Human Behavior Recognition

Using AI

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CAP 4630 – Intro to Artificial Intelligence

OBJECTIVES

01 Build an AI model capable of recognizing human actions from images

02 Understand how image data can be used to train deep learning models

03 Evaluate performance using standard metrics

04 Explore how this applies to real-world applications, including wildlife behavior research

What Is AI?

Artificial Intelligence allows computers to learn patterns from data and make decisions without being explicitly programmed.
In this project, AI learns to identify visual human actions based on image features.

Where Is AI Used?

Medicine

AI analyzes X-rays, MRIs, and scans to detect diseases early and support diagnosis.

CyberSecurity

AI detects abnormal behavior in networks and prevents potential cyberattacks.

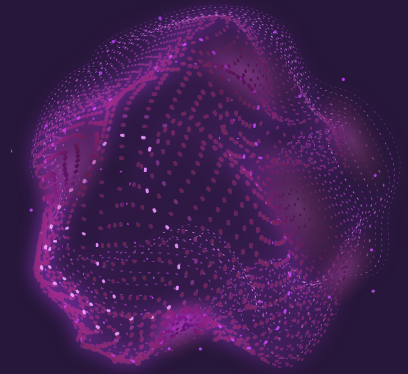
Environmental

AI monitors wildlife, tracks behavior, and helps with conservation — similar to how we study beluga whale behaviors.

How Do We Train AI?

AI model training typically includes:

- Learning from Examples: Model sees labeled images
- Prediction: Model generates outputs
- Correction: Model updates its internal weights
- Repetition: Learning improves with each training cycle



Training Process

Prepare Data

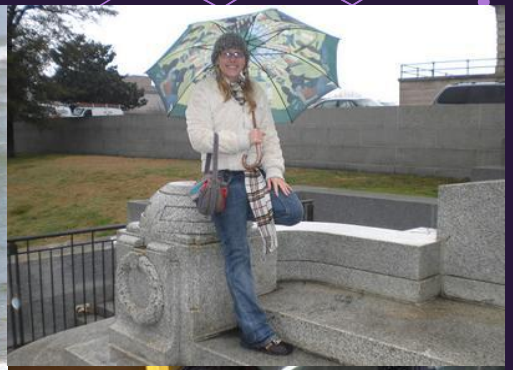
Collect, clean, label, and organize image data.

Design Model

Choose a neural network architecture suitable for recognizing visual features.

Train and Validate

Model learns from training images and is validated using unseen images to measure generalization.



The Approach: Dataset

I trained the model on the Stanford-40 Human Actions dataset, which contains 40 different behaviors such as:

- Fishing
- Walking the dog
- Jumping
- Playing guitar
- Cooking
- Cutting vegetables
- Taking photos

This dataset provides ~9,500 labeled images.

Image Preprocessing

Resize

All Images are Resized to 224 x 224

Normalize

Pixel Values are Normalized to improve stability

Convert To Tensor

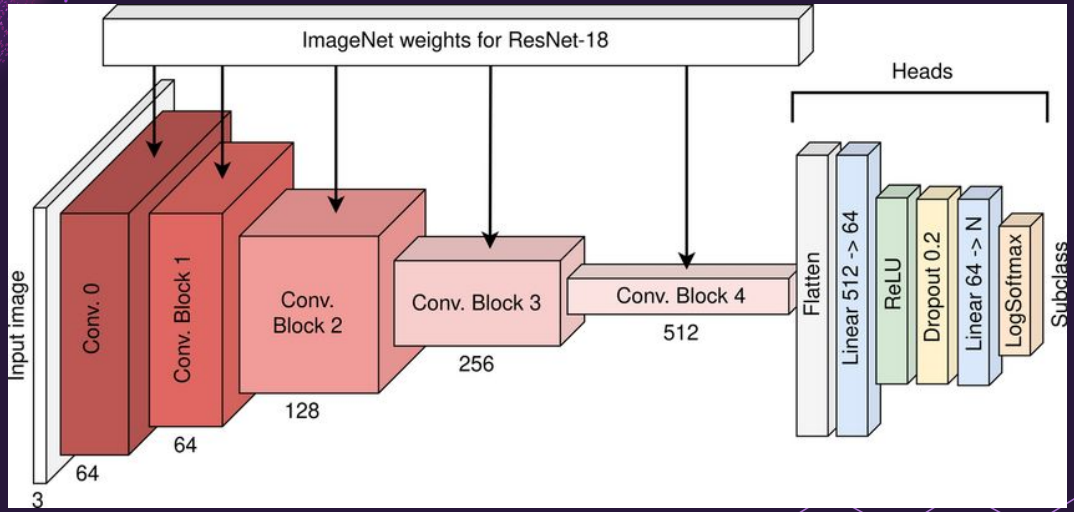
Images are converted to tensor to be used by PyTorch

