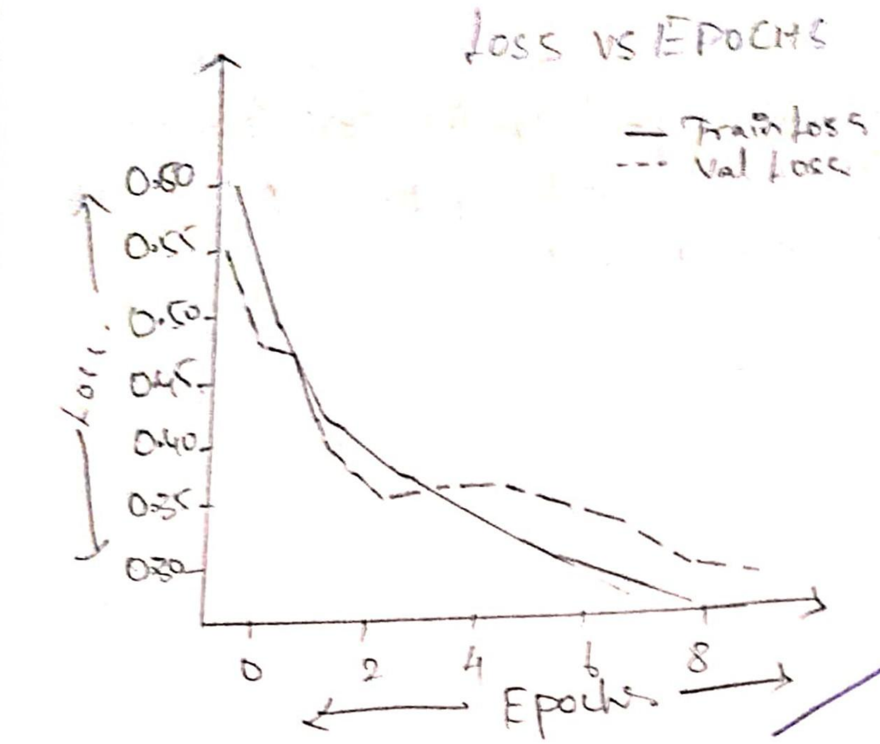
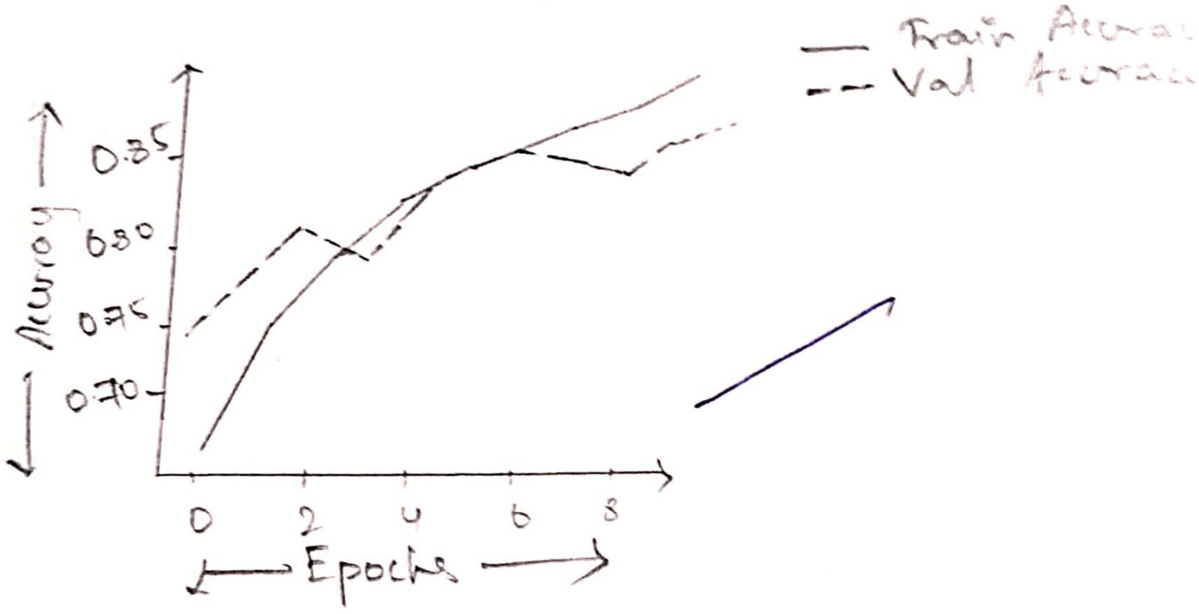
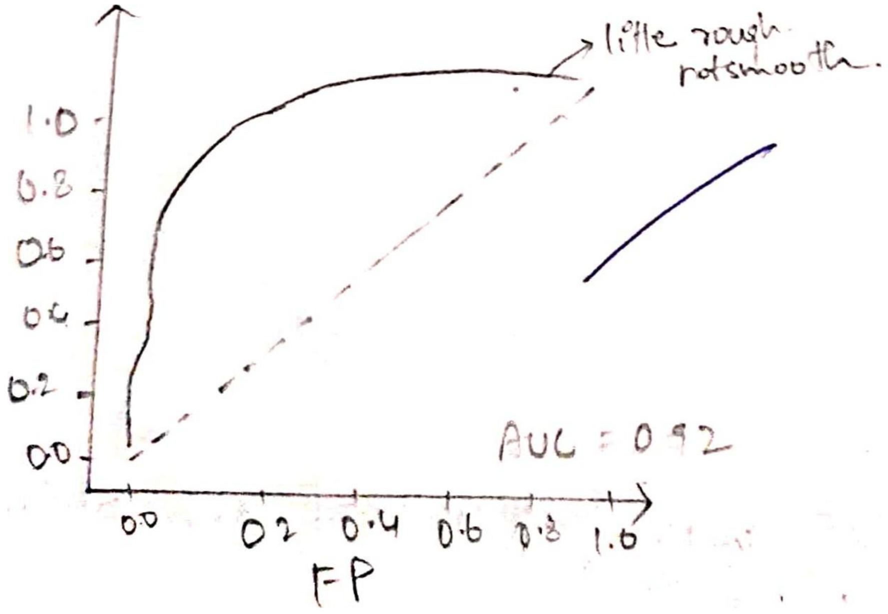

