In [1]:

```python
import math
import re
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import Dataset as DT
from torch.utils.data import DataLoader as DL
from sklearn.metrics import confusion_matrix, f1_score
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import KFold
import warnings
import numpy as np
import nltk
from nltk.tokenize import word_tokenize
import string
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from gensim.models import Word2Vec
import matplotlib.pyplot as plt

warnings.filterwarnings('ignore')
```

In [2]:

```python
def read_lexicons_files(lex_files):
    with open(lex_files, "r", encoding = 'utf-8') as ff:
        data = ff.readlines()
#     basic cleaning of data
    data = [dt.strip().split('\t') for dt in data]
    lexicon_dict = {}
    for v in data:
        if len(v) == 3:
            key = v[0]
            value = {'-ve': float(v[1]), '+ve': float(v[2])}
            lexicon_dict[key] = value

    return lexicon_dict
```

In [3]:

```
def load_data(tfile, lfile):
    with open(tfile, 'r',encoding = 'utf-8') as n:
        tweetsandtext = n.readlines()

    with open(lfile, 'r',encoding = 'utf-8') as n:
        labelsforencoding = n.readlines()

    return tweetsandtext, labelsforencoding
```

In [4]:

```
def data_clean_tweets(t):

    t = re.sub(r'http\S+|www\S+|https\S+|\S+@\S+', '', t)
     # Remove numbers
    t = re.sub(r'\d+', '', t)
    t = re.sub('[^a-zA-Z0-9\s]', '', t)

    tz = word_tokenize(t)
    tz = [x.lower() for x in tz if x not in string.punctuation]
    sws = set(stopwords.words('english'))
    tz = [x for x in tz if x not in sws]
    st = PorterStemmer()
    tz = [st.stem(x) for x in tz]
    cleaned_text = ' '.join(tz)
    return cleaned_text
```

In [5]:

```python
def get_feature(tweet, lexicons):
    # Split tweet into words
    words = tweet.split()

    # Count words in the tweet
    total_words = len(words)

    # Finding the longest word
    longest_word = max(words, key=len)

    # Set 12 features to the list
    feature_set = [0] * 12

    # Calculate lexicon scores for each word in the tweet
    for i, lex_dict in enumerate(lexicons[:9]):
        score = 0
        for word in words:
            sentiment_dict = lex_dict.get(word, {'-ve': 0, '+ve': 0})
            score += sentiment_dict['-ve'] + sentiment_dict['+ve']
        feature_set[i] = score

    # Log of the word count for the tweet
    if total_words > 0:
        feature_set[9] = math.log(total_words)
    else:
        feature_set[9] = 0

    # Log of length of longest word
    if longest_word:
        feature_set[10] = math.log(len(longest_word))
    else:
        feature_set[10] = 0

    # Count of words that have 5 characters or more
    long_word_count = sum([1 for word in words if len(word) >= 5])

    # Log of count of long words
    if long_word_count > 0:
        feature_set[11] = math.log(long_word_count)
    else:
        feature_set[11] = 0
```

```python
    return feature_set
```

In [6]:

```python
class SentimentDataset(DT):
    def __init__(self, feat, l):
        # Convert  to PyTorch tensors
        if not isinstance(features, tt):
            feat = tt(feat)
        if not isinstance(labels, tt):
            l = tt(l)

        self.feat = feat
        self.l = l

    def __len__(self):
        # Return length of dataset
        return len(self.feat)

    def __getitem__(self, index):
        # Checking if the index is in range
        assert index < len(self), "Index out of range"
        feat = self.feat[index]
        l = self.l[index]

        return feat, l
```

