CS 5350/6350, DS 4350: Machine Learning Spring 2024

Project Milestone - 2

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In the previous milestone, I implemented full & depth-limit decision trees with the ID3 algorithm on the misc dataset. In milestone 2, I decided to use simple, average, and aggressive perceptron with learning rates/margins of 0.01, 0.1, and 1 on the glove, a bag of words, and tfidf datasets.

For perceptron, an online learning setup is developed, i.e., updating the weights when we make a mistake. I trained for 20 and 50 epochs, but epochs greater than 20 did not yield much difference. The labels for all the datasets are 0 or 1. To fit into perceptron algorithms, I replaced label 0 with -1. The initial weights for each feature are the same, and values lie within the range of -0.01 to 0.01. The weight vector also has bias with a value of 1.

One of the challenges I faced was the low accuracy of perceptron, less than 50% with labels 0 and 1. After debugging and changing the labels to -1 and 1 worked for me. Later, I replaced -1 with 0 for eval submission. Another improvement of 2% accuracy comes by shuffling the training dataset every epoch with the same random seed.

The results of this milestone are as follows.

- Simple Perceptron on the bag of words and tfidf dataset achieved an accuracy of 67% and 68%, respectively, with a learning rate of 0.01.
- Average Perceptron performed best only on the tfidf dataset with an accuracy of 66%. The other two datasets yielded less than 60% accuracy.
- Aggressive Perceptron also did well on the tfidf dataset with an accuracy of 68%.

My plan for the final milestone is the following:

- To design and develop code to implement Logistic Regression with all the datasets.
- To try out Ensembling Learning on the outputs of decision tree and logistic regression. The outputs from each learning algorithm will be features for the perceptron algorithm.
- Revisit the perceptron using a mixed dataset and normalizing the feature values to see if it increases the accuracy.
- If time permits, I wish to implement neural network classification.

In conclusion, for project milestone 2, I successfully implemented simple, average, and aggressive perceptron on the glove, bag of words, and tfidf dataset and achieved height accuracy of 68%. The results for the test datasets and implementation of my code are on the following pages.

Project Milestone 2

```
import math
import json
import random
import numpy as np
import pandas as pd
```

Dataset Import

```
# Glove
glove_df_train = pd.read_csv("../project_data/data/glove/glove.train.csv")
glove_df_test = pd.read_csv("../project_data/data/glove/glove.test.csv")
glove_df_eval = pd.read_csv("../project_data/data/glove/glove.eval.anon.csv")

# Add bias
glove_df_train["bias"] = 1
glove_df_test["bias"] = 1
glove_df_eval["bias"] = 1

# Replace label 0 with -1
glove_df_train.loc[glove_df_train["label"] == 0, "label"] = -1
glove_df_test.loc[glove_df_test["label"] == 0, "label"] = -1
glove_df_eval.loc[glove_df_eval["label"] == 0, "label"] = -1

glove_df_train

# Bag of words
bow_df_train = pd.read_csv("../project_data/data/bag-of-words/bow.train.csv")
bow_df_test = pd.read_csv("../project_data/data/bag-of-words/bow.test.csv")
bow_df_eval = pd.read_csv("../project_data/data/bag-of-words/bow.eval.anon.csv")

# Add bias
bow_df_train["bias"] = 1
bow_df_test["bias"] = 1
bow_df_eval["bias"] = 1

# Replace label 0 with -1
bow_df_train.loc[bow_df_train["label"] == 0, "label"] = -1
bow_df_test.loc[bow_df_test["label"] == 0, "label"] = -1
bow_df_eval.loc[bow_df_eval["label"] == 0, "label"] = -1


# Bag of words
tfidf_df_train = pd.read_csv("../project_data/data/tfidf/tfidf.train.csv")
tfidf_df_test = pd.read_csv("../project_data/data/tfidf/tfidf.test.csv")
tfidf_df_eval = pd.read_csv("../project_data/data/tfidf/tfidf.eval.anon.csv")


# Add bias
tfidf_df_train["bias"] = 1
tfidf_df_test["bias"] = 1
tfidf_df_eval["bias"] = 1

# Replace label 0 with -1
tfidf_df_train.loc[tfidf_df_train["label"] == 0, "label"] = -1
```

```
tfidf_df_test.loc[tfidf_df_test["label"] == 0, "label"] = -1
tfidf_df_eval.loc[tfidf_df_eval["label"] == 0, "label"] = -1

print("Glove Dataset")
glove_df_train

print("BOW Dataset")
bow_df_train

print("TFIDF Dataset")
tfidf_df_train
```

```
Glove Dataset
BOW Dataset
TFIDF Dataset
```

	label	x0	x1	x2	x3	x4	x5	x6	x7
0	1	0.177057	0.063437	0.083603	0.407604	0.119183	0.096883	0.047931	0.117364
1	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.020774	0.000000
2	-1	0.000000	0.109398	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
3	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
4	1	0.000000	0.000000	0.044455	0.000000	0.000000	0.000000	0.000000	0.000000
...	...	...	...	...	...	...	...	...	...
17495	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
17496	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
17497	-1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
17498	-1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
17499	-1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

17500 rows × 10002 columns

Common Functions

```
def get_max_key_by_value(map):
    max_key = ""
    max_val = float("-inf")

    for key, val in map.items():
        if val > max_val:
            max_val = val
            max_key = key

    # print("map: ", map, "max_key: ", max_key)
    return max_key


def initialize_weights(feature_count):
    rand_start = -0.01
    rand_end = 0.01
    random_number = random.uniform(rand_start, rand_end)

    weights = [] # All weights and bias should be same.
```

```
    for _ in range(feature_count):
        weights.append(random_number)

    return weights


def predict(weights, example):
    value = np.dot(weights, example)
    return 1 if value > 0 else -1


def test_accuracy(df, weights, store_eval=False):
    eval_list = []
    total = df.shape[0]
    correct_prediction = 0

    for _, row in df.iterrows():
        example = row.tolist()
        actual_label = example[0]  # y
        example = example[1:]  # x

        predicted_label = predict(weights, example)
        if predicted_label == actual_label:
            correct_prediction += 1

        if store_eval:
            eval_list.append(predicted_label)

    # print(f"Test accuracy. Correct Pred: {correct_prediction}, Total: {total}")
    return correct_prediction / total, eval_list


def export_prediction_to_csv(file_name, prediction_list):
    # Change back -1 to 0
    for index, p in enumerate(prediction_list):
        if p == -1:
            prediction_list[index] = 0


    df = pd.DataFrame(prediction_list)
    df.to_csv(file_name, index=True, index_label="example_id", header=["label"])
```

Simple Perceptron

```
epochs = 50
learning_rates = [1, 0.1, 0.01]


def simple_perceptron(df, learning_rate, weights):
    for _, row in df.iterrows():
        example = row.tolist()
        actual_label = example[0]  # y
        example = example[1:]  # x

        value = actual_label * (np.dot(weights, example))

        # update
        if value < 0:
            for index in range(len(weights)):
```

```
                # w = w + r * y * x
                weights[index] += learning_rate * actual_label * example[index]

    return weights


def simple_perceptron_setup(df_train, df_test):
    best_weights = []
    best_accuracy = 0.0
    best_learning_rate = 0.0

    initial_weights = initialize_weights(feature_count=df_train.shape[1] - 1)

    for learning_rate in learning_rates:
        weights = initial_weights[:]  # New learning rate start with same initial weig
        print(f"\n\tLearning rate: {learning_rate}")

        for epoch in range(epochs):
            # Shuffle the whole data frame.
            df_train = df_train.sample(frac=1, random_state=1)

            weights = simple_perceptron(df=df_train, learning_rate=learning_rate, weig
            accuracy, _ = test_accuracy(df=df_test, weights=weights, store_eval=False)
            print(f"\t\tEpoch: {epoch + 1}, Accuracy: {accuracy}")

            if accuracy >= best_accuracy:
                best_accuracy = accuracy
                best_weights = weights
                best_learning_rate = learning_rate

    return best_learning_rate, best_accuracy, best_weights
```

Average Perceptron

```
epochs = 50
learning_rates = [1, 0.1, 0.01]


def average_perceptron(df, learning_rate, weights, avg_weights):
    for _, row in df.iterrows():
        example = row.tolist()
        actual_label = example[0]  # y
        example = example[1:]  # x

        # y(wT x + b)
        value = actual_label * (np.dot(weights, example))

        # update
        if value < 0:
            for index in range(len(weights)):
                # w = w + r * y * x
                weights[index] += learning_rate * actual_label * example[index]

        for index in range(len(weights)):
            avg_weights[index] += weights[index]

    return weights, avg_weights


def average_perceptron_setup(df_train, df_test):
```

```
    best_weights = []
    best_accuracy = 0.0
    best_learning_rate = 0.0

    initial_weights = initialize_weights(feature_count=df_train.shape[1] - 1)

    for learning_rate in learning_rates:
        weights = initial_weights[:]  # New learning rate start with same initial weig
        avg_weights = initial_weights[:]  # Copy the list because list is mutable.
        print(f"\n\tLearning rate: {learning_rate}")

        for epoch in range(epochs):
            # Shuffle the whole data frame.
            df_train = df_train.sample(frac=1, random_state=1)

            weights, avg_weights = average_perceptron(
                df=df_train, learning_rate=learning_rate, weights=weights, avg_weights
            )
            accuracy, _ = test_accuracy(df=df_test, weights=avg_weights, store_eval=Fa
            print(f"\t\tEpoch: {epoch + 1}, Accuracy: {accuracy}")

            if accuracy >= best_accuracy:
                best_accuracy = accuracy
                best_weights = weights

                best_learning_rate = learning_rate

    return best_learning_rate, best_accuracy, best_weights
```

