WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

CS/ECE/ME 532 Sec. 004
Matrix Methods in Machine Learning

[Unit 1] Introduction – Overview

Learning Objectives

At the end of this module, students will be able to:
- Multiply matrices and vectors
- Use inner products to represent polynomial and multi-dimensional functions
- Determine whether vectors are orthogonal

Significance of Unit

Unit 1 introduces the ideas of matrices, multiplication of matrices, and machine learning–how to take data and have a computer learn from that data, to recognize patterns and make predictions. We will start with the basics: the definition of a matrix and the definition of a vector. We will also define matrix-vector multiplication and the inner products of vectors, which is important because we can represent a function as the inner product of some data with a set of weights that the machine is going to learn and then make inference on the data. When we learn those weights, we can solve problems that involve products of a matrix and a vector. We will also introduce outer product multiplication of a column vector times a row vector, to represent patterns in matrices, which can be used to make predictions.

Key Topics

1. Machine learning and example problems
2. Supervised and unsupervised learning
3. Why matrix methods?
4. Vectors, matrices, inner and outer products
5. Orthogonality of vectors
6. Inner products for representing polynomial and multi-dimensional functions
   - 6.1. Predictive models
   - 6.2. Decision boundaries

Learning Activities

- Instructional Units 1.1–1.3
- Activity 1
- Instructional Units 1.4, 1.5
- Activity 2
- Instructional Unit 1.6
- Activity 3
- Ethics in Machine Learning
- Assignment 1
- Unit 1 Overview Quiz

Recommended Reading

- LE 1.1 Data Mining and Pattern Recognition
- LE 1.2 Vectors and Matrices
- LE 1.6 Notation
- LE 2.1 Matrix-Vector Multiplication
- LE 2.2 Matrix-Matrix Multiplication