In [7]:

```python
enc_type = 'utf-8'
```

In [8]:

```python
all_lexicon_files = ['3DS.tsv', '4chan.tsv', '2007scape.tsv', 'ACTrade.tsv',
                 'amiugly.tsv', 'BabyBumps.tsv', 'baseball.tsv', 'canada.tsv',
                 'CasualConversation.tsv', 'DarknetMarkets.tsv', 'darksouls.tsv', 'elderscrollsonline.tsv
                 'Eve.tsv', 'Fallout.tsv', 'fantasyfootball.tsv', 'GameDeals.tsv', 'gamegrumps.tsv', 'hal
                 'Homebrewing.tsv', 'IAmA.tsv', 'india.tsv', 'jailbreak.tsv', 'Jokes.tsv', 'KerbalSpacePr
                 'Keto.tsv', 'leagueoflegends.tsv', 'Libertarian.tsv', 'magicTCG.tsv', 'MakeupAddiction.t
                 'Naruto.tsv', 'nba.tsv', 'oculus.tsv', 'OkCupid.tsv', 'Parenting.tsv', 'pathofexile.tsv'
                 'raisedbynarcissists.tsv', 'Random_Acts_Of_Amazon.tsv', 'science.tsv', 'Seattle.tsv',
                 'TalesFromRetail.tsv', 'talesfromtechsupport.tsv', 'ultrahardcore.tsv', 'videos.tsv',
                 'Warthunder.tsv', 'whowouldwin.tsv', 'xboxone.tsv', 'yugioh.tsv']
```

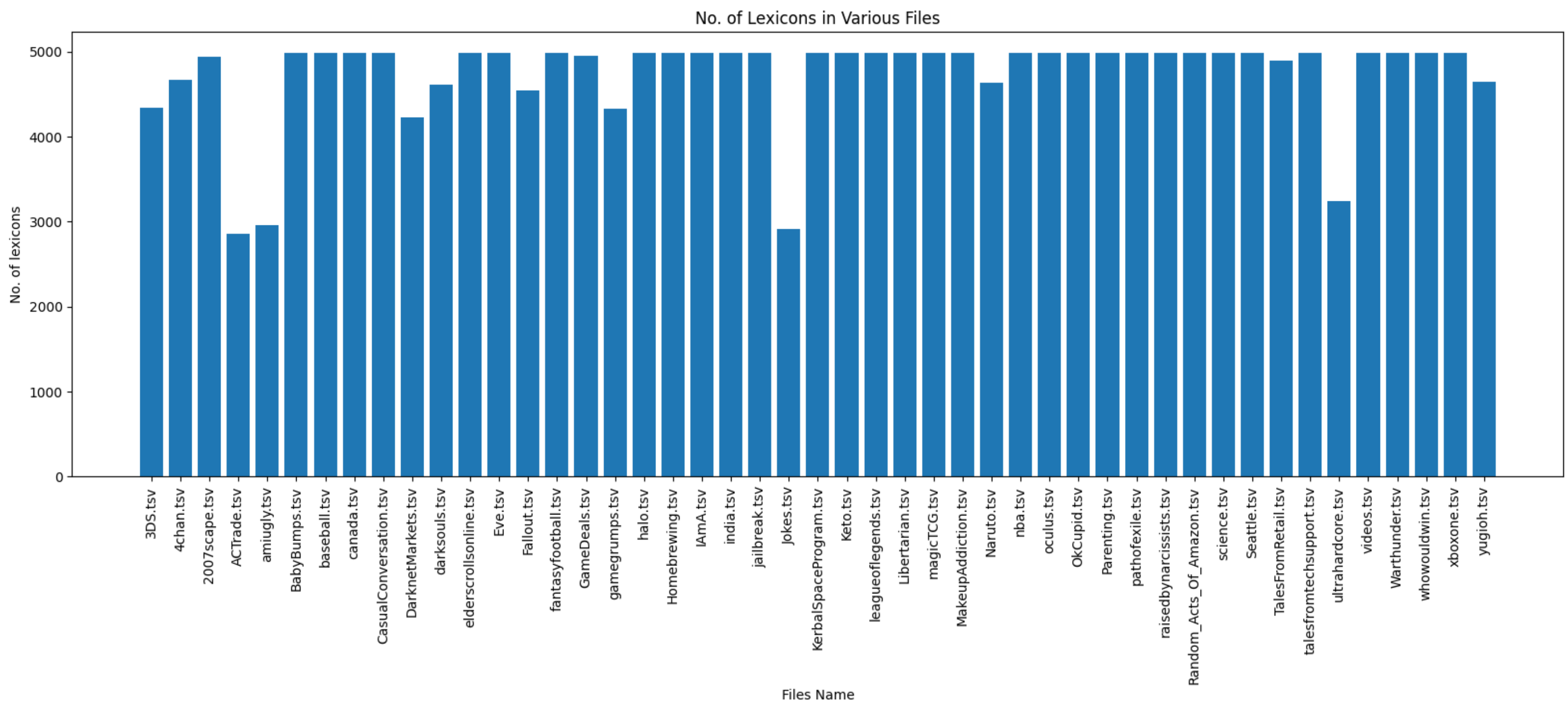
In [9]:
```
adj = "adjectives/2000.tsv"
freq = "adjectives/2000.tsv"
adjectives = read_lexicons_files(adj)
frequency = read_lexicons_files(freq)
```

