LS30A - Lab 4

Aaron

Review about vector field

2. **(Based on Fall 2014 midterm) How Frankenstein (F) and his bride (B) feel for each other is described by the following system of differential equations:**

$$F'=B$$

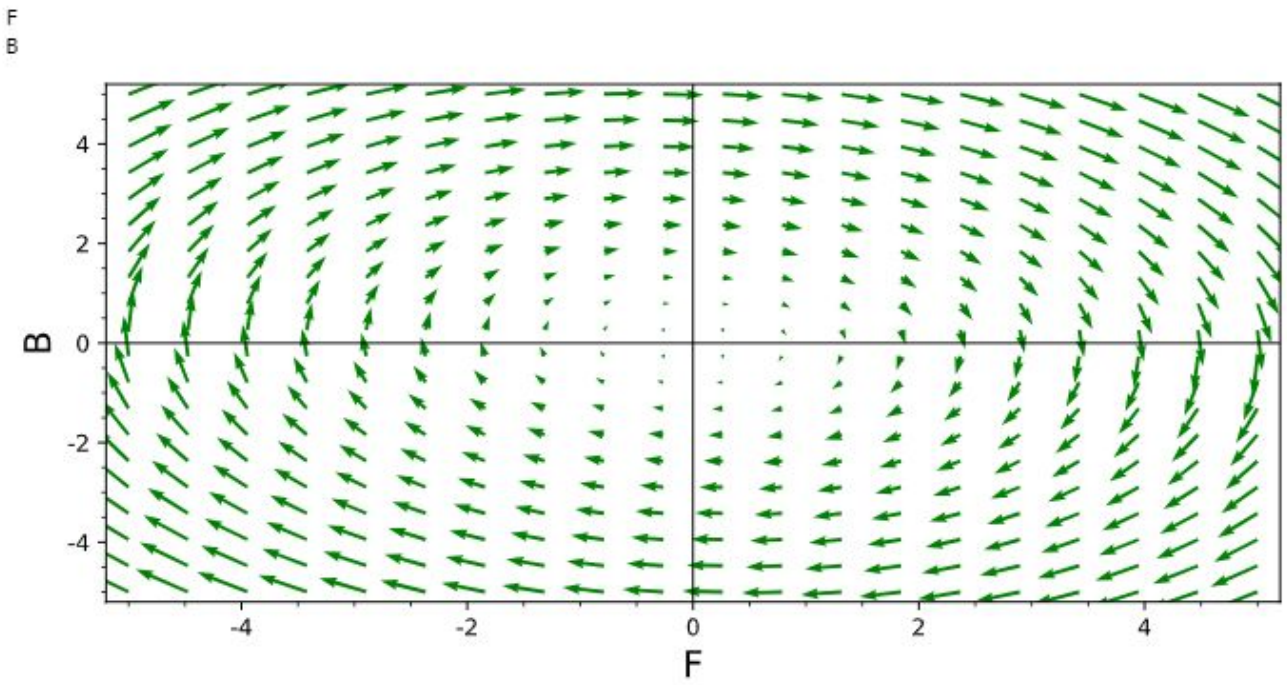
$$B'=-F-0.1B$$

   a. **Sketch the vector field for this system. (6-8 change vectors should be enough for an exam, but just draw 3 for now.)**
   b. **Use Sage to plot the vector field (Hint: You'll probably want to use the function plot_vector_field, which was explained in textbook section 1.5.). Check that your sketched vector field matches this.**

F	B	F’	B’
0	0	F'=B=0	B'=-F-0.1B=0-0=0
1	1	F'=B=1	B'=-F-0.1B=-1-0.1=-1.1
-1	1	F'=B=1	B'=-F-0.1B=1-0.1=0.9

Draw a vector starting at point (0,0) with length 0
Draw a vector starting at point (1,1) that goes right 1 unit and down 1.1 unit
Draw a vector starting at point (-1,1) that goes right 1 unit and up 0.9 unit

```
# Symbolically declare variables F and B
var("F")
var("B")
# Define functions F' and B'
Fprime(F,B) = B
Bprime(F,B) = -F-0.1*B
# make vector field plot
vf = plot_vector_field([Fprime,Bprime],(F,-5,5),(B,-5,5),color="green",axes_labels=["F","B"])
show(vf)
```



Review about Lab3

Write a function

Purpose: to iterate an input function a certain number of times starting from a given initial value and output the list of values

Input: number of times the iteration should be performed;
initial value;
function to be iterated

Output: list of values of iteration

This function is very useful for Lab4, If it does not work, make sure you get an iterate function from your classmates and acknowledge them in your Lab 4!

```
4
5   def iterate(num_iteration, initial_value, func_name):
6       # declare a list to save all intermediate values
7       value_list = []
8       # Add initial value to the list
9       value_list.append(initial_value)
10
11      # iteration
12      for i in srange(num_iteration):
13          temp = func_name(value_list[-1])
14          value_list.append(temp)
15
16      return value_list
17
18  f(x) = x^2+1
19  iterate(4,1,f)
```

```
[1, 2, 5, 26, 677]
```

Euler’s Method

1. **The growth rate of a sea lion population is given by the differential equation N'=0.2N(1-N/100). The current population is 10 sea lions. Using Euler’s method with a step size of 0.1 year, find the (approximate) population 0.2 years later.**

Euler's Method

t	N_{old} = N(t)	delta-t	N'(t)	N_{new} = N(t+delta-t) = N(t) + delta-t * N'(t)
0	10	0.1	0.2*10*(1-10/100) =0.2*10*0.9 = 1.8	10+0.1*1.8 = 10+0.18 = 10.18
0.1	10.18	0.1	0.2*10.18*(1-10.18/100) =1.829	10.18+0.1*1.829 = 10.36
0.2	10.36			

Thus, we estimate that, at 0.2 years, the population has 10.36 sea lions.

Euler's Method

```
1  sim_result = iterate(1000, 10, new_N)
2  time = srange(0, 1000, 0.1)
3  list_plot(zip(time, sim_result), axes_labels = ["time","Population"],plotjoined = True)
```