Aggressive Perceptron

```
epochs = 50
margins = [1, 0.1, 0.01]

def aggressive_perceptron(df, margin, weights):
    for _, row in df.iterrows():
        example = row.tolist()
        actual_label = example[0]  # y
        example = example[1:]  # x

        # y(wT x + b)
        learning_rate = (margin - (actual_label * (np.dot(weights, example)))) / (np.d
        value = actual_label * (np.dot(weights, example))

        # update
        if value <= margin:
            for index in range(len(weights)):
                # w = w + r * y * x
                weights[index] += learning_rate * actual_label * example[index]

    return weights

def aggressive_perceptron_setup(df_train, df_test):
    best_weights = []
    best_margin = 0.0
    best_accuracy = 0.0

    initial_weights = initialize_weights(feature_count=df_train.shape[1] - 1)

    for margin in margins:
```

```
        weights = initial_weights[:]  # New learning rate start with same initial weig
        print(f"\n\tMargin: {margin}")

        for epoch in range(epochs):
            # Shuffle the whole data frame.
            df_train = df_train.sample(frac=1, random_state=1)

            weights = aggressive_perceptron(df=df_train, margin=margin, weights=weight
            accuracy, _ = test_accuracy(df=df_test, weights=weights, store_eval=False
            print(f"\t\tEpoch: {epoch + 1}, Accuracy: {accuracy}")

            if accuracy >= best_accuracy:
                best_accuracy = accuracy
                best_weights = weights
                best_margin = margin

    return best_margin, best_accuracy, best_weights
```

Training Setup & Results

To invoke one of more datasets on one or more perceptron.

```
dataset_setup_dict = {
    "Glove": {"Train": glove_df_train, "Test": glove_df_test, "Eval": glove_df_eval},
    "BOW": {"Train": bow_df_train, "Test": bow_df_test, "Eval": bow_df_eval},
    "TFIDF": {"Train": tfidf_df_train, "Test": tfidf_df_test, "Eval": tfidf_df_eval},
}

train_setup_dict = {
    "PerceptronMap": {
        "Simple": simple_perceptron_setup,
        "Average": average_perceptron_setup,
        "Aggressive": aggressive_perceptron_setup,
    },
    # "Datasets": ["Glove"],
    # "Datasets": ["BOW"],
    # "Datasets": ["TFIDF"],
    "Datasets": ["Glove", "BOW", "TFIDF"],
    # "PerceptronSetups": ["Simple"],
    # "PerceptronSetups": ["Average"],
    # "PerceptronSetups": ["Aggressive"],
    "PerceptronSetups": ["Simple", "Average", "Aggressive"],
}


def train_setup():
    for perceptron in train_setup_dict["PerceptronSetups"]:
        for dataset in train_setup_dict["Datasets"]:
            print(f"\n{perceptron} Perceptron: {dataset} Dataset\n")

            best_hyper_param, best_accuracy, best_weights = train_setup_dict["Percept
                df_train=dataset_setup_dict[dataset]["Train"], df_test=dataset_setup_
            )

            print(f"\n\tBest parameter: {best_hyper_param} & test accuracy: ", best_a
            _, prediction_list = test_accuracy(
                df=dataset_setup_dict[dataset]["Eval"], weights=best_weights, store_ev
            )
```

```
            export_file_name = "{0}_perceptron_{1}_eval_dataset_prediction.csv".format(
                perceptron.lower(), dataset.lower()
            )
            export_prediction_to_csv(export_file_name, prediction_list)


train_setup()
```

```
Simple Perceptron


        Glove Dataset

        Learning rate: 1
                Epoch: 1, Accuracy: 0.5906666666666667
                Epoch: 2, Accuracy: 0.6413333333333333
                Epoch: 3, Accuracy: 0.6048888888888889
                Epoch: 4, Accuracy: 0.6231111111111111
                Epoch: 5, Accuracy: 0.5662222222222222
                Epoch: 6, Accuracy: 0.6311111111111111
                Epoch: 7, Accuracy: 0.56
                Epoch: 8, Accuracy: 0.5324444444444445
                Epoch: 9, Accuracy: 0.5226666666666666
                Epoch: 10, Accuracy: 0.6084444444444445
                Epoch: 11, Accuracy: 0.5337777777777778
                Epoch: 12, Accuracy: 0.5688888888888889
                Epoch: 13, Accuracy: 0.6306666666666667
                Epoch: 14, Accuracy: 0.6417777777777778
                Epoch: 15, Accuracy: 0.528
                Epoch: 16, Accuracy: 0.5813333333333334
                Epoch: 17, Accuracy: 0.6373333333333333
                Epoch: 18, Accuracy: 0.5222222222222223
                Epoch: 19, Accuracy: 0.6284444444444445
                Epoch: 20, Accuracy: 0.5466666666666666
                Epoch: 21, Accuracy: 0.5631111111111111
                Epoch: 22, Accuracy: 0.5386666666666666
                Epoch: 23, Accuracy: 0.536
                Epoch: 24, Accuracy: 0.5262222222222223
                Epoch: 25, Accuracy: 0.6102222222222222
                Epoch: 26, Accuracy: 0.6026666666666667
                Epoch: 27, Accuracy: 0.6342222222222222
                Epoch: 28, Accuracy: 0.6204444444444445
                Epoch: 29, Accuracy: 0.624
                Epoch: 30, Accuracy: 0.6324444444444445
                Epoch: 31, Accuracy: 0.6022222222222222
                Epoch: 32, Accuracy: 0.5444444444444444
                Epoch: 33, Accuracy: 0.5933333333333334
                Epoch: 34, Accuracy: 0.5906666666666667
                Epoch: 35, Accuracy: 0.5493333333333333
                Epoch: 36, Accuracy: 0.5902222222222222
                Epoch: 37, Accuracy: 0.6155555555555555
                Epoch: 38, Accuracy: 0.6133333333333333
                Epoch: 39, Accuracy: 0.54
                Epoch: 40, Accuracy: 0.5417777777777778
                Epoch: 41, Accuracy: 0.5933333333333334
                Epoch: 42, Accuracy: 0.5168888888888888
                Epoch: 43, Accuracy: 0.6191111111111111
                Epoch: 44, Accuracy: 0.5404444444444444
                Epoch: 45, Accuracy: 0.5391111111111111
                Epoch: 46, Accuracy: 0.5977777777777777
                Epoch: 47, Accuracy: 0.6288888888888889
                Epoch: 48, Accuracy: 0.6128888888888889
                Epoch: 49, Accuracy: 0.5884444444444444
```

```
        Epoch: 49, Accuracy: 0.5884444444444444
        Epoch: 50, Accuracy: 0.548


Learning rate: 0.1
        Epoch: 1, Accuracy: 0.624
        Epoch: 2, Accuracy: 0.624
        Epoch: 3, Accuracy: 0.5653333333333334
        Epoch: 4, Accuracy: 0.5466666666666666
        Epoch: 5, Accuracy: 0.6026666666666667
        Epoch: 6, Accuracy: 0.58
        Epoch: 7, Accuracy: 0.5231111111111111
        Epoch: 8, Accuracy: 0.6253333333333333
        Epoch: 9, Accuracy: 0.5595555555555556
        Epoch: 10, Accuracy: 0.62
        Epoch: 11, Accuracy: 0.6488888888888888
        Epoch: 12, Accuracy: 0.5577777777777778
        Epoch: 13, Accuracy: 0.6093333333333333
        Epoch: 14, Accuracy: 0.6266666666666667
        Epoch: 15, Accuracy: 0.5173333333333333
        Epoch: 16, Accuracy: 0.6195555555555555
        Epoch: 17, Accuracy: 0.6404444444444445
        Epoch: 18, Accuracy: 0.5991111111111111
        Epoch: 19, Accuracy: 0.6151111111111112
        Epoch: 20, Accuracy: 0.6213333333333333
        Epoch: 21, Accuracy: 0.6368888888888888
        Epoch: 22, Accuracy: 0.6222222222222222
        Epoch: 23, Accuracy: 0.6124444444444445
        Epoch: 24, Accuracy: 0.6431111111111111
        Epoch: 25, Accuracy: 0.5813333333333334
        Epoch: 26, Accuracy: 0.6391111111111111
        Epoch: 27, Accuracy: 0.5533333333333333
        Epoch: 28, Accuracy: 0.6328888888888888
        Epoch: 29, Accuracy: 0.588
        Epoch: 30, Accuracy: 0.5213333333333333
        Epoch: 31, Accuracy: 0.6506666666666666
        Epoch: 32, Accuracy: 0.6333333333333333
        Epoch: 33, Accuracy: 0.6151111111111112
        Epoch: 34, Accuracy: 0.6235555555555555
        Epoch: 35, Accuracy: 0.6191111111111111
        Epoch: 36, Accuracy: 0.5244444444444445
        Epoch: 37, Accuracy: 0.5315555555555556
        Epoch: 38, Accuracy: 0.5386666666666666
        Epoch: 39, Accuracy: 0.5093333333333333
        Epoch: 40, Accuracy: 0.5964444444444444
        Epoch: 41, Accuracy: 0.6271111111111111
        Epoch: 42, Accuracy: 0.6151111111111112
        Epoch: 43, Accuracy: 0.5893333333333334
        Epoch: 44, Accuracy: 0.5035555555555555
        Epoch: 45, Accuracy: 0.588
        Epoch: 46, Accuracy: 0.6511111111111111
        Epoch: 47, Accuracy: 0.576
        Epoch: 48, Accuracy: 0.6253333333333333
        Epoch: 49, Accuracy: 0.532
        Epoch: 50, Accuracy: 0.6173333333333333


Learning rate: 0.01
        Epoch: 1, Accuracy: 0.588
        Epoch: 2, Accuracy: 0.6235555555555555
        Epoch: 3, Accuracy: 0.6257777777777778
        Epoch: 4, Accuracy: 0.5395555555555556
```

```
        Epoch: 5, Accuracy: 0.504
        Epoch: 6, Accuracy: 0.6488888888888888
        Epoch: 7, Accuracy: 0.5333333333333333
        Epoch: 8, Accuracy: 0.548
        Epoch: 9, Accuracy: 0.5773333333333334
        Epoch: 10, Accuracy: 0.6186666666666667
        Epoch: 11, Accuracy: 0.6195555555555555
        Epoch: 12, Accuracy: 0.5866666666666667
        Epoch: 13, Accuracy: 0.5493333333333333
        Epoch: 14, Accuracy: 0.5377777777777778
        Epoch: 15, Accuracy: 0.5986666666666667
        Epoch: 16, Accuracy: 0.5893333333333334
        Epoch: 17, Accuracy: 0.6008888888888889
        Epoch: 18, Accuracy: 0.5613333333333334
        Epoch: 19, Accuracy: 0.5631111111111111
        Epoch: 20, Accuracy: 0.6057777777777777
        Epoch: 21, Accuracy: 0.6444444444444445
        Epoch: 22, Accuracy: 0.5493333333333333
        Epoch: 23, Accuracy: 0.5146666666666667
        Epoch: 24, Accuracy: 0.6582222222222223
        Epoch: 25, Accuracy: 0.6226666666666667
        Epoch: 26, Accuracy: 0.6417777777777778
        Epoch: 27, Accuracy: 0.6088888888888889
        Epoch: 28, Accuracy: 0.5995555555555555
        Epoch: 29, Accuracy: 0.5906666666666667
        Epoch: 30, Accuracy: 0.5471111111111111
        Epoch: 31, Accuracy: 0.5648888888888889
        Epoch: 32, Accuracy: 0.5888888888888889
        Epoch: 33, Accuracy: 0.5435555555555556
        Epoch: 34, Accuracy: 0.6168888888888889
        Epoch: 35, Accuracy: 0.6435555555555555
        Epoch: 36, Accuracy: 0.62
        Epoch: 37, Accuracy: 0.5071111111111111
        Epoch: 38, Accuracy: 0.6084444444444445
        Epoch: 39, Accuracy: 0.6248888888888889
        Epoch: 40, Accuracy: 0.568
        Epoch: 41, Accuracy: 0.5706666666666667
        Epoch: 42, Accuracy: 0.58
        Epoch: 43, Accuracy: 0.6288888888888889
        Epoch: 44, Accuracy: 0.5844444444444444
        Epoch: 45, Accuracy: 0.608
        Epoch: 46, Accuracy: 0.608
        Epoch: 47, Accuracy: 0.5764444444444444
        Epoch: 48, Accuracy: 0.636
        Epoch: 49, Accuracy: 0.5844444444444444
        Epoch: 50, Accuracy: 0.6422222222222222

Best parameter: 0.01 & test accuracy:  0.6582222222222223

BOW Dataset

Learning rate: 1
        Epoch: 1, Accuracy: 0.6715555555555556
        Epoch: 2, Accuracy: 0.6591111111111111
        Epoch: 3, Accuracy: 0.6462222222222223
        Epoch: 4, Accuracy: 0.6604444444444444
        Epoch: 5, Accuracy: 0.6622222222222223
        Epoch: 6, Accuracy: 0.6733333333333333
        Epoch: 7, Accuracy: 0.6777777777777778
        Epoch: 8, Accuracy: 0.6822222222222222
        Epoch: 9, Accuracy: 0.6755555555555556
```

```
        Epoch: 10, Accuracy: 0.6857777777777778
        Epoch: 11, Accuracy: 0.6622222222222223
        Epoch: 12, Accuracy: 0.6853333333333333
        Epoch: 13, Accuracy: 0.6804444444444444
        Epoch: 14, Accuracy: 0.6826666666666666
        Epoch: 15, Accuracy: 0.6857777777777778
        Epoch: 16, Accuracy: 0.6777777777777778
        Epoch: 17, Accuracy: 0.6764444444444444
        Epoch: 18, Accuracy: 0.6866666666666666
        Epoch: 19, Accuracy: 0.6946666666666667
        Epoch: 20, Accuracy: 0.6902222222222222
        Epoch: 21, Accuracy: 0.6777777777777778
        Epoch: 22, Accuracy: 0.6902222222222222
        Epoch: 23, Accuracy: 0.6911111111111111
        Epoch: 24, Accuracy: 0.6906666666666667
        Epoch: 25, Accuracy: 0.6822222222222222
        Epoch: 26, Accuracy: 0.6973333333333334
        Epoch: 27, Accuracy: 0.696
        Epoch: 28, Accuracy: 0.6831111111111111
        Epoch: 29, Accuracy: 0.6844444444444444
        Epoch: 30, Accuracy: 0.6991111111111111
        Epoch: 31, Accuracy: 0.688
        Epoch: 32, Accuracy: 0.6857777777777778
        Epoch: 33, Accuracy: 0.7008888888888889
        Epoch: 34, Accuracy: 0.6844444444444444
        Epoch: 35, Accuracy: 0.6884444444444444
        Epoch: 36, Accuracy: 0.6973333333333334
        Epoch: 37, Accuracy: 0.6951111111111111
        Epoch: 38, Accuracy: 0.6915555555555556
        Epoch: 39, Accuracy: 0.6871111111111111
        Epoch: 40, Accuracy: 0.6946666666666667
        Epoch: 41, Accuracy: 0.6893333333333334
        Epoch: 42, Accuracy: 0.7
        Epoch: 43, Accuracy: 0.6991111111111111
        Epoch: 44, Accuracy: 0.6871111111111111
        Epoch: 45, Accuracy: 0.6888888888888889
        Epoch: 46, Accuracy: 0.6897777777777778
        Epoch: 47, Accuracy: 0.6951111111111111
        Epoch: 48, Accuracy: 0.6924444444444444
        Epoch: 49, Accuracy: 0.6751111111111111
        Epoch: 50, Accuracy: 0.6866666666666666


Learning rate: 0.1
        Epoch: 1, Accuracy: 0.6608888888888889
        Epoch: 2, Accuracy: 0.6595555555555556
        Epoch: 3, Accuracy: 0.6662222222222223
        Epoch: 4, Accuracy: 0.6693333333333333
        Epoch: 5, Accuracy: 0.6684444444444444
        Epoch: 6, Accuracy: 0.6782222222222222
        Epoch: 7, Accuracy: 0.6697777777777778
        Epoch: 8, Accuracy: 0.6551111111111111
        Epoch: 9, Accuracy: 0.6804444444444444
        Epoch: 10, Accuracy: 0.6866666666666666
        Epoch: 11, Accuracy: 0.6777777777777778
        Epoch: 12, Accuracy: 0.688
        Epoch: 13, Accuracy: 0.6875555555555556
        Epoch: 14, Accuracy: 0.6995555555555556
        Epoch: 15, Accuracy: 0.6871111111111111
        Epoch: 16, Accuracy: 0.6728888888888889
        Epoch: 17, Accuracy: 0.7017777777777777
        Epoch: 18, Accuracy: 0.6933333333333334
```

