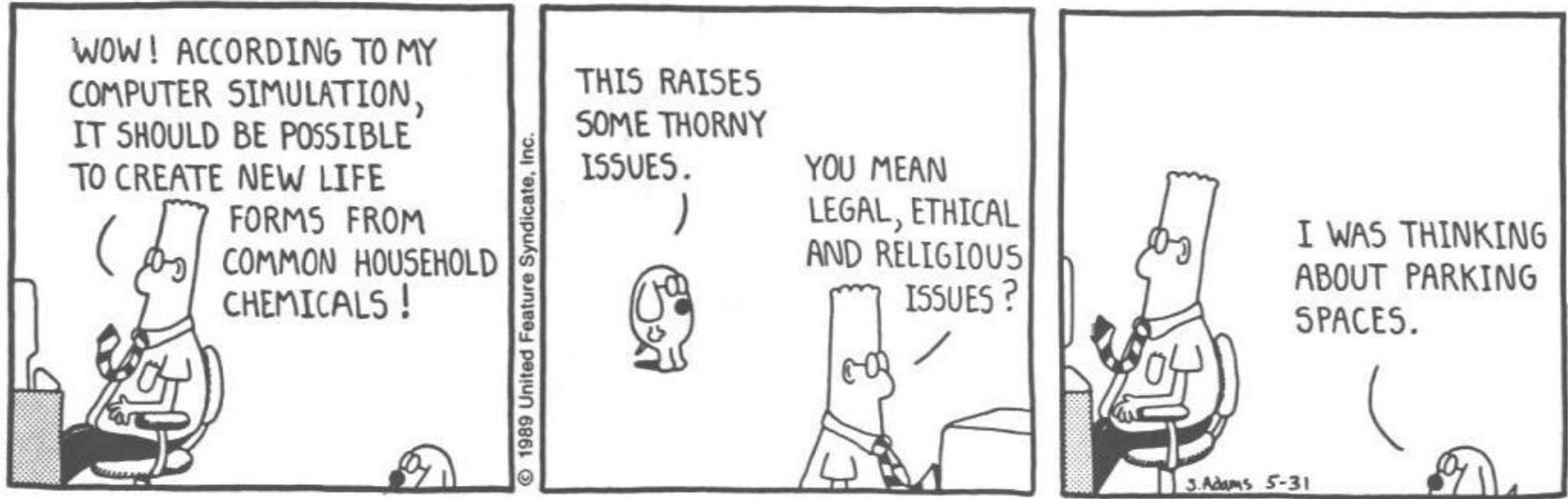
Robert C Newman

Origin of Life

- Many talk today as though life came about by purely natural processes, and it's only a matter of time until we learn how it happened.

- Here we suggest that life is far more complex than most people think, and it is hardly likely to have happened by chance.
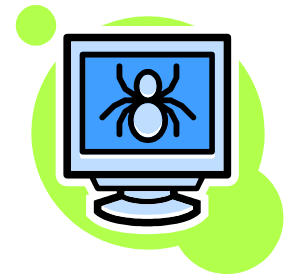
Origin of Life

Topics of Discussion

- In thinking about the complexity of life, we will take a different tack than is usual.

- We will look at computers rather than biology.

- We want to look at:
  - Computer Viruses
  - Artificial Life

Computer Viruses

- What are computer viruses?

- Computer programs which invade a computer and try to take over its functions, rather like biological viruses do with human cells.

- Most of us with computer experience have had to deal with such viruses from time to time.

Computer Viruses

- Excellent discussion in Mark Ludwig, *Computer Viruses, Artificial Life & Evolution.*

- CVs are closer to artificial life than anything else humans have made.

- They are able to reproduce.

- They can often hide from predators.

- They can survive outside captivity.

Origin of Computer Viruses

- No one claims they arose by chance.

- They are designed by intelligent (if malevolent) creators.

- How likely would it be for something as complex as a computer virus to arise by chance in the computer environment?

How Likely to Arise by Chance?

- Ludwig's "First International Virus Writing Contest" (1993)
  - Devise shortest virus possible.
  - Must have certain minimal functions.
- Ludwig gives a sample, the grand prize winner, and several runners-up.
- All are over 100 bytes in length.

