Project Proposal

The purpose of the program will be to model ecosystems and analyze populations of different species using concepts from ecology and population genetics. Given initial conditions, such as initial population size, it will calculate the expected population at a future time. It would also predict the number of individuals with a particular phenotype based on allele frequencies in the population.

The program will use differential equations to calculate future population sizes. It will input whether or not a population exists in a predator-prey relationship. This will determine the particular equation used. The future size of populations not in a predator-prey relationship will be calculated using the logistic equation = r(1 - ) y, which has the solution y = where is the initial population size, r is the growth rate constant, K is the carrying capacity, or upper limit for growth, and y is the population at time t. For populations existing in a predator-prey relationship, the Lotka-Volterra equations dx/dt = ax – αxy = x(a – αy) and dy/dt = -cy + γxy = y(-c + γx), in which x is the prey population, y is the predator population, a is the prey growth rate, c is the predator death rate, and α and γ are based on the level of interaction between the two species, will be used. The Hardy-Weinberg equation, which is derived from the binomial expansion + 2pq + in which p is the allele for the dominant trait and q is the allele for the recessive trait, will be used to find the frequencies of different genotypes in a population, from which phenotypes can also be found. All initial values and species specific constants will be included as data fields in a class and the equations used in the calculations will be member functions.

One challenge in this program will be in designing useful test cases. For the population equations, it may be difficult to determine how accurate and realistic the projections, at least for the predator-prey equations. One reason for this is the complexity of the equations. Also, it could be challenging to find realistic values for a, y, α, and γ.