In [2]:

```
import torch
import torch.nn as nn
import torch.optim as optim
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import roc_auc_score, accuracy_score, precision_score, recall_
import matplotlib.pyplot as plt
from torch.utils.data import Dataset, DataLoader
from tqdm import tqdm
from torch.nn.utils import clip_grad_norm_
from transformers import BertModel, BertTokenizer
from torch.optim import AdamW
from torch.optim.lr_scheduler import ReduceLROnPlateau
import torch.cuda.amp

# Set random seeds for reproducibility
torch.manual_seed(42)
np.random.seed(42)

# 1. Data Processing (unchanged)
def load_and_preprocess_data(csv_path):
    df = pd.read_pickle(csv_path)
    df['feat_1024'] = df['feat_1024'].apply(lambda x: np.array(x))

    structured_cols = ['bun', 'calcium', 'creatinine', 'glucose', 'magnesium', 'sod
    for col in structured_cols:
        df[col] = pd.to_numeric(df[col], errors='coerce').fillna(0)

    scaler = StandardScaler()
    df[structured_cols] = scaler.fit_transform(df[structured_cols])

    df['mortality_label'] = pd.to_numeric(df['mortality_label'], errors='coerce').f

    class_counts = df['mortality_label'].value_counts()
    print(f"Class distribution: {class_counts.to_dict()}")
    print(f"Percentage of positive samples: {class_counts.get(1, 0) / len(df) * 100

    return df, structured_cols

# 2. Dataset Class (unchanged)
class MultimodalDataset(Dataset):
    def __init__(self, df, structured_cols, tokenizer, max_length=512):
        self.df = df
        self.structured_cols = structured_cols
        self.tokenizer = tokenizer
        self.max_length = max_length

    def __len__(self):
        return len(self.df)

    def __getitem__(self, idx):
        row = self.df.iloc[idx]
```

```
        img_feat = torch.tensor(row['feat_1024'], dtype=torch.float32)

        text = str(row['combined_note'])
        text_feat = self.tokenizer(
            text,
            max_length=self.max_length,
            padding='max_length',
            truncation=True,
            return_tensors='pt'
        )

        struct_data = [float(row[col]) for col in self.structured_cols]
        struct_feat = torch.tensor(struct_data, dtype=torch.float32)
        label = torch.tensor(float(row['mortality_label']), dtype=torch.float32)

        return {
            'img_feat': img_feat,
            'input_ids': text_feat['input_ids'].squeeze(0),
            'attention_mask': text_feat['attention_mask'].squeeze(0),
            'struct_feat': struct_feat,
            'label': label
        }

# 3. Model Architecture (modified)
class MultimodalFusionModel(nn.Module):
    def __init__(self, bert_model_name='bert-base-uncased', img_dim=1024, struct_di
        super().__init__()
        self.bert = BertModel.from_pretrained(bert_model_name)
        self.bert_hidden_size = self.bert.config.hidden_size

        self.img_projection = nn.Sequential(
            nn.Linear(img_dim, hidden_dim),
            nn.ReLU(),
            nn.Dropout(dropout_rate)
        )

        self.struct_projection = nn.Sequential(
            nn.Linear(struct_dim, hidden_dim),
            nn.ReLU(),
            nn.Dropout(dropout_rate))

        self.attention = nn.Sequential(
            nn.Linear(self.bert_hidden_size + hidden_dim * 2, hidden_dim),
            nn.Tanh(),
            nn.Linear(hidden_dim, 3),
            nn.Softmax(dim=1)
        )

        # Modified classifier (removed Sigmoid)
        self.classifier = nn.Sequential(
            nn.Linear(self.bert_hidden_size + hidden_dim * 2, hidden_dim),
            nn.ReLU(),
            nn.Dropout(dropout_rate),
            nn.Linear(hidden_dim, 1)  # No activation here
        )
```

```python
    def forward(self, img_feat, input_ids, attention_mask, struct_feat):
        bert_outputs = self.bert(input_ids=input_ids, attention_mask=attention_mask
        text_embed = bert_outputs.last_hidden_state[:, 0, :]

        img_proj = self.img_projection(img_feat)
        struct_proj = self.struct_projection(struct_feat)

        combined = torch.cat([text_embed, img_proj, struct_proj], dim=1)
        attention_weights = self.attention(combined)

        text_embed = text_embed * attention_weights[:, 0].unsqueeze(1)
        img_proj = img_proj * attention_weights[:, 1].unsqueeze(1)
        struct_proj = struct_proj * attention_weights[:, 2].unsqueeze(1)

        fused = torch.cat([text_embed, img_proj, struct_proj], dim=1)
        return self.classifier(fused).squeeze()