Loss vs Epochs
— Train Loss
--- Val Loss
Loss
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0
2
4
6
8
Epochs


— Train Accuracy
--- Val Accuracy
Accuracy
0.85
0.80
0.75
0.70
0
2
4
6
8
Epochs

pc(イリこ(い。,


little rough
not smooth.
1.0
0.8
0.6
0.4
0.2
0.0
AUC = 0.92
0.0
0.2
0.4
0.6
0.8
1.0
FP

Exp-7 BUILD A CNN MODEL TO CLASSFY CAT & DOG IMAGES

AIM

To design and implement a Convolution Neural Network (CNN) model to classify images of cats and dogs using a binary classification approch.

OBJECTIVES

↳ Load and preprocess the dataset of cat and dog images.

↳ Build a CNN model for binary image classification.

↳ Train and validate the model using appropriate evalution metrics.

↳ Plot training history (loss vs accuracy).

↳ Evalute model performance using confusion matrix classification report, and ROC-AUC curve.

PSEUDOCODE

↳ Load and preprocess image dataset:
- Resize image to uniform size
- Normalize pixel values
- Split into training and validation sets.

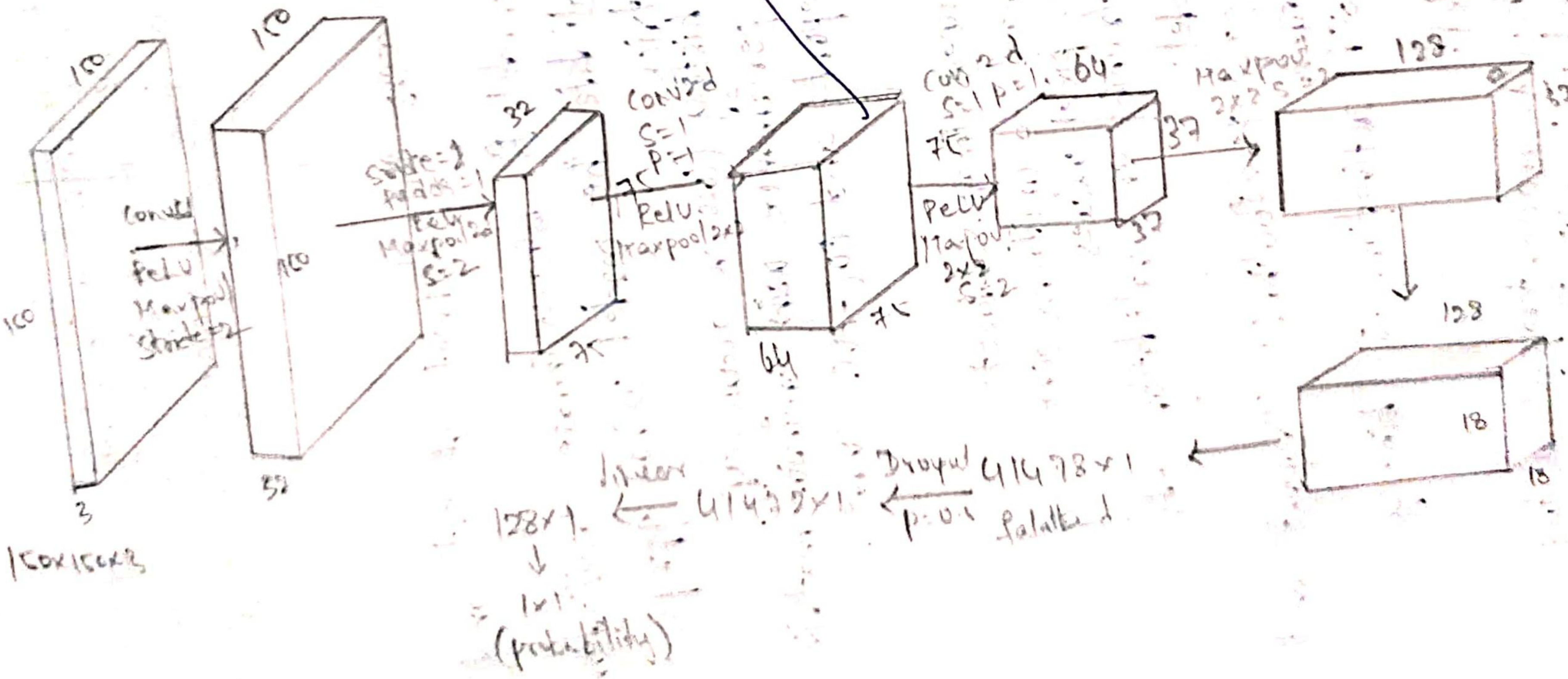
↳ Bulding CNN model:
- Add Conv2D, MaxPooling 2D Dropout and Dense layers.
- Use sigmoid activation for binary classification

↳ Compile the model:
- Use 'binary_crossentropy' as loss
- Use 'adam' optimizer
- Track 'accuracy' metric

