# Flood Debris Classification After Heavy Rains Using Convolutional Neural Networks (CNNs)

**Problem Statement**

Urban areas worldwide are facing increased flooding due to climate change, resulting in hazardous debris scattered across streets and public places. Manual assessment of debris after floods is slow and risky, often delaying emergency responses and cleanup operations. There is a pressing need for an automated system that can quickly and accurately classify post-flood street conditions using visual data, allowing cities to respond efficiently and improve public safety.

**Objective**

To develop an AI-powered image classification solution leveraging Convolutional Neural Networks (CNNs) that can automatically categorize post-rain street images into three classes:

- Safe
- Debris Present
- Needs Immediate Cleaning

This system will assist municipal authorities by providing rapid, reliable assessments for effective resource allocation and disaster management.

**Dataset**

**Dataset Name:** Roadway Flooding Image Dataset (Kaggle)

**About the Dataset:**

The dataset consists of annotated images depicting various street and road conditions following heavy rainfall events. Images are labeled based on visible debris and flooding severity, making them suitable for training and testing machine learning models for urban flood detection and debris classification.

**Source:** Kaggle Roadway Flooding Image Dataset

**Dataset Link:**

https://www.kaggle.com/datasets/saurabhshahane/roadway-flooding-image-dataset

## Methodology

### Data Collection & Preparation:

- Download and organize street images from Kaggle's flood datasets.
- Preprocess images: resize, normalize, split into training and test sets.

### Model Development:

- Build and train a CNN model (Python, TensorFlow/Keras).
- Apply data augmentation to improve generalization and robustness.

### Model Evaluation:

- Measure performance using accuracy, precision, recall, and F1-score.
- Validate results using unseen test images and confusion matrix.

### Application (for later phases):

- Design a simple interface to upload an image and receive classification results.
- Demonstrate real-time assessment capability.

## Impact

This project showcases the practical application of artificial intelligence in urban disaster management supporting timely response, cleaner environments, and improved public safety. It also encourages sustainable city practices and increases resilience against climate change-driven flooding events.