In [10]:
```
lexicon_values = []
xz = {}
for i in all_lexicon_files:
    z = read_lexicons_files('subreddits/'+i)
    xz[i] = len(z)
    lexicon_values.append(z)
```

In [11]:
```
names = list(xz.keys())
values = list(xz.values())
```

In [12]:

```python
plt.figure(figsize=(20, 6))
plt.bar(names, values)
plt.xticks(rotation=90)
plt.xlabel('Files Name')
plt.ylabel('No. of lexicons')
plt.title('No. of Lexicons in Various Files')
plt.show()
```



In [13]:

```python
combined = [adjectives, frequency] + lexicon_values
```

In [14]:

```python
train_text, train_labels = load_data('sentiment/train_text.txt', 'sentiment/train_labels.txt')
val_text, val_labels = load_data('sentiment/val_text.txt', 'sentiment/val_labels.txt')
test_text, test_labels = load_data('sentiment/test_text.txt', 'sentiment/test_labels.txt')
```

In [15]:

```
train_text = [data_clean_tweets(tweet) for tweet in train_text]
val_text = [data_clean_tweets(tweet) for tweet in val_text]
test_text = [data_clean_tweets(tweet) for tweet in test_text]
```

In [16]:

```
def get_embedding(tweet, model, size):
    words = tweet.split()
    vec = np.zeros(size)
    count = 0
    for word in words:
        try:
            vec += model.wv[word]
            count += 1
        except KeyError:
            pass
    if count != 0:
        vec /= count
    return vec
tt = torch.tensor
```

In [17]:

```
tokenized_tweets = [tweet.split() for tweet in train_text + val_text + test_text]

#Word2Vec model
word2vec_model = Word2Vec(tokenized_tweets, vector_size=300, window=5, min_count=1, workers=4)
```

In [18]:

```
# Encode labels
dts = torch.long
encoder = LabelEncoder()
train_labels = encoder.fit_transform(train_labels)
val_labels = encoder.transform(val_labels)
test_labels = encoder.transform(test_labels)

y_train = tt(train_labels, dtype=dts)
y_val = tt(val_labels, dtype=dts)
y_test = tt(test_labels, dtype=dts)

```

In [19]:
```
X_train_embed = np.array([get_embedding(tweet, word2vec_model, 300) for tweet in train_text])
X_val_embed = np.array([get_embedding(tweet, word2vec_model, 300) for tweet in val_text])
X_test_embed = np.array([get_embedding(tweet, word2vec_model, 300) for tweet in test_text])

# Combine train, validation, and test data
X_all = np.concatenate((X_train_embed, X_val_embed, X_test_embed), axis=0)
y_all = np.concatenate((y_train, y_val, y_test), axis=0)
```

