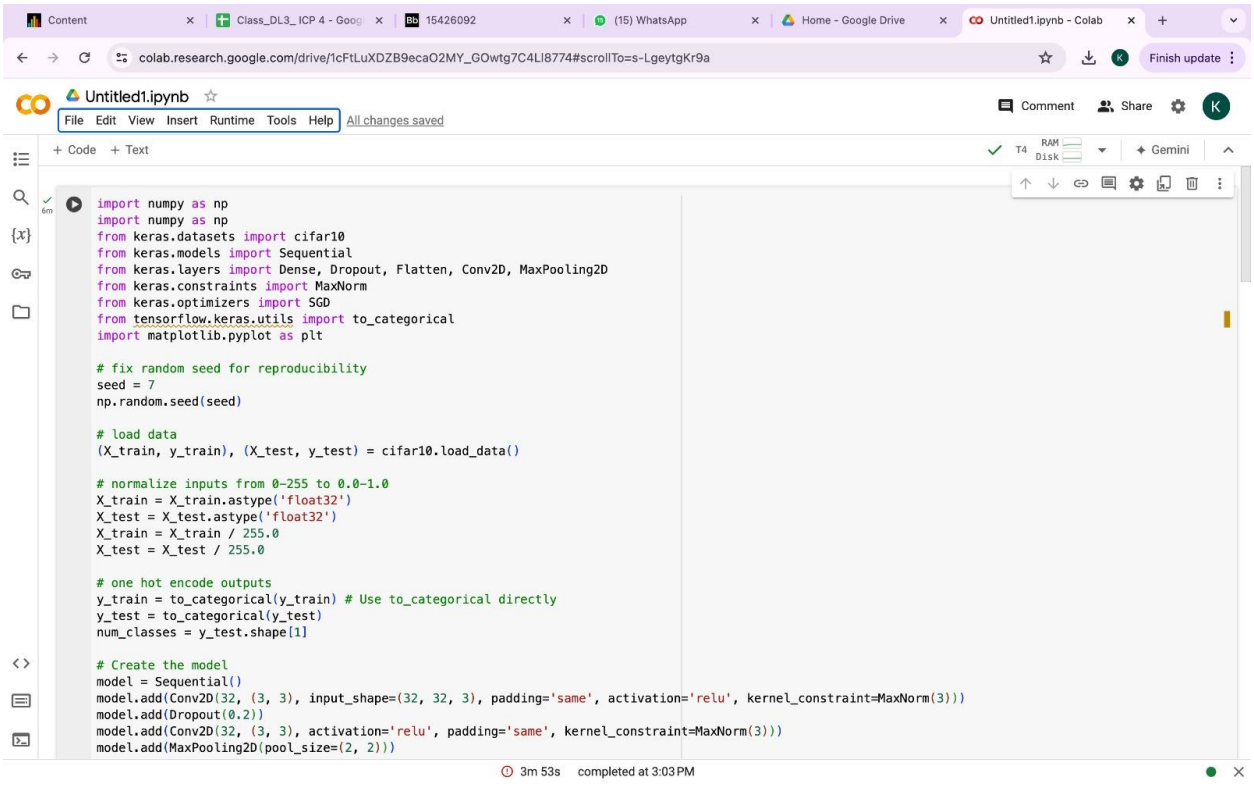
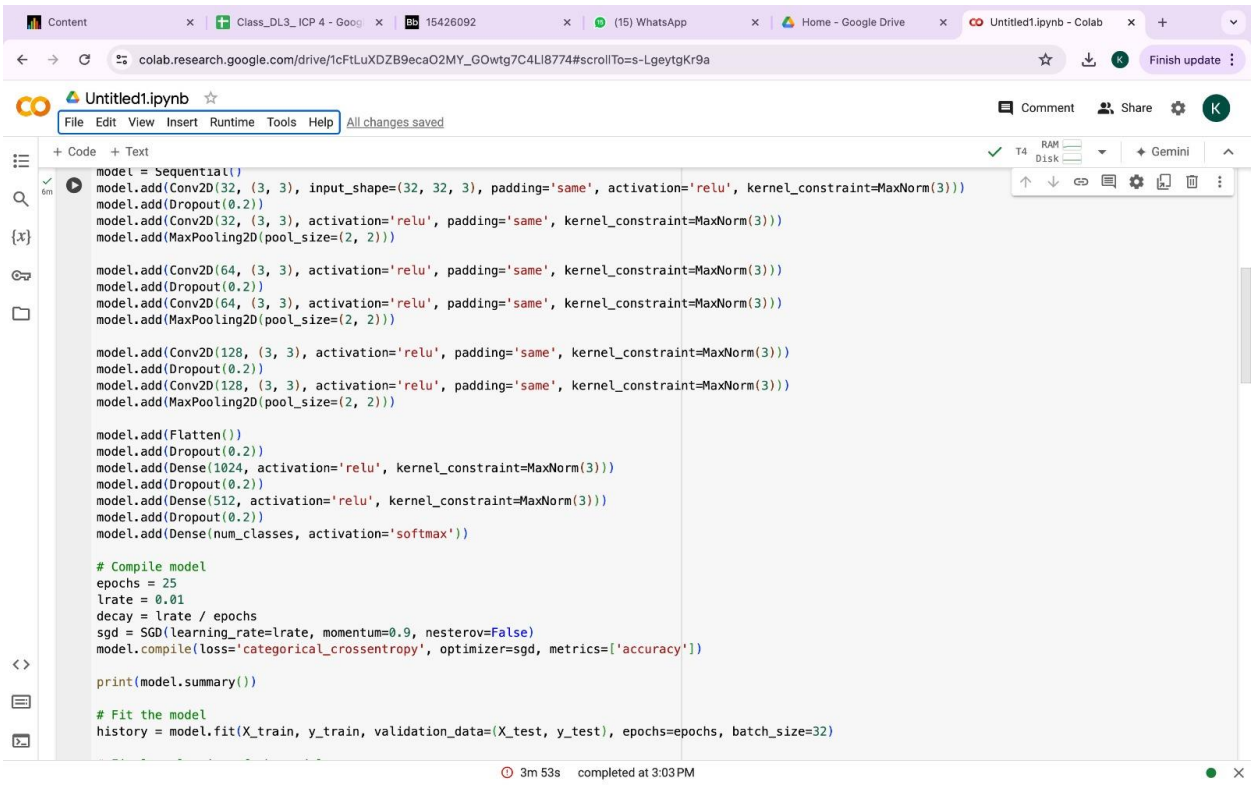
ASSIGNMENT-4

DINESH KUMAR MANDE
STUDENT ID- 700765226

GitHub Link:

https://github.com/dxm52260/icp-4

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model = Sequential()
model.add(Conv2D(32, (3, 3), input_shape=(32, 32, 3), padding='same', activation='relu', kernel_constraint=MaxNorm(3)))
model.add(Dropout(0.2))
model.add(Conv2D(32, (3, 3), activation='relu', padding='same', kernel_constraint=MaxNorm(3)))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Conv2D(64, (3, 3), activation='relu', padding='same', kernel_constraint=MaxNorm(3)))
model.add(Dropout(0.2))
model.add(Conv2D(64, (3, 3), activation='relu', padding='same', kernel_constraint=MaxNorm(3)))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Conv2D(128, (3, 3), activation='relu', padding='same', kernel_constraint=MaxNorm(3)))
model.add(Dropout(0.2))
model.add(Conv2D(128, (3, 3), activation='relu', padding='same', kernel_constraint=MaxNorm(3)))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Flatten())
model.add(Dropout(0.2))
model.add(Dense(1024, activation='relu', kernel_constraint=MaxNorm(3)))
model.add(Dropout(0.2))
model.add(Dense(512, activation='relu', kernel_constraint=MaxNorm(3)))
model.add(Dropout(0.2))
