AI From Scratch in C++ - Course Outline

Week 1: Linear Regression

MSE Loss, Gradient Descent, fit() and predict() functions, Synthetic data generation, Loss tracking.

Week 2: Logistic Regression

Sigmoid, Binary Cross-Entropy, Classification boundary, Predict binary output.

Week 3: k-Nearest Neighbors

Euclidean Distance, Memory storage, Sorting distances, Majority voting.

Week 4: Naive Bayes

Gaussian model, Class priors, Log probability handling.

Week 5: Decision Tree

Entropy, Information Gain, Recursive tree building and traversal for predictions.

Week 6: Random Forest

Bootstrap sampling, Multiple trees, Majority vote aggregation.

Week 7: Matrix Math Library

Implement your own Matrix class, Operator overloading, Dot product, Transpose, etc.

Week 8: Perceptron

Basic neural model, Step/tanh activation, Logic gates training (AND/OR).

Week 9: Multilayer Perceptron (MLP)

Multiple layers, Backpropagation, Sigmoid/ReLU activations.

Week 10: MNIST with MLP

PGM image parsing, Feedforward classifier, Accuracy and loss tracking.

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Week 11: Convolutional Neural Networks

2D convolution, Pooling, Padding/Stride, Combine with MLP.

Week 12: Recurrent Neural Networks

Sequential inputs, State preservation, Backpropagation through time (BPTT).

Week 13: Optimizers

SGD, Momentum, AdaGrad, RMSProp, Adam. Learning performance comparison.

Week 14: Regularization

L1/L2 penalties, Dropout, Early stopping methods.

Week 15: Reinforcement Learning (optional)

Q-Learning agent, Gridworld environment, Bellman update.

Week 16: Final Projects

Choose 1-2: CNN classifier, Chatbot, Gridworld agent, Image compression, etc.