$$\left[\frac{N-F+2P}{S}\right]+1$$

$$\frac{150-3+2}{2}$$

$$\frac{149}{3} \approx 50$$



↳ Train the model:
- Use training and validation data
- Set epochs and batch size

↳ Evaluate the model:
- Plot accuracy and loss curves
- Plot ROC-AUC curve.
- Print classification report and confusion matrix

OBSERVATION

	Precision	recall	f1-score	support
Cat	0.84	0.80	0.82	2527
Dog	0.81	0.84	0.83	2465
accuracy			0.82	4992
macroavg	0.82	0.82	0.82	4992
weightedavg	0.82	0.82	0.82	4992

Confusion Matrix.

Actual \ Predicted	Cat	Dog
Cat	2191	331
Dog	516	1954

RESULT:

The CNN Model is impleted and we have got the accuracy of 82% successfully.

https://colab.research.google.com/drive/17JV3PPlhdLl1AigFBlgoN8KlZ5Ejv_dS?authuser=2

LAB_7.ipynb

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```python
import kagglehub

# Download latest version
path = kagglehub.dataset_download("karakaggle/kaggle-cat-vs-dog-dataset")

print("Path to dataset files:", path)
```

```
Downloading from https://www.kaggle.com/api/v1/datasets/download/karakaggle/kaggle-cat-vs-dog-dataset?dataset_version_number=1...
100%|██████████| 787M/787M [00:08<00:00, 93.8MB/s]Extracting files...
Path to dataset files: /root/.cache/kagglehub/datasets/karakaggle/kaggle-cat-vs-dog-dataset/versions/1
```

