In [1]:
```
import pandas as pd
import seaborn as sns
import neattext.functions as nfx
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.linear_model import LogisticRegression
import joblib
```

In [2]:
```
df_train = pd.read_csv('train_150k.txt', sep='\t', names=['sent', 'twe
df_test = pd.read_csv('test_62k.txt', sep='\t', names=['sent', 'tweet

print("Training Dataset\n", df_train.head())
print("\nTesting Dataset\n", df_test.head())
print("\nSent total count\n", df_train['sent'].value_counts())
```

```
Training Dataset
    sent                                               tweet
0     0  Starting  back at work today   Looks like it'l...
1     1  Sugar levels dropping... munchies setting in. ...
2     1     @karineb22 yeah!!! have a great summer break!
3     1  hannah montana was very good.  now going to re...
4     1  @Mayra326 aww, have fun!  I just had my 3D las...

Testing Dataset
    sent                                               tweet
0     1  @justineville ...yeahhh. ) i'm 39 tweets from ...
1     0  @ApplesnFeathers aww. Poor baby! On your only ...
2     0  @joeymcintyre With my refunded $225 (Australia...
3     0  It's fine. Today sucks just because me those t...
4     0  Im just chilling on psp and stuff, but sitting...

Sent total count
 0    75019
1    74966
Name: sent, dtype: int64
```

In [3]:
```
# Remove user handles
df_train['Clean_Tweet'] = df_train['tweet'].apply(nfx.remove_userhand
df_test['Clean_Tweet'] = df_test['tweet'].apply(nfx.remove_userhandles

# Remove stopwords
df_train['Clean_Tweet'] = df_train['Clean_Tweet'].apply(nfx.remove_sto
df_test['Clean_Tweet'] = df_test['Clean_Tweet'].apply(nfx.remove_stopw

print(df_train.head())
```

```
   sent                                                tweet  \
0     0  Starting  back at work today   Looks like it'l...
1     1  Sugar levels dropping... munchies setting in. ...
2     1     @karineb22 yeah!!! have a great summer break!
3     1  hannah montana was very good.  now going to re...
4     1  @Mayra326 aww, have fun!  I just had my 3D las...

                                        Clean_Tweet
0  Starting work today Looks like it'll raining c...
1  Sugar levels dropping... munchies setting in. ...
2                        yeah!!! great summer break!
3          hannah montana good. going read twilight.
4                                aww, fun! 3D week!
```

In [4]:
```
X_train = df_train['Clean_Tweet']
y_train = df_train['sent']

X_test = df_test['Clean_Tweet']
y_test = df_test['sent']
```

In [5]:
```
X_train, X_val, y_train, y_val = train_test_split(X_train, y_train, te
```

In [6]:
```
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.linear_model import Perceptron
from sklearn.metrics import accuracy_score

# Convert text to numerical features using TF-IDF
vectorizer = TfidfVectorizer(max_features=5000)
X_train_tfidf = vectorizer.fit_transform(X_train)
X_val_tfidf = vectorizer.transform(X_val)  # Use validation set

# Define and train the Perceptron model
perceptron = Perceptron(max_iter=1000, tol=1e-3, random_state=42)
perceptron.fit(X_train_tfidf, y_train)

# Make predictions
y_pred = perceptron.predict(X_val_tfidf)

# Evaluate the model
accuracy = accuracy_score(y_val, y_pred)
print("Perceptron Accuracy:", accuracy)
```

```
Perceptron Accuracy: 0.6903058049604409
```

In [7]:
```
from sklearn.pipeline import Pipeline
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.linear_model import LogisticRegression

# Updated: Use TF-IDF instead of CountVectorizer
pipe_lr = Pipeline(steps=[
    ('tfidf', TfidfVectorizer(max_features=50000)),
    ('lr', LogisticRegression(max_iter=200))
])

# Train the model
pipe_lr.fit(X_train, y_train)

# Evaluate the model
print("Logistic Regression Accuracy:", pipe_lr.score(X_val, y_val))
```

```
Logistic Regression Accuracy: 0.7661125433371855
```

In [8]:
```
pipe_lr = Pipeline(steps=[('cv', CountVectorizer()), ('lr', LogisticRe
pipe_lr.fit(X_train, y_train)
print("Logistic Regression Accuracy:", pipe_lr.score(X_val, y_val))
```

```
/Users/sakshi/opt/anaconda3/lib/python3.9/site-packages/sklearn/line
ar_model/_logistic.py:814: ConvergenceWarning: lbfgs failed to conve
rge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as sh
own in:
    https://scikit-learn.org/stable/modules/preprocessing.html (http
s://scikit-learn.org/stable/modules/preprocessing.html)
Please also refer to the documentation for alternative solver option
s:
    https://scikit-learn.org/stable/modules/linear_model.html#logist
ic-regression (https://scikit-learn.org/stable/modules/linear_model.
html#logistic-regression)
  n_iter_i = _check_optimize_result(

Logistic Regression Accuracy: 0.7620010667614899
```

In [9]:
```
from sklearn.pipeline import Pipeline
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.svm import LinearSVC

# Define pipeline
pipe_svm = Pipeline(steps=[
    ('tfidf', TfidfVectorizer()),
    ('svc', LinearSVC())
])

# Train the model
pipe_svm.fit(X_train, y_train)

# Evaluate the model
print("SVM Accuracy:", pipe_svm.score(X_val, y_val))
```

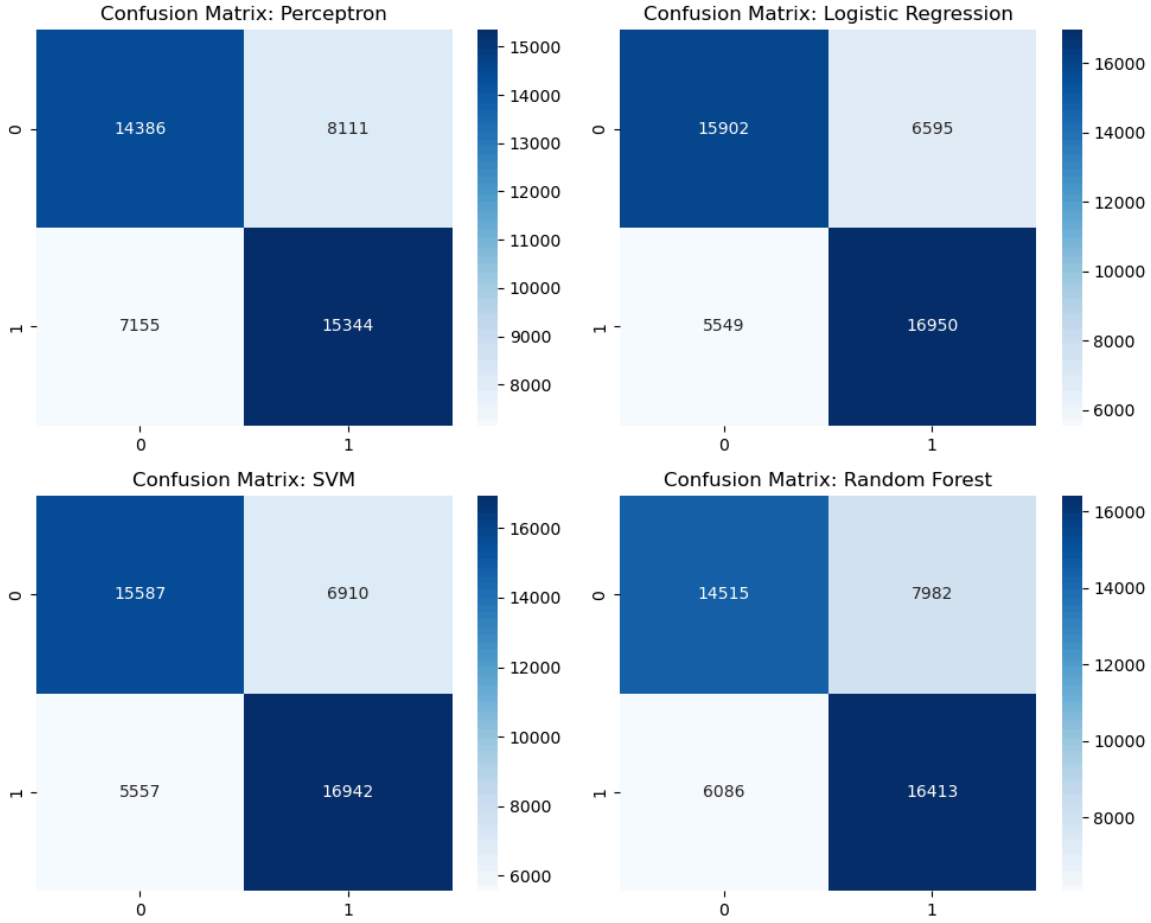
```
SVM Accuracy: 0.7508445195128456
```

