King Fahd University of Petroleum and Minerals

MATH 405 - Learning from Data (Term 251)

Dr. Maher Boudabra

Course Syllabus

Instructor Information

Instructor: Dr. Maher Boudabra
Office: 203-5
Email: maher.boudabra@gmail.com
Office Hours: Monday and Wednesday from 14.00 to 15.00

Course Description

This course introduces fundamental mathematical tools for learning from data. Topics include vector and matrix operations, orthogonality, projection, eigen-decomposition, factorization, covariance, the multivariate Gaussian distribution, optimization methods, and statistical estimation techniques. Applications to machine learning include linear regression and neural networks.

References

- Linear Algebra and Learning from Data, by Gilbert Strang (5th edition)*
- Applied Linear Algebra, by Peter J. Olver and Chehrzad Shakiban (Second Edition)
- Mathematics for machine learning, by Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong

Course Schedule (15 Weeks)

1. Week 1: Review of basic vector and matrix operations
2. Week 2: Orthogonality and Projection
3. Week 3: Eigendecomposition

4. Week 4: Factorization (LU, QR, SVD)
5. Week 5: Covariance and Variance-Covariance Matrices
6. Week 6: Multivariate Gaussian Distribution
7. Week 7: Minimum Problems and Optimization Basics
8. Week 8: Lagrange Multipliers
9. Week 9: Linear Programming
10. Week 10: Least-Squares Estimation
11. Week 11: Maximum Likelihood Estimation
12. Week 12: Gradient Descent Methods
13. Week 13: Applications to Machine Learning – Linear Regression
14. Week 14: Applications to Machine Learning – Neural Networks
15. Week 15: Review and Catch up

Assessments and Grading

Final Exam	40%
Midterm Exam	25%
Class Evaluation	15%
Final Project	20%

Course Policies

Attendance: Students are expected to attend all classes. More than 25% absences may result in failing the course. Excused absences must be justified with valid documentation.

Cheating and Plagiarism: Academic dishonesty in any form (cheating, plagiarism, unauthorized collaboration, or falsifying data) will result in disciplinary action in accordance with university regulations, which may include a failing grade in the course.

Make-up Exams: Make-up exams will only be given in exceptional cases with documented evidence.