

Report for exercise 5 from group H

Tasks addressed: 5
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Last compiled: 2020-01-07
Source code: <https://gitlab.lrz.de/ga53rog/praktikum-ml-crowd>

The work on tasks was divided in the following way:

Ahmad Bin Qasim (03693345)	Task 1	33%
	Task 2	33%
	Task 3	33%
	Task 4	33%
	Task 5	33%
Kaan Atukalp (03709123)	Task 1	33%
	Task 2	33%
	Task 3	33%
	Task 4	33%
	Task 5	33%
Martin Meinel (03710370)	Task 1	33%
	Task 2	33%
	Task 3	33%
	Task 4	33%
	Task 5	33%

Report on task 1, Approximating functions

Part 1:

For part 1 we loaded the linear data from the "linear_function.txt" file and tried to approximate the function linearly. We used a linear regression model to minimize the least square error. For this problem there exists a closed form solution to compute the matrix A which contains the parameters to map the input to the output with a minimal least square error to the original function, we want to approximate. The least squares error problem is defined by following equation:

$$\min_{\hat{f}} e(\hat{f}) = \min_{\hat{f}} \|F - \hat{f}(X)\|^2 = \min_A \|F - XA^T\|^2$$

Figure 1 shows the original linear data in blue and its linear approximation in orange. It can be easily seen that all data points are laying on the linear straight which was computed with the closed form solution. The data is linear so the function can be approximated perfectly.

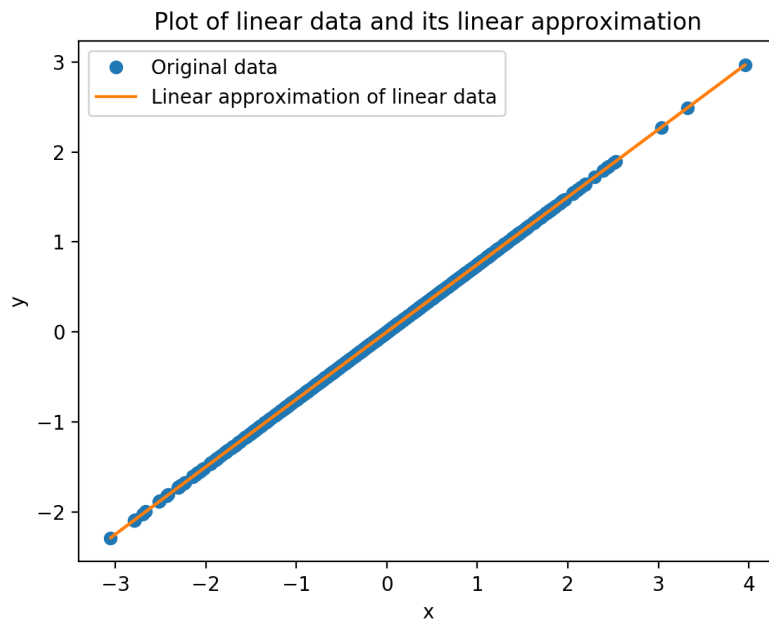


Figure 1: Plot of the linear data and its linear approximation

Part 2: In the second part we use a nonlinear dataset from the "nonlinear_function.txt" file and tried to approximate the function in a linear way again. Figure 2 shows then original data in blue again. The linear approximation of the function is shown in orange. It can be easily seen that the linear approximation fits very bad. The reason for that is that the function is nonlinear and we try to approximate it linearly.