How Likely to Arise by Chance?

- Shortest virus is 101 bytes
- There are 10^{243} possible files of length 101 bytes.
- If we have all 100 million PCs in world run full-time, making only 101-byte files at 1000/sec:
- Probability (hist univ) = 4 x 10^{-214}
- If every elementary particle in universe such a PC, then Probability = 6 x 10^{-100}

Summary on Computer Viruses

- Even very simple computer viruses are very complex from the viewpoint of random assembly.

- So we can see why no one thinks computer viruses formed by accident.

- But perhaps some other form of artificial life will show us how this could have happened.

Artificial Life

- What is artificial life?
- Attempts to mimic or reproduce life by human ingenuity.
- The term is commonly used today for attempts to mimic life by computer simulation, rather than by building up life from its basic biological components.

ARTIFICIAL LIFE

THE QUEST FOR A
NEW CREATION

STEVEN LEVY
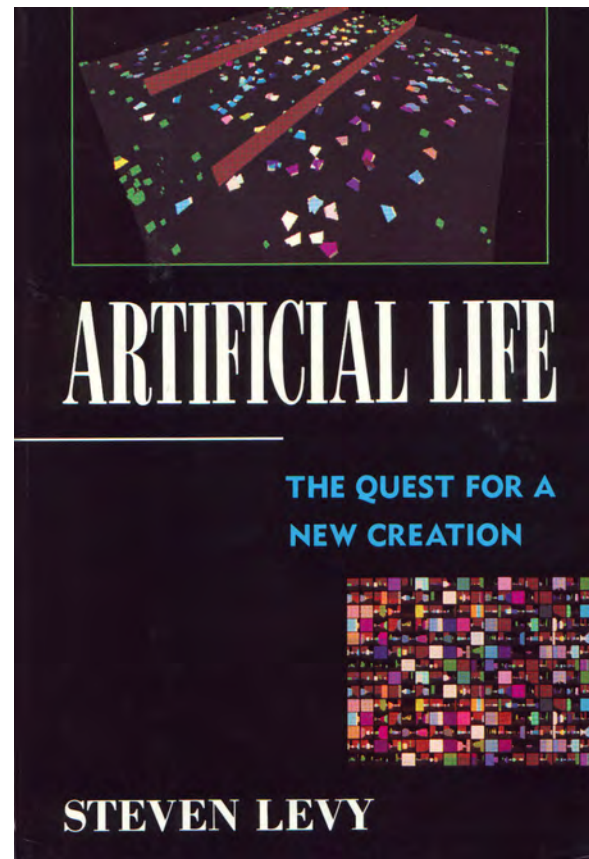
Making Artificial Life

- Over 50 years ago, John von Neumann sought to design a self-reproducing automaton.

- He imagined a rectangular array of identical computer chips, each wired to four neighbors.

- Though identical, the chips will behave differently depending on what operational state each is in.