model.add(Dense(num_classes, activation='softmax'))
# Compile model
epochs = 25
lrate = 0.01
decay = lrate / epochs
sgd = SGD(learning_rate=lrate, momentum=0.9, nesterov=False)
model.compile(loss='categorical_crossentropy', optimizer=sgd, metrics=['accuracy'])
print(model.summary())
# Fit the model
history = model.fit(X_train, y_train, validation_data=(X_test, y_test), epochs=epochs, batch_size=32)
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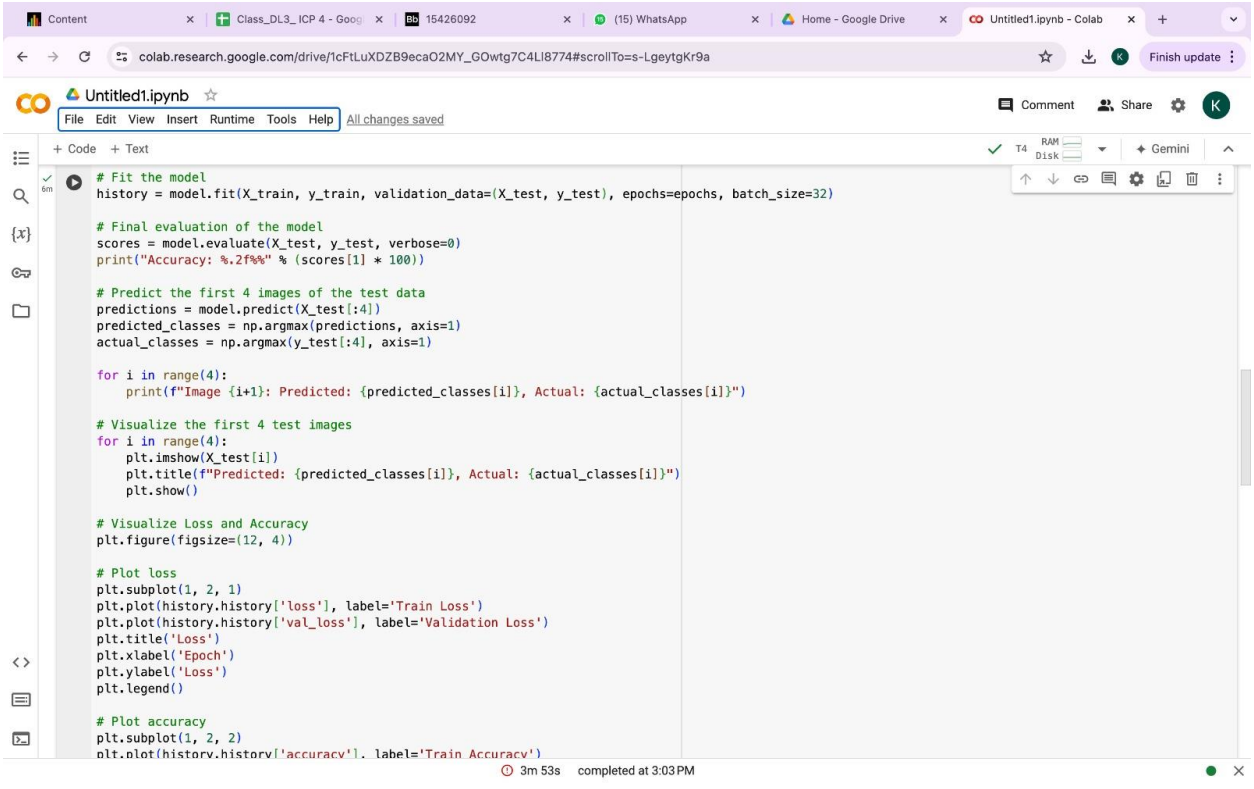
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# Fit the model
history = model.fit(X_train, y_train, validation_data=(X_test, y_test), epochs=epochs, batch_size=32)
# Final evaluation of the model
scores = model.evaluate(X_test, y_test, verbose=0)
print("Accuracy: %.2f%%" % (scores[1] * 100))
# Predict the first 4 images of the test data
predictions = model.predict(X_test[:4])
predicted_classes = np.argmax(predictions, axis=1)
actual_classes = np.argmax(y_test[:4], axis=1)
for i in range(4):
print(f"Image {i+1}: Predicted: {predicted_classes[i]}, Actual: {actual_classes[i]}")
# Visualize the first 4 test images
for i in range(4):
plt.imshow(X_test[i])
plt.title(f"Predicted: {predicted_classes[i]}, Actual: {actual_classes[i]}")
plt.show()
# Visualize Loss and Accuracy
plt.figure(figsize=(12, 4))
# Plot loss
plt.subplot(1, 2, 1)
plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
# Plot accuracy
plt.subplot(1, 2, 2)
plt.plot(history.history['accuracy'], label='Train Accuracy')
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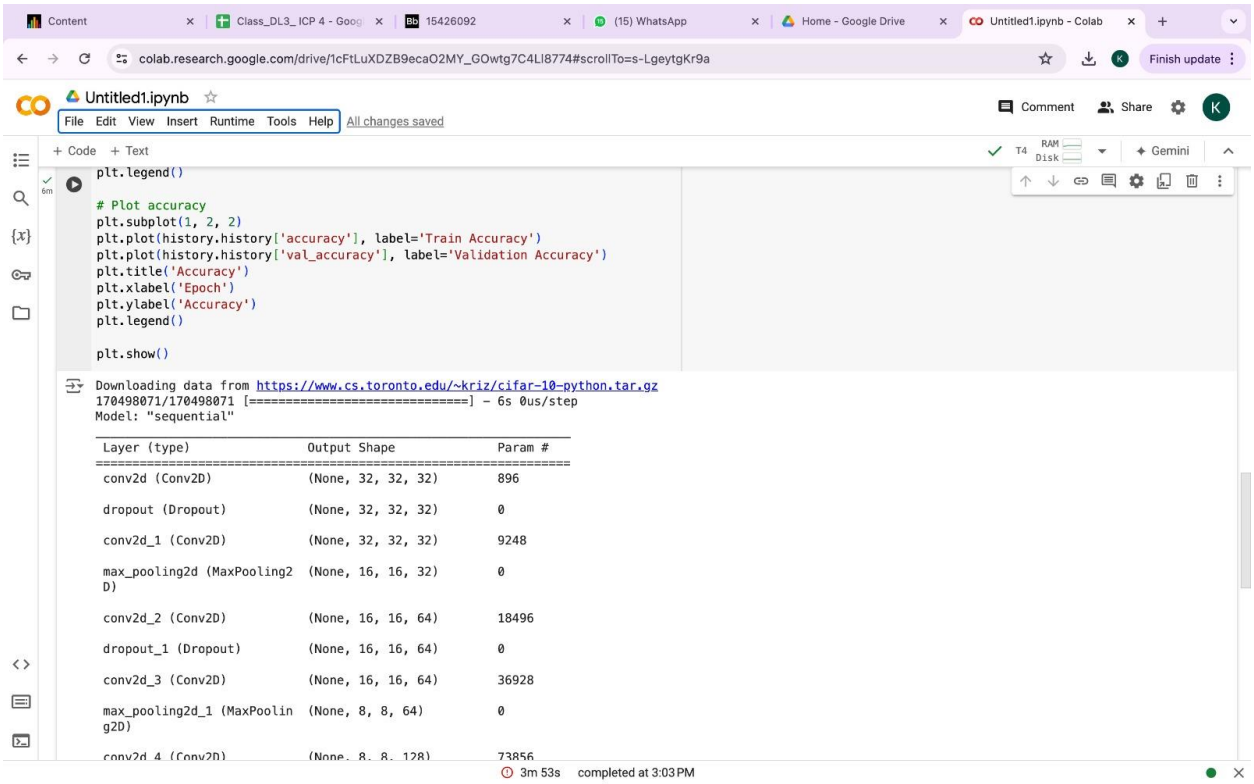
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plt.legend()
# Plot accuracy
plt.subplot(1, 2, 2)
plt.plot(history.history['accuracy'], label='Train Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()
plt.show()
Downloading data from https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz
170498071/170498071 [==============================] - 6s 0us/step
Model: "sequential"
Layer (type) Output Shape Param #
conv2d (Conv2D) (None, 32, 32, 32) 896
dropout (Dropout) (None, 32, 32, 32) 0
conv2d_1 (Conv2D) (None, 32, 32, 32) 9248
max_pooling2d (MaxPooling2D) (None, 16, 16, 32) 0
conv2d_2 (Conv2D) (None, 16, 16, 64) 18496
dropout_1 (Dropout) (None, 16, 16, 64) 0
conv2d_3 (Conv2D) (None, 16, 16, 64) 36928
max_pooling2d_1 (MaxPooling2D) (None, 8, 8, 64) 0
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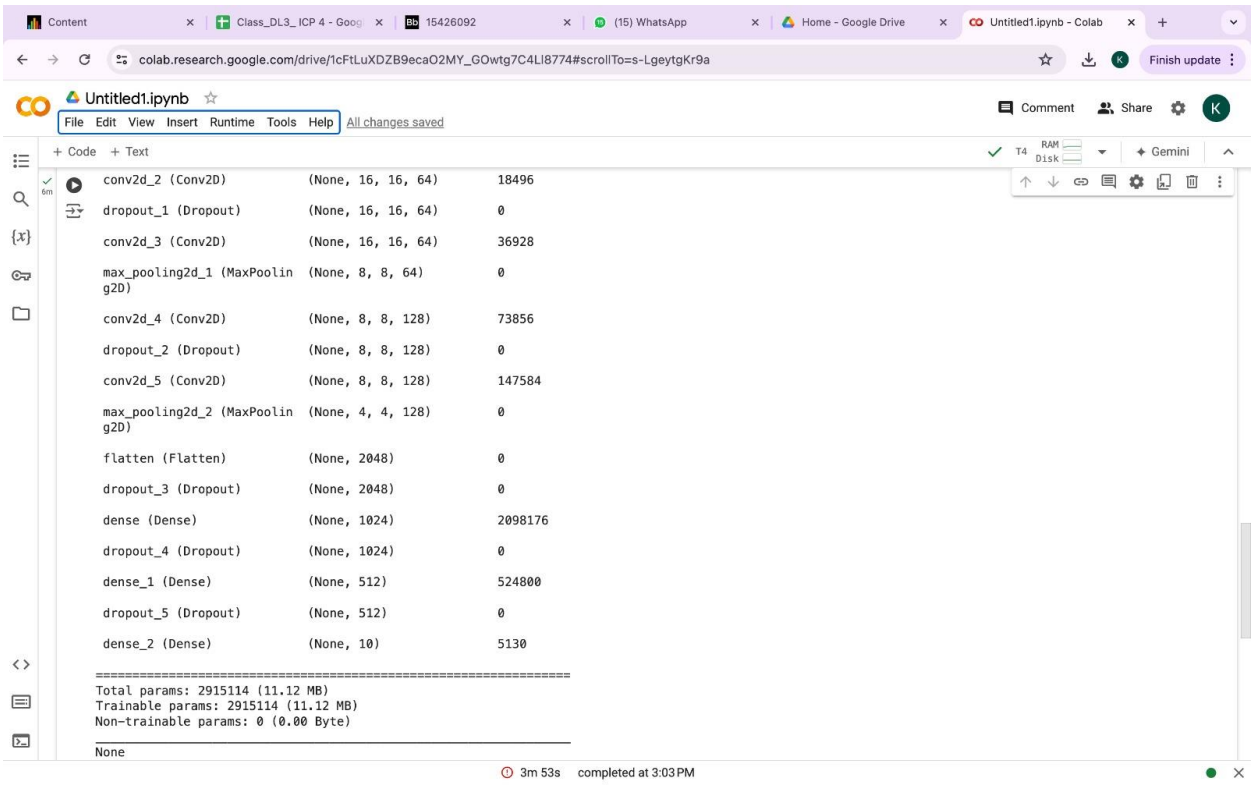
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conv2d_2 (Conv2D) (None, 16, 16, 64) 18496
dropout_1 (Dropout) (None, 16, 16, 64) 0
conv2d_3 (Conv2D) (None, 16, 16, 64) 36928
