Mathematical Models and UML Diagrams

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Contents

1. Use case

1.1 Use case description

Primary actor: user/client

Stakeholder and Interests:

- **User:** interested in prediction
- **Group 1:** wants to know the workout for the grass

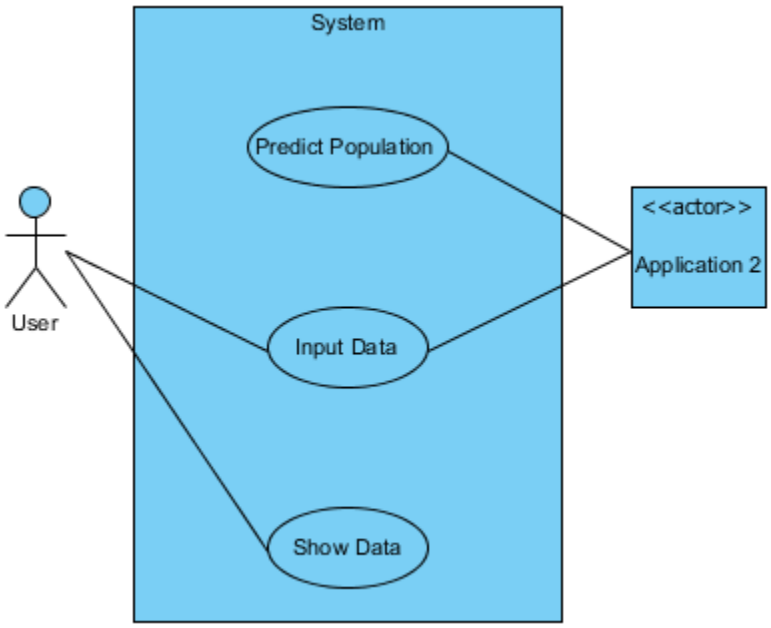
Precondition:

Post-condition:

Main Success:

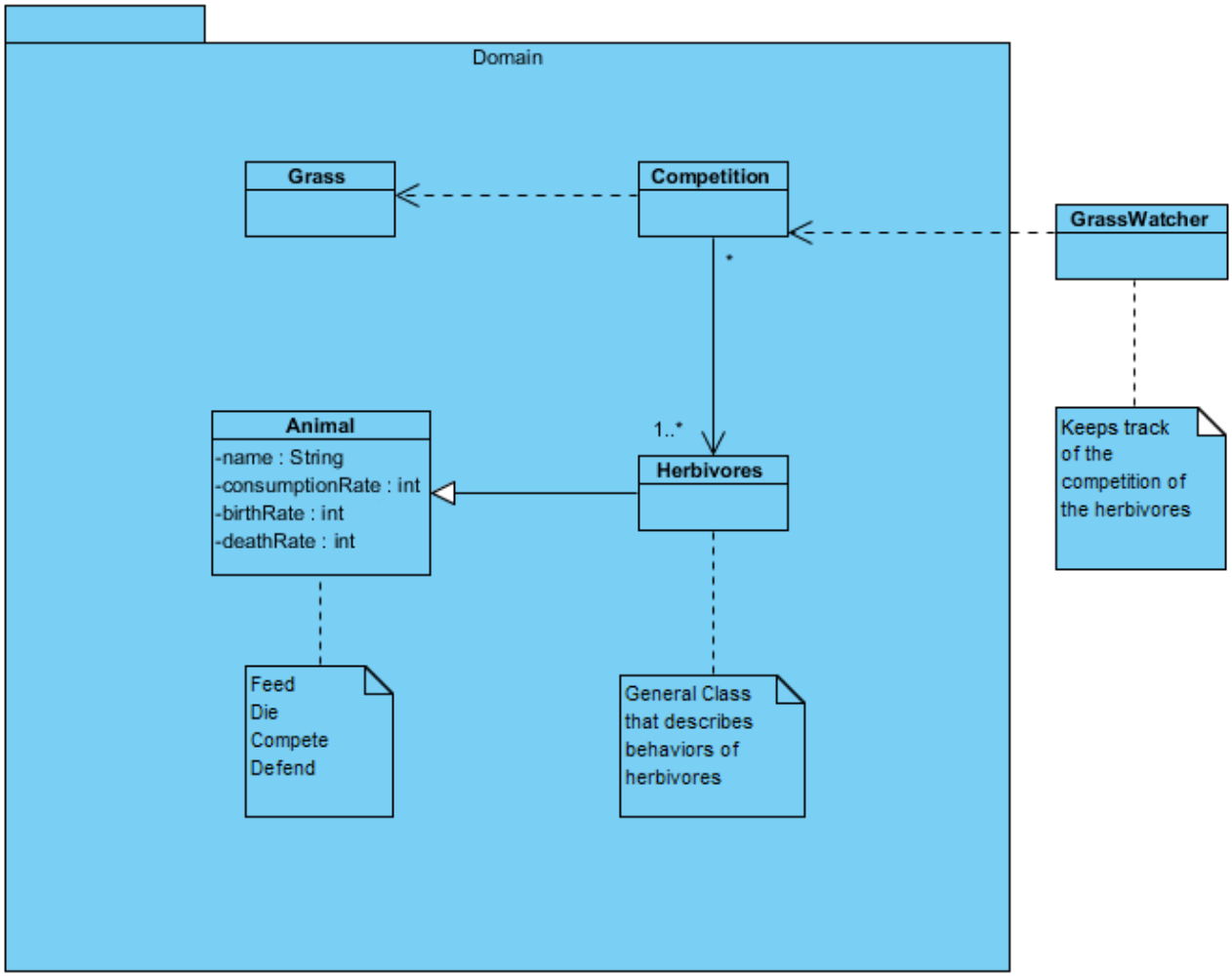
1. User opens the application.
2. System asks for parameters.
3. User enters variables.
4. System validates variables.
5. System processes variables in the formula.
6. System shows results.
7. System sends results to the other application.
8. User closes the program.

