

Exercise Sheet 7

Exercise 1: Types of differential equations (10 P)

For a state $\underline{u} \in \mathbb{R}^2$, come up with an example for each of the following types of differential equations:

- (a) linear, time-invariant ODE
- (b) linear, time-variant ODE
- (c) non-linear, time-invariant ODE
- (d) non-linear, time-variant ODE
- (e) partial differential equation

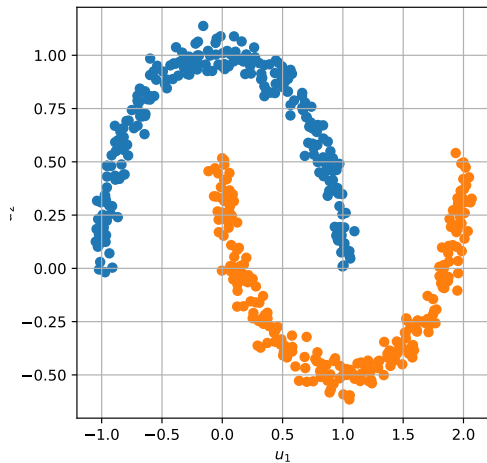
Exercise 2: Programming (70 P)

Download the programming files on ISIS and follow the instructions.

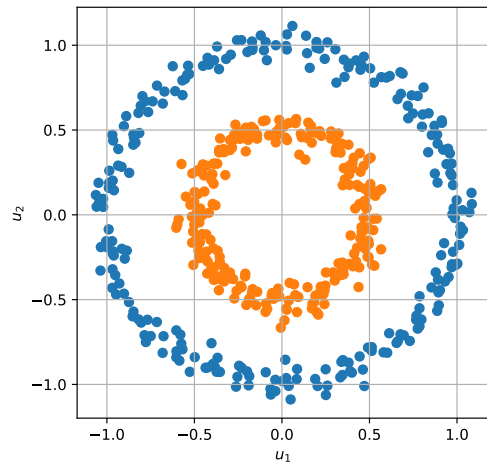
Exercise 3: Neural ODE classifier (20 P)

Using the neural ODE from the trajectory optimization problem in programming exercise 2, you now want to train a binary classifier on the “moons” dataset depicted in Figure 1a.

- (a) In bullet-points, describe the changes you have to make to the existing code to train a classifier.
- (b) In 2 to 3 sentences, explain why the “circles” dataset depicted in Figure 1b is difficult to classify for a Neural ODE and explain how this difficulty can be avoided.



(a) Moons



(b) Circles

Figure 1: Datasets for binary classification