# 4. Training Utilities (unchanged)
def compute_metrics(y_true, y_pred, threshold=0.5):
    y_pred = np.array(y_pred)
    y_pred_bin = (y_pred >= threshold).astype(int)
    return {
        'auc': roc_auc_score(y_true, y_pred),
        'accuracy': accuracy_score(y_true, y_pred_bin),
        'precision': precision_score(y_true, y_pred_bin, zero_division=0),
        'recall': recall_score(y_true, y_pred_bin, zero_division=0),
        'f1': f1_score(y_true, y_pred_bin, zero_division=0)
    }

def find_optimal_threshold(y_true, y_pred):
    thresholds = np.arange(0.1, 0.9, 0.05)
    best_threshold = 0.5
    best_f1 = 0
    for threshold in thresholds:
        f1 = f1_score(y_true, (y_pred >= threshold).astype(int), zero_division=0)
        if f1 > best_f1:
            best_f1 = f1
            best_threshold = threshold
    return best_threshold

# 5. Training Loop (enhanced)
def train_model(model, train_loader, val_loader, criterion, optimizer, num_epochs=2
    model = model.to(device)
    history = {'train': [], 'val': []}
    best_f1 = 0.0
    patience = 5
    epochs_without_improvement = 0
    scaler = torch.cuda.amp.GradScaler()
    scheduler = ReduceLROnPlateau(optimizer, 'max', patience=2, factor=0.1)

    for epoch in range(num_epochs):
        model.train()
        train_preds, train_labels = [], []
        train_loss = 0

        for batch in tqdm(train_loader, desc=f"Epoch {epoch+1}/{num_epochs}"):
```

```
            optimizer.zero_grad()

            with torch.cuda.amp.autocast():
                outputs = model(
                    batch['img_feat'].to(device),
                    batch['input_ids'].to(device),
                    batch['attention_mask'].to(device),
                    batch['struct_feat'].to(device)
                )
                loss = criterion(outputs, batch['label'].to(device))

            scaler.scale(loss).backward()
            clip_grad_norm_(model.parameters(), clip_value)
            scaler.step(optimizer)
            scaler.update()

            train_loss += loss.item() * batch['img_feat'].size(0)
            train_preds.extend(torch.sigmoid(outputs.detach()).cpu().numpy())
            train_labels.extend(batch['label'].cpu().numpy())

        # Validation phase
        model.eval()
        val_preds, val_labels = [], []
        val_loss = 0

        with torch.no_grad():
            for batch in val_loader:
                outputs = model(
                    batch['img_feat'].to(device),
                    batch['input_ids'].to(device),
                    batch['attention_mask'].to(device),
                    batch['struct_feat'].to(device)
                )
                loss = criterion(outputs, batch['label'].to(device))

                val_loss += loss.item() * batch['img_feat'].size(0)
                val_preds.extend(torch.sigmoid(outputs).cpu().numpy())
                val_labels.extend(batch['label'].cpu().numpy())

        # Calculate metrics
        train_loss /= len(train_loader.dataset)
        val_loss /= len(val_loader.dataset)

        train_metrics = compute_metrics(train_labels, train_preds)
        val_metrics = compute_metrics(val_labels, val_preds)
        best_threshold = find_optimal_threshold(val_labels, val_preds)
        val_metrics_thresh = compute_metrics(val_labels, val_preds, best_threshold)

        # Store history
        history['train'].append({'loss': train_loss, **train_metrics})
        history['val'].append({
            'loss': val_loss,
            **val_metrics,
            'best_threshold': best_threshold,
            **val_metrics_thresh
        })
```

```
        # Update scheduler
        scheduler.step(val_metrics['f1'])

        # Print metrics
        print(f"\nEpoch {epoch+1}/{num_epochs}")
        print(f"Train Loss: {train_loss:.4f} | Val Loss: {val_loss:.4f}")
        print(f"Val AUC: {val_metrics['auc']:.4f} | Best Threshold: {best_threshold
        print(f"Val F1: {val_metrics_thresh['f1']:.4f} | Precision: {val_metrics_th
        print(f"Current LR: {optimizer.param_groups[0]['lr']:.2e}")

        if val_metrics_thresh['f1'] > best_f1:
            best_f1 = val_metrics_thresh['f1']
            epochs_without_improvement = 0
            torch.save({
                'model_state_dict': model.state_dict(),
                'threshold': best_threshold,
                'epoch': epoch
            }, "best_multimodal_model.pth")
            print("Saved new best model!")


