Lecture 15  The Complexity of Life

Text: Read Chap 6
Packet: Review T. Rex and Crater of Doom
Project: Happy to talk to you.
Midterm: Monday Feb. 18, 2002
   Short answer (identify terms ...)
   and some short essay questions

Last time: "The Andromeda Strain" is an example of a possible ET life form
   built on some chemical elements H, C, N, O
   but with no organic compounds such as amino acids.

1) Amino acids are easy to make and may be common. Why not use them?

2) Was organism adapted to life in space? Some Earth bacteria survived
   for a few years on the Moon. Could an organism hitch a ride
   on an asteroid traveling from say Mars to Earth? Not impossible but unlikely.

The Complexity of Life

How complex is life? Very. What does this have to say about origin of life?

How much more complex is intelligent life? What does this have to say about origin of intelligence
   and how common intelligence is in Universe?
Information content of DNA

Each rung in ladder can be one of four bases

- Adenine (A) : 00
- Cytosine (C) : 01
- Guanine (G) : 10
- Thymine (T) : 11

Binary code (one example)

Need two bits of information to specify 4 possible bases.

A Gene is a functional length of DNA about 1200 base pairs long.

A gene encodes about

\[ N_{gene} = 2 \times 1200 = 2400 \text{ bits of information.} \]

This information is copied when DNA replicates and it is used when a messenger RNA molecule is synthesised.

Information content of organisms

1. Virus \( \sim \) 50 genes \( 50 \times 2400 \leq 120000 \text{ bits} \)

   Note: a virus is often not considered to be alive because it needs other organisms to function.

2. E. Coli \( \sim \) 2500 genes \( \sim 6 \times 10^6 \text{ bits} \)

   \( 8 \text{ bits} = 1 \text{ byte} \)

\[ \text{= 0.75 Megabytes} \]
Recently complete DNA sequence of humans is available. It is surprising that we have fewer genes than we had previously thought.

Modern # [≈ 35,000 genes]

35000 x 2400 = 8.4 x 10^7 bits

⇒ 10.5 Megabytes

You can fit whole DNA blue print of a bacterium on a single 1.44 MB floppy disk.

The print of Man might take 8 floppy disks.

Note this is a remarkably efficient encoding. Detailed instructions for building all of the proteins etc necessary for life with all its required functions are included.

This small information cache contains collective wisdom from all the species alive before Man.

Note mothers and fathers can pass additional information to their children. Is natural selection and evolution enough to explain this information?
The tree of life shows how all organisms are related.

I said we are "slime mold second cousins".

1. Human cells and slime molds have similar 16S ribosomal RNA.

2. This strongly suggests that both organisms evolved from a common ancestor.

However, I did not mean to imply any moral or philosophical implications.

"Nonscientific" alternatives to Evolution

1. Creationism → Bible is literally true; Earth is only 6000 years old (not 4.6 billion). Organisms don't evolve; they were created, complete, by God.

Lots of evidence that Earth is much much older than 6000 years and you can watch organisms evolve in the laboratory.

2. Intelligent Design

Acknowledges that Earth is billions of years old and that organisms change over time. But claims that the astounding complexity of the Earth's plants and animals could not have just happened through natural selection.
In short evolution happened just as scientists said but it happened because the hand of god was behind it. If science discovers something "ugly" it is just science. If science discovers something "beautiful" (read Man) then it is because of intelligent design.

What was intelligently designed? Man of course. Monkeys, Corn, Amoeba, Slime molds, E. coli, Lifi.

Was the Earth intelligently designed? It is quite remarkable that it has such a stable climate.

Was the solar system "intelligently" designed? Sun puts out enough light that Earth can be a safe distance away. Sun lasts long enough. Jupiter's gravity deflects many comets out of solar system keeping Earth safe.

Was the Universe intelligently designed? Laws of physics allow stars to make chemical elements and shine at an appropriate rate ...
Was the diamond in my wife's wedding ring intelligently designed? How about the slime mold infecting this lecture demonstration table?

Is intelligent design a testable theory? It appears not.

Intelligent design wishes to claim responsibility for the fruits of evolution.

Is evolution blind?

Random mutations occur. Those which help an organism survive lead to more offspring.

1) Are the mutations really random?

Yes! not only are they random but random mutations are occurring today all around us as we speak.

2) Is evolution enough to explain man?

It is very powerful. It is hard to tell evolution itself from God behind it.

Is evolution morally good? Evolution appears morally neutral. Evolution must occur. Small changes will creep up in any complex system and these changes will be tested. Evolution will lead to more sophisticated organisms because these can be better adapted to survive. But this does not necessarily imply that more sophisticated organisms are better than less sophisticated ones.
Are other worlds and other life forms also intelligently designed? We have the same laws of physics and the same evolution happening everywhere in the universe.

Is evolution repeatable? What is the role of blind chance in evolution? If "the experiment" is repeated, will the results be the same? No!