Lecture 15 Part 1 - Midterm Exam Review

Midterm Exam: Monday, October 21

Section	Date	Time	Location	Modality
EEE 4773	Monday, October 21	7:20pm-9:20pm	TUR L007	in-person
EEL 5840 on-campus	Monday, October 21	7:20pm-9:20pm	TUR L007	in-person
EEL 5840 EDGE/Online	October 20-21	anytime within 48 hours	HonorLock	online

Midterm Exam Coverage

- **Coverage**: lectures 1-14 (modules 1-4)
- **Practice exam**: available in the Assignment-Solutions repo
    - Solutions will be posted with HW2 solutions (Saturday morning). I encourage to solve exercises prior to checking solutions.
- **Allowed Material**
    1. A 1-page letter-sized formula sheet (front and back, handwritten with **pen** or typed). **Formulas only!**
        - **Do not include** pseudo-code, solved exercises, lecture derivations or any written definitions.
    2. Scientific calculator
- **Total time**: 2 hours

Midterm Exam Coverage

The midterm exam will cover all materials from Lecture 1-14. These include:

1. **Introduction to Machine Learning (Lectures 1-3)**
    - Definition of Machine Learning, Artificial Intelligence and Deep Learning
    - Types of learning in Machine Learning
    - Supervised Learning diagram
    - (Linear) Regression

2. **Experimental Design and Analysis (Lectures 4-5)**
    - Feature representation: polynomial basis function, radial basis function, etc.
        - Basis functions in general
    - Model selection
    - Occam's Razor
    - Generalization
    - Regularization: ridge and lasso
    - Performance Metrics for regression: error metrics, Q-Q plot
    - Cross-Validation
    - The No Free Lunch Theorem
    - Experimental Design
    - Hyperparameters tuning
    - The Curse of Dimensionality
3. **Bayesian Learning (Lectures 5-8)**
    - Frequentist vs Bayesian statistics
    - Bayesian interpretation of Regression Least Squares Objective Function
    - Maximum Likelihood Estimation (MLE)
    - Maximum A Posteriori (MAP)
    - Bayesian Prior Equivalence
    - Conjugate Priors, Online update
4. **Generative Models (Lectures 9-14)**
    - Distinction between classification and regression
    - Probabilistic Generative Models
    - Naive Bayes Classifier
    - Mixture Models
        - Gaussian Mixture Models (GMMs)
    - The Expectation-Maximization (EM) algorithm
    - Hidden latent variables

How to prepare for exam

This is a suggestion only.

1. Review/read all Notebooks.
2. Create your formula sheet. **Do not include written descriptions, pseudo-code or solved exercises (including derivations).**
3. Review/redo exercises from HW1 and HW2.

4. Review/redo exercises from practicals 1, 2 and 3.
5. Solve practice exam/s provided.
6. Find more practice questions in textbooks.

Discussion Board Questions

Thank you for posting questions!

Post 1

Y. Yan -

I would like to clarify the expected depth of response for questions that require the Bayesian interpretation of optimization functions, such as Fall 2023's Q5 and Spring 2024's Q4. Specifically, for a question like Spring 2024's Q4, if I respond with:

"The optimization problem corresponds to minimizing the negative log-likelihood under the assumption that the residuals ϵ_i follow a Laplace distribution,"

would this level of response be sufficient to earn full credit? Or do I need to further expand my answer by:

1. Writing out the full PDF of the distribution (e.g., Laplace or Weibull).
2. Explicitly deriving the negative log-likelihood step-by-step.
3. Providing additional mathematical interpretations or assumptions.

It would be helpful to know whether these types of questions generally require a high-level conceptual explanation or if detailed mathematical derivations are expected for full marks. This way, I can ensure that my answers meet the grading expectations without unnecessary steps.

Thank you for your guidance!