    return model, history

# 6. Evaluation Function (unchanged)
def evaluate_model(model, loader, threshold, device):
    model.eval()
    preds, labels = [], []

    with torch.no_grad():
        for batch in tqdm(loader, desc="Evaluating"):
            outputs = model(
                batch['img_feat'].to(device),
                batch['input_ids'].to(device),
                batch['attention_mask'].to(device),
                batch['struct_feat'].to(device)
            )
            preds.extend(torch.sigmoid(outputs).cpu().numpy())
            labels.extend(batch['label'].cpu().numpy())

    metrics = compute_metrics(np.array(labels), np.array(preds), threshold)

    print(f"\nEvaluation Results (Threshold={threshold:.2f}):")
    print(f"AUC: {metrics['auc']:.4f}")
    print(f"Accuracy: {metrics['accuracy']:.4f}")
    print(f"Precision: {metrics['precision']:.4f}")
    print(f"Recall: {metrics['recall']:.4f}")
    print(f"F1 Score: {metrics['f1']:.4f}")

    return metrics

# 7. Main Execution (enhanced)
def main():
    device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
    print(f"Using device: {device}")
```

```python
# Data loading
df, structured_cols = load_and_preprocess_data("final_image_feats.pkl")
tokenizer = BertTokenizer.from_pretrained('bert-base-uncased')

# Data splits
train_df, test_df = train_test_split(df, test_size=0.2, random_state=42, strati
train_df, val_df = train_test_split(train_df, test_size=0.25, random_state=42,

print(f"\nData splits:")
print(f"Train: {len(train_df)} samples")
print(f"Val: {len(val_df)} samples")
print(f"Test: {len(test_df)} samples")

# Datasets and DataLoaders
batch_size = 16
train_dataset = MultimodalDataset(train_df, structured_cols, tokenizer)
val_dataset = MultimodalDataset(val_df, structured_cols, tokenizer)
test_dataset = MultimodalDataset(test_df, structured_cols, tokenizer)

train_loader = DataLoader(train_dataset, batch_size=batch_size, shuffle=True, p
val_loader = DataLoader(val_dataset, batch_size=batch_size, shuffle=False, pin_
test_loader = DataLoader(test_dataset, batch_size=batch_size, shuffle=False, pi

# Handle class imbalance
class_counts = train_df['mortality_label'].value_counts()
pos_weight = torch.tensor([class_counts[0] / class_counts[1]], device=device)
criterion = nn.BCEWithLogitsLoss(pos_weight=pos_weight)

# Model and optimizer
model = MultimodalFusionModel(
    bert_model_name='bert-base-uncased',
    img_dim=1024,
    struct_dim=len(structured_cols)
)

optimizer = AdamW([
    {'params': model.bert.parameters(), 'lr': 2e-5},
    {'params': [p for n, p in model.named_parameters() if 'bert' not in n], 'lr
], weight_decay=1e-4)

# Training
model, history = train_model(
    model=model,
    train_loader=train_loader,
    val_loader=val_loader,
    criterion=criterion,
    optimizer=optimizer,
    num_epochs=100,
    device=device
)

# Evaluation
checkpoint = torch.load("best_multimodal_model.pth", weights_only=False)
model.load_state_dict(checkpoint['model_state_dict'])
test_metrics = evaluate_model(model, test_loader, checkpoint['threshold'], devi
```

```python
    # Plotting
    plt.figure(figsize=(12, 8))
    metrics = ['loss', 'auc', 'f1', 'accuracy']
    for i, metric in enumerate(metrics, 1):
        plt.subplot(2, 2, i)
        plt.plot([x[metric] for x in history['train']], label='Train')
        plt.plot([x[metric] for x in history['val']], label='Val')
        plt.title(metric.upper())
        plt.xlabel('Epoch')
        plt.legend()
    plt.tight_layout()
    plt.savefig('training_history.png')
    plt.show()

if __name__ == "__main__":
    main()
```

```
Using device: cuda
Class distribution: {0: 1069, 1: 91}
Percentage of positive samples: 7.84%

Data splits:
Train: 696 samples
Val: 232 samples
Test: 232 samples
/tmp/ipykernel_3339871/3334015219.py:158: FutureWarning: `torch.cuda.amp.GradScaler
(args...)` is deprecated. Please use `torch.amp.GradScaler('cuda', args...)` instea
d.
