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

A Breakdown

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x/y/zz

Near Decomposability & the Speed of Evolution

- Concept
- Thought Experiment
- NCD Example

Near Decomposability & the Speed of Evolution

- Simon posits there is a universal fundamental property for multi-celled organisms/dynamic systems
    - Dubbed “Near Complete Decomposability” (NCD) as the more decomposed the structure becomes, the more composable it is for dynamic fitness.
- Paper is based in biology but logic extends to physics, chemistry, and even extends into human organizations such as firms or governments (p. 598)

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

". . . an organism must obtain enough energy from the environment to sustain its metabolic processes and to reproduce; the organism's metabolic and reproductive requirements are in turn determined by its processes for energy acquisition and use."

Simon, 2002

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Problem-Solving

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

ND Table

	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	-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
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
7	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

- 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