```python
import os
os.chdir("/root/.cache/kagglehub/datasets/karakaggle/kaggle-cat-vs-dog-dataset/versions/1")
```

```python
os.listdir()
```

```
['kagglecatsanddogs_3367a']
```

```python
os.chdir("kagglecatsanddogs_3367a")
```

```python
os.listdir()
```

```
['readme[1].txt', 'MSR-LA - 3467.docx', 'PetImages']
```

```python
os.chdir("PetImages")
```

```python
os.getcwd()
```

```
'/root/.cache/kagglehub/datasets/karakaggle/kaggle-cat-vs-dog-dataset/versions/1/kagglecatsanddogs_3367a/PetImages'
```

```python
import os
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.metrics import classification_report, confusion_matrix, roc_auc_score, roc_curve
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import DataLoader, random_split
from torchvision import datasets, transforms, models
```

```python
# Set device (GPU if available)
device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
print(f"Using device: {device}")
```

```
Using device: cuda
```

```python
# Parameters
DATA_DIR = "/root/.cache/kagglehub/datasets/karakaggle/kaggle-cat-vs-dog-dataset/versions/1/kagglecatsanddogs_3367a/PetImages"
BATCH_SIZE = 32
IMG_SIZE = 150
EPOCHS = 10
LR = 1e-4
# Data Transforms
train_transform = transforms.Compose([
    transforms.Resize((IMG_SIZE, IMG_SIZE)),
    transforms.RandomHorizontalFlip(),
    transforms.RandomRotation(20),
    transforms.ToTensor(),
    transforms.Normalize([0.5]*3, [0.5]*3)
])

val_transform = transforms.Compose([
    transforms.Resize((IMG_SIZE, IMG_SIZE)),
    transforms.ToTensor(),
    transforms.Normalize([0.5]*3, [0.5]*3)
])
```

```python
# Load Dataset
full_dataset = datasets.ImageFolder(DATA_DIR, transform = train_transform)
```

```python
# Train-Val Split (80%-20%)
train_size = int(0.8 * len(full_dataset))
```

```python
])
```

```python
# Load Dataset
full_dataset = datasets.ImageFolder(DATA_DIR, transform = train_transform)
```

```python
# Train-Val Split (80%-20%)
train_size = int(0.8 * len(full_dataset))
val_size = len(full_dataset) - train_size
train_dataset, val_dataset = random_split(full_dataset, [train_size, val_size])
```

```python
# Change val dataset transform
val_dataset.dataset.transform = val_transform
```

```python
# DataLoaders
train_loader = DataLoader(train_dataset, batch_size=BATCH_SIZE, shuffle=True)
val_loader = DataLoader(val_dataset, batch_size=BATCH_SIZE, shuffle=False)
```

```python
# Simple CNN Model
class SimpleCNN(nn.Module):
    def __init__(self):
        super(SimpleCNN, self).__init__()
        self.features = nn.Sequential(
            nn.Conv2d(3, 32, 3, padding=1),  # (B,32,150,150)
            nn.ReLU(),
            nn.MaxPool2d(2),  # (B,32,75,75)
```


```python
# DataLoaders
train_loader = DataLoader(train_dataset, batch_size=BATCH_SIZE, shuffle=True)
val_loader = DataLoader(val_dataset, batch_size=BATCH_SIZE, shuffle=False)
```


```python
# Simple CNN Model
class SimpleCNN(nn.Module):
    def __init__(self):
        super(SimpleCNN, self).__init__()
        self.features = nn.Sequential(
            nn.Conv2d(3, 32, 3, padding=1),  # (B,32,150,150)
            nn.ReLU(),
            nn.MaxPool2d(2),  # (B,32,75,75)

            nn.Conv2d(32, 64, 3, padding=1),
            nn.ReLU(),
            nn.MaxPool2d(2),  # (B,64,37,37)

            nn.Conv2d(64, 128, 3, padding=1),
            nn.ReLU(),
            nn.MaxPool2d(2),  # (B,128,18,18)
        )
        self.classifier = nn.Sequential(
            nn.Flatten(),
            nn.Dropout(0.5),
            nn.Linear(128*18*18, 128),
            nn.ReLU(),
            nn.Linear(128, 1),
            nn.Sigmoid()  # Output probability for binary classification
        )
```