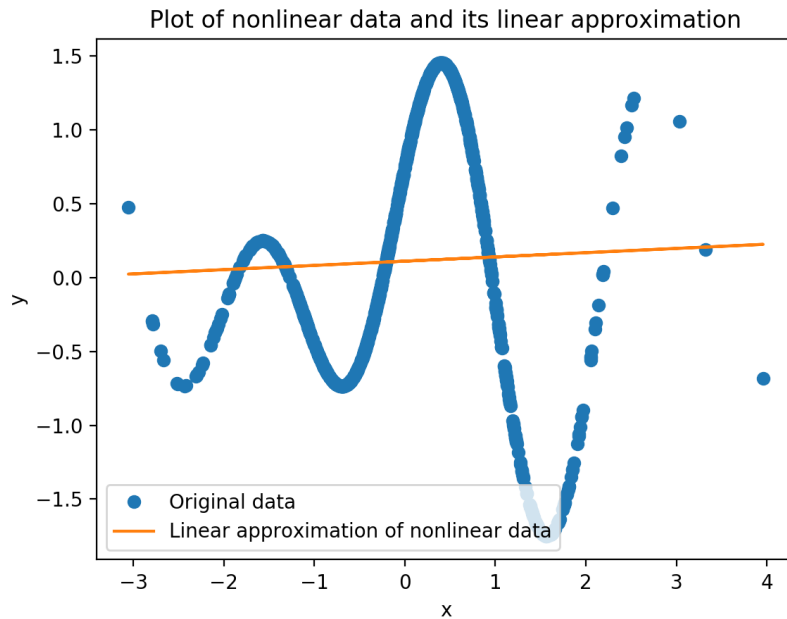


Figure 2: Nonlinear data and its linear approximation

Part 3: After we tried to approximate the nonlinear dataset with a linear function in part 2, we now try to approximate the unknown nonlinear function with a combination of radial basis function:

$$\phi_l(x) = \exp(-\|x_l - x\|^2 / \epsilon^2)$$

x_l is the center of the basis function and usually just a random point of the data set. There is one x_l for each radial basis function. We have to choose how many basis functions L we use to approximate the nonlinear function. Besides, we have to choose ϵ appropriately. Figure 3 shows the original data in blue and the approximated function which makes use of radial basis functions in orange. It can be easily seen that the approximation is by far better than the linear approximation of part 2. In general the approximation fits the original function quite well.

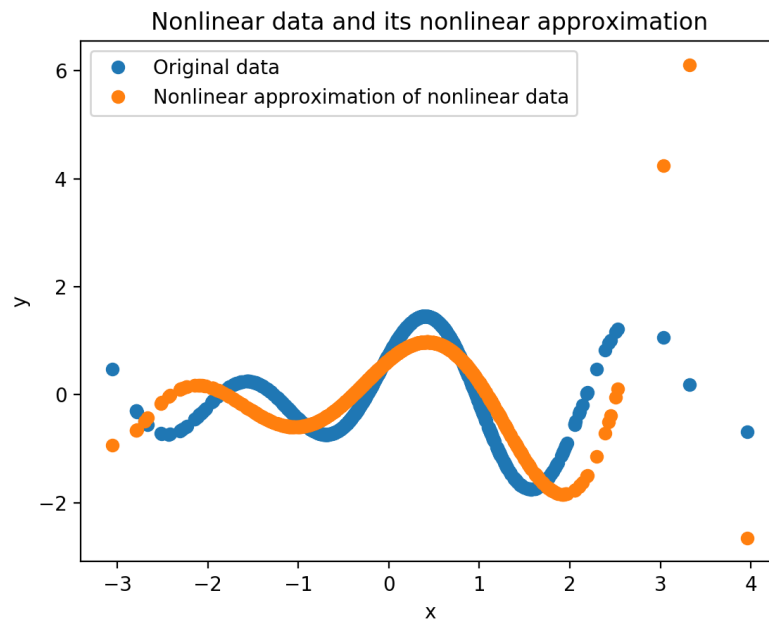


Figure 3: Nonlinear data and its nonlinear approximation with radial basis functions

Report on task 2, First step of a single pedestrian

They stepped successfully (see figure).

Report on task 3, Approximating nonlinear vector fields

- not done -

Report on task 4, Obstacle avoidance

Pedestrians can avoid obstacles, using Dijkstras algorithm. See figure.

Report on task 5, Tests

TEST1: RiMEA scenario 1 (straight line, ignore premovement time)

- not done, but citing RiMEA guidelines -

TEST2: RiMEA scenario 4 (fundamental diagram, be careful with periodic boundary conditions).

- test successful -

TEST3: RiMEA scenario 6 (movement around a corner).

- test successful -

TEST4: RiMEA scenario

- test successful -
