Complexity Economics: Problem Set Lab 4 (Group 3)

Consider the following setting:

- Populations of rabbits and cats share the same ecosystem.
- The rabbit population multiplies at a constant rate 0.1.
- Cats feed on rabbits. This results in 1 in 2000 (0.0005) rabbits being taken (dying) per cat, but is important for cat population growth. The cat population grows 0.1 for each rabbit being taken by a cat ($0.1 * 0.0005$ per rabbit and cat).
- Both populations are threatened by cars (i.e. they face a chance of 0.05 to be run over).
- Table 1 summarizes all aspects and environmental factors impacting the two populations.

Please proceed as follows:

1. (45 min)
   (a) Discuss in the group how this system could be investigated using a python program.
   (b) Write a python program to study the problem (one python program per group).
   (c) Exchange your python program with group 4. You will be given the python program written by group 4, which deals with a different dynamical system.
2. (30 min)
   (a) Analyze and understand the python program written by group 4.
3. (15 min)
   (a) Discuss the two python programs together with group 4.

Additional notes

- Claudius and Torsten will be around. If you have any questions or if you are stuck anywhere, please feel free to ask or talk to us.
- If you are done with your program and have lots of time left, consider adding further aspects such as visualizing your results. For visualizing, you may use python code similar to the example given in the code listing below.
- Consider commenting your code extensively. This will make it easier for the other group to understand your program.

	Rabbit population 	Cat population 
Variable	R_t	C_t
Rabbit population growth rate	0.1	
Interaction (and cat population growth rate)	$-0.0005 R_t C_t$	$0.1 \times 0.0005 R_t C_t$
Cars 	$-0.05 R_t$	$-0.05 C_t$
Initial population size	400	50

Tabelle 1: Influences on the system.

Script: visualization of functions with matplotlib

```
1  import matplotlib.pyplot as plt
2  import numpy as np
3
4  x = np.arange(200) / 200.
5  y = x * (1 - x)
6  plt.figure()
7  plt.title("A function")
8  plt.xlabel("x")
9  plt.ylabel("y")
10 plt.plot(x, y)
11 plt.savefig("some_example_function.pdf")
12 plt.show()
```