AI 6000
AI Foundations

MEMORIAL
U N I V E R S I T Y

Department of Computer Science

Course Description:
AI Foundations provides the prerequisite mathematical background for further study in Artificial Intelligence.

Learning Goals:
The goal of this course is to provide the essential mathematical foundations needed to understand the concepts and algorithms used in Artificial Intelligence. This background is usually taught in several math courses that will go deeper into each of the areas covered. This course will refresh and advance basic knowledge in areas such as vector calculus, linear algebra and statistics to the point where it can be applied in the understanding of core AI techniques.

The core AI techniques will serve as primary motivating examples around which the course material will be structured. For an example of this approach, the mathematical underpinnings for the backpropagation algorithm used to train neural networks will be established. Backpropagation requires the concepts of partial derivatives, function composition, and matrix multiplication. Once these concepts have been covered, the algorithm will be presented as an example of their application. Another motivating example would be Principal Components Analysis (PCA) which is an important method for dimensionality reduction. PCA requires the concepts of linear transformations, eigenvalues, eigenvectors, and covariance matrices. The set of motivating examples chosen could be different year-by-year but would consistently support the same fundamental topics listed below.

Topics:
1. Linear algebra
2. Analytic geometry
3. Matrix decompositions
4. Vector calculus
5. Probability distributions
6. Continuous optimization

Textbook:
[Mathematics for Machine Learning](). by M. P. Deisenroth, A. A. Faisal, and C. S. Ong., Cambridge University Press, 2020.

Evaluation (representative):
The final grade in this course will be determined as follows:

Assignments	30%
Midterm examination	30%
Final examination	40%