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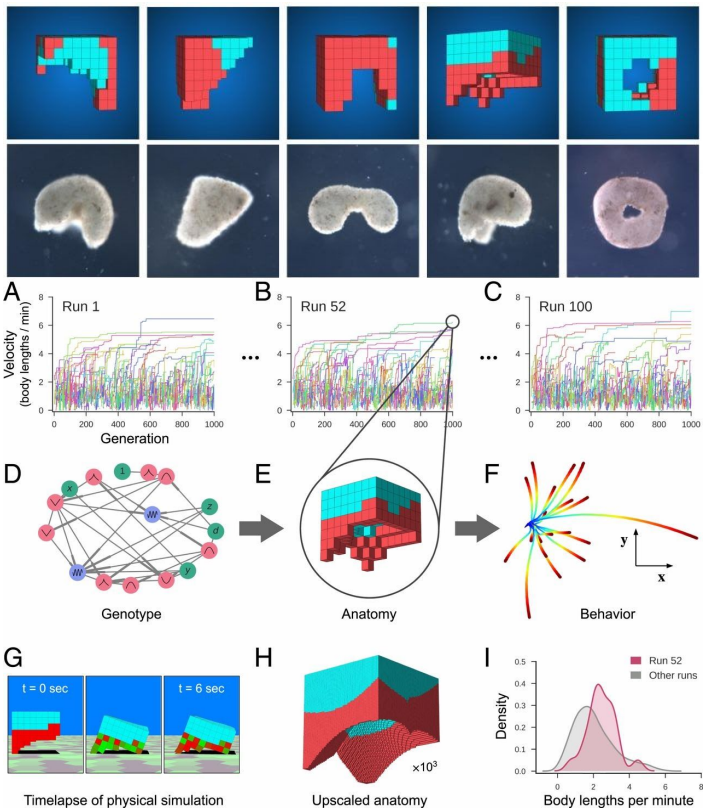
Food for Thought

Is it possible to create a cross between a machine and a living being?

What are the ethical concerns of creating programmable lifeforms?

How far are we from being able to use nanotechnology in commercially available applications?



What are Xenobots?

- Considered by the *Independent* as the "*First Living Robots*"
- A group of researchers took cells from frog embryos. These organisms were created using a supercomputer and evolutionary algorithms.
- "*It's both a living thing made of living cells and a machine that researchers can program to express certain behaviors*" (Simon, 2020)

What Have Researchers Learned?

- Scientists can better understand how cells communicate, their unique structures and behaviors
- Challenges that come with constructing robots from living tissue

Does This Have *Anything* to Do with This Class?

- The same principles of training neural networks apply to both machine learning and this interesting hybrid of technical and biological research.
- One of the main goals is to randomize behavior and find out which bots do their jobs well, and which don't. Essentially, the way they determine which bots will be used and which don't is determined by more and more data being given so that a larger sample size can be analyzed.

Algorithm:

- Generate random 3D configurations of 500 - 1000 skin and heart cells
    - Two groups of cells: passive (non-moving) and contractile (moving)
- Each design is tested in a virtual environment (e.g. how far cells move when the heart's beating)
- Scientists had to choose 100 generations (the single fastest design moves on to the next generation) before surgeons can build them in the laboratory

Significance (taken from the study—see below)

Most technologies are made from steel, concrete, chemicals, and plastics, which degrade over time and can produce harmful ecological and health side effects. It would thus be useful to build technologies using self-renewing and biocompatible materials, of which the ideal candidates are living systems themselves. Thus, we here present a method that designs completely biological machines from the ground up: computers automatically design new machines in simulation, and the best designs are then built by combining together different biological tissues. This suggests others may use this approach to design a variety of living machines to safely deliver drugs inside the human body, help with environmental remediation, or further broaden our understanding of the diverse forms and functions life may adopt. (Kriegman, Blackiston, Levin, and Bongard, 2020)

Resources

Original study: https://www.pnas.org/content/early/2020/01/07/1910837117

LiveScience article: https://www.livescience.com/frogbots-living-robots.html

Wired: https://www.wired.com/story/xenobot/

The Independent: https://www.independent.co.uk/life-style/gadgets-and-tech/news/living-robots-xenobots-living-cells-frog-embryos-a9282251.html

The Guardian: https://www.theguardian.com/science/2020/jan/13/scientists-use-stem-cells-from-frogs-to-build-first-living-robots