Deep Learning Assignment

Overview

Use the **FathomNet** dataset of underwater imagery to build image classification systems for marine organisms. The dataset includes diverse classes of underwater species and environments. Build CNNs from scratch, apply transfer learning, and evaluate models on robust metrics.

Learning Objectives

- Design and train a CNN from scratch for multi-class classification.
- Apply Transfer Learning (pretrained backbones + fine-tuning) and compare performance.
- Implement preprocessing pipelines suited to underwater imagery.
- Produce clear evaluation, visualizations, and a short technical report.

Dataset (links)

- FathomNet dataset: https://www.fathomnet.org/

Requirements (mandatory)

1. **Data preparation (document exactly what you do):**
2. **Model A — CNN from scratch:**
    - Implement a convolutional neural network of your design (minimum: 3 conv blocks + pooling + dense head). Include justification for architecture, regularization (dropout, batchnorm), and optimizer choices.
    - Train at least 2 different hyperparameter configurations (e.g., learning rate, batch size) and report validation curves.
3. **Model B — Transfer Learning:**
    - Use at least one pretrained backbone. Replace top layers and fine-tune (unfreeze some layers).
    - Compare three strategies: (i) feature extraction (freeze backbone), (ii) fine-tuning top blocks,Report results.

4. **Handling Novel / OOD Classes (required baseline):**

   - Implement a simple rule to flag images as *unknown* / out-of-distribution.
   - Report precision/recall for known vs unknown detection on a held-out subset that contains novel categories (or simulate by holding out some classes).

5. **Evaluation:**

   - Report per-class precision/recall/F1, macro-averaged F1, and overall accuracy. Provide confusion matrix heatmap.
   - Plot training/validation loss and accuracy curves for main experiments.

6. **Reproducibility:**

   - Provide a single Jupyter Notebook (or Colab) that runs the main pipeline (data loading, training small epoch run, evaluation) and a `requirements.txt` or `environment.yml`. Seed random generators for reproducibility where possible.

Deliverables

- Jupyter Notebook (.ipynb) with code cells and concise comments.
- Technical report (PDF, 2–3 pages) summarizing methods, main results, and discussion.
- Optional: Colab link or saved model weights / small sample submission file.
