

LABORATORY INSTRUCTION PAGES

LABORATORY EXPERIMENTS WITH

LIFE3000

Using JOHN CONWAY'S GAME of Life
A TWO DIMENSIONAL CELLULAR AUTOMATA
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GENSCI 104 - ARTIFICIAL LIFE, CHAOS, AND COMPLEXITY
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PURPOSE

The purpose here is for you to experience first hand the behavior of an Artificial Life system called *The Game of Life* invented by John Conway. At this point we are not going to tell you much about it, or how it works. We just want you to experience the experiments, and observe and record the outcomes.

The Instructions for opening the program and for the experiments are in these pages. Data sheets for recording the results of your experiments are in a separate packet titled RECORD OF EXPERIMENTAL RESULTS at the back of these Instructions

NOTES AND COMMENTS

- ☺ **Life 3000** is a lot of fun to play with. There are many options available and an almost unlimited variety of ways to play Life. You may get the urge to start experimenting, and we encourage you to do so, **but after** you have done the experiments below.
- ☺ When it comes time to do the formal experiments **follow the instructions below**. They are designed to systematically lead you through a series of observations.
- ☺ You may consult with your instructor about questions that come up in your experiments.

¹ Life3000, along with other A-Life programs came with the book Artificial Life Playhouse by Stehen Prata: Waite Group Press. The book is now out of print, although similar programs are available on the www.

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- ☺ You may discuss your experiments with other class members, but the results in your **A**Record of Experimental Results **@** must follow logically from your own observations and specific experimental results.

OPENING THE LIFE3000 PROGRAM

- The Life3000 program is available only in the Geology Department computer lab, Miller 232. All the computers have the program.
- Turn the computer and monitor on. It will open to a Windows95 screen.
- When the Windows Program Screen comes open:
 - ☞ Click on the **A-Life** icon to bring that window up front.
 - ☞ Double click the **Life3000** icon to bring up the **Life3000** program.

EXPLORING THE LIFE3000 PROGRAM

- Life3000** is a Windows based program. Observe the tool bar at the top. Move the cursor across FILE, EDIT, WORLD, OPTIONS to see what is there.
- Under WORLD click the GLOBE and peruse the options available. We use them later.
- Place the cursor on the large blank screen on the right. Click the left button and a pixel will light up; it is said to be **A**alive.**@** Click the same pixel with the right button and it will become **A**dead.**@**
- Hold the left button down and swirl the pointer across the screen. Pixels will light up as you go.
 - ☞ Clicking GENOCIDE to the left clears the screen of everything.
 - ☞ EDIT: UNDO will get your last screen back.

Experiment One - Life3000

A Large Random Array of Live Cells

CREATE A LARGE RANDOM PATTERN OF LIVE CELLS by holding the left mouse button down and swirling the arrow across the array.

- ☞ The pattern should not possess any obvious shapes or forms.
- ☞ Get the population to at least 200 live cells.

1. Click **PROCREATE** AND **OBSERVE THE OUTCOME.**

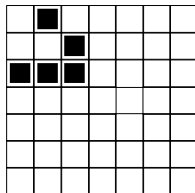
- ☞ Click GENOCIDE, and then do it again by creating another random array.
 - ☞ Do it several times more.
- ☞ In the experimental record describe what happened, the final outcomes (sketch typical samples if simple). How many generations did it take? Note that Pattern Test under OPTION will, if turned on, tell you when life is Stable, Extinct, or Repeating, and at how many generations.

Go to Record of Experimental Results to record your experimental data.


Experiment Two - Life3000

A Very Simple Array of Live Cells

CREATE A SIMPLE PATTERN OF LIVE CELLS as shown in the illustration below. Place the pattern high and to the left on the grid.



2. Click ONE CYCLE and observe the outcome.

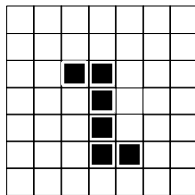
- ☞ In the Experimental Record sketch the outcome.
 - ☞ Repeat the Aone cycle ⇒ sketch@several times more, drawing the outcome at each step.
 - ☞ Now click PROCREATE and watch what happens. Describe it.
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Experiment Three - Life3000

Variations on a Simple Array

CREATE A SIMPLE PATTERN OF LIVE CELLS as shown in the illustration below. Place the pattern somewhere near the middle of the grid.

- ☞ Click PROCREATE and watch what happens. This is the default state.
- ☞ In this series of experiments we are going to systematically change the Birth neighbors and observe how the patterns change.



3. RETURN TO THE ORIGINAL PATTERN. THERE ARE TWO WAYS TO DO THIS.

- ① Go to EDIT: UNDO and click it. It will take you back to the state you were in *just before* the last run.
 - ② Redraw the pattern.
- ☞ Go to WORLD on the tool bar and click it.
 - ☞ Click the **GLOBE** that comes up.
 - ☞ Go to BIRTH NEIGHBORS and set them to **0, 0**. Leave the SURVIVAL NEIGHBORS at the **2, 3** default.
 - ☞ Click PROCREATE and observe what happens. Do it several times if you want.
 - ☞ Describe what happened, the final outcome, and the number of generations it took.

4. RETURN TO THE ORIGINAL PATTERN.

- ☞ Change the BIRTH NEIGHBORS to **1, 1**.
- ☞ Click PROCREATE and observe what happens. Do it several times if you want.
- ☞ Describe what happened, the final outcome, and the number of generations it took.

5. RETURN TO THE ORIGINAL PATTERN.

- ⇒ Change the BIRTH NEIGHBORS to **2, 2**.
- ⇒ Click PROCREATE and observe what happens. Do it several times if you want.
- ⇒ Describe what happened, the final outcome, and the number of generations it took.