Split Data

Dataset divided into 80% training and 20% validation

Model Architecture: ResNet-18

- Uses convolutional layers to extract features
- Pretrained on ImageNet
- Final classification layer replaced for 40 classes
- Good balance of accuracy and speed
- Works well for action recognition



Training Pipeline

- Load Dataset
- Preprocess Images
- Create Train/Validation Split
- Train ResNet-18 Model
- Evaluate Using Metrics
- Make Predictions on New Images

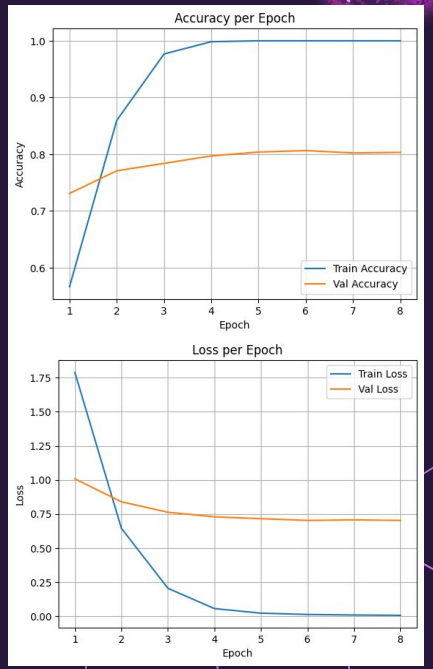
Training Metrics

I tracked the following during training:

- Accuracy: 79.6%
- Precision: 78.3%
- Recall: 77.8%
- F1 Score: 77.8%

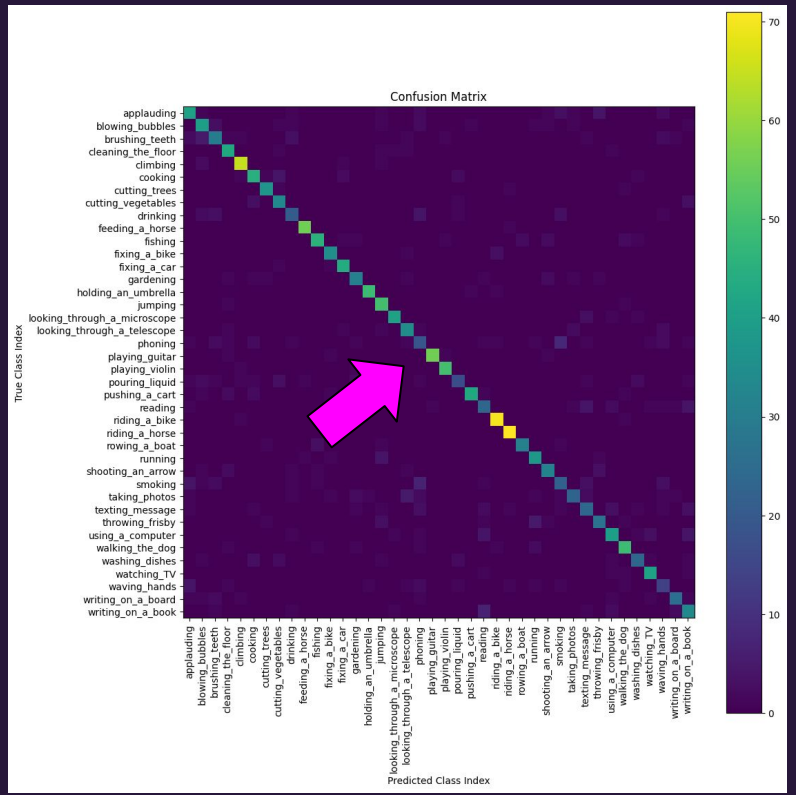
Observations:

