Machine Learning for Maths - Session 1 Summary

1. What is Machine Learning?

- ML is about teaching machines to learn from data (instead of explicit programming).
- The goal is to classify or predict outcomes by identifying patterns in the data.

Human vs Machine Learning

- Humans learn from experience.
- Machines learn from data using mathematical functions.

Core ML Concepts

- Data is divided into categories (labels).
- ML finds the best geometric structure (line, curve, etc.) to separate or predict categories.

Geometric Intuition

- Lines (or more complex shapes like ellipses) are used to separate classes.
- There are infinitely many possible lines, but ML picks the one with minimum error (loss).

Steps in an ML Workflow

1. Data Collection & Cleaning
2. Exploratory Data Analysis (EDA) & Visualization
3. Choose the geometric model (e.g., line, curve)
4. Define a Loss Function (quantifies the error)
5. Train the model (optimize weights to minimize loss)

Important Terminologies

- Target / Label / Dependent Variable: Output variable to predict (Y)
- Independent Variables / Features: Input variables used to predict (X)
- Record / Data Point: One row of data (x1, x2, ..., Y)
- Binary Classification: Predict one of two classes

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- Multi-class Classification: Predict one of more than two classes
- Supervised Learning: Labels are available in training data
- Unsupervised Learning: Labels are not available in training data

Math Behind Classifiers

- Equation of a line: y = mx + c
  * m = slope (tan(theta)), angle with x-axis
  * c = intercept (y when x = 0)
- In multiple dimensions: w1*x1 + w2*x2 + w0 = 0
  * w = weights (slope), x = features, w0 = bias term
  * This equation divides the feature space into two half-spaces
- Classifier: A function (usually geometric) that separates data points into different classes.