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# Machine Learning for Robotics and Computer Vision
# Winter term 2013

## Homework Assignment 2

Topic: Regression
November 15th, 2013

**Exercise 1:**

A car with a driver assistant system is equipped with a laser range scanner that can detect pedestrians in front of the car. A tracking software computes position estimates of pedestrians with respect to the car-centered coordinate frame. In the situation we consider here, the car waits in front of a red light and pedestrians cross the street.

a) The tracker yields these two tracked position estimates at a frequency of $1Hz$:

$$\mathcal{T}_1 = \left\{ \begin{pmatrix} -6.12 \\ 4.12 \end{pmatrix} \begin{pmatrix} -4.85 \\ 4.37 \end{pmatrix} \begin{pmatrix} -3.86 \\ 4.54 \end{pmatrix} \begin{pmatrix} -2.76 \\ 4.5 \end{pmatrix} \begin{pmatrix} -1.61 \\ 5.02 \end{pmatrix} \begin{pmatrix} -0.751 \\ 5.06 \end{pmatrix} \right\}$$

$$\mathcal{T}_2 = \left\{ \begin{pmatrix} 4.34 \\ 3.1 \end{pmatrix} \begin{pmatrix} 3.03 \\ 3.01 \end{pmatrix} \begin{pmatrix} 1.59 \\ 3.21 \end{pmatrix} \begin{pmatrix} 0.233 \\ 3.58 \end{pmatrix} \begin{pmatrix} -1.01 \\ 3.59 \end{pmatrix} \begin{pmatrix} -2.51 \\ 3.93 \end{pmatrix} \right\}$$

Plot these data into a car-centered coordinate frame with the x-axis pointing to the right and the y-axis pointing in driving direction.

b) Assume that the borders of the street are at $x = -5m$ and $x = 3m$. When do the two pedestrians reach the other side of the street, assuming they walk with constant speed? Which speed to they have? What is the residual error of the estimation?

c) Now assume that the pedestrians move with constant acceleration. When do they reach the side of the street now? What is the residual error now?

*Hint for b) and c): Use the Polynomial Regression method introduced on slides 8 - 12 of the lecture.*

**Exercise 2: Programming**

Write a class `Regression` that implements linear regression where the basis functions can be chosen between the three we learned in the lecture. Apply this class to the data from Exercise 1.

*Download the file 'ClassCode.tgz' available at the course's website. To compile the project, first make sure that libGSL and CMake are installed, then type in a console window:*

```
tar -xzf ClassCode.tgz
cd classcode
cd build
cmake ..
make
```

*This will extract the archive and compile the project. In the subdirectory 'regression' you will find example source code for this assignment.*

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The next exercise class will take place on **May 17th, 2013**.

For downloads of slides and of homework assignments and for further information on the course see

`http://vision.in.tum.de`

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