Von Neumann's Chips

Von Neumann's Automaton

Constructing Unit	**Constructing Arm**	Unit Under Construction
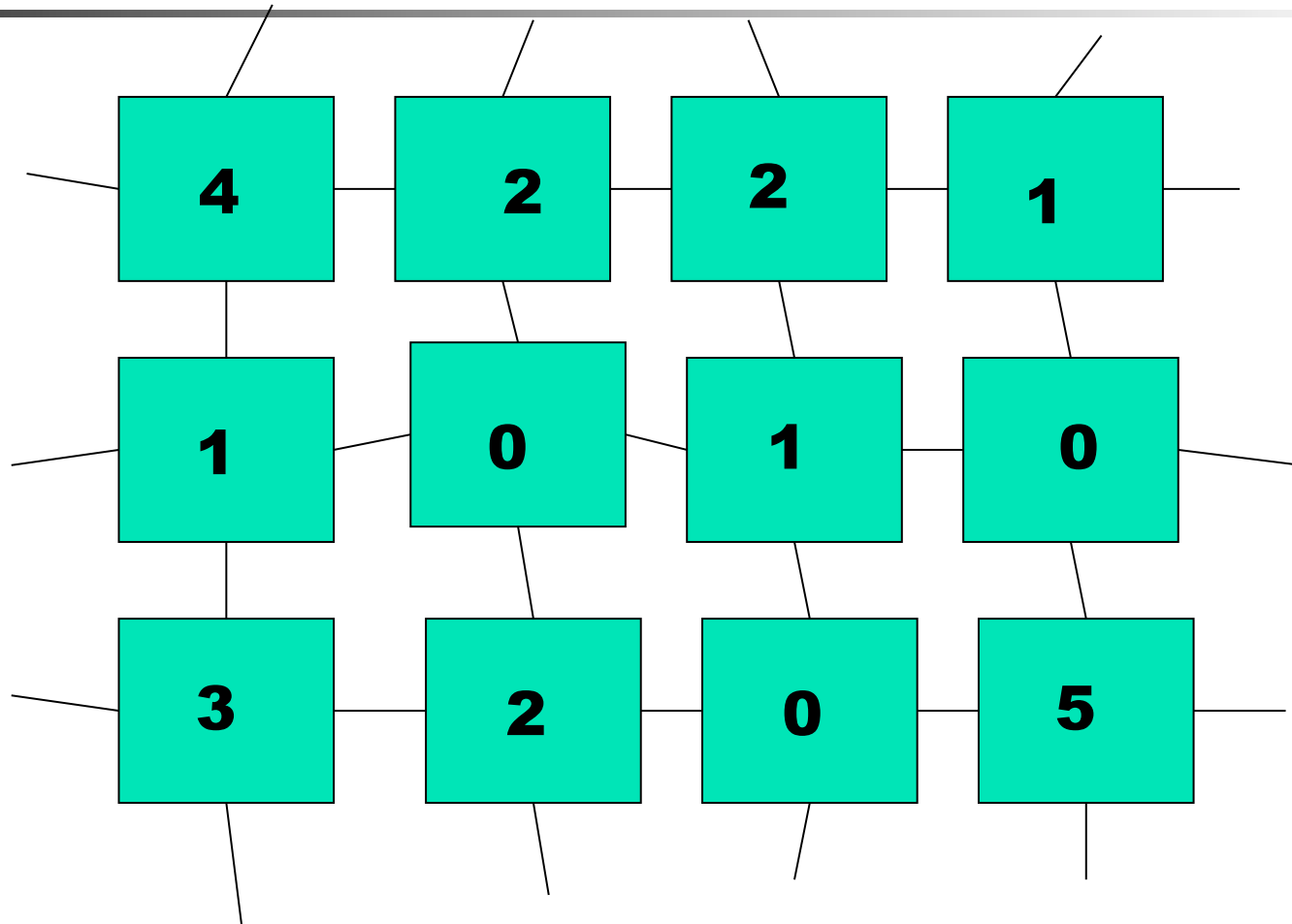
Memory Control
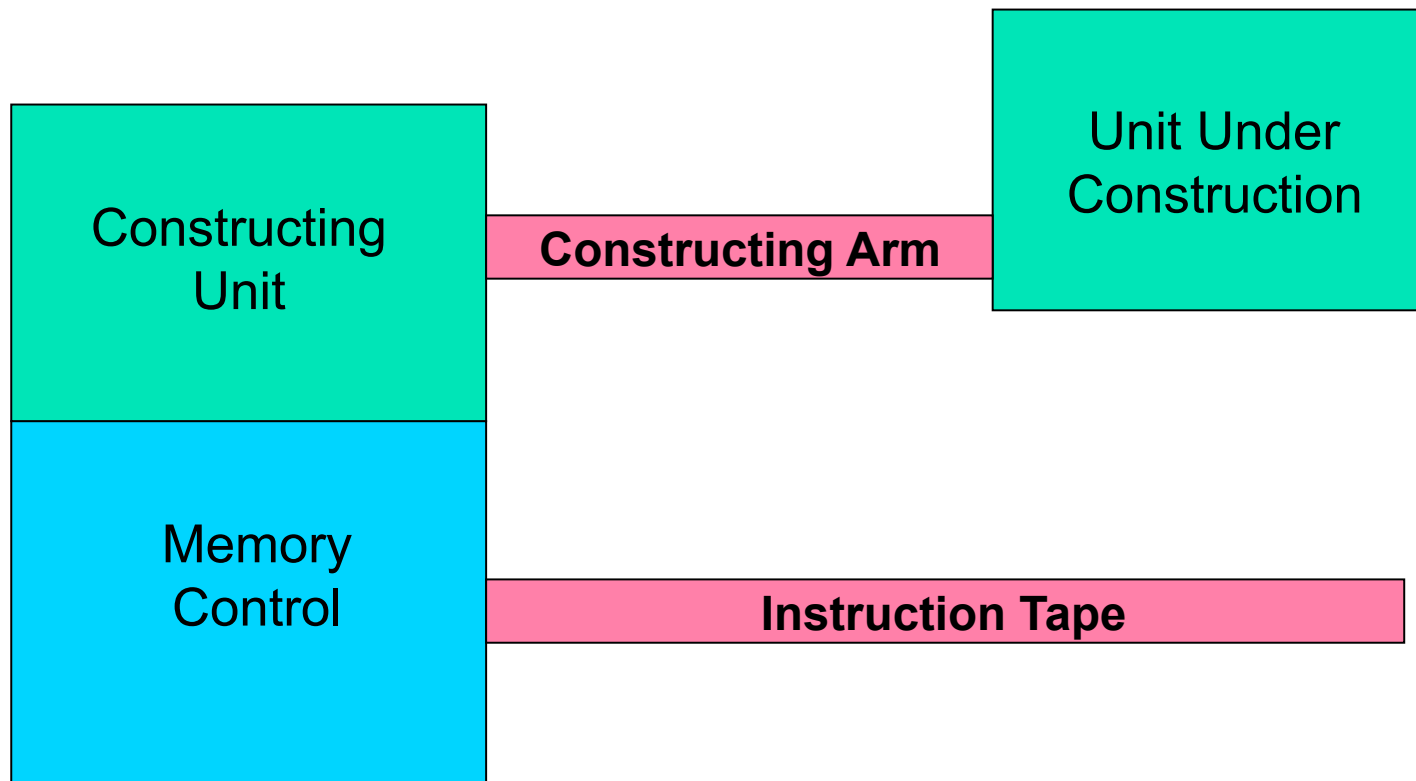
Instruction Tape

