From LUCA to Cyanobacteria: Simulation of Prokaryotic Evolution With Geological Processes Using Software Unity

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The aim of this work is to create a program capable of simulating the evolution of organisms together with geological processes. For simplicity, I have focused on the evolution of prokaryotes from LUCA (Last Universal Common Ancestor, from which all present-day organisms are assumed to have descended) to cyanobacteria, which are not included. The program runs in Unity software, and it is mainly written in C#. Additional programs, such as terrain generation or prokaryote models, are written in C++. At the beginning of the simulation, the terrain is randomly generated. After the terrain is generated, the distribution of organisms begins. The default organism is LUCA, which is placed around the pre-generated black smokers. It is also possible to create your original organism as well as change the placement (such as evenly, or to a selected location). Once the generation is done, the evolution process can commence. This is done in 4 steps. First, the prokaryotes migrate to new areas. If they can withstand the local conditions (acidity, toxicity...) and get enough resources, they can then divide and mutate. The cycle then repeats itself. The program itself is capable of simulating the evolution of novel prokaryotes, which evolve not only their form but also their locomotor apparatus (flagellum, pilli), metabolism, and interaction with their environment. The evolution of organisms also is simultaneous with the evolution of the landscape. Plate tectonics create new mountain ranges that subsequently erode and weather. The simulation is fast, capable of simulating tens of thousands of years within minutes. The programs used in this work have other applications, such as in simulating bacterial resistance to antibiotics.

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