Epoch: 18, Accuracy: 0.6795555555555556
Epoch: 19, Accuracy: 0.6795555555555556
Epoch: 20, Accuracy: 0.68
Epoch: 21, Accuracy: 0.6848888888888889
Epoch: 22, Accuracy: 0.6977777777777778
Epoch: 23, Accuracy: 0.6906666666666667
Epoch: 24, Accuracy: 0.6835555555555556
Epoch: 25, Accuracy: 0.6902222222222222
Epoch: 26, Accuracy: 0.6822222222222222
Epoch: 27, Accuracy: 0.6951111111111111
Epoch: 28, Accuracy: 0.6911111111111111
Epoch: 29, Accuracy: 0.6968888888888889
Epoch: 30, Accuracy: 0.688
Epoch: 31, Accuracy: 0.6893333333333334
Epoch: 32, Accuracy: 0.6893333333333334
Epoch: 33, Accuracy: 0.6862222222222222
Epoch: 34, Accuracy: 0.6968888888888889
Epoch: 35, Accuracy: 0.6884444444444444
Epoch: 36, Accuracy: 0.6755555555555556
Epoch: 37, Accuracy: 0.6946666666666667
Epoch: 38, Accuracy: 0.6782222222222222
Epoch: 39, Accuracy: 0.6777777777777778
Epoch: 40, Accuracy: 0.6813333333333333
Epoch: 41, Accuracy: 0.688
Epoch: 42, Accuracy: 0.6911111111111111
Epoch: 43, Accuracy: 0.6813333333333333
Epoch: 44, Accuracy: 0.6906666666666667
Epoch: 45, Accuracy: 0.6942222222222222
Epoch: 46, Accuracy: 0.6915555555555556
Epoch: 47, Accuracy: 0.6764444444444444
Epoch: 48, Accuracy: 0.6888888888888889
Epoch: 49, Accuracy: 0.6862222222222222
Epoch: 50, Accuracy: 0.6844444444444444

Learning rate: 0.01
Epoch: 1, Accuracy: 0.6457777777777778
Epoch: 2, Accuracy: 0.6426666666666667
Epoch: 3, Accuracy: 0.652
Epoch: 4, Accuracy: 0.6862222222222222
Epoch: 5, Accuracy: 0.6764444444444444
Epoch: 6, Accuracy: 0.6755555555555556
Epoch: 7, Accuracy: 0.6773333333333333
Epoch: 8, Accuracy: 0.6755555555555556
Epoch: 9, Accuracy: 0.6804444444444444
Epoch: 10, Accuracy: 0.652
Epoch: 11, Accuracy: 0.6751111111111111
Epoch: 12, Accuracy: 0.6822222222222222
Epoch: 13, Accuracy: 0.6737777777777778
Epoch: 14, Accuracy: 0.6915555555555556
Epoch: 15, Accuracy: 0.6782222222222222
Epoch: 16, Accuracy: 0.676
Epoch: 17, Accuracy: 0.6857777777777778
Epoch: 18, Accuracy: 0.696
Epoch: 19, Accuracy: 0.6742222222222222
Epoch: 20, Accuracy: 0.6884444444444444
Epoch: 21, Accuracy: 0.6968888888888889
Epoch: 22, Accuracy: 0.6822222222222222
Epoch: 23, Accuracy: 0.6853333333333333
Epoch: 24, Accuracy: 0.6795555555555556
Epoch: 25, Accuracy: 0.6928888888888889
Epoch: 26, Accuracy: 0.6893333333333334

```
        Epoch: 27, Accuracy: 0.6862222222222222
        Epoch: 28, Accuracy: 0.6808888888888889
        Epoch: 29, Accuracy: 0.6897777777777778
        Epoch: 30, Accuracy: 0.6888888888888889
        Epoch: 31, Accuracy: 0.6866666666666666
        Epoch: 32, Accuracy: 0.6871111111111111
        Epoch: 33, Accuracy: 0.6835555555555556
        Epoch: 34, Accuracy: 0.6906666666666667
        Epoch: 35, Accuracy: 0.6866666666666666
        Epoch: 36, Accuracy: 0.692
        Epoch: 37, Accuracy: 0.6768888888888889
        Epoch: 38, Accuracy: 0.6924444444444444
        Epoch: 39, Accuracy: 0.6804444444444444
        Epoch: 40, Accuracy: 0.6937777777777778
        Epoch: 41, Accuracy: 0.6808888888888889
        Epoch: 42, Accuracy: 0.6942222222222222
        Epoch: 43, Accuracy: 0.6844444444444444
        Epoch: 44, Accuracy: 0.68
        Epoch: 45, Accuracy: 0.688
        Epoch: 46, Accuracy: 0.6942222222222222
        Epoch: 47, Accuracy: 0.6808888888888889
        Epoch: 48, Accuracy: 0.6906666666666667
        Epoch: 49, Accuracy: 0.6942222222222222
        Epoch: 50, Accuracy: 0.6937777777777778

Best parameter: 0.1 & test accuracy:  0.7017777777777777

TFIDF Dataset

Learning rate: 1
        Epoch: 1, Accuracy: 0.6288888888888889
        Epoch: 2, Accuracy: 0.6884444444444444
        Epoch: 3, Accuracy: 0.6977777777777778
        Epoch: 4, Accuracy: 0.716
        Epoch: 5, Accuracy: 0.6782222222222222
        Epoch: 6, Accuracy: 0.7048888888888889
        Epoch: 7, Accuracy: 0.6222222222222222
        Epoch: 8, Accuracy: 0.688
        Epoch: 9, Accuracy: 0.6933333333333334
        Epoch: 10, Accuracy: 0.7111111111111111
        Epoch: 11, Accuracy: 0.6915555555555556
        Epoch: 12, Accuracy: 0.6795555555555556
        Epoch: 13, Accuracy: 0.684
        Epoch: 14, Accuracy: 0.7044444444444444
        Epoch: 15, Accuracy: 0.7035555555555556
        Epoch: 16, Accuracy: 0.6955555555555556
        Epoch: 17, Accuracy: 0.6946666666666667
        Epoch: 18, Accuracy: 0.6942222222222222
        Epoch: 19, Accuracy: 0.6937777777777778
        Epoch: 20, Accuracy: 0.6955555555555556
        Epoch: 21, Accuracy: 0.7017777777777777
        Epoch: 22, Accuracy: 0.6973333333333334
        Epoch: 23, Accuracy: 0.6915555555555556
        Epoch: 24, Accuracy: 0.7044444444444444
        Epoch: 25, Accuracy: 0.6982222222222222
        Epoch: 26, Accuracy: 0.6871111111111111
        Epoch: 27, Accuracy: 0.7031111111111111
        Epoch: 28, Accuracy: 0.7004444444444444
        Epoch: 29, Accuracy: 0.6991111111111111
        Epoch: 30, Accuracy: 0.6942222222222222
        Epoch: 31, Accuracy: 0.6693333333333333
```

```
        Epoch: 32, Accuracy: 0.6942222222222222
        Epoch: 33, Accuracy: 0.6906666666666667
        Epoch: 34, Accuracy: 0.6951111111111111
        Epoch: 35, Accuracy: 0.6582222222222223
        Epoch: 36, Accuracy: 0.6982222222222222
        Epoch: 37, Accuracy: 0.6897777777777778
        Epoch: 38, Accuracy: 0.6915555555555556
        Epoch: 39, Accuracy: 0.6582222222222223
        Epoch: 40, Accuracy: 0.6773333333333333
        Epoch: 41, Accuracy: 0.6746666666666666
        Epoch: 42, Accuracy: 0.6915555555555556
        Epoch: 43, Accuracy: 0.6751111111111111
        Epoch: 44, Accuracy: 0.6733333333333333
        Epoch: 45, Accuracy: 0.6888888888888889
        Epoch: 46, Accuracy: 0.664
        Epoch: 47, Accuracy: 0.6933333333333334
        Epoch: 48, Accuracy: 0.6933333333333334
        Epoch: 49, Accuracy: 0.6902222222222222
        Epoch: 50, Accuracy: 0.6684444444444444


Learning rate: 0.1
        Epoch: 1, Accuracy: 0.6173333333333333
        Epoch: 2, Accuracy: 0.6991111111111111
        Epoch: 3, Accuracy: 0.6706666666666666
        Epoch: 4, Accuracy: 0.6368888888888888
        Epoch: 5, Accuracy: 0.6742222222222222
        Epoch: 6, Accuracy: 0.6795555555555556
        Epoch: 7, Accuracy: 0.6102222222222222
        Epoch: 8, Accuracy: 0.7022222222222222
        Epoch: 9, Accuracy: 0.6973333333333334
        Epoch: 10, Accuracy: 0.6915555555555556
        Epoch: 11, Accuracy: 0.6928888888888889
        Epoch: 12, Accuracy: 0.684
        Epoch: 13, Accuracy: 0.6853333333333333
        Epoch: 14, Accuracy: 0.6986666666666667
        Epoch: 15, Accuracy: 0.6937777777777778
        Epoch: 16, Accuracy: 0.6942222222222222
        Epoch: 17, Accuracy: 0.6928888888888889
        Epoch: 18, Accuracy: 0.6515555555555556
        Epoch: 19, Accuracy: 0.692
        Epoch: 20, Accuracy: 0.7
        Epoch: 21, Accuracy: 0.6835555555555556
        Epoch: 22, Accuracy: 0.7
        Epoch: 23, Accuracy: 0.6942222222222222
        Epoch: 24, Accuracy: 0.692
        Epoch: 25, Accuracy: 0.6613333333333333
        Epoch: 26, Accuracy: 0.6995555555555556
        Epoch: 27, Accuracy: 0.6884444444444444
        Epoch: 28, Accuracy: 0.6884444444444444
        Epoch: 29, Accuracy: 0.6946666666666667
        Epoch: 30, Accuracy: 0.6942222222222222
        Epoch: 31, Accuracy: 0.6982222222222222
        Epoch: 32, Accuracy: 0.6533333333333333
        Epoch: 33, Accuracy: 0.6875555555555556
        Epoch: 34, Accuracy: 0.6933333333333334
        Epoch: 35, Accuracy: 0.6862222222222222
        Epoch: 36, Accuracy: 0.6955555555555556
        Epoch: 37, Accuracy: 0.6906666666666667
        Epoch: 38, Accuracy: 0.6933333333333334
        Epoch: 39, Accuracy: 0.696
        Epoch: 40, Accuracy: 0.6942222222222222
```

```
        Epoch: 41, Accuracy: 0.6911111111111111
        Epoch: 42, Accuracy: 0.6928888888888889
        Epoch: 43, Accuracy: 0.6662222222222223
        Epoch: 44, Accuracy: 0.684
        Epoch: 45, Accuracy: 0.6911111111111111
        Epoch: 46, Accuracy: 0.6813333333333333
        Epoch: 47, Accuracy: 0.6662222222222223
        Epoch: 48, Accuracy: 0.6866666666666666
        Epoch: 49, Accuracy: 0.6804444444444444
        Epoch: 50, Accuracy: 0.6733333333333333


Learning rate: 0.01
        Epoch: 1, Accuracy: 0.6853333333333333
        Epoch: 2, Accuracy: 0.6911111111111111
        Epoch: 3, Accuracy: 0.7053333333333334
        Epoch: 4, Accuracy: 0.692
        Epoch: 5, Accuracy: 0.704
        Epoch: 6, Accuracy: 0.6817777777777778
        Epoch: 7, Accuracy: 0.6568888888888889
        Epoch: 8, Accuracy: 0.6666666666666666
        Epoch: 9, Accuracy: 0.6791111111111111
        Epoch: 10, Accuracy: 0.6897777777777778
        Epoch: 11, Accuracy: 0.6777777777777778
        Epoch: 12, Accuracy: 0.7022222222222222
        Epoch: 13, Accuracy: 0.6653333333333333
        Epoch: 14, Accuracy: 0.6897777777777778
        Epoch: 15, Accuracy: 0.6986666666666667
        Epoch: 16, Accuracy: 0.6724444444444444
        Epoch: 17, Accuracy: 0.7026666666666667
        Epoch: 18, Accuracy: 0.7115555555555556
        Epoch: 19, Accuracy: 0.6973333333333334
        Epoch: 20, Accuracy: 0.7177777777777777
        Epoch: 21, Accuracy: 0.6702222222222223
        Epoch: 22, Accuracy: 0.7057777777777777
        Epoch: 23, Accuracy: 0.7062222222222222
        Epoch: 24, Accuracy: 0.7017777777777777
        Epoch: 25, Accuracy: 0.6937777777777778
        Epoch: 26, Accuracy: 0.6884444444444444
        Epoch: 27, Accuracy: 0.6933333333333334
        Epoch: 28, Accuracy: 0.6386666666666667
        Epoch: 29, Accuracy: 0.6875555555555556
        Epoch: 30, Accuracy: 0.6995555555555556
        Epoch: 31, Accuracy: 0.684
        Epoch: 32, Accuracy: 0.6902222222222222
        Epoch: 33, Accuracy: 0.7008888888888889
        Epoch: 34, Accuracy: 0.6902222222222222
        Epoch: 35, Accuracy: 0.6982222222222222
        Epoch: 36, Accuracy: 0.6995555555555556
        Epoch: 37, Accuracy: 0.688
        Epoch: 38, Accuracy: 0.6946666666666667
        Epoch: 39, Accuracy: 0.688
        Epoch: 40, Accuracy: 0.6773333333333333
        Epoch: 41, Accuracy: 0.68
        Epoch: 42, Accuracy: 0.6906666666666667
        Epoch: 43, Accuracy: 0.6902222222222222
        Epoch: 44, Accuracy: 0.6831111111111111
        Epoch: 45, Accuracy: 0.6888888888888889
        Epoch: 46, Accuracy: 0.688
        Epoch: 47, Accuracy: 0.6826666666666666
        Epoch: 48, Accuracy: 0.6822222222222222
```

```
                Epoch: 49, Accuracy: 0.6915555555555556
                Epoch: 50, Accuracy: 0.6964444444444444

        Best parameter: 0.01 & test accuracy:  0.7177777777777777

Average Perceptron

        Glove Dataset

        Learning rate: 1
                Epoch: 1, Accuracy: 0.6524444444444445
                Epoch: 2, Accuracy: 0.6577777777777778
                Epoch: 3, Accuracy: 0.6626666666666666
                Epoch: 4, Accuracy: 0.6626666666666666
                Epoch: 5, Accuracy: 0.6626666666666666
                Epoch: 6, Accuracy: 0.6626666666666666
                Epoch: 7, Accuracy: 0.6635555555555556
                Epoch: 8, Accuracy: 0.6617777777777778
                Epoch: 9, Accuracy: 0.664
                Epoch: 10, Accuracy: 0.6622222222222223
                Epoch: 11, Accuracy: 0.6622222222222223
                Epoch: 12, Accuracy: 0.6635555555555556
                Epoch: 13, Accuracy: 0.664
                Epoch: 14, Accuracy: 0.6644444444444444
                Epoch: 15, Accuracy: 0.6653333333333333
                Epoch: 16, Accuracy: 0.6648888888888889
                Epoch: 17, Accuracy: 0.6653333333333333
                Epoch: 18, Accuracy: 0.6644444444444444
                Epoch: 19, Accuracy: 0.6657777777777778
                Epoch: 20, Accuracy: 0.6635555555555556
                Epoch: 21, Accuracy: 0.6666666666666666
                Epoch: 22, Accuracy: 0.6648888888888889
                Epoch: 23, Accuracy: 0.6648888888888889
                Epoch: 24, Accuracy: 0.6648888888888889
                Epoch: 25, Accuracy: 0.6666666666666666
                Epoch: 26, Accuracy: 0.668
                Epoch: 27, Accuracy: 0.6666666666666666
                Epoch: 28, Accuracy: 0.6653333333333333
                Epoch: 29, Accuracy: 0.664
                Epoch: 30, Accuracy: 0.6644444444444444
                Epoch: 31, Accuracy: 0.6653333333333333
                Epoch: 32, Accuracy: 0.6662222222222223
                Epoch: 33, Accuracy: 0.6657777777777778
                Epoch: 34, Accuracy: 0.6653333333333333
                Epoch: 35, Accuracy: 0.6653333333333333
                Epoch: 36, Accuracy: 0.6653333333333333
                Epoch: 37, Accuracy: 0.6662222222222223
                Epoch: 38, Accuracy: 0.6648888888888889
                Epoch: 39, Accuracy: 0.6635555555555556
                Epoch: 40, Accuracy: 0.6635555555555556
                Epoch: 41, Accuracy: 0.6631111111111111
                Epoch: 42, Accuracy: 0.6635555555555556
                Epoch: 43, Accuracy: 0.6631111111111111
                Epoch: 44, Accuracy: 0.6622222222222223
                Epoch: 45, Accuracy: 0.6626666666666666
                Epoch: 46, Accuracy: 0.6613333333333333
                Epoch: 47, Accuracy: 0.6608888888888889
                Epoch: 48, Accuracy: 0.6613333333333333

                Epoch: 49, Accuracy: 0.6622222222222223
                Epoch: 50, Accuracy: 0.6626666666666666
```

```
Learning rate: 0.1
        Epoch: 1, Accuracy: 0.6533333333333333
        Epoch: 2, Accuracy: 0.6622222222222223
        Epoch: 3, Accuracy: 0.6635555555555556
        Epoch: 4, Accuracy: 0.6648888888888889
        Epoch: 5, Accuracy: 0.6662222222222223
        Epoch: 6, Accuracy: 0.6657777777777778
        Epoch: 7, Accuracy: 0.6644444444444444
        Epoch: 8, Accuracy: 0.6657777777777778
        Epoch: 9, Accuracy: 0.6662222222222223
        Epoch: 10, Accuracy: 0.6653333333333333
        Epoch: 11, Accuracy: 0.6617777777777778
        Epoch: 12, Accuracy: 0.6657777777777778
        Epoch: 13, Accuracy: 0.664
        Epoch: 14, Accuracy: 0.6626666666666666
        Epoch: 15, Accuracy: 0.6648888888888889
        Epoch: 16, Accuracy: 0.6653333333333333
        Epoch: 17, Accuracy: 0.6653333333333333
        Epoch: 18, Accuracy: 0.6666666666666666
        Epoch: 19, Accuracy: 0.6657777777777778
        Epoch: 20, Accuracy: 0.6657777777777778
        Epoch: 21, Accuracy: 0.6671111111111111
        Epoch: 22, Accuracy: 0.6657777777777778
        Epoch: 23, Accuracy: 0.6662222222222223
        Epoch: 24, Accuracy: 0.6635555555555556
        Epoch: 25, Accuracy: 0.664
        Epoch: 26, Accuracy: 0.6626666666666666
        Epoch: 27, Accuracy: 0.6635555555555556
        Epoch: 28, Accuracy: 0.6644444444444444
        Epoch: 29, Accuracy: 0.6644444444444444
        Epoch: 30, Accuracy: 0.6626666666666666
        Epoch: 31, Accuracy: 0.6631111111111111
        Epoch: 32, Accuracy: 0.664
        Epoch: 33, Accuracy: 0.6631111111111111
        Epoch: 34, Accuracy: 0.6626666666666666
        Epoch: 35, Accuracy: 0.6631111111111111
        Epoch: 36, Accuracy: 0.6653333333333333
        Epoch: 37, Accuracy: 0.6653333333333333
        Epoch: 38, Accuracy: 0.6653333333333333
        Epoch: 39, Accuracy: 0.6648888888888889
        Epoch: 40, Accuracy: 0.6644444444444444
        Epoch: 41, Accuracy: 0.6644444444444444
        Epoch: 42, Accuracy: 0.6657777777777778
        Epoch: 43, Accuracy: 0.6662222222222223
        Epoch: 44, Accuracy: 0.6653333333333333
        Epoch: 45, Accuracy: 0.6648888888888889
        Epoch: 46, Accuracy: 0.6648888888888889
        Epoch: 47, Accuracy: 0.6657777777777778
        Epoch: 48, Accuracy: 0.6662222222222223
        Epoch: 49, Accuracy: 0.6666666666666666

        Epoch: 50, Accuracy: 0.6653333333333333

Learning rate: 0.01
        Epoch: 1, Accuracy: 0.6497777777777778
        Epoch: 2, Accuracy: 0.6631111111111111
        Epoch: 3, Accuracy: 0.6622222222222223
        Epoch: 4, Accuracy: 0.6706666666666666
        Epoch: 5, Accuracy: 0.6693333333333333
        Epoch: 6, Accuracy: 0.6671111111111111
        Epoch: 7, Accuracy: 0.6675555555555556
```

```
        Epoch: 8, Accuracy: 0.6662222222222223
        Epoch: 9, Accuracy: 0.6657777777777778
        Epoch: 10, Accuracy: 0.6662222222222223
        Epoch: 11, Accuracy: 0.6662222222222223
        Epoch: 12, Accuracy: 0.6688888888888889
        Epoch: 13, Accuracy: 0.6675555555555556
        Epoch: 14, Accuracy: 0.6706666666666666
        Epoch: 15, Accuracy: 0.6697777777777778
        Epoch: 16, Accuracy: 0.6688888888888889
        Epoch: 17, Accuracy: 0.6706666666666666
        Epoch: 18, Accuracy: 0.6671111111111111
        Epoch: 19, Accuracy: 0.6657777777777778
        Epoch: 20, Accuracy: 0.6675555555555556
        Epoch: 21, Accuracy: 0.6666666666666666
        Epoch: 22, Accuracy: 0.668
        Epoch: 23, Accuracy: 0.6688888888888889
        Epoch: 24, Accuracy: 0.668
        Epoch: 25, Accuracy: 0.6693333333333333
        Epoch: 26, Accuracy: 0.6675555555555556
        Epoch: 27, Accuracy: 0.6675555555555556
        Epoch: 28, Accuracy: 0.6666666666666666
        Epoch: 29, Accuracy: 0.6666666666666666
        Epoch: 30, Accuracy: 0.6662222222222223
        Epoch: 31, Accuracy: 0.6666666666666666
        Epoch: 32, Accuracy: 0.6662222222222223
        Epoch: 33, Accuracy: 0.6648888888888889
        Epoch: 34, Accuracy: 0.6657777777777778
        Epoch: 35, Accuracy: 0.6653333333333333
        Epoch: 36, Accuracy: 0.6671111111111111
        Epoch: 37, Accuracy: 0.6675555555555556
        Epoch: 38, Accuracy: 0.6657777777777778
        Epoch: 39, Accuracy: 0.6657777777777778
        Epoch: 40, Accuracy: 0.6662222222222223
        Epoch: 41, Accuracy: 0.6648888888888889
        Epoch: 42, Accuracy: 0.6657777777777778
        Epoch: 43, Accuracy: 0.6666666666666666
        Epoch: 44, Accuracy: 0.6657777777777778
        Epoch: 45, Accuracy: 0.6671111111111111
        Epoch: 46, Accuracy: 0.6657777777777778
        Epoch: 47, Accuracy: 0.6653333333333333
        Epoch: 48, Accuracy: 0.6644444444444444
        Epoch: 49, Accuracy: 0.6653333333333333
        Epoch: 50, Accuracy: 0.6666666666666666


Best parameter: 0.01 & test accuracy:  0.6706666666666666
BOW Dataset

Learning rate: 1
        Epoch: 1, Accuracy: 0.6822222222222222
        Epoch: 2, Accuracy: 0.6857777777777778
        Epoch: 3, Accuracy: 0.692
        Epoch: 4, Accuracy: 0.6973333333333334
        Epoch: 5, Accuracy: 0.7053333333333334
        Epoch: 6, Accuracy: 0.704
        Epoch: 7, Accuracy: 0.7008888888888889
        Epoch: 8, Accuracy: 0.7031111111111111
        Epoch: 9, Accuracy: 0.7008888888888889
        Epoch: 10, Accuracy: 0.704
        Epoch: 11, Accuracy: 0.7053333333333334
        Epoch: 12, Accuracy: 0.7044444444444444
```

```
        Epoch: 13, Accuracy: 0.7053333333333334
        Epoch: 14, Accuracy: 0.7035555555555556
        Epoch: 15, Accuracy: 0.7057777777777777
        Epoch: 16, Accuracy: 0.7057777777777777
        Epoch: 17, Accuracy: 0.7044444444444444
        Epoch: 18, Accuracy: 0.7026666666666667
        Epoch: 19, Accuracy: 0.7022222222222222
        Epoch: 20, Accuracy: 0.7017777777777777
        Epoch: 21, Accuracy: 0.7
        Epoch: 22, Accuracy: 0.6995555555555556
        Epoch: 23, Accuracy: 0.6986666666666667
        Epoch: 24, Accuracy: 0.6991111111111111
        Epoch: 25, Accuracy: 0.7017777777777777
        Epoch: 26, Accuracy: 0.6986666666666667
        Epoch: 27, Accuracy: 0.7008888888888889
        Epoch: 28, Accuracy: 0.7017777777777777
        Epoch: 29, Accuracy: 0.7026666666666667
        Epoch: 30, Accuracy: 0.7008888888888889
        Epoch: 31, Accuracy: 0.7004444444444444
        Epoch: 32, Accuracy: 0.7004444444444444
        Epoch: 33, Accuracy: 0.7004444444444444
        Epoch: 34, Accuracy: 0.6995555555555556
        Epoch: 35, Accuracy: 0.6982222222222222
        Epoch: 36, Accuracy: 0.6982222222222222
        Epoch: 37, Accuracy: 0.6986666666666667
        Epoch: 38, Accuracy: 0.6964444444444444
        Epoch: 39, Accuracy: 0.696
        Epoch: 40, Accuracy: 0.6982222222222222
        Epoch: 41, Accuracy: 0.6973333333333334
        Epoch: 42, Accuracy: 0.6986666666666667
        Epoch: 43, Accuracy: 0.6986666666666667
        Epoch: 44, Accuracy: 0.6995555555555556
        Epoch: 45, Accuracy: 0.7008888888888889
        Epoch: 46, Accuracy: 0.7022222222222222
        Epoch: 47, Accuracy: 0.7031111111111111
        Epoch: 48, Accuracy: 0.7035555555555556

        Epoch: 49, Accuracy: 0.704
        Epoch: 50, Accuracy: 0.7026666666666667

Learning rate: 0.1
        Epoch: 1, Accuracy: 0.6706666666666666
        Epoch: 2, Accuracy: 0.6884444444444444
        Epoch: 3, Accuracy: 0.684
        Epoch: 4, Accuracy: 0.6871111111111111
        Epoch: 5, Accuracy: 0.6911111111111111
        Epoch: 6, Accuracy: 0.6955555555555556
        Epoch: 7, Accuracy: 0.6986666666666667
        Epoch: 8, Accuracy: 0.7013333333333334
        Epoch: 9, Accuracy: 0.7026666666666667
        Epoch: 10, Accuracy: 0.7053333333333334
        Epoch: 11, Accuracy: 0.7057777777777777
        Epoch: 12, Accuracy: 0.7048888888888889
        Epoch: 13, Accuracy: 0.7048888888888889
        Epoch: 14, Accuracy: 0.7044444444444444
        Epoch: 15, Accuracy: 0.7053333333333334
        Epoch: 16, Accuracy: 0.708
        Epoch: 17, Accuracy: 0.7084444444444444
        Epoch: 18, Accuracy: 0.7088888888888889
        Epoch: 19, Accuracy: 0.7071111111111111
        Epoch: 20, Accuracy: 0.7053333333333334
        Epoch: 21, Accuracy: 0.7048888888888889
```

```
        Epoch: 21, Accuracy: 0.7048888888888889
        Epoch: 22, Accuracy: 0.704
        Epoch: 23, Accuracy: 0.7017777777777777
        Epoch: 24, Accuracy: 0.7
        Epoch: 25, Accuracy: 0.6995555555555556
        Epoch: 26, Accuracy: 0.7
        Epoch: 27, Accuracy: 0.7
        Epoch: 28, Accuracy: 0.7004444444444444
        Epoch: 29, Accuracy: 0.7004444444444444
        Epoch: 30, Accuracy: 0.6982222222222222
        Epoch: 31, Accuracy: 0.6977777777777778