Von Neumann's Automaton

- Memory Control Unit – 300 x 500 chips
- Constructing Unit – 300 x 500 chips
- Instruction Tape – 150,000 chips
- Whole thing about as complicated as a modern computer!

Langton's Simple Automaton

- Much simpler than von Neumann's
- Modified a small component part of a previous automaton so that it would reproduce itself
- A 10 x 10 loop with a 5 x 3 arm
- The "instruction tape" fits inside and extends arm by 6 units, turns left, repeats this 3 times, till arm collides with self, breaks off new loop and makes new arms for each.
- Reproduces in 151 time-steps
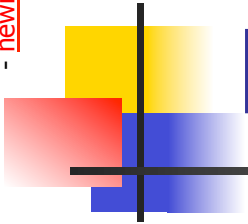
Langton's Simple Automaton

```
    22222222
2170140142
2022222202
272      212
212      212
202      212
272      212
2122222122222
207107107111112
 2222222222222
```

Langton's Simple Automaton

Bottom panel shows later generations:

Byl's Simpler Automaton

T = 0   **T = 5**   **T = 10**

```
 22          22           22    3

2632        2342         2462

2642        266633       23664363

 25          2212         221222
```

T = 15   **T = 20**   **T = 25**

```
 22    3       22    2       22      22

2662      3    2632   362    2345  2632

243664362      264366432     2662  2642

 2212222        2212222       22  2  25
```
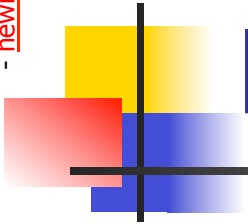
Ludwig's Simpler Automaton

