

I love your attitude! Here's a set of milestone challenges (in order) that act as "boss fights" for your ML/DL/CV journey. Each milestone will force you to master key concepts, math, and code. Tackle them one by one—when you clear a milestone, you'll know you've truly "leveled up."

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## **Milestone 1: Linear Algebra & Numpy Warrior**

- Implement vector addition, dot product, and matrix multiplication in pure Python and NumPy.
  - Visualize vectors and transformations in 2D (rotate, scale, project a vector).
  - Write a function to compute eigenvalues and eigenvectors for a 2x2 matrix.
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## **Milestone 2: Statistics & Probability Challenger**

- Simulate dice rolls and coin tosses in Python—calculate empirical probabilities.
  - Compute mean, variance, standard deviation for a random dataset without using built-in functions.
  - Visualize and explain normal distribution vs. uniform distribution (use matplotlib).
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## **Milestone 3: Calculus & Gradient Descent Duelist**

- Numerically compute the derivative of a function (e.g.,  $f(x) = x^2 + 3x + 2$ ) using Python.
  - Implement gradient descent to find the minimum of a simple quadratic function.
  - Plot the function and show how the algorithm steps downhill.
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## **Milestone 4: ML From Scratch Conqueror**

- Implement linear regression with gradient descent (no scikit-learn!).
  - Implement logistic regression (classification) from scratch.
  - Evaluate model accuracy on a toy dataset you generate.
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## **Milestone 5: scikit-learn Sprinter**

- Load a real dataset (Iris, Titanic, MNIST) with scikit-learn.
  - Train at least 3 different classifiers and compare their accuracy.
  - Perform cross-validation and plot a confusion matrix.
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## **Milestone 6: Neural Network Novice**

- Implement a single-layer perceptron (NN) from scratch, including backpropagation.
  - Train it on a linearly separable dataset and visualize the decision boundary.
  - Explain each mathematical step (forward pass, loss, gradient, weight update).
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## **Milestone 7: PyTorch/Keras Initiate**

- Build a small MLP (multi-layer perceptron) with PyTorch or Keras.
  - Train it on MNIST or FashionMNIST for digit/image classification.
  - Visualize loss and accuracy curves.
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## **Milestone 8: OpenCV Explorer**

- Load an image using OpenCV.
  - Convert to grayscale, blur it, and detect edges (Canny).
  - Draw shapes and add text on an image.
  - Detect faces with Haar cascades or a simple pre-trained model.
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## **Milestone 9: Convolutional Crusader**

- Build a simple CNN for image classification (PyTorch/Keras).
  - Visualize feature maps and explain convolution operation mathematically.
  - Achieve >90% accuracy on MNIST or CIFAR-10 (small subset).
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## **Milestone 10: End-to-End Pipeline Hero**

- Take a dataset (images or tabular), preprocess/clean it, train a model, evaluate, and visualize results.
- Automate the pipeline (load data → preprocess → split → train → evaluate → plot).
- Write up your approach and results in a Jupyter notebook.

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## **Special Boss Mode (Optional)**

- Implement PCA from scratch and use it to reduce dimensionality of a dataset, then visualize.
- Try adversarial attacks: fool a simple classifier you built.
- Deploy a trained model as a REST API (using Flask or FastAPI).

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Defeat these milestones, and you'll be a true ML/DL/CV warrior.

Whenever you're stuck, call for "backup" (ask me for hints, code, or more challenges).

Ready? Choose your first boss and start the war!