## Predator-prey systems

The aim of this exercise is to study the dynamics of predator-prey systems.

1. Set up the Lotka-Volterra predator-prey system. Think of two real interacting species and determine the parameter values. Solve for the equilibrium abundances of prey and predators.

2. Solve the system numerically and plot the results as the number of predators and prey as a function of time, and as the phase portrait (predators vs. prey). Does the system reach the equilibrium determined above?

In the second part you should make one or more extensions to the system. Determine the parameter values for your new system. Do a full analysis of your model, i.e. find the equilibria analytically (if possible) and compare with the numerical (matlab) solution. Discuss similarities and differences between your system and the pure Lotka-Volterra system.

Invent your own extension or use one of the following:

- Type II functional response: $C(N) = C_{\max}\frac{bN}{bN+C_{\max}}$, where the encouter rate is $b$ and the maximum consumption is $C_{\max}$.
- Type III functional response $C(N) = C_{\max}\frac{(bN)^2}{(bN)^2+C_{\max}^2}$
- A constant immigration of prey (or predators).
- Mortality due to hunger
- Predator-dependent functional response, where the consumption ratio is reduced by a factor $\exp(-qP)$, where $P$ is the predator population.
- Add a carrying capacity for the prey – or the predators.
- Add a competitor.
- Add a super-predator.
- Introduce the effect that the assimilation efficiency of consumption declines with the rate of consumption.
- ...