  scaler = torch.cuda.amp.GradScaler()
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(ar
gs...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 1/100: 100%|██████████| 44/44 [00:23<00:00,  1.86it/s]
Epoch 1/100
Train Loss: 1.3062 | Val Loss: 1.2858
Val AUC: 0.6121 | Best Threshold: 0.40
Val F1: 0.1611 | Precision: 0.0881 | Recall: 0.9444
Current LR: 2.00e-05
Saved new best model!
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(ar
gs...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 2/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 2/100
Train Loss: 1.2792 | Val Loss: 1.2400
Val AUC: 0.6555 | Best Threshold: 0.45
Val F1: 0.2121 | Precision: 0.1458 | Recall: 0.3889
Current LR: 2.00e-05
Saved new best model!
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 3/100: 100%|██████████| 44/44 [00:24<00:00,  1.83it/s]
Epoch 3/100
Train Loss: 1.2088 | Val Loss: 2.2224
Val AUC: 0.6477 | Best Threshold: 0.10
Val F1: 0.2000 | Precision: 0.1429 | Recall: 0.3333
Current LR: 2.00e-05
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 4/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 4/100
Train Loss: 1.4321 | Val Loss: 1.1335
Val AUC: 0.6900 | Best Threshold: 0.70
Val F1: 0.2759 | Precision: 0.3636 | Recall: 0.2222
Current LR: 2.00e-05
Saved new best model!
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 5/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 5/100
Train Loss: 1.4040 | Val Loss: 1.3573
Val AUC: 0.6301 | Best Threshold: 0.70
Val F1: 0.3200 | Precision: 0.5714 | Recall: 0.2222
Current LR: 2.00e-05
Saved new best model!
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 6/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 6/100
Train Loss: 1.3314 | Val Loss: 1.2301
Val AUC: 0.6809 | Best Threshold: 0.80
Val F1: 0.3333 | Precision: 0.6667 | Recall: 0.2222
Current LR: 2.00e-05
Saved new best model!
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 7/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 7/100
Train Loss: 1.4459 | Val Loss: 1.8913
Val AUC: 0.6880 | Best Threshold: 0.35
Val F1: 0.2286 | Precision: 0.2353 | Recall: 0.2222
Current LR: 2.00e-05
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 8/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 8/100
Train Loss: 1.1383 | Val Loss: 4.0910
Val AUC: 0.7025 | Best Threshold: 0.50
Val F1: 0.1053 | Precision: 1.0000 | Recall: 0.0556
Current LR: 2.00e-05
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 9/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 9/100
Train Loss: 2.6594 | Val Loss: 3.4019
Val AUC: 0.7126 | Best Threshold: 0.55
Val F1: 0.2745 | Precision: 0.2121 | Recall: 0.3889
Current LR: 2.00e-06
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 10/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 10/100
Train Loss: 1.5014 | Val Loss: 3.4034
Val AUC: 0.7638 | Best Threshold: 0.30
Val F1: 0.4211 | Precision: 0.4000 | Recall: 0.4444
Current LR: 2.00e-06
Saved new best model!
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 11/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 11/100
Train Loss: 1.3529 | Val Loss: 3.2669
Val AUC: 0.7861 | Best Threshold: 0.55
Val F1: 0.4375 | Precision: 0.5000 | Recall: 0.3889
Current LR: 2.00e-06
Saved new best model!
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 12/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 12/100
Train Loss: 1.3230 | Val Loss: 3.3959
Val AUC: 0.7884 | Best Threshold: 0.55
Val F1: 0.4667 | Precision: 0.5833 | Recall: 0.3889
Current LR: 2.00e-06
Saved new best model!