1.2 Use case diagram

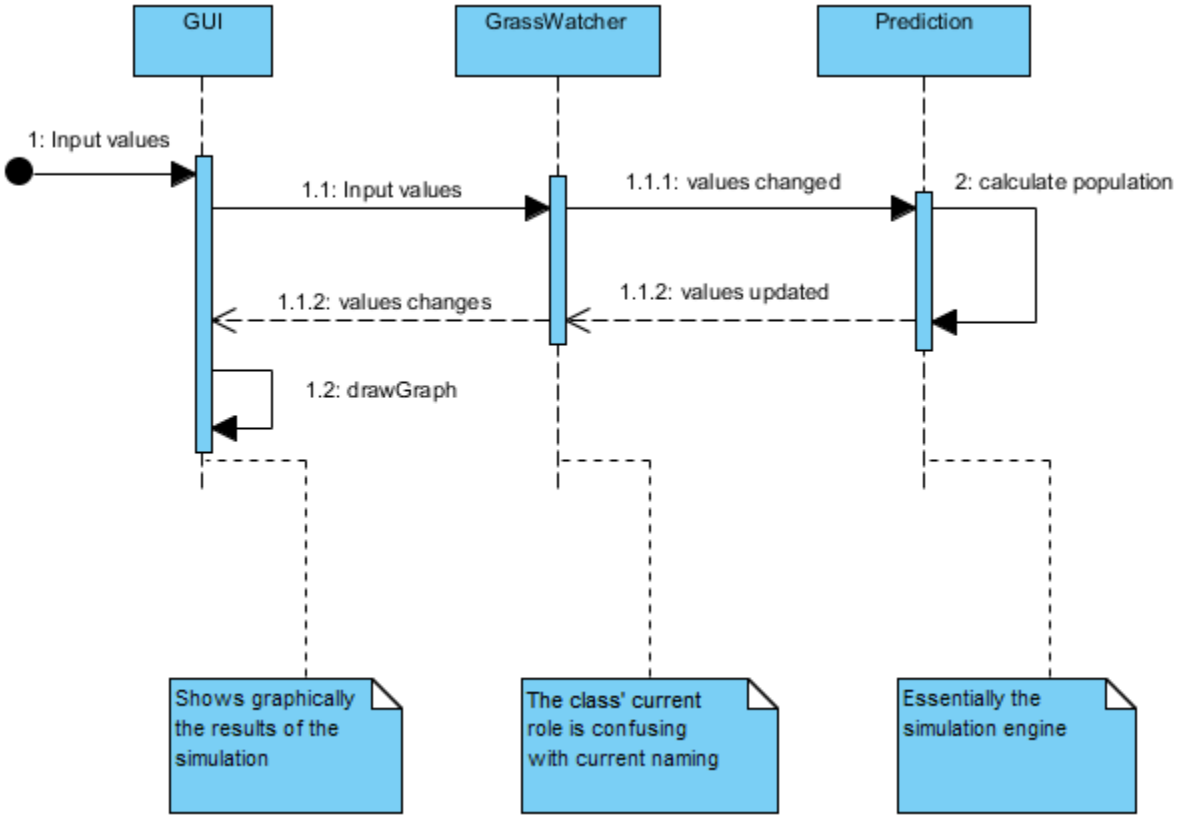


2. UML Diagrams

2.1 Domain Diagram



2.2 Sequence Diagram



3. Mathematical Models

3.1 Competitive Lotka-Volterra Equation

$$\frac{dx_i}{dt} = r_i x_i \left(1 - \frac{\sum_{j=1}^{N} a_{ij} x_j}{K_i}\right)$$

Calculation of the effect of competing species on the growth of species *i*. (Schoener,1974)

- $\frac{dx_i}{dt}$ refers to the population growth rate of species *i*.
- r_i refers to the intrinsic rate of increase of species *i*.
- x_i refers to the population of species *i*.
- N refers to the total amount of competing species.
- K_i refers to the carrying capacity of species *i*.
- a_{ij} refers to the competition coefficient of species *j* upon *i*.
    - Note that a_{ii} is equal to 1.

3.2 Competition Coefficient

$$a_{ij} = \frac{\sum_h p_{ih} p_{jh}}{\sum_h {p_{ih}}^2}$$

Calculation of the competition of species *j* on species *i*. (Gotelli,2008)

- a_{ij} is the competition coefficient
- p_{ih} refers to the relative utilization of resource *h* by species *i*, computed as a fraction of the total utilization of all resources for species *i*.

References:

Schoener, T. (1974). Some Methods for Calculating Competition Coefficients from Resource-Utilization Spectra. *The American Naturalist, 108*(961), 332-340. Retrieved from http://www.jstor.org/stable/2459895

Gotelli, Nicholas J. (2008). *A Primer of Ecology.* Sunderland, MA: Sinauer.