Crop Health Analysis Using NDVI

Objective:

Develop an Web Application AI-powered system to automate crop health monitoring using satellite-derived NDVI (Normalized Difference Vegetation Index) values Classifying The Data into 4 Categories Based on the NDVI Values

```
Non-Plant[-1:0], Unhealthy[0:0.33],
Moderate[0.33:0.66], Very Healthy [0.66:1]
```

Dataset Overview

MODIS Terra MOD13QA Dataset

- Spatial Resolution: 250m/pixel
- Temporal Resolution: 16-day intervals

Structure:

- Format: HDF4 files (4,800 x 4,800 pixels)
- Scaling: Raw values multiplied by 10,000
- Fill Values: -3000 (indicates invalid/no-data pixels)

HDFView 3.3.2

File Window Tools Help

Recent Files | C:\Users\pc\Downloads\MOD13Q1.A2022017.h08v05.061.2022034233650.hdf

- MOD13Q1.A2022017.h08v05.061
  - MODIS_Grid_16DAY_250m_50
    - Data Fields
      - 250m 16 days NDVI (dimer
      - 250m 16 days EVI (dimensi
      - 250m 16 days VI Quality (di
      - 250m 16 days red reflectan
      - 250m 16 days NIR reflectan
      - 250m 16 days blue reflectar
      - 250m 16 days MIR reflectar
      - 250m 16 days view zenith a
      - 250m 16 days sun zenith ar
      - 250m 16 days relative azim
      - 250m 16 days composite d
      - 250m 16 days pixel reliabili
    - Grid Attributes

Object Attribute Info | General Object Info

Number of attributes = 9

Name	Type	Array Size	Value[50](...)
long_name	8-bit character	17	250m 16 days NDVI
units	8-bit character	4	NDVI
valid_range	16-bit integer	2	-2000, 10
_FillValue	16-bit integer	1	-3000
scale_factor	64-bit floating-point	1	10000.0
scale_factor_err	64-bit floating-point	1	0.0
add_offset	64-bit floating-point	1	0.0
add_offset_err	64-bit floating-point	1	0.0
calibrated_nt	32-bit integer	1	5

Implementation Steps

Automated Data Acquisition:.

- Authenticate with NASA LAADS using Bearer tokens
- Download HDF4 files via wget with robotic restrictions bypass
- Store files in Google Drive for collaborative access

Data Processing Pipeline:

- Chunk Splitting: Divide 4,800x4,800 images into 500x500 chunks
- Handling the Default Fill Value
- Normalization: Divide by 10,000 to restore [-1, 1] range
- Resizing: Scale to 299x299 for InceptionV3 compatibility
- Gaussian Blur: Smooth data while preserving NaN regions
- Mean Imputation: Replace NaN with valid pixel mean
- Vegetation Masking:

Model Training:

- Model Architecture (InceptionV3)
    - Base Model: InceptionV3 with ImageNet weights (frozen)
   - Optimizer: Adam (lr=0.0001)
    - Loss: Categorical Crossentropy

Model Summary:

```python
Model: "InceptionV3_Custom"

_____
Layer (type)                Output Shape              Param #
=================================================================
input_1 (InputLayer)        [(None, 299, 299, 3)]     0
inception_v3 (Functional)   (None, 8, 8, 2048)        21802784
global_average_pooling2d     (None, 2048)             0
dense (Dense)               (None, 1024)              2098176
dropout (Dropout)           (None, 1024)              0
dense_1 (Dense)             (None, 4)                 4100
=================================================================
Total params: 23,905,060
Trainable params: 2,102,276
Non-trainable params: 21,802,784
```

Training Summary:

The model achieved a training accuracy of **98.38%** with a training loss of 0.0549. On the validation set, it reached a validation accuracy of **92.99%** and a validation loss of 0.1552. The learning rate during this stage was 1e-5.
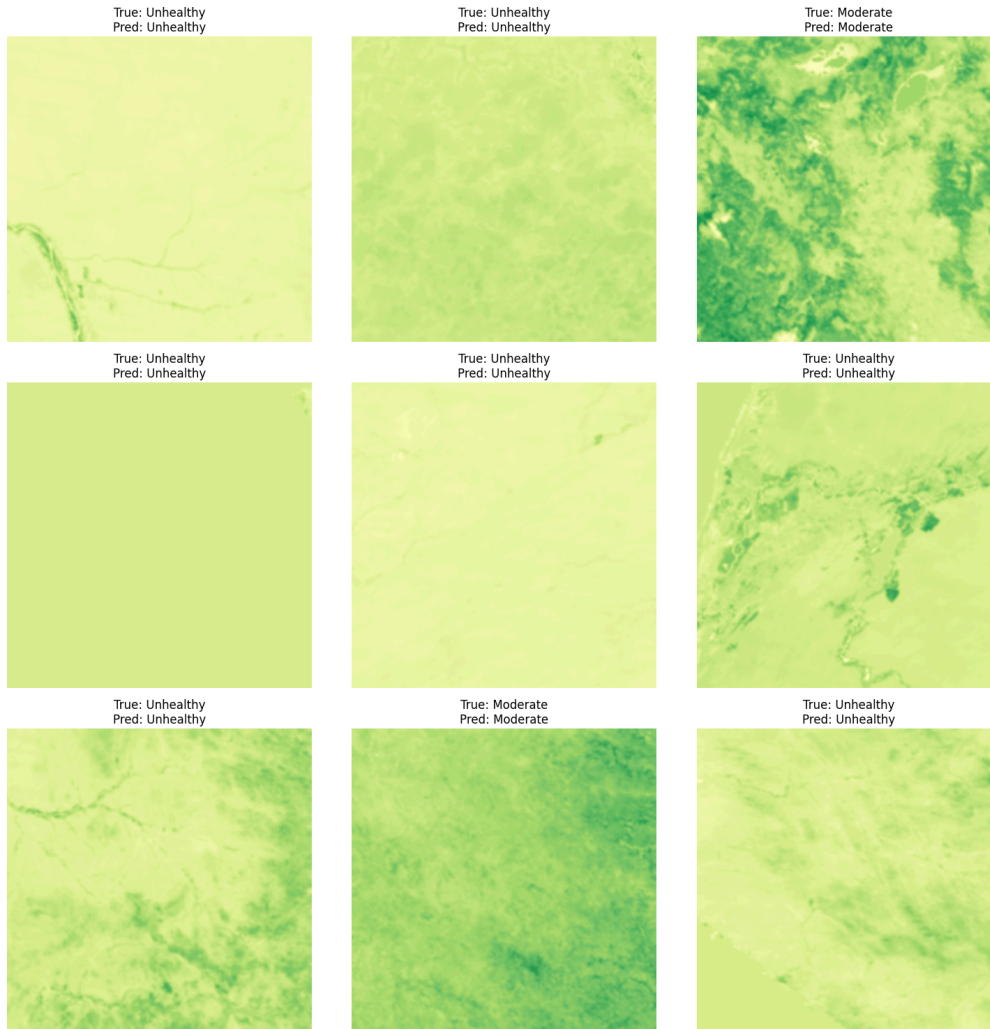
Multi-Format Preprocessing

Supported Input Types:

- **TIFF/TIF**
- **NPY**
- **RGB Images: Convert to VARI (Visible Atmospheric Resistance Index)**