- Some actions were easier to classify due to clearer visual cues
- Similar actions resulted in overlaps (example: reading vs writing)
- Model performance improved steadily during training

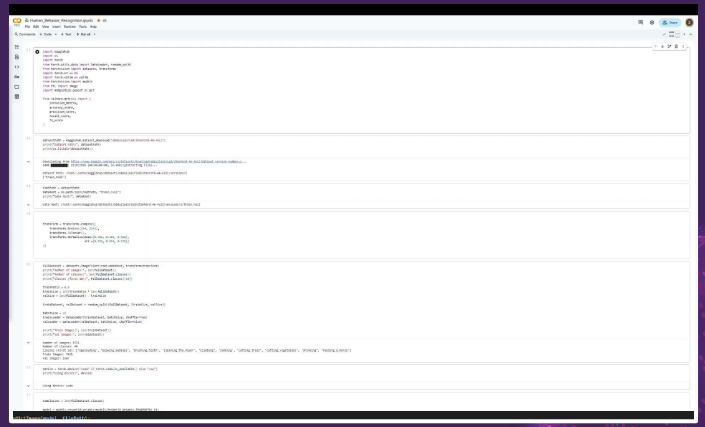


Confusion Matrix

- Shows which actions the model predicted correctly
- Reveals which actions were commonly misclassified
- Helps identify difficult categories that need more training data

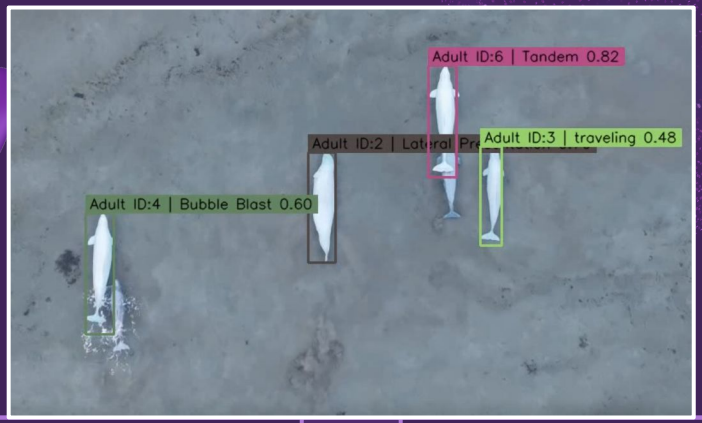


Project Demo



Demo Video

(Select an image → Model predicts action + confidence instantly)



Why It Matters

AI-based behavior recognition is important because it:

- Helps automate the process of analyzing large amounts of images or video
- Improves accuracy and consistency compared to manual review
- Saves researchers and analysts significant time
- Identifies patterns that humans may overlook

The same technology used in this project directly connects to real environmental research. For example, my senior project used a similar AI pipeline to classify beluga whale behaviors from drone footage — showing how image-based behavior recognition can support real conservation efforts.

Conclusion

- Successfully trained a model to classify 40 human behaviors
- Implemented a full AI pipeline from dataset preparation to evaluation
- Learned key concepts in deep learning, preprocessing, model training, and metric analysis
- Demonstrated how this technology can generalize to real-world research like beluga monitoring