```python
        x = self.features(x)
        x = self.classifier(x)
        return x

model = SimpleCNN().to(device)
print(model)
```

```
SimpleCNN(
  (features): Sequential(
    (0): Conv2d(3, 32, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (1): ReLU()
    (2): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
    (3): Conv2d(32, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (4): ReLU()
    (5): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
    (6): Conv2d(64, 128, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (7): ReLU()
    (8): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
  )
  (classifier): Sequential(
    (0): Flatten(start_dim=1, end_dim=-1)
    (1): Dropout(p=0.5, inplace=False)
    (2): Linear(in_features=41472, out_features=128, bias=True)
    (3): ReLU()
    (4): Linear(in_features=128, out_features=1, bias=True)
    (5): Sigmoid()
  )
)
```

```python
# Loss and optimizer
criterion = nn.BCELoss()
```

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LAB_7.ipynb

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```python
# Loss and optimizer
criterion = nn.BCELoss()
optimizer = optim.Adam(model.parameters(), lr=LR)
```

```python
# Training and validation loop
train_losses, val_losses = [], []
train_accs, val_accs = [], []

for epoch in range(EPOCHS):
    model.train()
    running_loss, running_corrects = 0, 0

    for inputs, labels in train_loader:
        inputs = inputs.to(device)
        labels = labels.unsqueeze(1).float().to(device)  # For BCELoss

        optimizer.zero_grad()
        outputs = model(inputs)
        loss = criterion(outputs, labels)
        loss.backward()
        optimizer.step()

        running_loss += loss.item() * inputs.size(0)
        preds = (outputs > 0.5).float()
        running_corrects += torch.sum(preds == labels)

    epoch_loss = running_loss / train_size
    epoch_acc = running_corrects.double() / train_size
    train_losses.append(epoch_loss)
```

Variables Terminal

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LAB_7.ipynb

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```python
        optimizer.zero_grad()
        outputs = model(inputs)
        loss = criterion(outputs, labels)
        loss.backward()
        optimizer.step()

        running_loss += loss.item() * inputs.size(0)
        preds = (outputs > 0.5).float()
        running_corrects += torch.sum(preds == labels)

    epoch_loss = running_loss / train_size
    epoch_acc = running_corrects.double() / train_size
    train_losses.append(epoch_loss)
```


```python
    train_accs.append(epoch_acc.item())

    # Validation
    model.eval()
    val_running_loss, val_running_corrects = 0, 0
    all_preds = []
    all_labels = []

    with torch.no_grad():
        for inputs, labels in val_loader:
            inputs = inputs.to(device)
            labels = labels.unsqueeze(1).float().to(device)
            outputs = model(inputs)
            loss = criterion(outputs, labels)

            val_running_loss += loss.item() * inputs.size(0)
```


Variables Terminal

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LAB_7.ipynb

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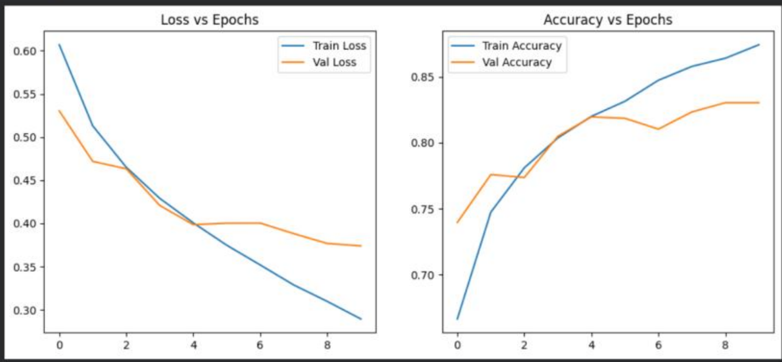
```python
            val_running_corrects += torch.sum(preds == labels)

            all_preds.extend(outputs.cpu().numpy())
            all_labels.extend(labels.cpu().numpy())

    val_loss = val_running_loss / val_size
    val_acc = val_running_corrects.double() / val_size
    val_losses.append(val_loss)
    val_accs.append(val_acc.item())

    print(f"Epoch {epoch+1}/{EPOCHS}.. "
          f"Train loss: {epoch_loss:.4f}.. Train acc: {epoch_acc:.4f}.. "
          f"Val loss: {val_loss:.4f}.. Val acc: {val_acc:.4f}")
```

