

Mathematics Foundations for Computer Science - CO5263

ASSIGNMENT TOPICS HK242 (duration: 3 weeks)

Topics: Each group has to choose one of the following topics in the text D2L (<https://d2l.ai/index.html>) to understand the specified contents, solve exercises as well as run all computational examples therein, and fill in this form for registration:

https://hocict-my.sharepoint.com/:x/g/personal/nakhuong_hocict_edu_vn/EbNhzx6d6n9Ov1XhCH1VElgBu2RBapy3RJlxaRe0vmfa3A?e=1ejVGD.

The groups must not have duplicate topics; the group that chooses first will have priority in selecting their desired topic.

1. Linear Algebra: https://d2l.ai/chapter_preliminaries/linear-algebra.html
2. Calculus: https://d2l.ai/chapter_preliminaries/calculus.html
3. Automatic Differentiation: https://d2l.ai/chapter_preliminaries/autograd.html
4. Probability and Statistics: https://d2l.ai/chapter_preliminaries/probability.html
5. Multilayer Perceptrons, Forward Propagation, Backward Propagation, and Computational Graphs (Sections 5.1, 5.2, 5.3): https://d2l.ai/chapter_multilayer-perceptrons/index.html
6. RNN's Backpropagation Through Time: https://d2l.ai/chapter_recurrent-neural-networks/bptt.html
7. Convexity: (Section 12.1-12.2): https://d2l.ai/chapter_optimization/index.html
8. GD, SGD, Minibatch SGD (Sections 12.3-12.5): https://d2l.ai/chapter_optimization/index.html
9. Momentum: https://d2l.ai/chapter_optimization/momentum.html
10. ADAGrad: https://d2l.ai/chapter_optimization/adagrad.html
11. RMSProp: https://d2l.ai/chapter_optimization/rmsprop.html
12. ADADelta and ADAM (12.9-12.10): https://d2l.ai/chapter_optimization/adam.html
13. Word Embedding: https://d2l.ai/chapter_natural-language-processing-pretraining/word2vec.html
14. Gaussian Process Priors: https://d2l.ai/chapter_gaussian-processes/gp-priors.html
15. Gaussian Process Inference: https://d2l.ai/chapter_gaussian-processes/gp-inference.html

Evaluation

- Student teams will present notebooks and Q&A in the class.
- The full report (in notebook form) and complete portfolio (folder, GitHub repo) will also be examined.

Reports and presentations

- *Starting week: the 16th in calendar week (~ the 12th learning week).*
- *A team will deliver an oral presentation, at most 20 minutes for presenting and 10 minutes for Q&A. - Time to start the presentation in the class: Week 19 (May 10, 2025)*
- Reports

- o A full (text) report in notebook format based on D2L's materials should include:
 - Introduction (*Problem statement, Applications, How some CS problems have been solved using the methods in this topic.*)
 - **Detail computations in step-by-step with your own concrete examples**
 - Corresponding Implementation in Python
 - **Solve all exercises in detail with steps of reasoning and computations, together with Python implementation**
 - References D2L and further References.
- o Presentation slides (summarize the notebook).
- o Source codes (embedded in the notebook).
- Report submission: Only the team leader submits **the link** containing all contents of the assignment (**preferred GitHub repo**) to LMS at <https://lms.hcmut.edu.vn/mod/assign/view.php?id=515431>.