Department of Computer Science, National Chiao Tung University
DCP 2354 Linear Algebra
Computer Simulation Assignment I

Due date: Wednesday, November 16, 2016

Instructions: In this assignment, you need to fit a data model to two datasets $\{x_n, y_n\}_{n=1}^{N}$ using the least-squares approximation technique. That is, for each dataset, the unknown model parameter $\mathbf{w} = (w_0, w_1, \ldots, w_8)$ has to be solved by minimizing

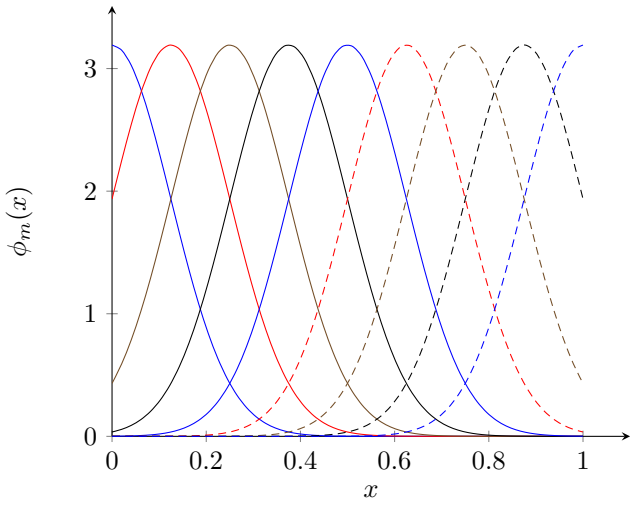
$$e(\mathbf{w}) = \sum_{n=1}^{N} (f(x_n, \mathbf{w}) - y_n)^2,$$

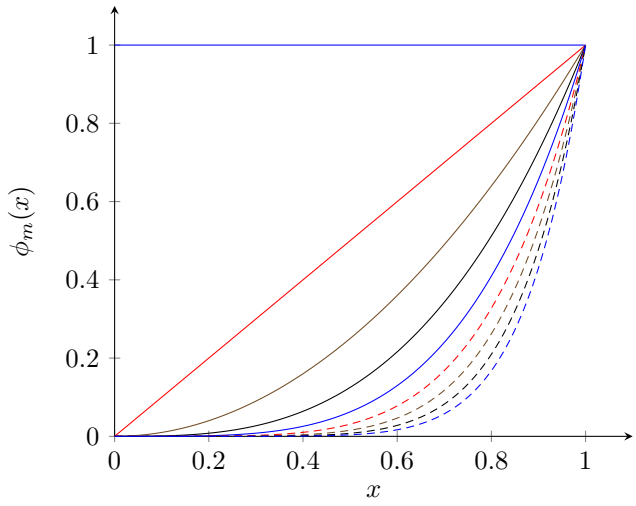
where the data model $f(x_n, \mathbf{w})$ is defined as

$$f(x_n, \mathbf{w}) = \mathbf{w}^{\mathbf{T}} \boldsymbol{\phi}(x_n) = w_0\phi_0(x_n) + w_1\phi_1(x_n) + \ldots + w_8\phi_8(x_n),$$

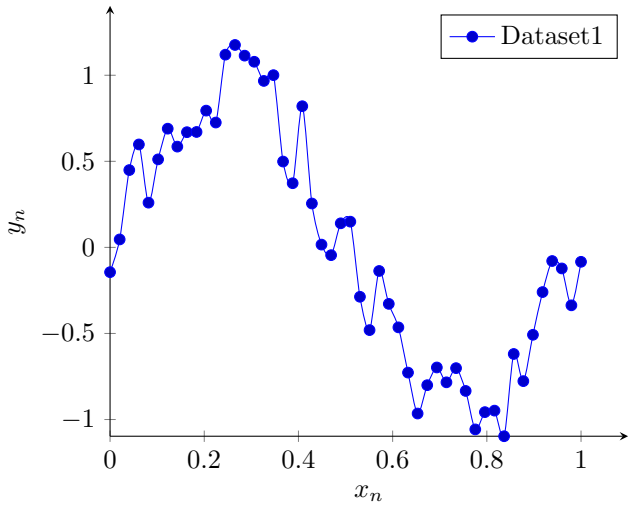
with the following definitions of the $\phi_m(x), m = 0, 1, \ldots, 8$

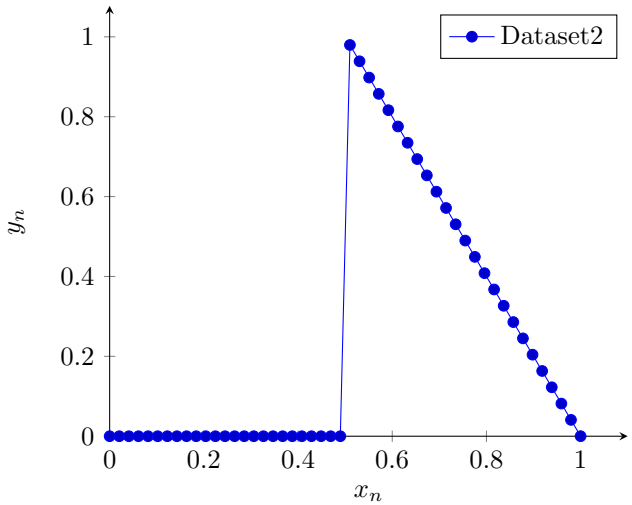
1. $\phi_m(x) = (1/\sqrt{2\pi}\sigma_m)\exp(-(x-\mu_m)^2/2\sigma_m^2), \mu_m = 0.125 \times m, \sigma_m = 0.125$
2. $\phi_m(x) = x^m$





The following display the waveforms from which the two datasets are drawn randomly.





Tasks to be completed for all 4 combinations of datasets and models:

1) Compute the normalized approximation error $e(\mathbf{w})/N$.

2) Compare your model function against the dataset by displaying them together in a single plot.

3) Explain your result.

Notes
* You can use any programming language and/or tool for visualization.
* You have to submit source code and a document (in PDF) summarizing the results.
* Upload in .zip format. Don't use .rar or .7z
* File name: studentID_phw1.zip. (0123456_phw1.zip)