```
/usr/local/lib/python3.12/dist-packages/PIL/TiffImagePlugin.py:950: UserWarning: Truncated File Read
  warnings.warn(str(msg))
Epoch 1/10.. Train loss: 0.6069.. Train acc: 0.6664.. Val loss: 0.5304.. Val acc: 0.7396
Epoch 2/10.. Train loss: 0.5130.. Train acc: 0.7474.. Val loss: 0.4719.. Val acc: 0.7758
Epoch 3/10.. Train loss: 0.4651.. Train acc: 0.7810.. Val loss: 0.4633.. Val acc: 0.7736
Epoch 4/10.. Train loss: 0.4291.. Train acc: 0.8036.. Val loss: 0.4208.. Val acc: 0.8049
Epoch 5/10.. Train loss: 0.4008.. Train acc: 0.8200.. Val loss: 0.3986.. Val acc: 0.8195
Epoch 6/10.. Train loss: 0.3748.. Train acc: 0.8314.. Val loss: 0.4004.. Val acc: 0.8185
Epoch 7/10.. Train loss: 0.3520.. Train acc: 0.8473.. Val loss: 0.4005.. Val acc: 0.8103
Epoch 8/10.. Train loss: 0.3288.. Train acc: 0.8578.. Val loss: 0.3882.. Val acc: 0.8233
Epoch 9/10.. Train loss: 0.3098.. Train acc: 0.8640.. Val loss: 0.3769.. Val acc: 0.8303
Epoch 10/10.. Train loss: 0.2895.. Train acc: 0.8742.. Val loss: 0.3741.. Val acc: 0.8303
```

```python
# Plot loss and accuracy curves
plt.figure(figsize=(12,5))

plt.subplot(1,2,1)
```


Variables Terminal

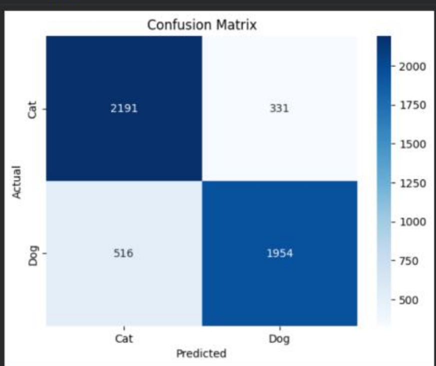
```
plt.show()
```




```
# Evaluate with sklearn metrics
all_preds = np.array(all_preds).flatten()
all_preds_binary = (all_preds > 0.5).astype(int)
all_labels = np.array(all_labels).flatten()

print("Classification Report:\n", classification_report(all_labels, all_preds_binary, target_names=full_dataset.classes))
```

```
Classification Report:
               precision    recall  f1-score   support

         Cat       0.81      0.87      0.84      2522
         Dog       0.86      0.79      0.82      2470

    accuracy                           0.83      4992
   macro avg       0.83      0.83      0.83      4992
weighted avg       0.83      0.83      0.83      4992
```

```
# Confusion matrix plot
cm = confusion_matrix(all_labels, all_preds_binary)
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=full_dataset.classes, yticklabels=full_dataset.classes)
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.title('Confusion Matrix')
plt.show()
```




```
# ROC-AUC Curve
fpr, tpr, _ = roc_curve(all_labels, all_preds)
```

```python
# ROC-AUC Curve
fpr, tpr, _ = roc_curve(all_labels, all_preds)
roc_auc = roc_auc_score(all_labels, all_preds)

plt.figure(figsize=(6,6))
plt.plot(fpr, tpr, label=f'ROC AUC = {roc_auc:.2f}')
plt.plot([0,1],[0,1],'k--')
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('ROC-AUC Curve')
plt.legend(loc='lower right')
plt.grid()
plt.show()
```