Herbert Simon's Nearly Complete Decomposability and the Speed of Evolution

A Breakdown

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Introduction

- Environments are not tailored to the organism - the organism is tailored to the environment.
- Over time, the organism AND the environment both change.
- Nearly decomposable systems extend organism fit into the dynamic environment through "trial and error"!

Near Decomposability

- Found within physics, chemistry, biology, and human social organizations alike
- Satisficing > Optimizing (because of the dynamic environment)

Near Decomposability

- Systems composed of components on specific levels evolve to fit their environment's landscape quicker than systems not composed of components.
- Component interactions within boxes at any level take place faster than same-level interactions.

Simon’s Thought Experiment

- Office building with many cubicles
- Tornado sweeps through and impacts the equilibrium temperature of all the cubes

What happens?

Simon’s Thought Experiment

- In minutes, nearly all cubic centimeters in each cubicle become essentially equal
- In an hour, all cubicles in the same room equalize
- In a day, all rooms in the building equalize to roughly the temperature as outside

Problem-Solving

- Problems require solutions that <u>fit</u> in the general landscape.
- Dynamic systems have fitness landscapes that <u>change</u>.
- <u>Dynamic fitness changes changes with the landscape.</u>

	1	2	3	4	5	6	7	8	9	10	11	12
1	-1	a	a	ε_1	ε_1	ε_1	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2
2	a	3 -1	a	ε_1	ε_1	ε_1	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2
3	a	a	-1	ε_1	ε_1	ε_1	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2
2 4	ε_1	ε_1	ε_1	-1	a	a	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2
5	ε_1	ε_1	ε_1	a	-1	a	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2
6	ε_1	ε_1	ε_1	a	a	-1	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2
1	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2	-1	a	a	ε_1	ε_1	ε_1
8	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2	a	-1	a	ε_1	ε_1	ε_1
9	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2	a	a	-1	ε_1	ε_1	ε_1
10	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2	ε_1	ε_1	ε_1	-1	a	a
11	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2	ε_1	ε_1	ε_1	a	-1	a
12	ε_2	ε_2	ε_2	ε_2	ε_2	ε_2	ε_1	ε_1	ε_1	a	a	-1

ND Table

- Three layers
- top layer: (1-6) + (7-12)
- Second layer: (1-3), (4-6), (7-9), (10-12)
- Third: Independent squares (1), (2), (3), etc

- ND systems increase in fitness as the smaller sublevels become "composed".
- When disturbed from equilibrium, the subsets at the lowest level of the system return to equilibrium when the sets above are still dynamically changing.

A default equilibrium

- A universal property enables each cubicle, then room, then the entire building to equalize.
- This property “confers greater fitness . . . and, most importantly, it accelerates the rate at which the fitness of organisms possessing it increases over time through standard processes”.
- The fitness landscape changes

Mechanics relying on dynamic processes iterate an environment or concept until it reaches an equilibrium, or a “a general fitness”.

- It changes until it reaches a generally fitting result.
- NOT OPTIMAL RESULTS

Implications

1. Systems that integrate with larger systems are typically nearly decomposable.
2. Against a non-ND system, an ND system will likely increase environmental fitness faster.
3. Systems that design around components independent from one another will increase fitness through mutation, crossover, and natural selection more rapidly than systems without this near-decomposability.

Questions?