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 13/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 13/100
Train Loss: 1.0548 | Val Loss: 3.3832
Val AUC: 0.7817 | Best Threshold: 0.60
Val F1: 0.4375 | Precision: 0.5000 | Recall: 0.3889
Current LR: 2.00e-06
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 14/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 14/100
Train Loss: 0.9655 | Val Loss: 3.2511
Val AUC: 0.7773 | Best Threshold: 0.70
Val F1: 0.4242 | Precision: 0.4667 | Recall: 0.3889
Current LR: 2.00e-06
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 15/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 15/100
Train Loss: 1.0327 | Val Loss: 3.3754
Val AUC: 0.7702 | Best Threshold: 0.85
Val F1: 0.3077 | Precision: 0.2857 | Recall: 0.3333
Current LR: 2.00e-07
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 16/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 16/100
Train Loss: 0.7414 | Val Loss: 3.5076
Val AUC: 0.7658 | Best Threshold: 0.80
Val F1: 0.3333 | Precision: 0.3333 | Recall: 0.3333
Current LR: 2.00e-07
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 17/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 17/100
Train Loss: 0.7711 | Val Loss: 3.5747
Val AUC: 0.7653 | Best Threshold: 0.55
Val F1: 0.3243 | Precision: 0.3158 | Recall: 0.3333
Current LR: 2.00e-07
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 18/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 18/100
Train Loss: 0.7572 | Val Loss: 3.5969
Val AUC: 0.7632 | Best Threshold: 0.20
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-08
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 19/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 19/100
Train Loss: 0.7583 | Val Loss: 3.6014
Val AUC: 0.7635 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-08
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 20/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 20/100
Train Loss: 0.7312 | Val Loss: 3.6051
Val AUC: 0.7640 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-08
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 21/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 21/100
Train Loss: 0.7167 | Val Loss: 3.6077
Val AUC: 0.7643 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 22/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 22/100
Train Loss: 0.7761 | Val Loss: 3.6077
Val AUC: 0.7643 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 23/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 23/100
Train Loss: 0.7296 | Val Loss: 3.6084
Val AUC: 0.7643 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 24/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 24/100
Train Loss: 0.7612 | Val Loss: 3.6087
Val AUC: 0.7643 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 25/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 25/100
Train Loss: 0.7491 | Val Loss: 3.6091
Val AUC: 0.7643 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 26/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 26/100
Train Loss: 0.7250 | Val Loss: 3.6093
Val AUC: 0.7643 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 27/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 27/100
Train Loss: 0.7774 | Val Loss: 3.6095
Val AUC: 0.7643 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 28/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 28/100
Train Loss: 0.7739 | Val Loss: 3.6097
Val AUC: 0.7643 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 29/100: 100%|██████████| 44/44 [00:24<00:00,  1.83it/s]
Epoch 29/100
Train Loss: 0.8691 | Val Loss: 3.6099
Val AUC: 0.7643 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 30/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 30/100
Train Loss: 0.7299 | Val Loss: 3.6100
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 31/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 31/100
Train Loss: 0.8590 | Val Loss: 3.6102
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 32/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 32/100
Train Loss: 0.7017 | Val Loss: 3.6104
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 33/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 33/100
Train Loss: 0.6853 | Val Loss: 3.6108
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 34/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 34/100
Train Loss: 0.8143 | Val Loss: 3.6109
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 35/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 35/100
Train Loss: 0.6588 | Val Loss: 3.6110
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 36/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 36/100
Train Loss: 0.8045 | Val Loss: 3.6112
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 37/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 37/100
Train Loss: 0.7820 | Val Loss: 3.6113
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 38/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 38/100
Train Loss: 0.7889 | Val Loss: 3.6118
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 39/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 39/100
Train Loss: 0.7230 | Val Loss: 3.6122