        Epoch: 32, Accuracy: 0.6977777777777778
        Epoch: 33, Accuracy: 0.7013333333333334
        Epoch: 34, Accuracy: 0.7013333333333334
        Epoch: 35, Accuracy: 0.7004444444444444
        Epoch: 36, Accuracy: 0.7004444444444444
        Epoch: 37, Accuracy: 0.7004444444444444
        Epoch: 38, Accuracy: 0.7
        Epoch: 39, Accuracy: 0.7004444444444444
        Epoch: 40, Accuracy: 0.7
        Epoch: 41, Accuracy: 0.7
        Epoch: 42, Accuracy: 0.7008888888888889
        Epoch: 43, Accuracy: 0.7008888888888889
        Epoch: 44, Accuracy: 0.7008888888888889
        Epoch: 45, Accuracy: 0.7008888888888889
        Epoch: 46, Accuracy: 0.7004444444444444
        Epoch: 47, Accuracy: 0.6977777777777778
        Epoch: 48, Accuracy: 0.6977777777777778
        Epoch: 49, Accuracy: 0.6977777777777778

        Epoch: 50, Accuracy: 0.6991111111111111

Learning rate: 0.01
        Epoch: 1, Accuracy: 0.6777777777777778
        Epoch: 2, Accuracy: 0.6884444444444444
        Epoch: 3, Accuracy: 0.6946666666666667
        Epoch: 4, Accuracy: 0.6964444444444444
        Epoch: 5, Accuracy: 0.7004444444444444
        Epoch: 6, Accuracy: 0.7022222222222222
        Epoch: 7, Accuracy: 0.6995555555555556
        Epoch: 8, Accuracy: 0.7026666666666667
        Epoch: 9, Accuracy: 0.7053333333333334
        Epoch: 10, Accuracy: 0.7031111111111111
        Epoch: 11, Accuracy: 0.7031111111111111
        Epoch: 12, Accuracy: 0.7057777777777777
        Epoch: 13, Accuracy: 0.7071111111111111
        Epoch: 14, Accuracy: 0.7066666666666667
        Epoch: 15, Accuracy: 0.7053333333333334
        Epoch: 16, Accuracy: 0.7057777777777777
        Epoch: 17, Accuracy: 0.7062222222222222
        Epoch: 18, Accuracy: 0.7071111111111111
        Epoch: 19, Accuracy: 0.7075555555555556
        Epoch: 20, Accuracy: 0.7084444444444444
        Epoch: 21, Accuracy: 0.7066666666666667
        Epoch: 22, Accuracy: 0.7048888888888889
        Epoch: 23, Accuracy: 0.7048888888888889
        Epoch: 24, Accuracy: 0.708
        Epoch: 25, Accuracy: 0.708
        Epoch: 26, Accuracy: 0.7071111111111111
        Epoch: 27, Accuracy: 0.708
        Epoch: 28, Accuracy: 0.7084444444444444
        Epoch: 29, Accuracy: 0.7084444444444444
```

```
        Epoch: 30, Accuracy: 0.7066666666666667
        Epoch: 31, Accuracy: 0.7057777777777777
        Epoch: 32, Accuracy: 0.704
        Epoch: 33, Accuracy: 0.7048888888888889
        Epoch: 34, Accuracy: 0.7026666666666667
        Epoch: 35, Accuracy: 0.7013333333333334
        Epoch: 36, Accuracy: 0.7013333333333334
        Epoch: 37, Accuracy: 0.7017777777777777
        Epoch: 38, Accuracy: 0.7008888888888889
        Epoch: 39, Accuracy: 0.7004444444444444
        Epoch: 40, Accuracy: 0.6995555555555556
        Epoch: 41, Accuracy: 0.6995555555555556
        Epoch: 42, Accuracy: 0.7008888888888889
        Epoch: 43, Accuracy: 0.7004444444444444
        Epoch: 44, Accuracy: 0.7004444444444444
        Epoch: 45, Accuracy: 0.7008888888888889
        Epoch: 46, Accuracy: 0.7013333333333334
        Epoch: 47, Accuracy: 0.7022222222222222
        Epoch: 48, Accuracy: 0.7013333333333334
        Epoch: 49, Accuracy: 0.7022222222222222
        Epoch: 50, Accuracy: 0.704


Best parameter: 0.1 & test accuracy:  0.7088888888888889
TFIDF Dataset

Learning rate: 1
        Epoch: 1, Accuracy: 0.7155555555555555
        Epoch: 2, Accuracy: 0.7293333333333333
        Epoch: 3, Accuracy: 0.7262222222222222
        Epoch: 4, Accuracy: 0.7248888888888889
        Epoch: 5, Accuracy: 0.7226666666666667
        Epoch: 6, Accuracy: 0.724
        Epoch: 7, Accuracy: 0.7217777777777777
        Epoch: 8, Accuracy: 0.7195555555555555
        Epoch: 9, Accuracy: 0.7177777777777777
        Epoch: 10, Accuracy: 0.7164444444444444
        Epoch: 11, Accuracy: 0.7146666666666667
        Epoch: 12, Accuracy: 0.7151111111111111
        Epoch: 13, Accuracy: 0.7146666666666667
        Epoch: 14, Accuracy: 0.7102222222222222
        Epoch: 15, Accuracy: 0.7128888888888889
        Epoch: 16, Accuracy: 0.7124444444444444
        Epoch: 17, Accuracy: 0.7137777777777777
        Epoch: 18, Accuracy: 0.7128888888888889
        Epoch: 19, Accuracy: 0.712
        Epoch: 20, Accuracy: 0.712
        Epoch: 21, Accuracy: 0.7151111111111111
        Epoch: 22, Accuracy: 0.7155555555555555
        Epoch: 23, Accuracy: 0.7173333333333334
        Epoch: 24, Accuracy: 0.7164444444444444
        Epoch: 25, Accuracy: 0.7137777777777777
        Epoch: 26, Accuracy: 0.7124444444444444
        Epoch: 27, Accuracy: 0.7124444444444444
        Epoch: 28, Accuracy: 0.7111111111111111
        Epoch: 29, Accuracy: 0.7106666666666667
        Epoch: 30, Accuracy: 0.7115555555555556
        Epoch: 31, Accuracy: 0.712
        Epoch: 32, Accuracy: 0.7106666666666667
        Epoch: 33, Accuracy: 0.712
        Epoch: 34, Accuracy: 0.7097777777777777
```

```
        Epoch: 35, Accuracy: 0.7111111111111111
        Epoch: 36, Accuracy: 0.7115555555555556
        Epoch: 37, Accuracy: 0.7115555555555556
        Epoch: 38, Accuracy: 0.7097777777777777
        Epoch: 39, Accuracy: 0.7088888888888889
        Epoch: 40, Accuracy: 0.7066666666666667
        Epoch: 41, Accuracy: 0.7057777777777777
        Epoch: 42, Accuracy: 0.7071111111111111
        Epoch: 43, Accuracy: 0.7062222222222222
        Epoch: 44, Accuracy: 0.704
        Epoch: 45, Accuracy: 0.704
        Epoch: 46, Accuracy: 0.7035555555555556
        Epoch: 47, Accuracy: 0.704
        Epoch: 48, Accuracy: 0.704

        Epoch: 49, Accuracy: 0.704
        Epoch: 50, Accuracy: 0.7048888888888889

Learning rate: 0.1
        Epoch: 1, Accuracy: 0.7111111111111111
        Epoch: 2, Accuracy: 0.7133333333333334
        Epoch: 3, Accuracy: 0.7173333333333334
        Epoch: 4, Accuracy: 0.7226666666666667
        Epoch: 5, Accuracy: 0.7244444444444444
        Epoch: 6, Accuracy: 0.7204444444444444
        Epoch: 7, Accuracy: 0.7231111111111111
        Epoch: 8, Accuracy: 0.7235555555555555
        Epoch: 9, Accuracy: 0.7253333333333334
        Epoch: 10, Accuracy: 0.72
        Epoch: 11, Accuracy: 0.7177777777777777
        Epoch: 12, Accuracy: 0.7164444444444444
        Epoch: 13, Accuracy: 0.716
        Epoch: 14, Accuracy: 0.7177777777777777
        Epoch: 15, Accuracy: 0.7155555555555555
        Epoch: 16, Accuracy: 0.7146666666666667
        Epoch: 17, Accuracy: 0.7142222222222222
        Epoch: 18, Accuracy: 0.7137777777777777
        Epoch: 19, Accuracy: 0.7133333333333334
        Epoch: 20, Accuracy: 0.7115555555555556
        Epoch: 21, Accuracy: 0.712
        Epoch: 22, Accuracy: 0.7115555555555556
        Epoch: 23, Accuracy: 0.7111111111111111
        Epoch: 24, Accuracy: 0.7106666666666667
        Epoch: 25, Accuracy: 0.7106666666666667
        Epoch: 26, Accuracy: 0.7106666666666667
        Epoch: 27, Accuracy: 0.7115555555555556
        Epoch: 28, Accuracy: 0.7115555555555556
        Epoch: 29, Accuracy: 0.7115555555555556
        Epoch: 30, Accuracy: 0.7097777777777777
        Epoch: 31, Accuracy: 0.7088888888888889
        Epoch: 32, Accuracy: 0.7088888888888889
        Epoch: 33, Accuracy: 0.7075555555555556
        Epoch: 34, Accuracy: 0.7062222222222222
        Epoch: 35, Accuracy: 0.7062222222222222
        Epoch: 36, Accuracy: 0.7053333333333334
        Epoch: 37, Accuracy: 0.7057777777777777
        Epoch: 38, Accuracy: 0.7066666666666667
        Epoch: 39, Accuracy: 0.7066666666666667
        Epoch: 40, Accuracy: 0.7066666666666667
        Epoch: 41, Accuracy: 0.7048888888888889
        Epoch: 42, Accuracy: 0.7066666666666667
        Epoch: 43, Accuracy: 0.7066666666666667
```

```
        Epoch: 43, Accuracy: 0.7066666666666667
        Epoch: 44, Accuracy: 0.7057777777777777
        Epoch: 45, Accuracy: 0.7053333333333334
        Epoch: 46, Accuracy: 0.7048888888888889
        Epoch: 47, Accuracy: 0.7053333333333334
        Epoch: 48, Accuracy: 0.704
        Epoch: 49, Accuracy: 0.7035555555555556

        Epoch: 50, Accuracy: 0.7031111111111111

Learning rate: 0.01
        Epoch: 1, Accuracy: 0.6897777777777778
        Epoch: 2, Accuracy: 0.7097777777777777
        Epoch: 3, Accuracy: 0.7186666666666667
        Epoch: 4, Accuracy: 0.7186666666666667
        Epoch: 5, Accuracy: 0.7195555555555555
        Epoch: 6, Accuracy: 0.7195555555555555
        Epoch: 7, Accuracy: 0.7146666666666667
        Epoch: 8, Accuracy: 0.7173333333333334
        Epoch: 9, Accuracy: 0.7213333333333334
        Epoch: 10, Accuracy: 0.7235555555555555
        Epoch: 11, Accuracy: 0.7208888888888889
        Epoch: 12, Accuracy: 0.7204444444444444
        Epoch: 13, Accuracy: 0.7195555555555555
        Epoch: 14, Accuracy: 0.7177777777777777
        Epoch: 15, Accuracy: 0.7168888888888889
        Epoch: 16, Accuracy: 0.7195555555555555
        Epoch: 17, Accuracy: 0.716
        Epoch: 18, Accuracy: 0.7146666666666667
        Epoch: 19, Accuracy: 0.7146666666666667
        Epoch: 20, Accuracy: 0.7128888888888889
        Epoch: 21, Accuracy: 0.7115555555555556
        Epoch: 22, Accuracy: 0.7088888888888889
        Epoch: 23, Accuracy: 0.7097777777777777
        Epoch: 24, Accuracy: 0.7115555555555556
        Epoch: 25, Accuracy: 0.712
        Epoch: 26, Accuracy: 0.7106666666666667
        Epoch: 27, Accuracy: 0.7111111111111111
        Epoch: 28, Accuracy: 0.7102222222222222
        Epoch: 29, Accuracy: 0.7111111111111111
        Epoch: 30, Accuracy: 0.7115555555555556
        Epoch: 31, Accuracy: 0.7128888888888889
        Epoch: 32, Accuracy: 0.7115555555555556
        Epoch: 33, Accuracy: 0.7111111111111111
        Epoch: 34, Accuracy: 0.7115555555555556
        Epoch: 35, Accuracy: 0.7111111111111111
        Epoch: 36, Accuracy: 0.7106666666666667
        Epoch: 37, Accuracy: 0.7088888888888889
        Epoch: 38, Accuracy: 0.708
        Epoch: 39, Accuracy: 0.7075555555555556
        Epoch: 40, Accuracy: 0.7093333333333334
        Epoch: 41, Accuracy: 0.7088888888888889
        Epoch: 42, Accuracy: 0.7075555555555556
        Epoch: 43, Accuracy: 0.7088888888888889
        Epoch: 44, Accuracy: 0.708
        Epoch: 45, Accuracy: 0.7075555555555556
        Epoch: 46, Accuracy: 0.7075555555555556
        Epoch: 47, Accuracy: 0.7084444444444444
        Epoch: 48, Accuracy: 0.708
        Epoch: 49, Accuracy: 0.7075555555555556
        Epoch: 50, Accuracy: 0.7075555555555556
```