In [10]:
```
pipe_rf = Pipeline(steps=[('cv', CountVectorizer()), ('rf', RandomFore
pipe_rf.fit(X_train, y_train)
print("Random Forest Accuracy:", pipe_rf.score(X_val, y_val))
```

```
Random Forest Accuracy: 0.7250644501733488
```

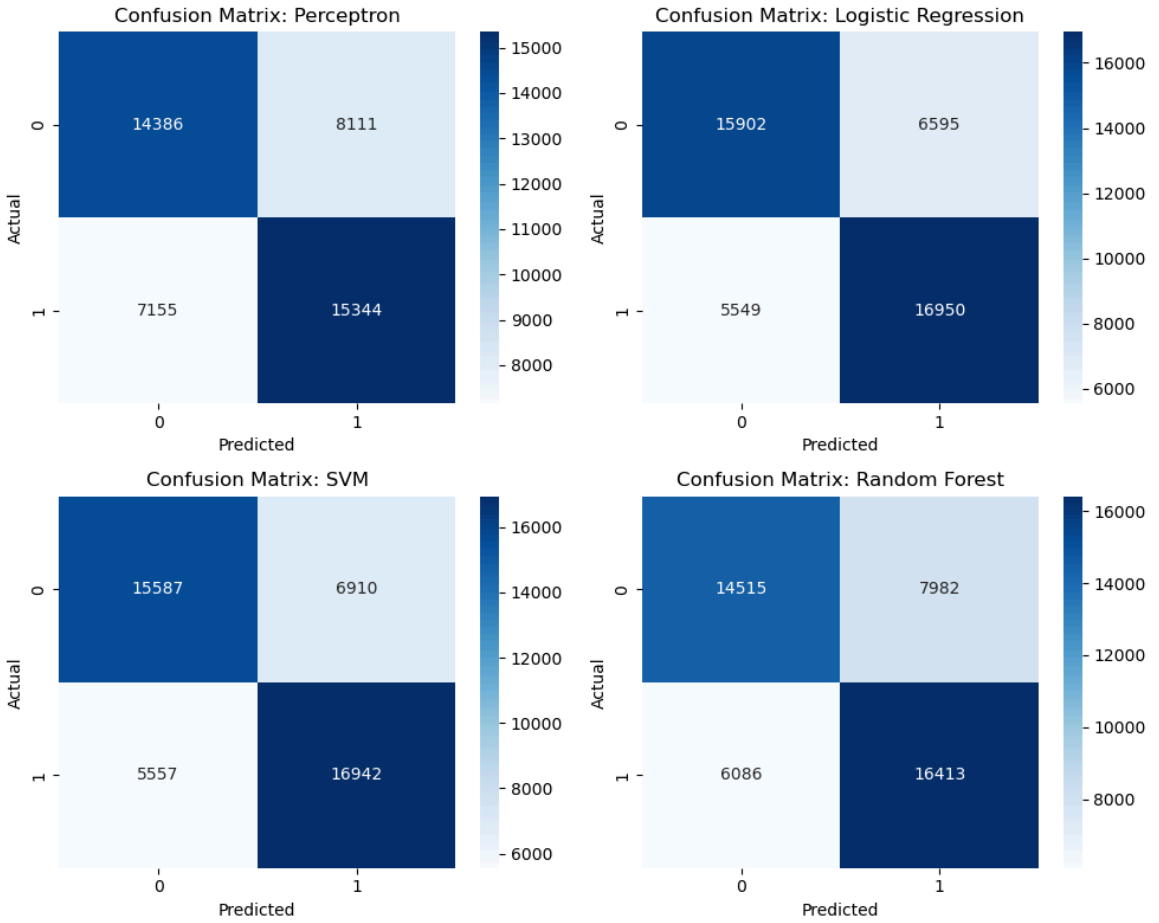
In [11]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.linear_model import Perceptron, LogisticRegression
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, confusion_matrix, roc_curv
from sklearn.preprocessing import label_binarize

# Reduce TF-IDF features for faster computation
vectorizer = TfidfVectorizer(max_features=5000)
X_train_tfidf = vectorizer.fit_transform(X_train[:10000])  # Training
X_val_tfidf = vectorizer.transform(X_val)

# Initialize models with optimized parameters
models = {
    "Perceptron": Perceptron(max_iter=500, tol=1e-3, random_state=42),
    "Logistic Regression": LogisticRegression(max_iter=500, random_sta
    "SVM": SVC(kernel='linear', C=1, probability=True),  # probabilit
    "Random Forest": RandomForestClassifier(n_estimators=5, random_sta
}

# Train and evaluate models
accuracies = {}
conf_matrices = {}
roc_curves = {}
roc_aucs = {}

# Convert labels to binary format for ROC curve
y_val_bin = label_binarize(y_val, classes=[0, 1])  # Assuming binary c

for name, model in models.items():
    model.fit(X_train_tfidf, y_train[:10000])  # Training on subset
    y_pred = model.predict(X_val_tfidf)

    # Store accuracy
    accuracies[name] = accuracy_score(y_val, y_pred)

    # Store confusion matrix
    conf_matrices[name] = confusion_matrix(y_val, y_pred)

    # ROC Curve
    if hasattr(model, "predict_proba"):  # Check if model supports pre
        y_proba = model.predict_proba(X_val_tfidf)[:, 1]
        fpr, tpr, _ = roc_curve(y_val, y_proba)
        roc_auc = auc(fpr, tpr)
        roc_curves[name] = (fpr, tpr)
        roc_aucs[name] = roc_auc