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 40/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 40/100
Train Loss: 0.8267 | Val Loss: 3.6124
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 41/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 41/100
Train Loss: 0.7978 | Val Loss: 3.6127
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 42/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 42/100
Train Loss: 0.8194 | Val Loss: 3.6130
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 43/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 43/100
Train Loss: 0.7159 | Val Loss: 3.6132
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 44/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 44/100
Train Loss: 0.7104 | Val Loss: 3.6134
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 45/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 45/100
Train Loss: 0.7747 | Val Loss: 3.6135
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 46/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 46/100
Train Loss: 0.8795 | Val Loss: 3.6137
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 47/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 47/100
Train Loss: 0.7441 | Val Loss: 3.6138
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 48/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 48/100
Train Loss: 0.7048 | Val Loss: 3.6139
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 49/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 49/100
Train Loss: 0.7216 | Val Loss: 3.6140
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 50/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 50/100
Train Loss: 0.7172 | Val Loss: 3.6142
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 51/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 51/100
Train Loss: 0.7700 | Val Loss: 3.6146
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 52/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 52/100
Train Loss: 0.7470 | Val Loss: 3.6146
Val AUC: 0.7641 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 53/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 53/100
Train Loss: 0.8030 | Val Loss: 3.6148
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 54/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 54/100
Train Loss: 0.8267 | Val Loss: 3.6149
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 55/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 55/100
Train Loss: 0.8481 | Val Loss: 3.6150
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 56/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 56/100
Train Loss: 0.8143 | Val Loss: 3.6152
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 57/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 57/100
Train Loss: 0.8237 | Val Loss: 3.6152
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 58/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 58/100
Train Loss: 0.8034 | Val Loss: 3.6154
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 59/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 59/100
Train Loss: 0.8727 | Val Loss: 3.6154
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 60/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 60/100
Train Loss: 0.8383 | Val Loss: 3.6156
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 61/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 61/100
Train Loss: 0.8246 | Val Loss: 3.6157
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 62/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 62/100
Train Loss: 0.7586 | Val Loss: 3.6157
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 63/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 63/100
Train Loss: 0.7380 | Val Loss: 3.6158
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 64/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 64/100
Train Loss: 0.7160 | Val Loss: 3.6160
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 65/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 65/100
Train Loss: 0.7776 | Val Loss: 3.6161
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 66/100: 100%|██████████| 44/44 [00:23<00:00,  1.84it/s]
Epoch 66/100
Train Loss: 0.7266 | Val Loss: 3.6162
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 67/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 67/100
Train Loss: 0.8510 | Val Loss: 3.6162
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 68/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 68/100
Train Loss: 0.7351 | Val Loss: 3.6163
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 69/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 69/100
Train Loss: 0.7624 | Val Loss: 3.6164
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 70/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 70/100
Train Loss: 0.7877 | Val Loss: 3.6164
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 71/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 71/100
Train Loss: 0.7403 | Val Loss: 3.6166
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 72/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 72/100
Train Loss: 0.7755 | Val Loss: 3.6168
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 73/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 73/100
