

Evolution through Programming

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Assignment 1

Welcome to Week 1 of our Evolution course! For each assignment, create a simulation in any programming language (e.g., Python, MATLAB, Java) and attach your code with your submission. Be sure to include clear explanations and any necessary calculations. Enjoy exploring evolution!

Question 1 - Simulating the Luria–Delbrück Experiment – Darwinian vs. Lamarckian Models

Objective:

Explore the underlying mechanisms of mutation and selection by simulating the classic Luria–Delbrück experiment. This assignment invites you to model both random mutations and induced mutations scenarios, and to compare the resulting probability distributions of survivors.

For additional background, refer to the [Luria–Delbrück experiment on Wikipedia](#).

Tasks:

- **Simulations:**
 - Run the following simulations for a large number of trials to collect sufficient data on the number of survivors (mutants) in each scenario:
 - **Random Model:**
 - Create a simulation where mutations occur randomly during the growth phase, *before* any selective pressure is applied.
 - Track the emergence and distribution of mutants over multiple simulated cultures.
 - **Induced Model:**
 - Develop an alternative simulation where mutations are triggered only in response to the selective agent (i.e., mutation happens *after* the selection pressure is introduced).
 - Record the number of survivors under these conditions.
 - **Combined Model:**

- Have both types of mutations, random and induced.
- **Calculations:**
 - Show the probability distribution of survivors for each model.
 - Compute statistical measures such as the mean and variance.
 - Compare the two distributions: In the Darwinian model, expect a larger variance with some cultures showing a high number of mutants and many with few or none, while the Lamarckian model should yield a Poisson distribution.
- **Explanation:**
 - Write a short explanation of the Luria–Delbrück experiment and how it provided evidence for random mutation (Darwinian evolution) rather than mutation as a direct response to environmental challenges (Lamarckian evolution).