# Convert to DataFrame
acc_df = pd.DataFrame(accuracies, index=["Accuracy"]).T

# ========== 2️⃣ CONFUSION MATRICES ==========
fig, axes = plt.subplots(2, 2, figsize=(10, 8))
axes = axes.flatten()
for i, (name, matrix) in enumerate(conf_matrices.items()):
    sns.heatmap(matrix, annot=True, fmt='d', cmap='Blues', ax=axes[i])
    axes[i].set_title(f"Confusion Matrix: {name}")
plt.tight_layout()
```

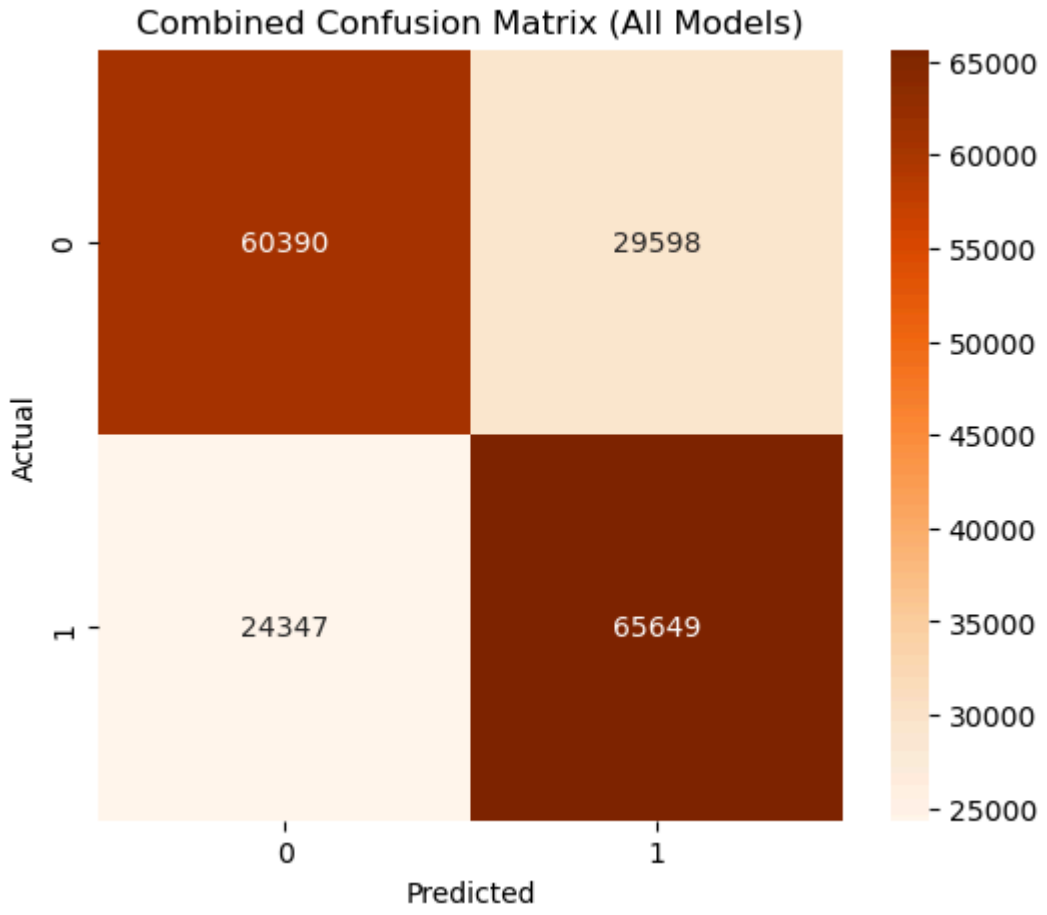
```
plt.show()
```

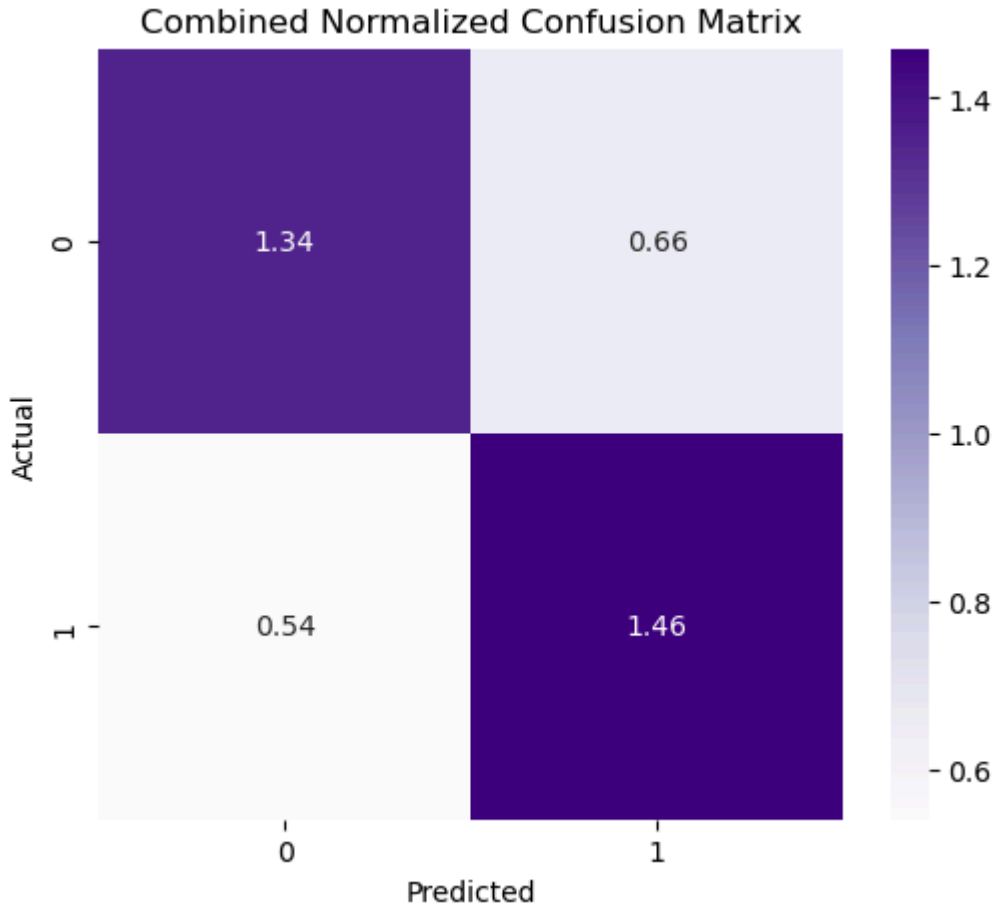

Confusion Matrix: Perceptron
14386
8111
7155
15344
Confusion Matrix: Logistic Regression
15902
6595
5549
16950
Confusion Matrix: SVM
15587
6910
5557
16942
Confusion Matrix: Random Forest
14515
7982
6086
16413

In [12]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.linear_model import Perceptron, LogisticRegression
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, confusion_matrix, roc_curv
from sklearn.preprocessing import label_binarize

# Reduce TF-IDF features for faster computation
vectorizer = TfidfVectorizer(max_features=5000)
X_train_tfidf = vectorizer.fit_transform(X_train[:10000])  # Training
X_val_tfidf = vectorizer.transform(X_val)

# Initialize models
models = {
    "Perceptron": Perceptron(max_iter=500, tol=1e-3, random_state=42),
    "Logistic Regression": LogisticRegression(max_iter=500, random_sta
    "SVM": SVC(kernel='linear', C=1, probability=True),
    "Random Forest": RandomForestClassifier(n_estimators=5, random_sta
}

# Train and evaluate models
accuracies = {}
conf_matrices = {}
roc_curves = {}
roc_aucs = {}

y_val_bin = label_binarize(y_val, classes=[0, 1])

for name, model in models.items():
    model.fit(X_train_tfidf, y_train[:10000])
    y_pred = model.predict(X_val_tfidf)

    # Accuracy
    accuracies[name] = accuracy_score(y_val, y_pred)

    # Confusion Matrix
    conf_matrices[name] = confusion_matrix(y_val, y_pred)

    # ROC Curve
    if hasattr(model, "predict_proba"):
        y_proba = model.predict_proba(X_val_tfidf)[:, 1]
        fpr, tpr, _ = roc_curve(y_val, y_proba)
        roc_auc = auc(fpr, tpr)
        roc_curves[name] = (fpr, tpr)
        roc_aucs[name] = roc_auc

# Accuracy Table
acc_df = pd.DataFrame(accuracies, index=["Accuracy"]).T

# 1️⃣ Plot Individual Confusion Matrices
fig, axes = plt.subplots(2, 2, figsize=(10, 8))
axes = axes.flatten()
for i, (name, matrix) in enumerate(conf_matrices.items()):
    sns.heatmap(matrix, annot=True, fmt='d', cmap='Blues', ax=axes[i])
    axes[i].set_title(f"Confusion Matrix: {name}")
    axes[i].set_xlabel("Predicted")
    axes[i].set_ylabel("Actual")
```

```
plt.tight_layout()
plt.show()

# 2️⃣ Combined Confusion Matrix (Raw Sum)
combined_conf_matrix = sum(conf_matrices.values())
plt.figure(figsize=(6, 5))
sns.heatmap(combined_conf_matrix, annot=True, fmt='d', cmap='Oranges')
plt.title("Combined Confusion Matrix (All Models)")
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.show()

# 3️⃣ Combined Normalized Confusion Matrix
normalized_matrices = [matrix / matrix.sum() for matrix in conf_matric
combined_normalized = sum(normalized_matrices)
plt.figure(figsize=(6, 5))
sns.heatmap(combined_normalized, annot=True, fmt='.2f', cmap='Purples
plt.title("Combined Normalized Confusion Matrix")
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.show()
```

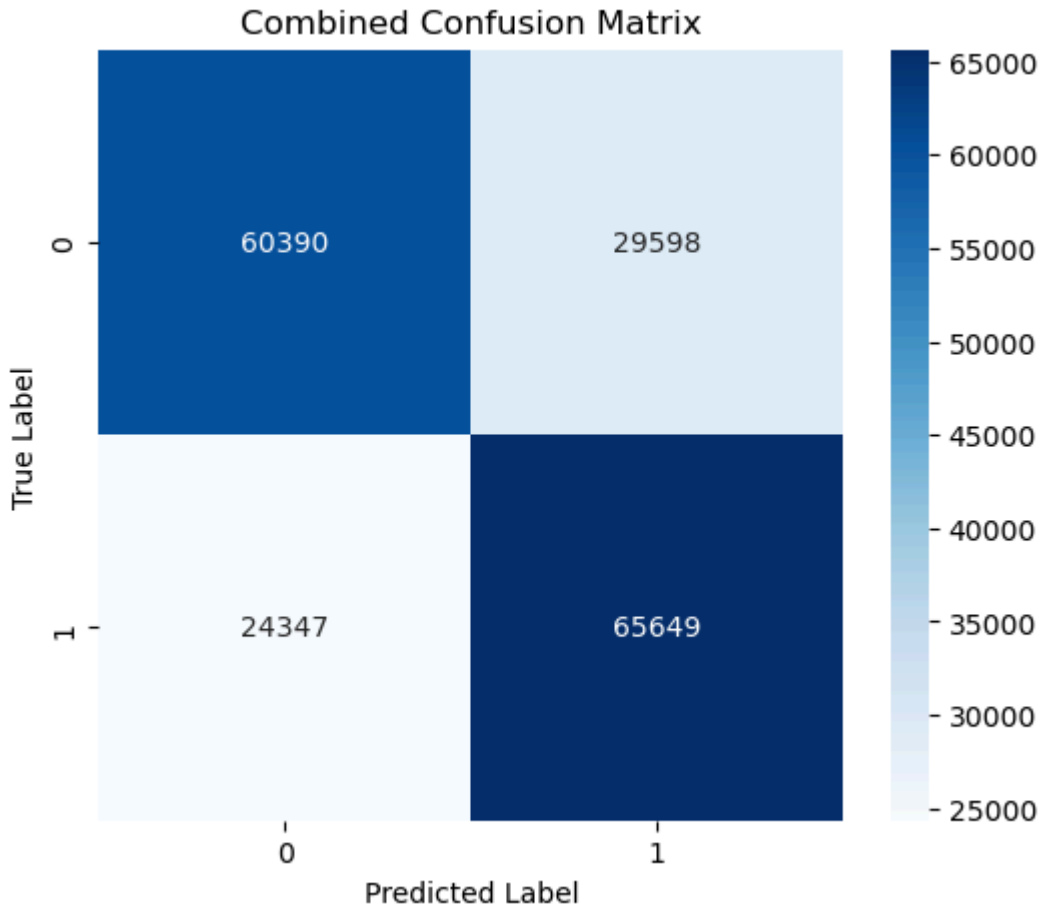



Combined Confusion Matrix (All Models)
60390
29598
24347
65649
Actual
Predicted
0
1
65000
60000
55000
50000
45000
40000
35000
30000
25000

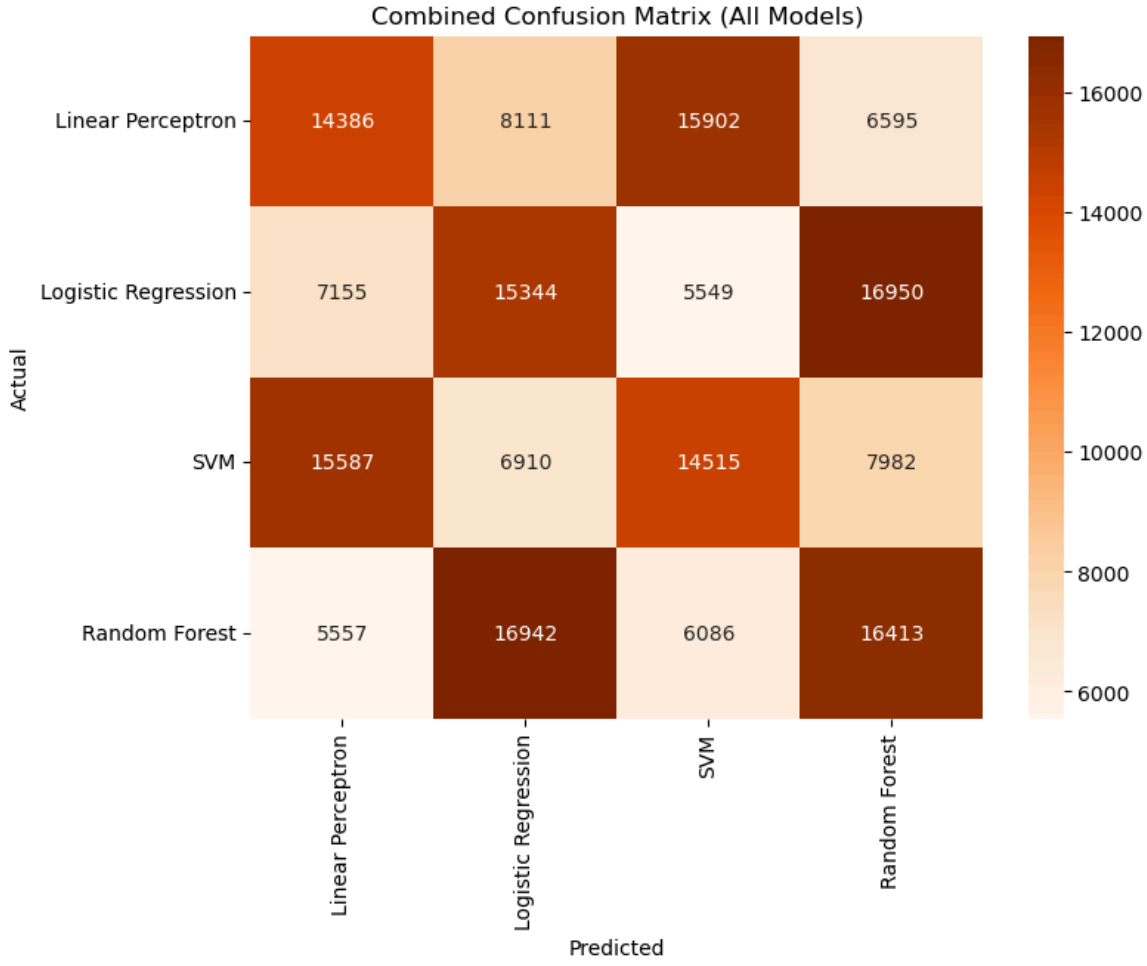

Combined Normalized Confusion Matrix
1.34
0.66
0.54
1.46
Actual
Predicted
0
1
1.4
1.2
1.0
0.8
0.6

In [13]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.linear_model import Perceptron, LogisticRegression
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, confusion_matrix, roc_curv
from sklearn.preprocessing import label_binarize

# Reduce TF-IDF features for faster computation
vectorizer = TfidfVectorizer(max_features=5000)
X_train_tfidf = vectorizer.fit_transform(X_train[:10000])  # Training
X_val_tfidf = vectorizer.transform(X_val)

# Initialize models with optimized parameters
models = {
    "Perceptron": Perceptron(max_iter=500, tol=1e-3, random_state=42),
    "Logistic Regression": LogisticRegression(max_iter=500, random_sta
    "SVM": SVC(kernel='linear', C=1, probability=True),  # probabilit
    "Random Forest": RandomForestClassifier(n_estimators=5, random_sta
}

# Train and evaluate models
accuracies = {}
conf_matrices = {}
roc_curves = {}
roc_aucs = {}

# Convert labels to binary format for ROC curve
y_val_bin = label_binarize(y_val, classes=[0, 1])  # Assuming binary c

for name, model in models.items():
    model.fit(X_train_tfidf, y_train[:10000])  # Training on subset
    y_pred = model.predict(X_val_tfidf)

    # Store accuracy
    accuracies[name] = accuracy_score(y_val, y_pred)

    # Store confusion matrix
    conf_matrices[name] = confusion_matrix(y_val, y_pred)

    # ROC Curve
    if hasattr(model, "predict_proba"):  # Check if model supports pre
        y_proba = model.predict_proba(X_val_tfidf)[:, 1]
        fpr, tpr, _ = roc_curve(y_val, y_proba)
        roc_auc = auc(fpr, tpr)
        roc_curves[name] = (fpr, tpr)
        roc_aucs[name] = roc_auc

# Combine confusion matrices by summing them
combined_matrix = sum(conf_matrices.values())

# Plot combined confusion matrix
plt.figure(figsize=(6, 5))
sns.heatmap(combined_matrix, annot=True, fmt='d', cmap='Blues')
plt.title("Combined Confusion Matrix")
plt.xlabel("Predicted Label")
plt.ylabel("True Label")
```

```
plt.show()
```

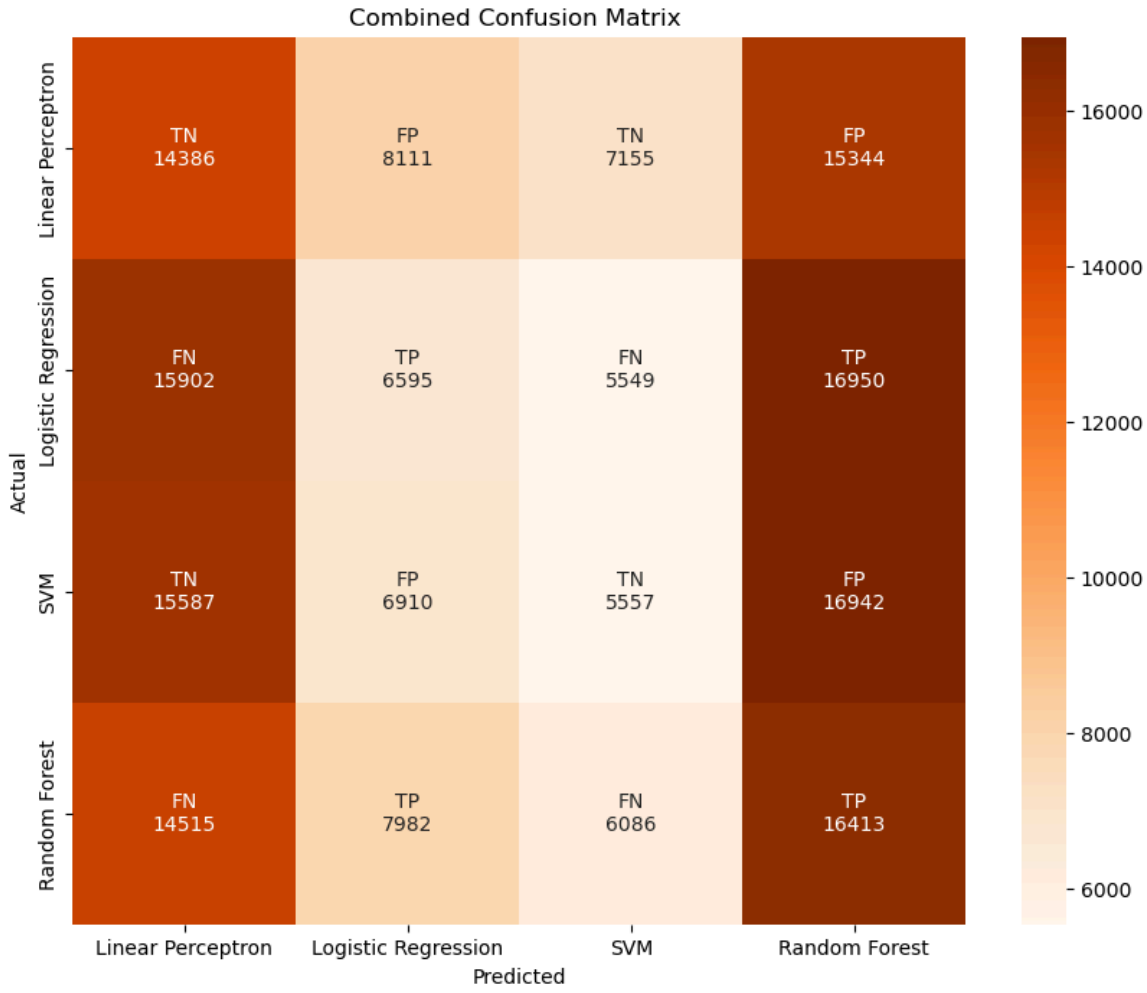

Combined Confusion Matrix
60390
29598
24347
65649
True Label
Predicted Label
0
1
0
1
65000
60000
55000
50000
45000
40000
35000
30000
25000

In [14]:
```
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt

# Initialize a 4x4 matrix to hold confusion matrices for each model
combined_conf_matrix = np.zeros((4, 4), dtype=int)

# Define the size for the grid (2x2 confusion matrices for each model)
matrix_size = 2  # Since we're working with binary classification

# Add confusion matrices of each model to the 4x4 grid
for idx, (name, matrix) in enumerate(conf_matrices.items()):
    row_start = (idx // 2) * matrix_size  # Determine the starting row
    col_start = (idx % 2) * matrix_size  # Determine the starting colu
    combined_conf_matrix[row_start:row_start+matrix_size, col_start:co

# Plotting the combined confusion matrix as a 4x4 matrix
plt.figure(figsize=(8, 6))
sns.heatmap(combined_conf_matrix, annot=True, fmt='d', cmap='Oranges',
            xticklabels=["Linear Perceptron", "Logistic Regression", "
            yticklabels=["Linear Perceptron", "Logistic Regression", "
plt.title("Combined Confusion Matrix (All Models)")
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.show()

# Normalize the confusion matrices and combine them
normalized_matrices = [matrix / matrix.sum() for matrix in conf_matric
combined_normalized = np.zeros((4, 4))

# Add normalized matrices to the combined normalized matrix
for idx, matrix in enumerate(normalized_matrices):
    row_start = (idx // 2) * matrix_size
    col_start = (idx % 2) * matrix_size
    combined_normalized[row_start:row_start+matrix_size, col_start:col

# Plotting the combined normalized confusion matrix as a 4x4 matrix
plt.figure(figsize=(8, 6))
sns.heatmap(combined_normalized, annot=True, fmt='.2f', cmap='Purples',
            xticklabels=["Linear Perceptron", "Logistic Regression", "
            yticklabels=["Linear Perceptron", "Logistic Regression", "
plt.title("Confusion Matrix")
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.show()
```

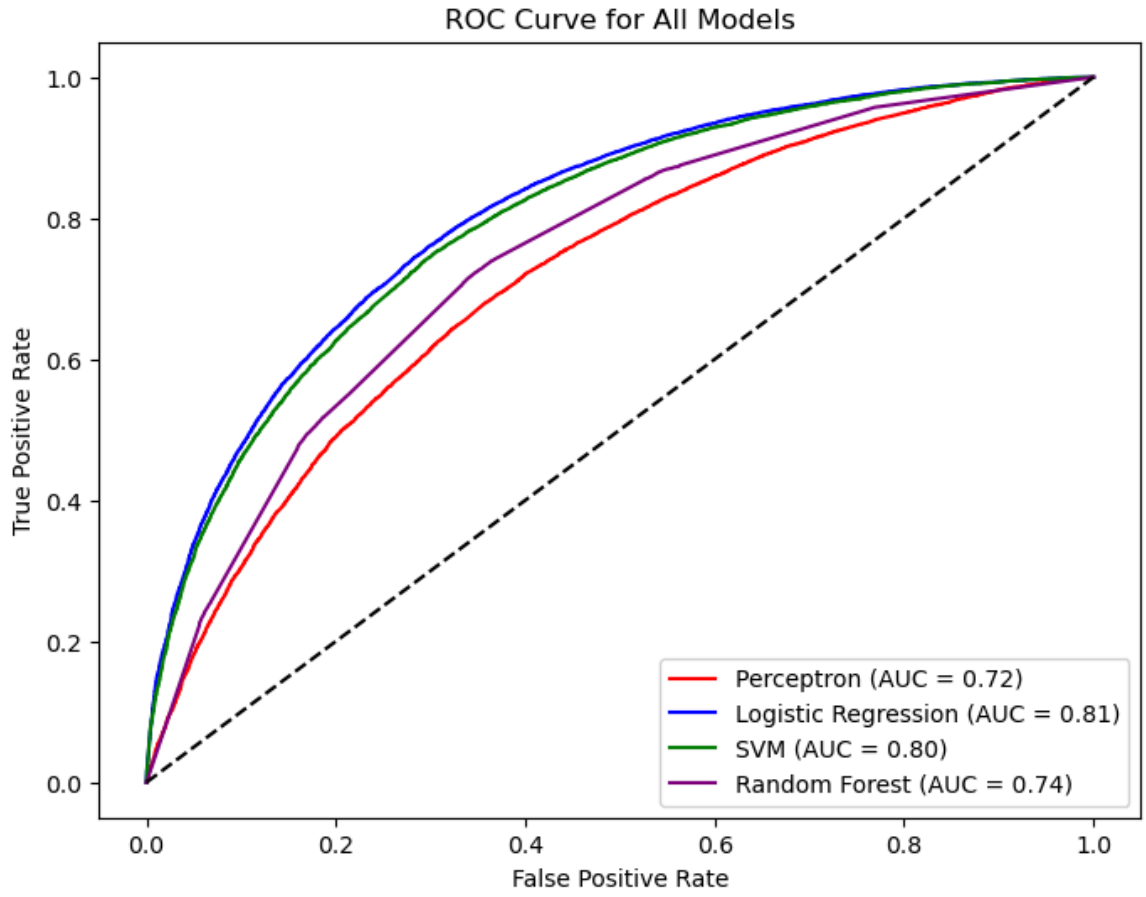

Combined Confusion Matrix (All Models)
Linear Perceptron
Logistic Regression
SVM
Random Forest
Actual
14386
8111
15902
6595
7155
15344
5549
16950
15587
6910
14515
7982
5557
16942
6086
16413
16000
14000
12000
10000
8000
6000
Linear Perceptron
Logistic Regression
SVM
Random Forest
Predicted


Confusion Matrix
Linear Perceptron
Logistic Regression
SVM
Random Forest
Actual
0.32
0.18
0.35
0.15
0.16
0.34
0.12
0.38
0.35
0.15
0.32
0.18
0.12
0.38
0.14
0.36
0.35
0.30
0.25
0.20
0.15
Linear Perceptron
Logistic Regression
SVM
Random Forest
Predicted

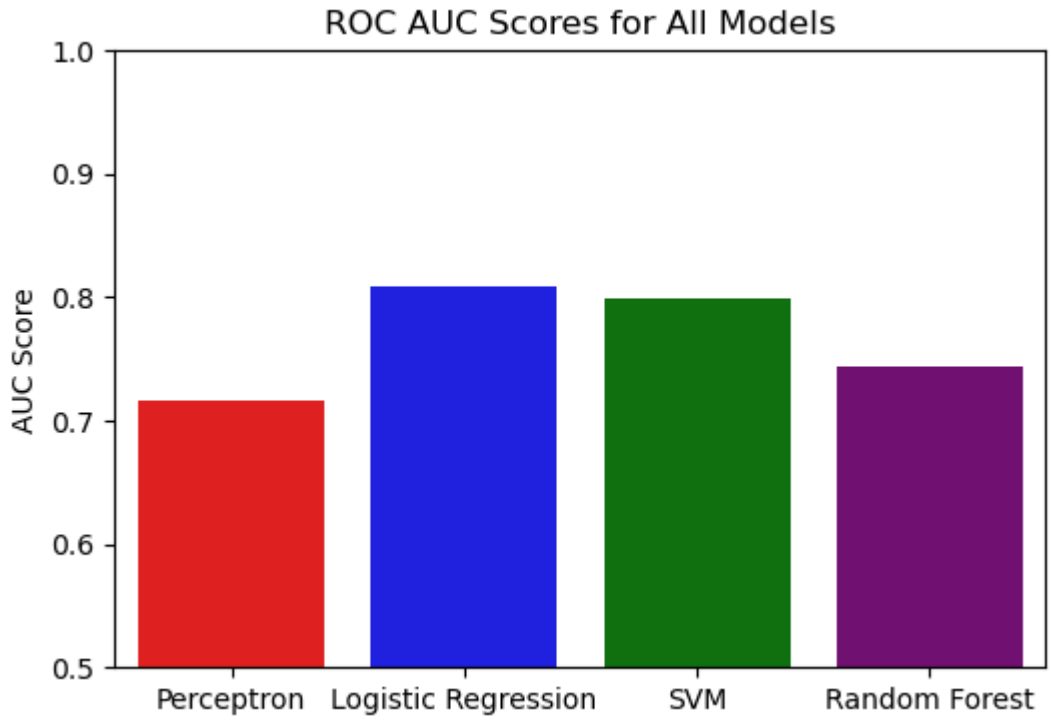
In [17]:
```
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt

# Define confusion matrices for each model
conf_matrices = {
    "Linear Perceptron": np.array([[14386, 8111], [15902, 6595]]),
    "Logistic Regression": np.array([[7155, 15344], [5549, 16950]]),
    "SVM": np.array([[15587, 6910], [14515, 7982]]),
    "Random Forest": np.array([[5557, 16942], [6086, 16413]])
}

model_names = list(conf_matrices.keys())
matrix_size = 2
grid_size = 4

# Combined matrix and annotation text
combined_conf_matrix = np.zeros((grid_size, grid_size), dtype=int)
annotations = [["" for _ in range(grid_size)] for _ in range(grid_size

# Fill combined matrix and annotation labels
for idx, (model, matrix) in enumerate(conf_matrices.items()):
    row_start = (idx // 2) * matrix_size
    col_start = (idx % 2) * matrix_size
    combined_conf_matrix[row_start:row_start+matrix_size, col_start:co

    # Annotating each cell with its meaning
    annotations[row_start][col_start] = f"TN\n{matrix[0][0]}"
    annotations[row_start][col_start+1] = f"FP\n{matrix[0][1]}"
    annotations[row_start+1][col_start] = f"FN\n{matrix[1][0]}"
    annotations[row_start+1][col_start+1] = f"TP\n{matrix[1][1]}"

# Plotting the labeled combined confusion matrix
plt.figure(figsize=(10, 8))
sns.heatmap(combined_conf_matrix, annot=annotations, fmt='', cmap='Ora
            xticklabels=model_names, yticklabels=model_names)
plt.title("Combined Confusion Matrix ")
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.show()
```


Combined Confusion Matrix
Linear Perceptron
Logistic Regression
SVM
Random Forest
Actual
TN 14386
FP 8111
TN 7155
FP 15344
FN 15902
TP 6595
FN 5549
TP 16950
TN 15587
FP 6910
TN 5557
FP 16942
FN 14515
TP 7982
FN 6086
TP 16413
Linear Perceptron
Logistic Regression
SVM
Random Forest
Predicted
16000
14000
12000
10000
8000
6000

In [18]:
```
plt.figure(figsize=(8, 6))

colors = {
    "Perceptron": "red",
    "Logistic Regression": "blue",
    "SVM": "green",
    "Random Forest": "purple"
}

for name, model in models.items():
    if name in ["Perceptron", "SVM"]:
        y_scores = model.decision_function(X_val_tfidf)  # Use decisio
    else:
        y_scores = model.predict_proba(X_val_tfidf)[:, 1]  # Use predi

    fpr, tpr, _ = roc_curve(y_val, y_scores)
    auc_score = auc(fpr, tpr)
    plt.plot(fpr, tpr, color=colors[name], label=f"{name} (AUC = {auc_

plt.plot([0, 1], [0, 1], 'k--')  # Diagonal line
plt.xlabel("False Positive Rate")
plt.ylabel("True Positive Rate")
plt.title("ROC Curve for All Models")
plt.legend()
plt.show()
```



In [19]:
```
from sklearn.metrics import roc_curve, auc

roc_aucs = {}

for name, model in models.items():
    if name in ["Perceptron", "SVM"]:
        y_scores = model.decision_function(X_val_tfidf)  # Use decisio
    else:
        y_scores = model.predict_proba(X_val_tfidf)[:, 1]  # Use predi

    fpr, tpr, _ = roc_curve(y_val, y_scores)
    roc_aucs[name] = auc(fpr, tpr)

# ========== 4️⃣ ROC AUC BAR PLOT ==========
plt.figure(figsize=(6, 4))
sns.barplot(x=list(roc_aucs.keys()), y=list(roc_aucs.values()), palett
plt.title("ROC AUC Scores for All Models")
plt.ylabel("AUC Score")
plt.ylim(0.5, 1.0)  # AUC ranges from 0.5 (random) to 1.0 (perfect)
plt.show()
```



In [20]:
```
pipeline_file = open("text_sentiment.pkl", "wb")
joblib.dump(pipe_lr, pipeline_file)
pipeline_file.close()
```

In [21]:
```
# Choose a model from previously trained models
model = models["Logistic Regression"]  # or "SVM", "Random Forest", "F

# Define test sentences
test_sentences = [
    "My oldest son is making a trip with my mother... I’m missing him'
    "Heading off to bed... Goodnight peeps",
    "Comfortablity has won out",
    "@justineville ...yeahhh. ) i'm 39 tweets from 1,600!",
    "@buggin469 I'm jealous... Kinda miss you guys",
    "blaaah. I don't feel good again",
    "I can't believe I didn't get any sleep last night – not even a si
]

# Transform and predict
test_sentences_tfidf = vectorizer.transform(test_sentences)
predicted_sents = model.predict(test_sentences_tfidf)

# Display results
for i, (sentence, sentiment) in enumerate(zip(test_sentences, predicte
    print(f"Sentence {i+1}: {sentence}")
    print(f"Predicted Sentiment: {'Positive' if sentiment == 1 else 'N
```

```
Sentence 1: My oldest son is making a trip with my mother... I’m mis
sing him
Predicted Sentiment: Negative

Sentence 2: Heading off to bed... Goodnight peeps
Predicted Sentiment: Positive

Sentence 3: Comfortablity has won out
Predicted Sentiment: Positive

Sentence 4: @justineville ...yeahhh. ) i'm 39 tweets from 1,600!
Predicted Sentiment: Positive

Sentence 5: @buggin469 I'm jealous... Kinda miss you guys
Predicted Sentiment: Negative