Train Loss: 0.8113 | Val Loss: 3.6171
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 74/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 74/100
Train Loss: 0.7090 | Val Loss: 3.6174
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 75/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 75/100
Train Loss: 0.8074 | Val Loss: 3.6174
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 76/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 76/100
Train Loss: 0.7561 | Val Loss: 3.6174
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 77/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 77/100
Train Loss: 0.7946 | Val Loss: 3.6174
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

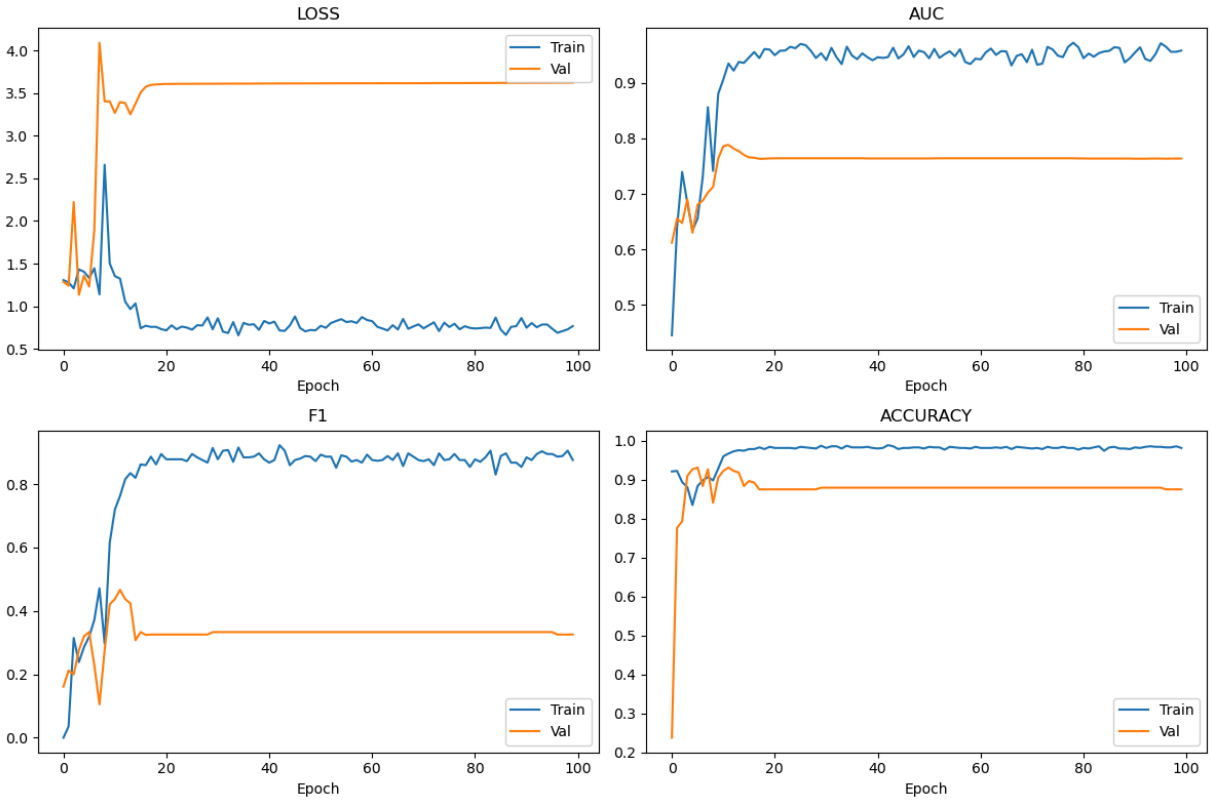
```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 78/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 78/100
Train Loss: 0.7289 | Val Loss: 3.6174
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 79/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 79/100
Train Loss: 0.7654 | Val Loss: 3.6176
Val AUC: 0.7643 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 80/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 80/100
Train Loss: 0.7457 | Val Loss: 3.6178
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 81/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 81/100
Train Loss: 0.7384 | Val Loss: 3.6181
Val AUC: 0.7640 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 82/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 82/100
Train Loss: 0.7429 | Val Loss: 3.6183
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 83/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 83/100
Train Loss: 0.7489 | Val Loss: 3.6186
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 84/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 84/100
Train Loss: 0.7453 | Val Loss: 3.6187
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 85/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 85/100
Train Loss: 0.8669 | Val Loss: 3.6190
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 86/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 86/100
Train Loss: 0.7253 | Val Loss: 3.6191
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 87/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 87/100
Train Loss: 0.6632 | Val Loss: 3.6195
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 88/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 88/100
Train Loss: 0.7579 | Val Loss: 3.6197
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 89/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 89/100
Train Loss: 0.7662 | Val Loss: 3.6200
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 90/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 90/100
Train Loss: 0.8616 | Val Loss: 3.6201
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 91/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 91/100
Train Loss: 0.7475 | Val Loss: 3.6205
Val AUC: 0.7635 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 92/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 92/100
Train Loss: 0.8026 | Val Loss: 3.6205
Val AUC: 0.7635 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 93/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 93/100
Train Loss: 0.7532 | Val Loss: 3.6207
Val AUC: 0.7635 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 94/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 94/100
Train Loss: 0.7851 | Val Loss: 3.6207
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 95/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 95/100
Train Loss: 0.7858 | Val Loss: 3.6207
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 96/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 96/100
Train Loss: 0.7358 | Val Loss: 3.6212
Val AUC: 0.7638 | Best Threshold: 0.20
Val F1: 0.3333 | Precision: 0.2917 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 97/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 97/100
Train Loss: 0.6883 | Val Loss: 3.6215
Val AUC: 0.7635 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
```

```
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 98/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 98/100
Train Loss: 0.7083 | Val Loss: 3.6222
Val AUC: 0.7638 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 99/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 99/100
Train Loss: 0.7289 | Val Loss: 3.6225
Val AUC: 0.7638 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
/tmp/ipykernel_3339871/3334015219.py:169: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuda', args...)` instead.
  with torch.cuda.amp.autocast():

poch 100/100: 100%|██████████| 44/44 [00:23<00:00,  1.85it/s]
Epoch 100/100
Train Loss: 0.7674 | Val Loss: 3.6230
Val AUC: 0.7638 | Best Threshold: 0.15
Val F1: 0.3256 | Precision: 0.2800 | Recall: 0.3889
Current LR: 2.00e-09
valuating: 100%|██████████| 15/15 [00:08<00:00,  1.85it/s]
Evaluation Results (Threshold=0.55):
AUC: 0.7586
Accuracy: 0.9181
Precision: 0.4545
Recall: 0.2778
F1 Score: 0.3448
```


LOSS
Train
Val
Epoch
AUC
Train
Val
Epoch
F1
Train
Val
Epoch
ACCURACY
Train
Val
Epoch

In [ ]: