EE613 — Nonlinear regression II — Exercises — Dec. 20, 2017

The main folder contains the script `demo_GPR01.m` as an example. This code can be run either from Matlab or from GNU Octave. First run the example, visualize the results and try to change the parameters.

Exercise 1: Sampling of prior and posterior distributions in a Gaussian process

The source code `demo_GPR01.m` provides an example of Gaussian process regression with a squared exponential kernel function. The example first generates stochastic samples from the prior distribution $\boldsymbol{y}^* \sim \mathcal{N}\big(\boldsymbol{\mu}(\boldsymbol{x}^*), \boldsymbol{K}(\boldsymbol{x}^*, \boldsymbol{x}^*)\big)$, by considering $\boldsymbol{\mu}(\boldsymbol{x}^*) = 0$. It then generates stochastic samples from the posterior distribution $\boldsymbol{y}^* | \boldsymbol{y} \sim \mathcal{N}(\boldsymbol{\mu}^*, \boldsymbol{\Sigma}^*)$ of the Gaussian process, by considering $\boldsymbol{\mu}(\boldsymbol{x}) = \boldsymbol{\mu}(\boldsymbol{x}^*) = 0$.

- The hyperparameters Θ_1^{GP}, Θ_2^{GP} and Θ_3^{GP} are respectively related to the scale of the output, scale of the input, and expected noise on the observed outputs. Run the script with different hyperparameters for the kernel function, and note your observations.

Exercise 2: Gaussian process regression with different types of kernel functions

In `demo_GPR01.m`, replace the squared exponential kernel function with a periodic kernel function, a polynomial kernel function, and a Matérn kernel function. You can start with the commented code as a guideline.

Exercise 3: Gaussian process regression *Vs* Gaussian mixture regression

- Adapt `demo_GMR01.m` from the previous lecture (a copy is contained in the folder), so that the same regression problem is treated with Gaussian process regression (GPR). What differences do you observe for the retrieved means and covariances?

- Remove a short portion of the datapoints from the sequence (e.g., from 1/2 of the trajectories to 3/4 of the trajectories). Run GMR and GPR again. What do you observe for the retrieved means and covariances?