ADAPTIVEDYNAMICS
Exercise 10-11

Exercise 10
This is a continuation of exercise 8 where we practiced to numerically calculate pairwise invadability plots. Now we analyze the evolution of a dimorphic resident population by calculating isoclines. Especially if you cannot solve this exercise, you should come to the exercise class where Paolo or Jaakko will teach you the required necessary methods.

Consider the Lotka-Volterra competition model with $K(x) = e^{-x^2}$ and $a(x, y) = e^{-\alpha(x-y)^2}$ so that you can compare the result with what was calculated analytically during one of the first lectures.

(a) Plot the region of mutual invadability using the invasion fitness from exercise 8. Calculate the population densities $n_1(x_1, x_2)$ and $n_2(x_1, x_2)$ in a dimorphic resident population of strategies x_1 and x_2, and check that $n_1(x_1, x_2)$ and $n_2(x_1, x_2)$ are positive if and only if x_1 and x_2 are mutually invadable. (Remember: it's a Lotka-Volterra model, so coexistence is possible if and only if the strategies can mutually invade.)

(b) Calculate the invasion fitness $s_{x_1,x_2}(y)$ of a mutant strategy y in a resident population of strategies x_1 and x_2, and plot the x_1- and x_2-isoclines in the region of mutual invadability. Label the parts of the isoclines depending on whether they correspond to a fitness minimum or maximum as a function of x_1 (in the case of the x_1-isocline) or x_2 (in the case of the x_2-isocline).

(c) Interpret the plots in terms of the strategy dynamics. Sketch the evolutionary tree, starting with a monomorphic resident population.

Exercise 11
The same questions as above, but now for the Lotka-Volterra competition model with $K(x) = e^{-(x-\delta)^4} + e^{-(x+\delta)^2}$ and $a(x, y) = e^{-\alpha(x-y)^2-\beta(x-y)}$ where $\alpha = 2.0$, $\beta = -0.4$ and $\delta = 1.0$