T = 0	T = 1	T = 2	T = 3	T = 4	T = 5
2	2	2	2	2	25
212	212	212	21	213	21 4
	3	5	2	2	2
		4	636	626	2
			6	262	212

Probabilities for Random Formation

- ## Langton's Automaton
  - ### P (hist univ) = 1×10^{-129}
- ## Byl's Automaton
  - ### P (hist univ) = 1×10^{-69}
- ## Ludwig's Automaton
  - ### P(Byl assump) = 1 every 10^{-14} sec
  - ### P(more reasonable) = 1×10^{-86}

Problems w/ Simple Automata

- Not good for anything but reproduction.

- Reproduction typically collapses with any mutation.

- A viable automaton will need to be able to reproduce while changing.

- Thus we need to add more chip states, increasing complexity.

A "Life" Automaton

- Try to be more general than three above automata.

- Don't tie to substrate especially designed for automaton.

- Use John Conway's game "Life" as substrate.

- Simplest reproducer is enormously complex, like von Neumann's!

The Problem of Fragility

- All these automata run in an empty environment.

- What happens if they contact other objects in their space?

- Have tested Langton automaton for this; results are disastrous.

- Automaton is too fragile to function in such a space.

Summary on Automata

- Universal constructors far too complex.

- Special constructors too specialized, too fragile to handle mutations.

- Need to build automata that are:
  - general enough to be flexible,
  - are robust, and
  - not too complex to form randomly.

- This looks to be impossible.

Real Life

- So far, the artificial life project is like the biological origin-of-life project.
- Both have produced some minor results, which have been hyped far out of proportion to their actual significance.
- Researchers realize you can't get funding if the funders think the project is hopeless!

What This Means

- Don't mistake research proposals for results!

- Don't mistake worldview-driven visions for a view of the real world.

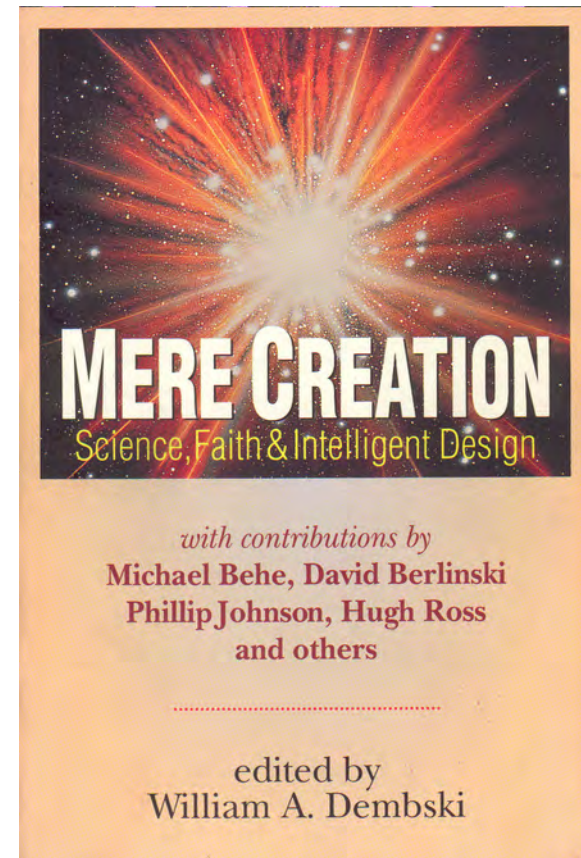- The results look far more like evidence of intelligent design.
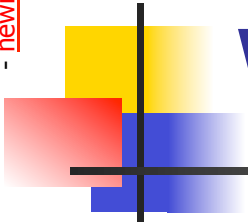
What This Means

For Further Reading...

My article "Artificial Life & Cellular Automata" in *Mere Creation: Science, Faith & Intelligent Design*, edited by William Dembski

MERE CREATION
Science, Faith & Intelligent Design

with contributions by
Michael Behe, David Berlinski
Phillip Johnson, Hugh Ross
and others

edited by
William A. Dembski

The End …

artificial life

Will man-made simulations prove life happened by itself?

Don't count on it!