In [20]:
```
class SentimentDataset(DT):
    def __init__(self, data, targets):
        # Checking if data and targets are of the same length
        assert len(data) == len(targets), "Data and targets must have the same length"

        # Convert data to tensors
        self.data = tt(data)
        self.targets = tt(targets)

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

    def __getitem__(self, index):
        # finding data and target at the given index
        data_point = self.data[index]
        target = self.targets[index]
        return data_point, target

```

In [21]:
```python
class SentimentModel(nn.Module):
    def __init__(self, indim, hdim, odim):
        super(SentimentModel, self).__init__()
        self.leyar1 = nn.Linear(indim, hdim)
        self.activation = nn.ReLU()
        self.l2 = nn.Linear(hdim, odim)
        self.output_layer = nn.Softmax(dim=1)

    def forward(self, z):
        z = self.leyar1(z)
        z = self.activation(z)
        z = self.l2(z)
        z = self.output_layer(z)
        return z
```

In [22]:
```python
input_size = 300
dty = torch.float32

data_train = SentimentDataset(tt(X_train_embed, dtype=dty), y_train)
data_val = SentimentDataset(tt(X_val_embed, dtype=dty), y_val)
data_test = SentimentDataset(tt(X_test_embed, dtype=dty), y_test)

load_train = DL(data_train, batch_size=64, shuffle=True)
load_val = DL(data_val, batch_size=64, shuffle=False)
load_test = DL(data_test, batch_size=64, shuffle=False)

```

In [23]:
```python
hidden_size = 64
num_classes = 3
batch_size = 32
model = SentimentModel(input_size, hidden_size, num_classes)
```

In [24]:
```python
criterion = nn.CrossEntropyLoss()
optimizer = optim.Adam(model.parameters(), lr=0.001)
```

In [25]:

```
def train(model, X, y, criterion, optimizer, num_epochs):
    ds = torch.utils.data.TensorDataset(X, y)
    dataloader = DL(ds, batch_size=batch_size, shuffle=True)

    train_losses = []
    train_accuracies = []

    for e in range(num_epochs):
        running_loss = 0.0
        running_corrects = 0
        total_samples = 0

        for inp, lab in dataloader:
            optimizer.zero_grad()
            out = model(inp)
            loss = criterion(out, lab)
            loss.backward()
            optimizer.step()

            _, preds = torch.max(out, 1)
            running_loss += loss.item() * inp.size(0)
            running_corrects += torch.sum(preds == lab.data)
            total_samples += inp.size(0)

        epoch_loss = running_loss / total_samples
        epoch_accuracy = running_corrects.double() / total_samples
        if (e + 1) % 25 == 0:
            print(f"Epoch {e+1}/{num_epochs} Loss: {epoch_loss:.6f} Accuracy: {epoch_accuracy:.6f}")
        train_losses.append(epoch_loss)
        train_accuracies.append(epoch_accuracy.item())

    return train_losses, train_accuracies
```

In [26]:
```
def validate(model, dataloader, criterion):
    model.eval()
    runLoss = 0.0

    with torch.no_grad():
        for ipnputs, lebles in dataloader:
            oput = model(ipnputs)
            lose = criterion(oput, lebles)
            runLoss += lose.item()

    return runLoss / len(dataloader)
```

In [27]:
```
def predict(model, X):
    model.eval()
    ds = torch.utils.data.TensorDataset(X)
    dloader = DL(ds, batch_size=batch_size, shuffle=False)

    pre = []
    with torch.no_grad():
        for inputs, in dloader:
            outputs = model(inputs)
            _, preds = torch.max(outputs, 1)
            pre.extend(preds.tolist())
    return pre
```