Sentence 6: blaaah. I don't feel good again
Predicted Sentiment: Negative

Sentence 7: I can't believe I didn't get any sleep last night – not
even a single hour. Coffee isn't helping, and I can't focus on anyth
ing today. It feels like this day just doesn't want to cooperate. 😩
#Exhausted #RunningOnEmpty
Predicted Sentiment: Negative
```

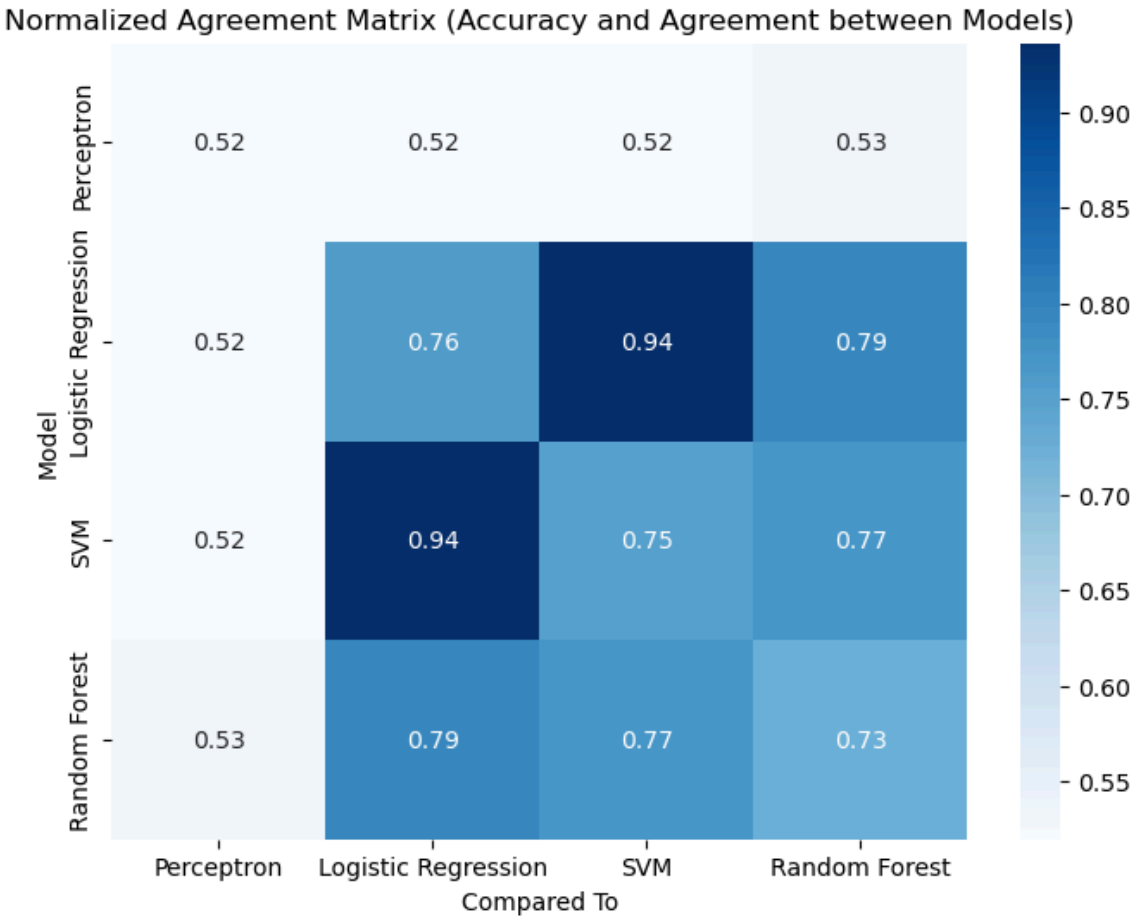
In [22]:
```
!pip install streamlit
```

```
python3.9/site-packages (from pandas<3,>=1.4.0->streamlit) (2024.1)
Requirement already satisfied: certifi>=2017.4.17 in ./opt/anaconda
3/lib/python3.9/site-packages (from requests<3,>=2.27->streamlit)
(2024.8.30)
Requirement already satisfied: charset-normalizer<4,>=2 in ./opt/an
aconda3/lib/python3.9/site-packages (from requests<3,>=2.27->stream
lit) (2.0.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in ./opt/anaconda
3/lib/python3.9/site-packages (from requests<3,>=2.27->streamlit)
(1.26.11)
Requirement already satisfied: idna<4,>=2.5 in ./opt/anaconda3/lib/
python3.9/site-packages (from requests<3,>=2.27->streamlit) (3.3)
Collecting smmap<6,>=3.0.1
  Using cached smmap-5.0.2-py3-none-any.whl (24 kB)
Requirement already satisfied: MarkupSafe>=0.23 in ./opt/anaconda3/
lib/python3.9/site-packages (from jinja2->altair<6,>=4.0->streamli
t) (2.0.1)
Requirement already satisfied: attrs>=17.4.0 in ./opt/anaconda3/li
b/python3.9/site-packages (from jsonschema>=3.0->altair<6,>=4.0->st
reamlit) (21.4.0)
```

In [23]:
```
from sklearn.metrics import precision_score, f1_score

# Dictionaries to store precision and f1 scores
precisions = {}
f1_scores = {}

# Loop through models and predictions
for name, model in models.items():
    y_pred = model.predict(X_val_tfidf)
    precisions[name] = precision_score(y_val, y_pred)
    f1_scores[name] = f1_score(y_val, y_pred)

# Display as DataFrame
metrics_df = pd.DataFrame({
    'Precision': precisions,
    'F1 Score': f1_scores
})

print(metrics_df)
```

```
                     Precision  F1 Score
Perceptron            0.654189  0.667798
Logistic Regression   0.719898  0.736252
SVM                   0.710297  0.731031
Random Forest         0.672802  0.700004
```

In [24]:
```
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.metrics import accuracy_score

# Define model predictions (use the actual predictions of your models
models = {
    'Perceptron': perceptron.predict(X_val_tfidf),
    'Logistic Regression': pipe_lr.predict(X_val),
    'SVM': pipe_svm.predict(X_val),
    'Random Forest': pipe_rf.predict(X_val)
}

model_names = list(models.keys())
n = len(model_names)

# Initialize the agreement matrix
agreement_matrix = np.zeros((n, n))

# Calculate the accuracy for each model and the agreement between the
for i in range(n):
    for j in range(n):
        if i == j:
            # Diagonal: accuracy of each model
            agreement_matrix[i, j] = accuracy_score(y_val, models[mode
        else:
            # Off-diagonal: agreement between two models (proportion o
            match = np.sum(models[model_names[i]] == models[model_name
            agreement_matrix[i, j] = match / len(y_val)

# Normalize the matrix to ensure values between 0 and 1
agreement_matrix = np.clip(agreement_matrix, 0, 1)

# Plotting the normalized agreement matrix
plt.figure(figsize=(8, 6))
sns.heatmap(agreement_matrix, annot=True, fmt='.2f', cmap='Blues',
            xticklabels=model_names, yticklabels=model_names)
plt.title("Normalized Agreement Matrix (Accuracy and Agreement betwee
plt.xlabel("Compared To")
plt.ylabel("Model")
plt.show()
```


Normalized Agreement Matrix (Accuracy and Agreement between Models)
Model
Perceptron
Logistic Regression
SVM
Random Forest
0.52 0.52 0.52 0.53
0.52 0.76 0.94 0.79
0.52 0.94 0.75 0.77
0.53 0.79 0.77 0.73
Perceptron
Logistic Regression
SVM
Random Forest
Compared To
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55