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Biology II AP

Mrs. -----

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Research Project

The *Evolutionizer*

The *Evolutionizer* is a computer simulation, with the aim of creating an environment in which the concept of biological evolution is emulated. This document is a basic summary of the program with instructions on how to run it. The main portion of the project is intended to be the program itself.

The program, written in C++, contains a 2-dimensional matrix, in which each square can hold one of 3 things: a food value, a barrier, or an organism. An organism consists mainly of its direction of movement, its stored energy, and most importantly, its "DNA". The "DNA" is a series of A's, B's, C's, and D's, which are interpreted by the program into a set of instructions, such as movement, turning, eating, examining the surroundings, etc. The most important instruction is the one for division, where the organism is copied, but with a chance of random mutations in the newly created organism.

The world contains a limited amount of food. While the food is able to grow periodically, there often is not enough to support all of the organisms in the world. This results in cycles, where a large amount of available food will cause a boom in population. Subsequently, there is a shortage of food, and many of the organisms are unable to survive, and they die off. Hopefully, one

or more of the random mutations during the population boom would have created an organism better able to survive this cycle. It would then survive, eventually taking over, unless superseded by another, more superior organism.

During the test runs, it appeared that this hypothesis was followed. The default organism code that the program contained was quickly mutated into much longer, more complex instruction sets (which the program allows you to view). Rather than the random changes in the code always causing the program to fail, enough of them were beneficial such that they became more “fit” in an evolutionary sense.

While this program was an extremely abstract simulation of “life”, it provided a basic working illustration of the feasibility of evolution, in a union of computer science and biology. Improvements that could be made include, among others, more fine-grained instructions, more types of mutations, larger worlds, and a more user-friendly interface, rather than the command line model currently used.

While the basic design of the program was formulated independently, much of the actual implementation was influenced later by Mike Ash’s *Creatures* for MacOS X. *Creatures* can be located at <http://www.mikeash.com/software/creatures/>, but it is shareware (i.e. it does not include full functionality without payment), and does not include source code. This project, released under the General Public License, includes source code, which could be easily extended by a programmer to implement further functionality. Also, some of the CollegeBoard C++ libraries were used

for data storage, and knowledge gained studying the AP Computer Science Marine Biology case study aided greatly in designing this simulation.

Instructions for usage:

- 1) -----
- 2) -----
- 3) -----
- 4) -----<clip>
- 5) Maximize the window by click the middle box in the top right-hand corner.
- 6) Type “evpre1” and press enter to run the program.

At this point, you will be presented with the representation of the world, with the organisms represented by “@”, food represented by “.”, and barriers represented by “+”. The rows are labeled with numbers running down the left of the screen, and the columns are labeled across the top (note that both begin with zero rather than one). A menu of options allows you to choose what to do next. Enter one of the digits, and follow the instructions presented on the screen. **You must not enter anything other than the expected numbers. The program is not expecting other input, and will behave extremely unpredictably if given other data!**

- 7) Selecting ‘1’ will let you run the simulation for however many steps you specify (try about 500 at a time, or several thousand once a stable population cycle seems to be established and you wish to “evolve” the dna extensively).

- 8) Options 2 through 5 will let you add or remove various things to the world. Please remember to enter the row and column properly, as labeled in the representation.
- 9) Option 6 will allow you to view the DNA of a specified organism. You can repeat this option with various organisms in order to compare the DNA sequences.
- 10) Option 7 will quit the program. If you quit, or if it crashes due to improper input, please return to step 6 to rerun the program.

Also, it is possible that the organisms at the beginning will not successfully survive until reproduction, leaving an empty world with only food and barriers. You have two options, to quit the program and restart it until they do survive, or you can manually add organisms with option 2 at the main menu.

In addition, if it appears that a single organism is moving around for several hundreds of steps without reproducing, it is possible that it's DNA doesn't contain the ability to reproduce (or it simply can't get enough energy to reproduce). Try adding a new organism with option 2.