In [28]:
```
num_epochs = 100
```

In [29]:

```
from sklearn.model_selection import KFold
from sklearn.metrics import accuracy_score
from sklearn.metrics import f1_score
from sklearn.metrics import confusion_matrix


foldsCount = 5
kf = KFold(n_splits=foldsCount, shuffle=True, random_state=42)
fold_accuracies = []
fold_f1s = []

all_train_losses = []
all_train_accuracies = []

for fold, (ti, tei) in enumerate(kf.split(X_all, y_all)):
    X_train_fold = tt(X_all[ti], dtype=dty)
    y_train_fold = tt(y_all[ti], dtype=torch.long)
    X_test_fold = tt(X_all[tei], dtype=dty)
    y_test_fold = tt(y_all[tei], dtype=torch.long)

    # cross-validation folds data
    model_w2v = SentimentModel(input_size, hidden_size, num_classes)
    opti = optim.Adam(model_w2v.parameters(), lr=0.001)
    train_losses, train_accuracies = train(model_w2v, X_train_fold, y_train_fold, criterion, opti, num_ep
    all_train_losses.append(train_losses)
    all_train_accuracies.append(train_accuracies)

    # testing using testdata
    y_pred_fold = predict(model_w2v, X_test_fold)
    fold_confusion_matrix = confusion_matrix(y_test_fold, y_pred_fold)
    print()
    print(f"Confusion Matrix for Fold {fold+1}:\n{fold_confusion_matrix}\n")
    # Finding accuracy
    fold_accuracy = accuracy_score(y_test_fold, y_pred_fold)
    fold_f1 = f1_score(y_test_fold, y_pred_fold, average='weighted')
    fold_accuracies.append(fold_accuracy)
    fold_f1s.append(fold_f1)
    print(f"Fold {fold+1} Accuracy: {fold_accuracy:.6f}, F1 Score: {fold_f1:.6f}")
    print()
    print()

average_accuracy = sum(fold_accuracies) / foldsCount
print()
```

