CIVE 650 - Spatiotemporal Data Analysis (2025 Fall)

Assignment 2
CO2 data imputation by Gaussian process

Date assigned: October 8, 2025
Date due: Oct 21, 2025

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The `CO2.csv` file gives the CO2 observations from Mauna Loa observatory. We assume there is no observation from 1981 to 2000 (as shown in Fig. 1), and the goal is to estimate the missing values by Gaussian process (GP).
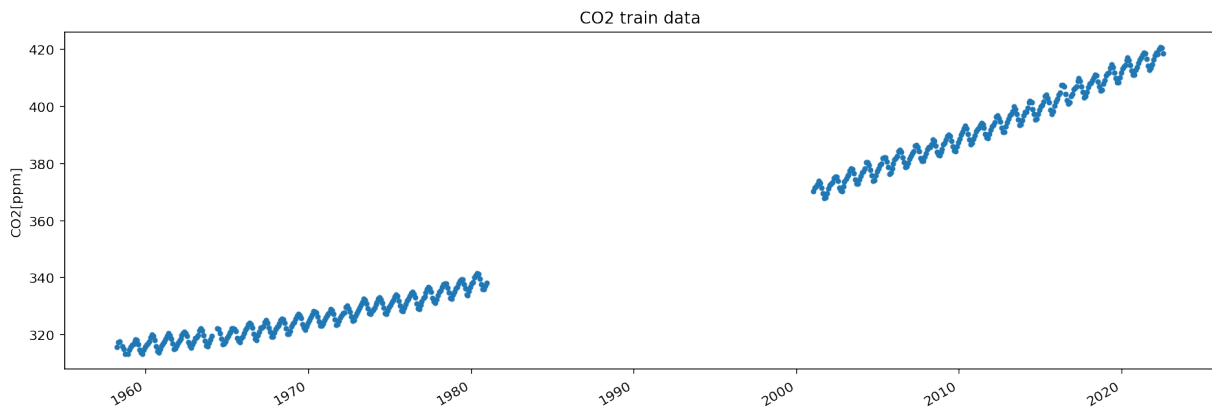

Figure 1: The CO2 train data

We will build GP from scratch and there is a jupyter notebook to help you. There are four tasks.

1. Estimate the missing part using an SE kernel + noise. You will need to implement the `log_marginal_likelihood` and the `prediction` function in the jupyter notebook.

2. Estimate the missing part using a linear kernel + noise. You will need to implement the `linear_kernel` function and find the best hyperparameters for it.

3. Estimate the missing part using a periodic kernel + noise. You will need to implement the `periodic_kernel` function and find the best hyperparameters for it.

4. Estimate the missing part using an SE + linear + periodic kernel + noise. You will need to define this new kernel by combination and find the best hyperparameters for it.

Please plot the estimated values and the confidence intervals for your estimations. You can also use MATLAB but the jupyter notebook is only for Python.