max_pooling2d_1 (MaxPoolin g2D) (None, 8, 8, 64) 0
conv2d_4 (Conv2D) (None, 8, 8, 128) 73856
dropout_2 (Dropout) (None, 8, 8, 128) 0
conv2d_5 (Conv2D) (None, 8, 8, 128) 147584
max_pooling2d_2 (MaxPoolin g2D) (None, 4, 4, 128) 0
flatten (Flatten) (None, 2048) 0
dropout_3 (Dropout) (None, 2048) 0
dense (Dense) (None, 1024) 2098176
dropout_4 (Dropout) (None, 1024) 0
dense_1 (Dense) (None, 512) 524800
dropout_5 (Dropout) (None, 512) 0
dense_2 (Dense) (None, 10) 5130
Total params: 2915114 (11.12 MB)
Trainable params: 2915114 (11.12 MB)
Non-trainable params: 0 (0.00 Byte)
None
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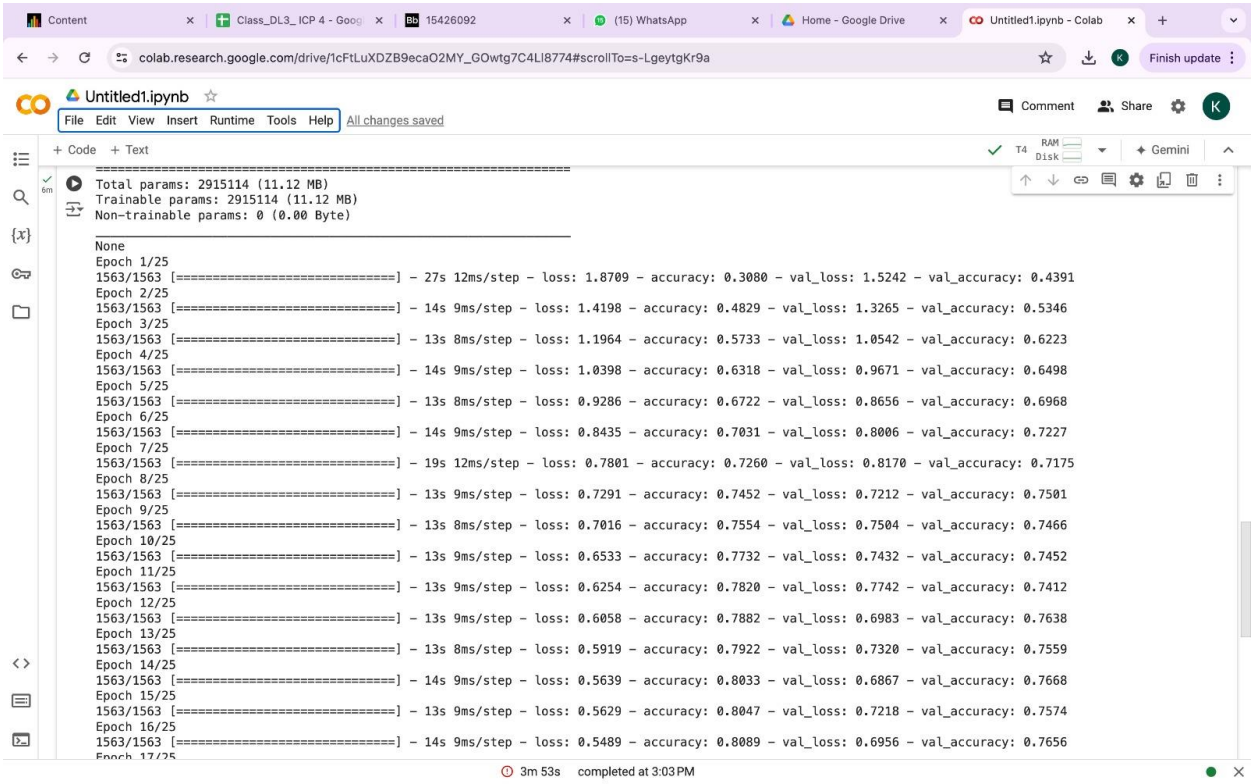
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Total params: 2915114 (11.12 MB)
Trainable params: 2915114 (11.12 MB)
Non-trainable params: 0 (0.00 Byte)
None
Epoch 1/25
1563/1563 [==========] - 27s 12ms/step - loss: 1.8709 - accuracy: 0.3080 - val_loss: 1.5242 - val_accuracy: 0.4391
Epoch 2/25
1563/1563 [==========] - 14s 9ms/step - loss: 1.4198 - accuracy: 0.4829 - val_loss: 1.3265 - val_accuracy: 0.5346
Epoch 3/25
1563/1563 [==========] - 13s 8ms/step - loss: 1.1964 - accuracy: 0.5733 - val_loss: 1.0542 - val_accuracy: 0.6223
Epoch 4/25
1563/1563 [==========] - 14s 9ms/step - loss: 1.0398 - accuracy: 0.6318 - val_loss: 0.9671 - val_accuracy: 0.6498