Best parameter: 1 & test accuracy: 0.7293333333333333
Aggressive Perceptron

Glove Dataset

Margin: 1
Epoch: 1, Accuracy: 0.5804444444444444
Epoch: 2, Accuracy: 0.6204444444444445
Epoch: 3, Accuracy: 0.6
Epoch: 4, Accuracy: 0.608
Epoch: 5, Accuracy: 0.548
Epoch: 6, Accuracy: 0.5595555555555556
Epoch: 7, Accuracy: 0.5911111111111111
Epoch: 8, Accuracy: 0.576
Epoch: 9, Accuracy: 0.6253333333333333
Epoch: 10, Accuracy: 0.5591111111111111
Epoch: 11, Accuracy: 0.6408888888888888
Epoch: 12, Accuracy: 0.6311111111111111
Epoch: 13, Accuracy: 0.6306666666666667
Epoch: 14, Accuracy: 0.6413333333333333
Epoch: 15, Accuracy: 0.5186666666666667
Epoch: 16, Accuracy: 0.6222222222222222
Epoch: 17, Accuracy: 0.6324444444444445
Epoch: 18, Accuracy: 0.5653333333333334
Epoch: 19, Accuracy: 0.6213333333333333
Epoch: 20, Accuracy: 0.5826666666666667
Epoch: 21, Accuracy: 0.6168888888888889
Epoch: 22, Accuracy: 0.5262222222222223
Epoch: 23, Accuracy: 0.5795555555555556
Epoch: 24, Accuracy: 0.5844444444444444
Epoch: 25, Accuracy: 0.5955555555555555
Epoch: 26, Accuracy: 0.6253333333333333
Epoch: 27, Accuracy: 0.6235555555555555
Epoch: 28, Accuracy: 0.5946666666666667
Epoch: 29, Accuracy: 0.5991111111111111
Epoch: 30, Accuracy: 0.6204444444444445
Epoch: 31, Accuracy: 0.6208888888888889
Epoch: 32, Accuracy: 0.5697777777777778
Epoch: 33, Accuracy: 0.6062222222222222
Epoch: 34, Accuracy: 0.5533333333333333
Epoch: 35, Accuracy: 0.5608888888888889
Epoch: 36, Accuracy: 0.5262222222222223
Epoch: 37, Accuracy: 0.6164444444444445
Epoch: 38, Accuracy: 0.5915555555555555
Epoch: 39, Accuracy: 0.5804444444444444
Epoch: 40, Accuracy: 0.5764444444444444
Epoch: 41, Accuracy: 0.6173333333333333
Epoch: 42, Accuracy: 0.5417777777777778
Epoch: 43, Accuracy: 0.6075555555555555
Epoch: 44, Accuracy: 0.5804444444444444
Epoch: 45, Accuracy: 0.5244444444444445
Epoch: 46, Accuracy: 0.6204444444444445

