

MATLAB Assignment-1

*SBL and Relevance Vector Machine(10 marks)**Mar. 2021*

1. Read and understand [R1] given below up to Section IV.
2. Generate the synthetic data as follows:
 - Generate a $N \times M$ design/dictionary matrix Φ , whose entries are each drawn from a standardized Gaussian distribution, i.e., $\mathcal{N}(0, 1)$.
 - Generate the $M \times 1$ sparse weight vector \mathbf{w} such that it has D_0 randomly selected nonzero entries (with standardized Gaussian distributed nonzero components).
 - Generate the noise entries $\epsilon_n \sim \mathcal{N}(0, \sigma^2)$ for all $n = 1, \dots, N$. Generate the observations $\mathbf{t} = \Phi\mathbf{w} + \epsilon$.
3. Generate \mathbf{t} for $N = 20$, $M = 40$, $D_0 = 7$, noise variances -20, -15, -10, -5 and 0 dB.
4. Apply SBL for regression from [R1] to get the maximum aposterior estimate of the weight vector \mathbf{w} , which is given by (13).
5. Plot the normalized mean squared error (NMSE), defined as

$$\text{NMSE} = \frac{\|\mathbf{w}_{MP} - \mathbf{w}\|^2}{\|\mathbf{w}\|^2}$$

for above noise variances.

[R1] Sparse Bayesian Learning and the Relevance Vector Machine Michael E. Tipping, Journal of Machine Learning Research 1 (2001) 211244

Instructions:

1. You will have to form a group of three students.
2. You will have to write the report on the paper upto Section IV. Deadline for submitting that is 11:59 pm April 15th 2021.
3. Simulate the problem given above in MATLAB. The code should execute without any problem, and output the desired plot. Code should be properly commented. Deadline for submitting the code is 11:59 pm April 25th 2021.

4. Report should be in your language and the code should be original. A group will be awarded zero marks if we feel that it has cheated. It is your responsibility to make sure that you do not share your code and report.

Guidelines FOR Preparing REPORT:

- Your report should be based on first four sections of the paper and it should also be split in four sections.
- Understand each section and express it in your own words. We do not expect you to write a journal paper but try to write grammatically correct sentences with proper punctuation.
- Type the equations and not copy paste it from the paper.

INSTRUCTIONS FOR REPORT SUBMISSION:

- Only electronic submissions of reports will be accepted. Your main PDF write-up must be typeset in LaTeX. No handwritten, scanned or photographed submissions would be accepted.
- We have provided a LaTeX template file `report_template.tex` to typeset your PDF write-up. Latex template is uploaded in Google classroom.
- Report must be in PDF with file name `<RollNo1>_<RollNo2>_<RollNo3>.pdf`. If you name your submission wrongly, we may unable to link it to you and you may lose credit.
- The file size should not be more than 1MB.
- Upload your report using this dropbox link: <https://tinyurl.com/s84z62wr/> by 11:59 pm April 15th 2021.

INSTRUCTIONS FOR MATLAB CODE SUBMISSION:

- All MATLAB codes (.m files) should be in one .zip/.rar folder, NO SEPARATE UPLOAD for each file.
- The folder name should be `<RollNo1>_<RollNo2>_<RollNo3>.zip/rar`. If you name your submission wrongly, we may unable to link it to you and you may lose credit.
- The .zip/.rar folder should be no more than 1MB in size.
- Your .zip/.rar folder should only contain only matlab code. Don't include training features, matlab figures etc.
- Upload your .zip/.rar folder via this dropbox link: <https://tiny.one/manvzu78/> by 11:59 pm April 25th 2021.