Epoch 5/25
1563/1563 [==========] - 13s 8ms/step - loss: 0.9286 - accuracy: 0.6722 - val_loss: 0.8656 - val_accuracy: 0.6968
Epoch 6/25
1563/1563 [==========] - 14s 9ms/step - loss: 0.8435 - accuracy: 0.7031 - val_loss: 0.8006 - val_accuracy: 0.7227
Epoch 7/25
1563/1563 [==========] - 19s 12ms/step - loss: 0.7801 - accuracy: 0.7260 - val_loss: 0.8170 - val_accuracy: 0.7175
Epoch 8/25
1563/1563 [==========] - 13s 9ms/step - loss: 0.7291 - accuracy: 0.7452 - val_loss: 0.7212 - val_accuracy: 0.7501
Epoch 9/25
1563/1563 [==========] - 13s 8ms/step - loss: 0.7016 - accuracy: 0.7554 - val_loss: 0.7504 - val_accuracy: 0.7466
Epoch 10/25
1563/1563 [==========] - 13s 9ms/step - loss: 0.6533 - accuracy: 0.7732 - val_loss: 0.7432 - val_accuracy: 0.7452
Epoch 11/25
1563/1563 [==========] - 13s 9ms/step - loss: 0.6254 - accuracy: 0.7820 - val_loss: 0.7742 - val_accuracy: 0.7412
Epoch 12/25
1563/1563 [==========] - 13s 9ms/step - loss: 0.6058 - accuracy: 0.7882 - val_loss: 0.6983 - val_accuracy: 0.7638
Epoch 13/25
1563/1563 [==========] - 13s 8ms/step - loss: 0.5919 - accuracy: 0.7922 - val_loss: 0.7320 - val_accuracy: 0.7559
Epoch 14/25
1563/1563 [==========] - 14s 9ms/step - loss: 0.5639 - accuracy: 0.8033 - val_loss: 0.6867 - val_accuracy: 0.7668
Epoch 15/25