6. RETURN TO THE ORIGINAL PATTERN.

- ⇒ Change the BIRTH NEIGHBORS to **3, 3**.
- ⇒ Click PROCREATE and observe what happens. Do it several times if you want.
- ⇒ Describe what happened, the final outcome, and the number of generations it took.

7. RETURN TO THE ORIGINAL PATTERN.

- ⇒ Change the BIRTH NEIGHBORS to **4, 4**.
- ⇒ Click PROCREATE and observe what happens. Do it several times if you want.
- ⇒ Describe what happened, the final outcome, and the number of generations it took.

8. THOUGHT EXPERIMENT.

- ⇒ Think about this. We have systematically increased the number of birth neighbors from **0, 0** to **4, 4**. Were there any systematic changes resulting. Describe any systematic changes you observed.

With the next two runs we are going to hold the Birth Neighbors Constant And Systematically Change the Survival Neighbors

9. RETURN TO THE ORIGINAL PATTERN YOU USED FOR EXPERIMENTS 3-7.

- ⇒ Now hold the BIRTH NEIGHBORS constant at the default **3, 3**.
- ⇒ Set the SURVIVAL NEIGHBORS also at **3, 3**.
- ⇒ Click PROCREATE and observe what happens. Do it several times if you want.
- ⇒ Describe what happened, the final outcome, and the number of generations it took.

10. RETURN TO THE ORIGINAL PATTERN.

- ⇒ Set the SURVIVAL NEIGHBORS at **4, 4**.
- ⇒ Click PROCREATE and observe what happens. Do it several times if you want.
- ⇒ Compare Run 10 with Run 9.

Now we are going to vary both Birth and Survival Neighbors in Various Ways

11. RETURN TO THE ORIGINAL PATTERN.

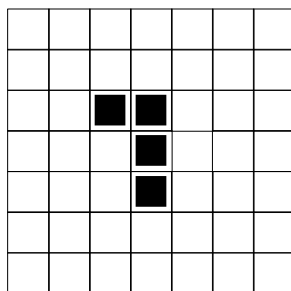
- ⇒ Set the BIRTH NEIGHBORS to **2, 4**; SURVIVAL NEIGHBORS at **3, 3**.
- ⇒ Click PROCREATE and observe what happens. Do it several times if you want.
- ⇒ Compare Run 11 with Runs 9 and 10.

12. RETURN TO THE ORIGINAL PATTERN.

- ⇒ Set the BIRTH NEIGHBORS to **3, 3**; SURVIVAL NEIGHBORS at **2, 4**.
- ⇒ Click PROCREATE and observe what happens. Do it several times if you want.
- ⇒ Compare Run 12 with Runs 9, 10, and 11.

Change the Initial Pattern

For the last two experiments we want you to slightly change the initial pattern to that shown below.

**13. Do a Comparison:**

- ⇒ First Run: Use the same BIRTH NEIGHBORS (**3, 3**); SURVIVAL NEIGHBORS (**2, 4**) as experiment 12.
- ⇒ Second Run: Now change the SURVIVAL NEIGHBORS at **2, 5**.
- ⇒ Describe the different outcomes of these two runs.



Number 13 above finishes the experiments on Life3000. We now want you to take a look at one more program. It is a boids program, short for *birdoid*. Boid programs simulate flocking or schooling behavior, including traffic behavior or walking in crowds.

OPENING MATFa s Boids PROGRAM

- The MatFa Boid program is available not only in the Geology Department computer lab, Miller 232, but can also be downloaded to your own personal computer from the World Wide Web. If you want your own copy go the front of this notebook and follow the instructions under **A**Downloading Files From the WWW.@
- Turn the computer and monitor on. It will open to a Windows95 screen.
- When the Windows Program Screen comes open:
 - Click on the **A-Life** icon to bring that window up front.
 - Double click the icon shown to the right to load the boid program.



14. Boids:

This program does a lot, but we want you to just watch it for now. The bright lines represent flying boids.

- Observe that at first they all start out **A**flying@randomly but soon they all begin to flock and fly together.
- Try This.** Click the TURMOIL button in the lower right and it resets the boids back to random. With this you can watch the flocking happen over and over.
- Try This.** Click on the screen and a yellow circle will appear. It is an obstacle the boids will fly around.
- Try This.** In the right column, toward the bottom is a box with the name DEFAULT in it. If you click on the down arrow it will allow you to load some other boid files (notice that the slide rule settings above the box change with each new file.)



DEMONSTRATIONS

If you have finished early, and are waiting for the class discussion, you are free to go back and explore some of the other things the Life3000 can do.

15. Alife DEMONSTRATIONS:

A tremendous amount of experimentation has been done with cellular automata (CA), and you can experiment too. Use your imagination. Be creative. Try some crazy ideas. The computer certainly does not care if it works or not. So, go ahead give it a try.

But you might also do the following, exploring a few of the CA behaviors people have discovered with Life3000. Take a look at them.

☞ Go To: **File: Open**, double click a file name, and click Procreate.



What Does It All Mean? (Class Discussion)

When everyone is finished we want to briefly discuss as a class what you have observed and what it all might mean.

For Life3000

- ☞ What have you observed?
- ☞ What is happening? Why did Life3000 behave this way?
- ☞ What meaning do you think it has, if any?
- ☞ Are there any practical applications to this stuff?

For MatFa⇒ Boids

- ☞ ACCEPT OR REJECT: The boids are behaving in ways similar to the Cellular Automata.