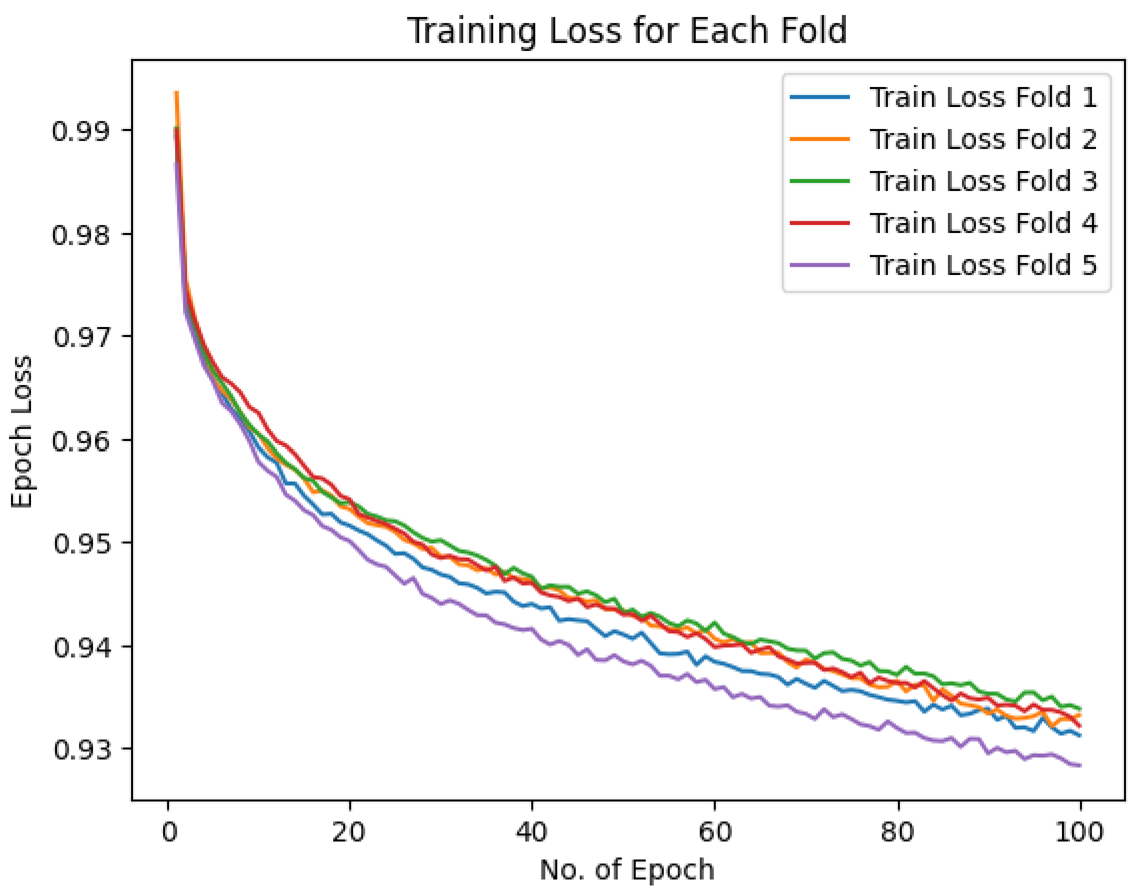
```
print()
print(f"Average Accuracy: ",average_accuracy*100)
average_f1 = sum(fold_f1s) / foldsCount
print("Average F1-score:",average_f1*100)
```

```
Epoch 25/100 Loss: 0.948883 Accuracy: 0.578622
Epoch 50/100 Loss: 0.941048 Accuracy: 0.589891
Epoch 75/100 Loss: 0.935682 Accuracy: 0.596924
Epoch 100/100 Loss: 0.931273 Accuracy: 0.602663

Confusion Matrix for Fold 1:
[[ 623 1218  428]
 [ 451 3749 1280]
 [ 115 1526 2590]]

Fold 1 Accuracy: 0.581135, F1 Score: 0.569202


Epoch 25/100 Loss: 0.951017 Accuracy: 0.577474
Epoch 50/100 Loss: 0.943405 Accuracy: 0.585864
Epoch 75/100 Loss: 0.936826 Accuracy: 0.594691
Epoch 100/100 Loss: 0.933241 Accuracy: 0.600367

Confusion Matrix for Fold 2:
[[ 610 1280  374]
 [ 434 3968 1089]
 [ 102 1711 2412]]

Fold 2 Accuracy: 0.583472, F1 Score: 0.569812


Epoch 25/100 Loss: 0.952047 Accuracy: 0.575763
Epoch 50/100 Loss: 0.943150 Accuracy: 0.586344
Epoch 75/100 Loss: 0.938528 Accuracy: 0.593084
Epoch 100/100 Loss: 0.933856 Accuracy: 0.600388

Confusion Matrix for Fold 3:
[[ 617 1373  253]
 [ 445 4349  744]
 [ 126 2007 2066]]

Fold 3 Accuracy: 0.586978, F1 Score: 0.569840


Epoch 25/100 Loss: 0.951324 Accuracy: 0.575033
Epoch 50/100 Loss: 0.942976 Accuracy: 0.586218
Epoch 75/100 Loss: 0.936917 Accuracy: 0.596006
Epoch 100/100 Loss: 0.932203 Accuracy: 0.601995
```

```
Confusion Matrix for Fold 4:
[[ 589 1324  378]
 [ 408 4010 1072]
 [ 107 1750 2342]]

Fold 4 Accuracy: 0.579382, F1 Score: 0.564096


Epoch 25/100 Loss: 0.946795 Accuracy: 0.580238
Epoch 50/100 Loss: 0.938444 Accuracy: 0.591361
Epoch 75/100 Loss: 0.932856 Accuracy: 0.599395
Epoch 100/100 Loss: 0.928354 Accuracy: 0.605217

Confusion Matrix for Fold 5:
[[ 431 1540  339]
 [ 252 4094 1134]
 [  74 1808 2307]]

Fold 5 Accuracy: 0.570331, F1 Score: 0.546543



Average Accuracy:  58.025993875481305
Average F1-score: 56.38984685081011
```