1563/1563 [==========] - 13s 9ms/step - loss: 0.5629 - accuracy: 0.8047 - val_loss: 0.7218 - val_accuracy: 0.7574
Epoch 16/25
1563/1563 [==========] - 14s 9ms/step - loss: 0.5489 - accuracy: 0.8089 - val_loss: 0.6956 - val_accuracy: 0.7656
Epoch 17/25
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Epoch 13/25
1563/1563 [==============================] - 13s 8ms/step - loss: 0.5919 - accuracy: 0.7922 - val_loss: 0.7320 - val_accuracy: 0.7559
Epoch 14/25
1563/1563 [==============================] - 14s 9ms/step - loss: 0.5639 - accuracy: 0.8033 - val_loss: 0.6867 - val_accuracy: 0.7668
Epoch 15/25
1563/1563 [==============================] - 13s 9ms/step - loss: 0.5629 - accuracy: 0.8047 - val_loss: 0.7218 - val_accuracy: 0.7574
Epoch 16/25
1563/1563 [==============================] - 14s 9ms/step - loss: 0.5489 - accuracy: 0.8089 - val_loss: 0.6956 - val_accuracy: 0.7656
Epoch 17/25
1563/1563 [==============================] - 13s 9ms/step - loss: 0.5425 - accuracy: 0.8110 - val_loss: 0.6944 - val_accuracy: 0.7700
Epoch 18/25
1563/1563 [==============================] - 13s 8ms/step - loss: 0.5400 - accuracy: 0.8135 - val_loss: 0.7085 - val_accuracy: 0.7672
Epoch 19/25
1563/1563 [==============================] - 13s 8ms/step - loss: 0.5300 - accuracy: 0.8174 - val_loss: 0.7361 - val_accuracy: 0.7536
Epoch 20/25
1563/1563 [==============================] - 13s 9ms/step - loss: 0.5294 - accuracy: 0.8190 - val_loss: 0.7582 - val_accuracy: 0.7432
Epoch 21/25
1563/1563 [==============================] - 13s 9ms/step - loss: 0.5337 - accuracy: 0.8178 - val_loss: 0.7690 - val_accuracy: 0.7401
Epoch 22/25
1563/1563 [==============================] - 13s 8ms/step - loss: 0.5297 - accuracy: 0.8176 - val_loss: 0.7100 - val_accuracy: 0.7624
Epoch 23/25
1563/1563 [==============================] - 13s 9ms/step - loss: 0.5381 - accuracy: 0.8167 - val_loss: 0.7305 - val_accuracy: 0.7607
Epoch 24/25
1563/1563 [==============================] - 13s 8ms/step - loss: 0.5381 - accuracy: 0.8152 - val_loss: 0.7220 - val_accuracy: 0.7616
Epoch 25/25
1563/1563 [==============================] - 13s 9ms/step - loss: 0.5532 - accuracy: 0.8124 - val_loss: 0.7634 - val_accuracy: 0.7495
Accuracy: 74.95%
1/1 [==============================] - 0s 378ms/step
Image 1: Predicted: 3, Actual: 3
Image 2: Predicted: 8, Actual: 8
Image 3: Predicted: 4, Actual: 8
Image 4: Predicted: 0, Actual: 0
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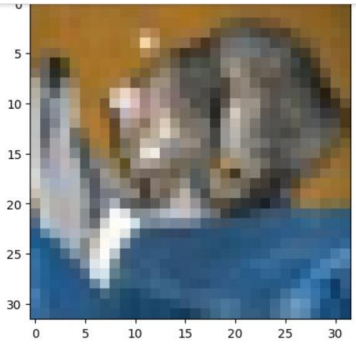

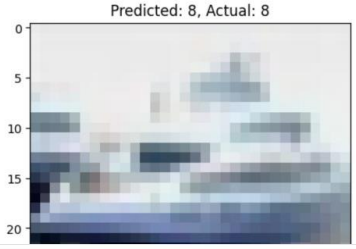

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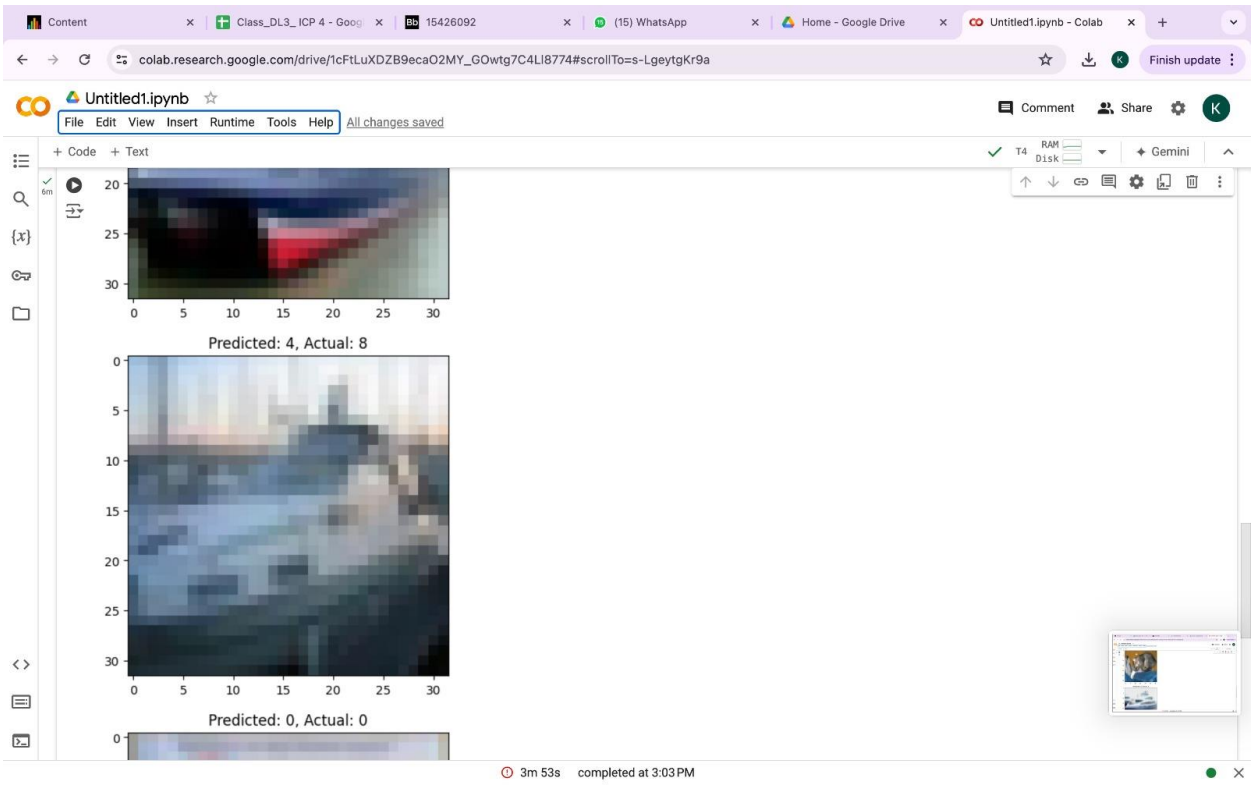
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Predicted: 4, Actual: 8
Predicted: 0, Actual: 0
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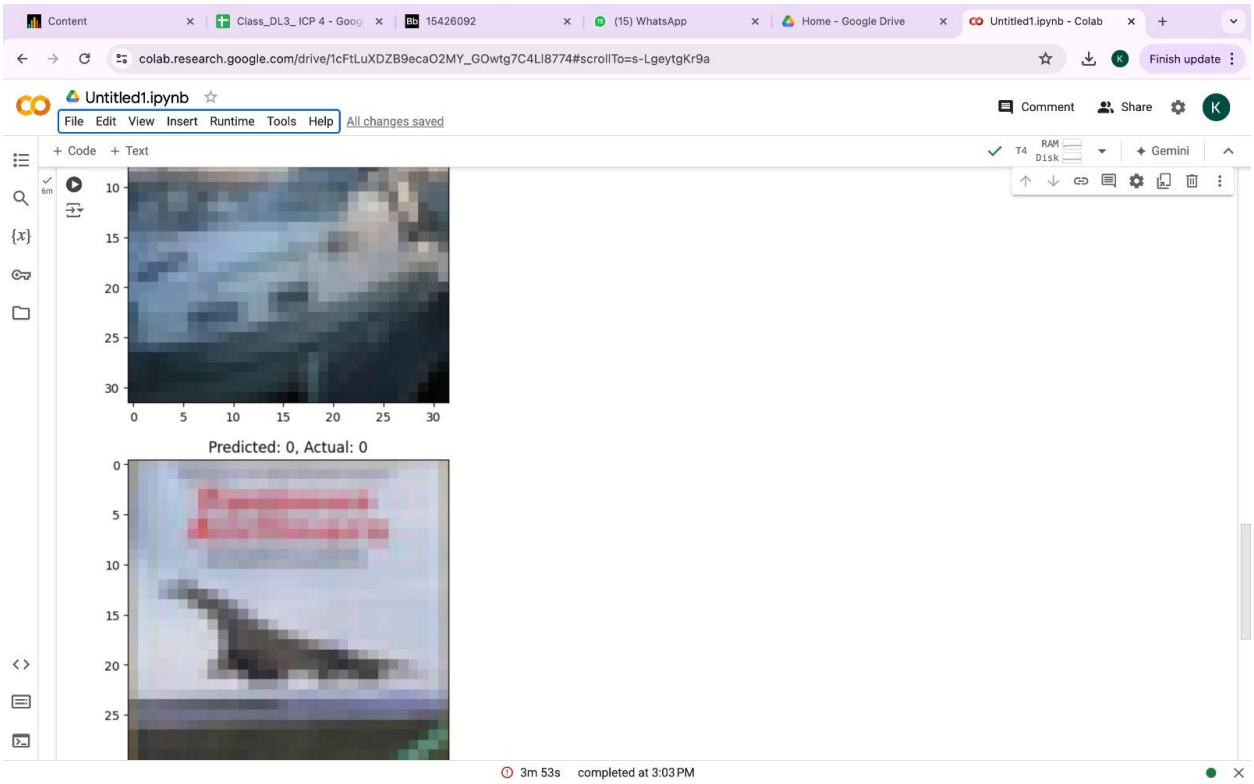
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Predicted: 0, Actual: 0
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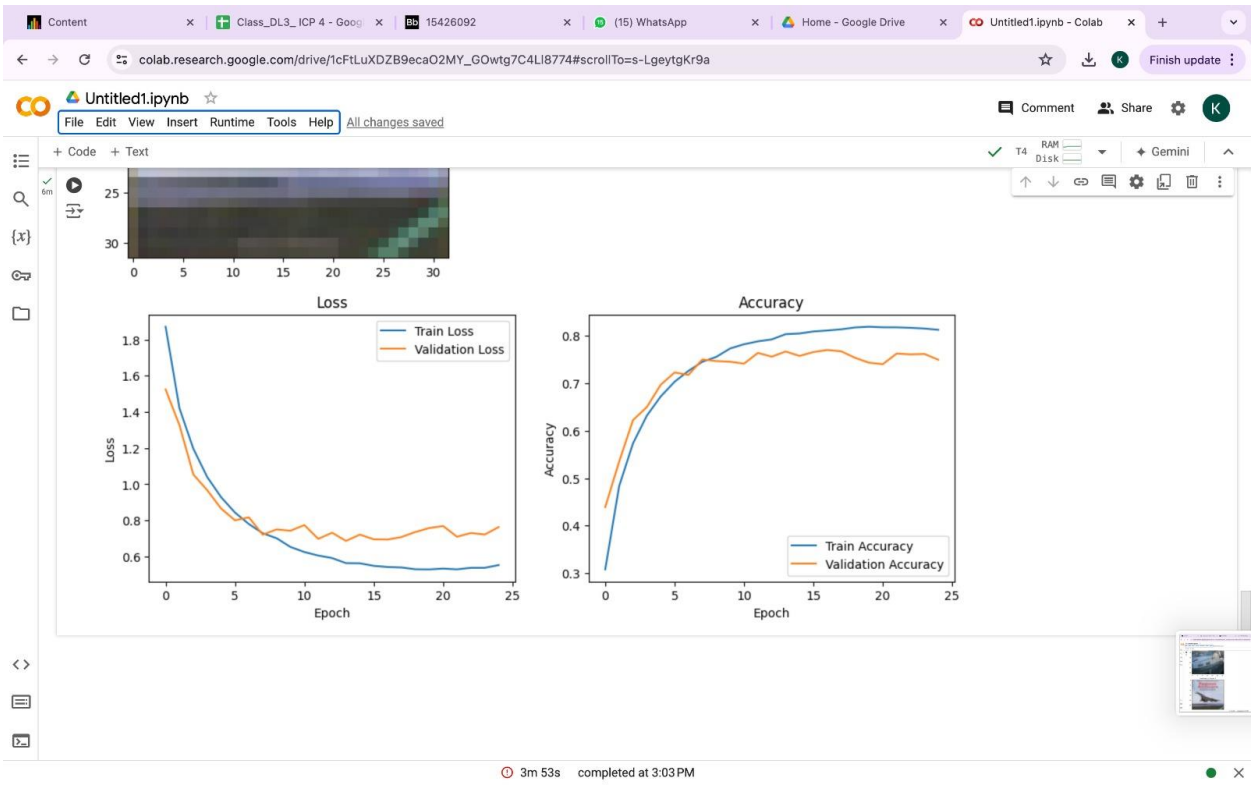

This code builds a Convolutional Neural Network (CNN) using Keras and TensorFlow to classify images from the CIFAR-10 dataset. It begins by importing necessary libraries, loading the CIFAR-10 dataset, normalizing the pixel values, and one-hot encoding the labels. The model is defined as a Sequential model with three blocks of Conv2D, Dropout, and MaxPooling2D layers, followed by Flatten and Dense layers for classification, using ReLU activations and MaxNorm constraints. The model is compiled with categorical crossentropy loss and SGD optimizer, then trained for 25 epochs with a batch size of 32. After training, the model's accuracy on the test set is evaluated, and predictions for the first 4 test images are printed alongside their actual labels. The code also includes visualizations of the first 4 test images with predicted and actual labels, as well as plots of training and validation loss and accuracy over the epochs.