

## Model Development Phase Template

Date	6 Feb 2026
Student Name	Sushant Dattatray Kadam
Project Title	greenclassify: deep learning-based approach for vegetable image

### Initial Model Training Code, Model Validation and Evaluation Report

The initial model training code will be showcased in the future through a screenshot. The model validation and evaluation report will include a summary and training and validation performance metrics for multiple models, presented through respective screenshots.

#### Initial Model Training Code (5 marks):

```
import keras
early_stopping=keras.callbacks.EarlyStopping(patience=10)

hist=model.fit(train_ds,
                epochs=100,
                verbose=1,
                validation_data=validation_ds,
                callbacks=early_stopping
                )
```

## Model Validation and Evaluation Report (5 marks):

Model	Summary	Training and Validation Performance Metrics																																																															
Custom CNN	<table> <tr> <th>Layer (type)</th><th>Output Shape</th><th>Param #</th></tr> <tr> <td>conv2d (Conv2D)</td><td>(None, 150, 150, 32)</td><td>896</td></tr> <tr> <td>batch_normalization (BatchNormalization)</td><td>(None, 150, 150, 32)</td><td>128</td></tr> <tr> <td>max_pooling2d (MaxPooling2D)</td><td>(None, 75, 75, 32)</td><td>0</td></tr> <tr> <td>dropout (Dropout)</td><td>(None, 75, 75, 32)</td><td>0</td></tr> <tr> <td>conv2d_1 (Conv2D)</td><td>(None, 75, 75, 64)</td><td>18,496</td></tr> <tr> <td>batch_normalization_1 (BatchNormalization)</td><td>(None, 75, 75, 64)</td><td>256</td></tr> <tr> <td>max_pooling2d_1 (MaxPooling2D)</td><td>(None, 37, 37, 64)</td><td>0</td></tr> <tr> <td>dropout_1 (Dropout)</td><td>(None, 37, 37, 64)</td><td>0</td></tr> <tr> <td>conv2d_2 (Conv2D)</td><td>(None, 37, 37, 128)</td><td>73,856</td></tr> <tr> <td>batch_normalization_2 (BatchNormalization)</td><td>(None, 37, 37, 128)</td><td>512</td></tr> <tr> <td>max_pooling2d_2 (MaxPooling2D)</td><td>(None, 18, 18, 128)</td><td>0</td></tr> <tr> <td>dropout_2 (Dropout)</td><td>(None, 18, 18, 128)</td><td>0</td></tr> <tr> <td>conv2d_3 (Conv2D)</td><td>(None, 18, 18, 256)</td><td>295,168</td></tr> <tr> <td>batch_normalization_3 (BatchNormalization)</td><td>(None, 18, 18, 256)</td><td>1,024</td></tr> <tr> <td>max_pooling2d_3 (MaxPooling2D)</td><td>(None, 9, 9, 256)</td><td>0</td></tr> <tr> <td>dropout_3 (Dropout)</td><td>(None, 9, 9, 256)</td><td>0</td></tr> <tr> <td>flatten (Flatten)</td><td>(None, 20736)</td><td>0</td></tr> <tr> <td>dense (Dense)</td><td>(None, 512)</td><td>10,617,344</td></tr> <tr> <td>dropout_4 (Dropout)</td><td>(None, 512)</td><td>0</td></tr> <tr> <td>dense_1 (Dense)</td><td>(None, 15)</td><td>7,695</td></tr> </table>	Layer (type)	Output Shape	Param #	conv2d (Conv2D)	(None, 150, 150, 32)	896	batch_normalization (BatchNormalization)	(None, 150, 150, 32)	128	max_pooling2d (MaxPooling2D)	(None, 75, 75, 32)	0	dropout (Dropout)	(None, 75, 75, 32)	0	conv2d_1 (Conv2D)	(None, 75, 75, 64)	18,496	batch_normalization_1 (BatchNormalization)	(None, 75, 75, 64)	256	max_pooling2d_1 (MaxPooling2D)	(None, 37, 37, 64)	0	dropout_1 (Dropout)	(None, 37, 37, 64)	0	conv2d_2 (Conv2D)	(None, 37, 37, 128)	73,856	batch_normalization_2 (BatchNormalization)	(None, 37, 37, 128)	512	max_pooling2d_2 (MaxPooling2D)	(None, 18, 18, 128)	0	dropout_2 (Dropout)	(None, 18, 18, 128)	0	conv2d_3 (Conv2D)	(None, 18, 18, 256)	295,168	batch_normalization_3 (BatchNormalization)	(None, 18, 18, 256)	1,024	max_pooling2d_3 (MaxPooling2D)	(None, 9, 9, 256)	0	dropout_3 (Dropout)	(None, 9, 9, 256)	0	flatten (Flatten)	(None, 20736)	0	dense (Dense)	(None, 512)	10,617,344	dropout_4 (Dropout)	(None, 512)	0	dense_1 (Dense)	(None, 15)	7,695	<p>Epoch 19/100  <b>469/469</b> — 13s 28ms/step - accuracy: 0.9572 - loss: 0.1619 - val_accuracy: 0.9327 - val_loss: 0.5387  Epoch 20/100  <b>469/469</b> — 14s 29ms/step - accuracy: 0.9600 - loss: 0.1507 - val_accuracy: 0.9330 - val_loss: 0.5599  Epoch 21/100  <b>469/469</b> — 13s 28ms/step - accuracy: 0.9588 - loss: 0.1710 - val_accuracy: 0.9683 - val_loss: 0.1612  Epoch 22/100  <b>469/469</b> — 13s 28ms/step - accuracy: 0.9710 - loss: 0.1268 - val_accuracy: 0.9657 - val_loss: 0.1943  Epoch 23/100  <b>469/469</b> — 20s 28ms/step - accuracy: 0.9669 - loss: 0.1486 - val_accuracy: 0.9818 - val_loss: 0.8997  Epoch 24/100  <b>469/469</b> — 14s 29ms/step - accuracy: 0.9691 - loss: 0.1338 - val_accuracy: 0.9733 - val_loss: 0.1589  Epoch 25/100  <b>469/469</b> — 13s 27ms/step - accuracy: 0.9721 - loss: 0.1103 - val_accuracy: 0.9373 - val_loss: 0.5844</p>
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