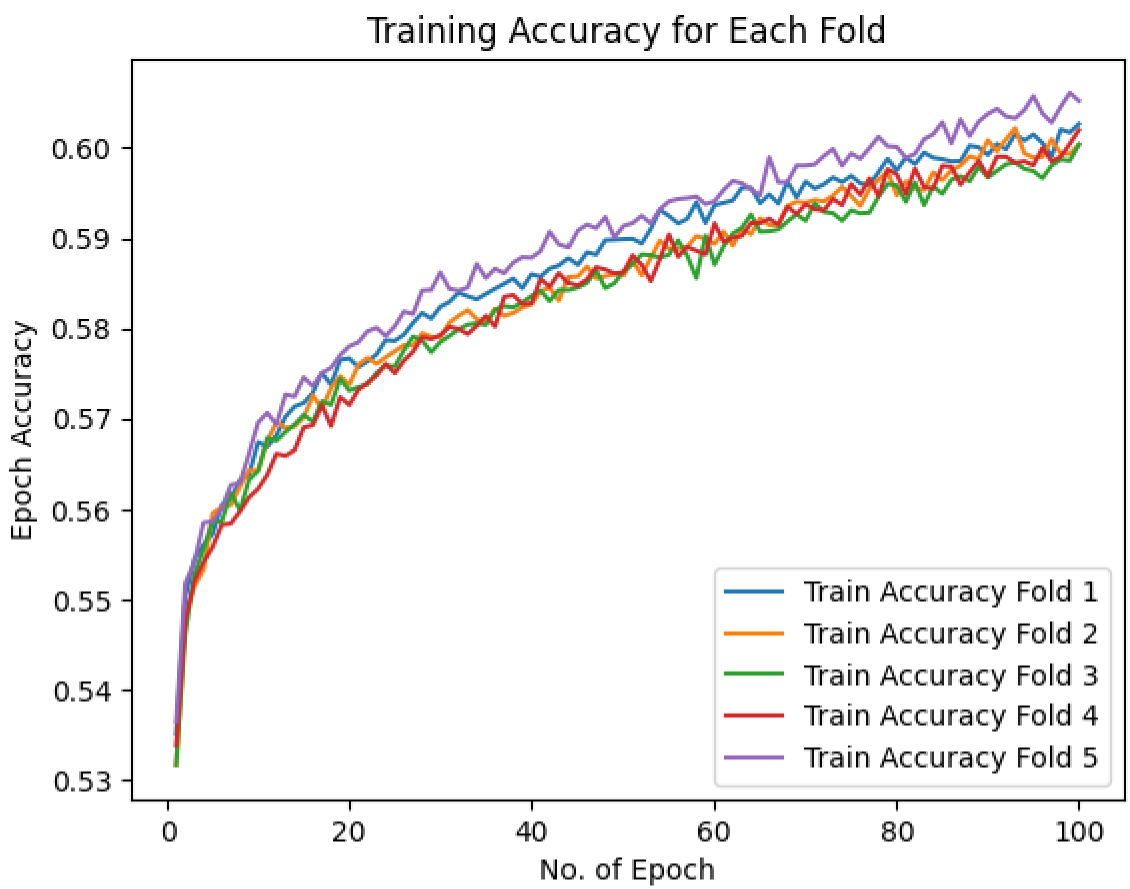
In [30]:

```
for fold, train_losses in enumerate(all_train_losses):
    plt.plot(range(1, num_epochs+1), train_losses, label=f'Train Loss Fold {fold+1}')

plt.title('Training Loss for Each Fold')
plt.xlabel('No. of Epoch')
plt.ylabel('Epoch Loss')
plt.legend()
plt.show()
```



In [31]:

```
for fold, train_accuracies in enumerate(all_train_accuracies):
    plt.plot(range(1, num_epochs+1), train_accuracies, label=f'Train Accuracy Fold {fold+1}')

plt.title('Training Accuracy for Each Fold')
plt.xlabel('No. of Epoch')
plt.ylabel('Epoch Accuracy')
plt.legend()
plt.show()
```



In [ ]:

```

```