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COMPUTER SIMULATIONS OF EVOLUTION

Introduction

Not a literature search
Not covering origin of life question
 tho 2 programs on diskette are self-reproducing automata
 REPRO - Langton's automaton in my *JASA* Spr 88 paper
 BYL - Byl's in his *JASA* Spr 89 paper
 both these can be "mutated" by manipulating data for structure & transition rules
Not dealing with competition & spread of varieties
 good deal has been done on ecology/population genetics
Rather, a description & investigation of three programs that relate to the **mechanism** of evolution:
 -- two described by Richard Dawkins in his *Blind Watchmaker* (1986), 46-75
 -- one devised by self
 these 3 programs also on diskette available from IBRI for \$5

Program BIOMORPH

Describe:
 program, slightly simplified from Dawkins, for building "organisms" from genetic information, selecting among mutants
 gene is sequence of eight small integers
 generates "tree" controlling branch length, angles,
 # of levels of branching, with mirror symmetry
 given original gene, program constructs all "one-step" mutations, displays on screen
 operator selects which mutant to succeed parent

Lessons from BIOMORPH:
 shows how:
 mutation operates on DNA
 selection operates on developed form, not on DNA
 see that:
 identical forms can conceal diff genetics
 leaving room for neutral mutation

Program SHAKES

Describe:
 Dawkins seeking to circumvent "monkeys typing Shakespeare" problem of enormous times involved
 choose target sentence/phrase
 start with gibberish of same length
 mutate gibberish, selecting mutant/parent which is closer to target to be new parent
 gibberish converges to target much faster than if monkeys were typing randomly

Dawkins gets convergence in typically 40-70 generations

Dawkins' version:

Not described in detail, so can't tell how he generated mutants, how many mutations per generation

My version:

One mutant each generation, compared w/ parent

Better of mutant/parent survives

I get much slower convergence, taking over 1000 generations

Lessons from SHAKES:

shows that a "ratchet mechanism" does work

important reason why many convinced evolution must be correct

but this is "guided evolution,"

which is considerably more efficient than even artificial selection, to say nothing of natural selection!

does not solve time question

which version is more realistic?

mutation rate in eukaryotes is 10^{-8} per replication

both ignore time involved for mutant to take over population!

my version suggests a problem

for mutating into complex or optimal structures:

last pieces of puzzle are *highly constrained*

Program MUNSEL

Describe:

simulate mutation & natural selection by analogy with human language

letter string is both gene and organism

mutation is random change in content and/or length

selection is "naturalized" by requiring that each

grouping in string be an English word

current version has operator do selecting,

but comparing with a spell-checker would be more objective

generates words of 1-4 letters rather easily

relative frequency of space character (and nature of selection) tends to keep words short

little success in getting intelligibility in 100s of steps

Lessons from MUNSEL:

complex organisms involve hierarchies of structure

somewhat like intelligible writing

letters > words > phrases/sentences > paragraphs

mutation only works at lowest level

nucleotides \Leftrightarrow letters

so becomes tougher to get anything acceptable as we move up hierarchy

non-selected mutation => gibberish

neutral mutations spread only by random walk

functional isolation seen here (as in terrain analogy)

many combinations cannot be reached by single mutations from acceptable

smaller groups

what is the relative size of islands of intelligibility vs oceans of gibberish

for each level of hierarchy?

can you really get there from here?

complex organs/organisms

crossing higher levels of bio classification