Implementation Plan: Disaster Detection System

DS 340W Data Science Capstone - Week 2

Technical Implementation Strategy

September 28, 2025

# Executive Summary

This implementation plan outlines the development strategy for a disaster detection system based on Weber et al.'s methodology. The plan encompasses architecture design, data pipeline development, training procedures, and deployment considerations. The goal is to create a robust, scalable system capable of real-time disaster detection from social media imagery.

# 1. System Architecture

## 1.1 Core Components

The system architecture consists of four primary components:

* Data Ingestion Pipeline: Real-time image collection from social media APIs
* Preprocessing Module: Image standardization and quality filtering
* Multi-Task CNN Engine: Incident detection and place recognition
* Output Interface: Classification results and confidence scoring

## 1.2 Technical Specifications

Hardware and software requirements for optimal system performance:

* GPU: NVIDIA RTX 4090 or equivalent (24GB VRAM minimum)
* Framework: PyTorch 2.0+ with CUDA 12.0 support
* Storage: 2TB SSD for dataset storage and model checkpoints

# 2. Development Timeline

## 2.1 Phase 1: Foundation (Weeks 3-4)

* Dataset download and preprocessing pipeline development
* Base ResNet-50 architecture implementation
* Multi-task head development and integration

## 2.2 Phase 2: Training (Weeks 5-6)

* Baseline model training with cross-entropy loss
* Class-negative loss function implementation and optimization
* Hyperparameter tuning and model validation

## 2.3 Phase 3: Enhancement (Weeks 7-8)

* Multi-scale attention mechanism integration
* Advanced data augmentation implementation
* Performance optimization and inference acceleration

# 3. Risk Assessment and Mitigation

## 3.1 Technical Risks

* Dataset size limitations: Mitigated through data augmentation and transfer learning
* Computational resources: Cloud GPU instances as backup option
* Model overfitting: Cross-validation and regularization strategies

# 4. Success Metrics

Project success will be evaluated using the following quantitative metrics:

* Mean Average Precision (mAP) > 70% on test set
* False positive rate reduction > 40% compared to baseline
* Inference time < 20ms per image for real-time processing