Epoch: 47, Accuracy: 0.5084444444444445
Epoch: 48, Accuracy: 0.5893333333333334
Epoch: 49, Accuracy: 0.584
Epoch: 50, Accuracy: 0.5568888888888889

Margin: 0.1
Epoch: 1, Accuracy: 0.6017777777777777

```
        Epoch: 2, Accuracy: 0.561/////////////8
        Epoch: 3, Accuracy: 0.624
        Epoch: 4, Accuracy: 0.5622222222222222
        Epoch: 5, Accuracy: 0.5893333333333334
        Epoch: 6, Accuracy: 0.6128888888888889
        Epoch: 7, Accuracy: 0.532
        Epoch: 8, Accuracy: 0.5826666666666667
        Epoch: 9, Accuracy: 0.6137777777777778
        Epoch: 10, Accuracy: 0.588
        Epoch: 11, Accuracy: 0.6075555555555555
        Epoch: 12, Accuracy: 0.5262222222222223
        Epoch: 13, Accuracy: 0.6226666666666667
        Epoch: 14, Accuracy: 0.5933333333333334
        Epoch: 15, Accuracy: 0.6133333333333333
        Epoch: 16, Accuracy: 0.5488888888888889
        Epoch: 17, Accuracy: 0.6342222222222222
        Epoch: 18, Accuracy: 0.5737777777777778
        Epoch: 19, Accuracy: 0.5964444444444444
        Epoch: 20, Accuracy: 0.6071111111111112
        Epoch: 21, Accuracy: 0.6102222222222222
        Epoch: 22, Accuracy: 0.6257777777777778
        Epoch: 23, Accuracy: 0.6364444444444445
        Epoch: 24, Accuracy: 0.616
        Epoch: 25, Accuracy: 0.592
        Epoch: 26, Accuracy: 0.5702222222222222
        Epoch: 27, Accuracy: 0.6084444444444445
        Epoch: 28, Accuracy: 0.6195555555555555
        Epoch: 29, Accuracy: 0.62
        Epoch: 30, Accuracy: 0.5222222222222223
        Epoch: 31, Accuracy: 0.604
        Epoch: 32, Accuracy: 0.5764444444444444
        Epoch: 33, Accuracy: 0.6062222222222222
        Epoch: 34, Accuracy: 0.6306666666666667
        Epoch: 35, Accuracy: 0.612
        Epoch: 36, Accuracy: 0.5493333333333333
        Epoch: 37, Accuracy: 0.5444444444444444
        Epoch: 38, Accuracy: 0.6102222222222222
        Epoch: 39, Accuracy: 0.624
        Epoch: 40, Accuracy: 0.5284444444444445
        Epoch: 41, Accuracy: 0.6208888888888889
        Epoch: 42, Accuracy: 0.5786666666666667
        Epoch: 43, Accuracy: 0.5293333333333333
        Epoch: 44, Accuracy: 0.5715555555555556
        Epoch: 45, Accuracy: 0.6111111111111112
        Epoch: 46, Accuracy: 0.5631111111111111
        Epoch: 47, Accuracy: 0.5728888888888889

        Epoch: 48, Accuracy: 0.5533333333333333
        Epoch: 49, Accuracy: 0.6044444444444445
        Epoch: 50, Accuracy: 0.5271111111111111

Margin: 0.01
        Epoch: 1, Accuracy: 0.5871111111111111
        Epoch: 2, Accuracy: 0.5897777777777777
        Epoch: 3, Accuracy: 0.5453333333333333
        Epoch: 4, Accuracy: 0.5733333333333334
        Epoch: 5, Accuracy: 0.5191111111111111
        Epoch: 6, Accuracy: 0.5964444444444444
        Epoch: 7, Accuracy: 0.5346666666666666
        Epoch: 8, Accuracy: 0.608
        Epoch: 9, Accuracy: 0.5991111111111111
        Epoch: 10, Accuracy: 0.5786666666666667
```

```
        Epoch: 11, Accuracy: 0.6262222222222222
        Epoch: 12, Accuracy: 0.576
        Epoch: 13, Accuracy: 0.6017777777777777
        Epoch: 14, Accuracy: 0.5346666666666666
        Epoch: 15, Accuracy: 0.5768888888888889
        Epoch: 16, Accuracy: 0.5955555555555555
        Epoch: 17, Accuracy: 0.584
        Epoch: 18, Accuracy: 0.5697777777777778
        Epoch: 19, Accuracy: 0.608
        Epoch: 20, Accuracy: 0.5635555555555556
        Epoch: 21, Accuracy: 0.5951111111111111
        Epoch: 22, Accuracy: 0.5795555555555556
        Epoch: 23, Accuracy: 0.5991111111111111
        Epoch: 24, Accuracy: 0.6351111111111111
        Epoch: 25, Accuracy: 0.6426666666666667
        Epoch: 26, Accuracy: 0.64
        Epoch: 27, Accuracy: 0.612
        Epoch: 28, Accuracy: 0.6111111111111112
        Epoch: 29, Accuracy: 0.5706666666666667
        Epoch: 30, Accuracy: 0.5022222222222222
        Epoch: 31, Accuracy: 0.5915555555555555
        Epoch: 32, Accuracy: 0.6115555555555555
        Epoch: 33, Accuracy: 0.5813333333333334
        Epoch: 34, Accuracy: 0.6066666666666667
        Epoch: 35, Accuracy: 0.548
        Epoch: 36, Accuracy: 0.6191111111111111
        Epoch: 37, Accuracy: 0.6355555555555555
        Epoch: 38, Accuracy: 0.6013333333333334
        Epoch: 39, Accuracy: 0.5746666666666667
        Epoch: 40, Accuracy: 0.5408888888888889
        Epoch: 41, Accuracy: 0.628
        Epoch: 42, Accuracy: 0.512
        Epoch: 43, Accuracy: 0.6253333333333333
        Epoch: 44, Accuracy: 0.6191111111111111
        Epoch: 45, Accuracy: 0.5902222222222222
        Epoch: 46, Accuracy: 0.5426666666666666
        Epoch: 47, Accuracy: 0.588
        Epoch: 48, Accuracy: 0.5524444444444444

        Epoch: 49, Accuracy: 0.6186666666666667
        Epoch: 50, Accuracy: 0.5453333333333333

Best parameter: 0.01 & test accuracy:  0.6426666666666667
BOW Dataset

Margin: 1
        Epoch: 1, Accuracy: 0.692
        Epoch: 2, Accuracy: 0.6937777777777778
        Epoch: 3, Accuracy: 0.6844444444444444
        Epoch: 4, Accuracy: 0.6973333333333334
        Epoch: 5, Accuracy: 0.6964444444444444
        Epoch: 6, Accuracy: 0.6751111111111111
        Epoch: 7, Accuracy: 0.6977777777777778
        Epoch: 8, Accuracy: 0.6875555555555556
        Epoch: 9, Accuracy: 0.6933333333333334
        Epoch: 10, Accuracy: 0.6782222222222222
        Epoch: 11, Accuracy: 0.6982222222222222
        Epoch: 12, Accuracy: 0.6946666666666667
        Epoch: 13, Accuracy: 0.6973333333333334
        Epoch: 14, Accuracy: 0.6942222222222222
        Epoch: 15, Accuracy: 0.6915555555555556
```

```
        Epoch: 16, Accuracy: 0.6844444444444444
        Epoch: 17, Accuracy: 0.6817777777777778
        Epoch: 18, Accuracy: 0.7071111111111111
        Epoch: 19, Accuracy: 0.6831111111111111
        Epoch: 20, Accuracy: 0.6911111111111111
        Epoch: 21, Accuracy: 0.692
        Epoch: 22, Accuracy: 0.6902222222222222
        Epoch: 23, Accuracy: 0.6866666666666666
        Epoch: 24, Accuracy: 0.6942222222222222
        Epoch: 25, Accuracy: 0.6973333333333334
        Epoch: 26, Accuracy: 0.6888888888888889
        Epoch: 27, Accuracy: 0.6937777777777778
        Epoch: 28, Accuracy: 0.6773333333333333
        Epoch: 29, Accuracy: 0.6924444444444444
        Epoch: 30, Accuracy: 0.6884444444444444
        Epoch: 31, Accuracy: 0.6893333333333334
        Epoch: 32, Accuracy: 0.6835555555555556
        Epoch: 33, Accuracy: 0.6853333333333333
        Epoch: 34, Accuracy: 0.6888888888888889
        Epoch: 35, Accuracy: 0.688
        Epoch: 36, Accuracy: 0.6928888888888889
        Epoch: 37, Accuracy: 0.6831111111111111
        Epoch: 38, Accuracy: 0.6822222222222222
        Epoch: 39, Accuracy: 0.6888888888888889
        Epoch: 40, Accuracy: 0.6897777777777778
        Epoch: 41, Accuracy: 0.688
        Epoch: 42, Accuracy: 0.684
        Epoch: 43, Accuracy: 0.6755555555555556
        Epoch: 44, Accuracy: 0.696
        Epoch: 45, Accuracy: 0.6782222222222222
        Epoch: 46, Accuracy: 0.6844444444444444

        Epoch: 47, Accuracy: 0.6937777777777778
        Epoch: 48, Accuracy: 0.7022222222222222
        Epoch: 49, Accuracy: 0.68
        Epoch: 50, Accuracy: 0.6826666666666666

Margin: 0.1
        Epoch: 1, Accuracy: 0.6928888888888889
        Epoch: 2, Accuracy: 0.6702222222222223
        Epoch: 3, Accuracy: 0.6831111111111111
        Epoch: 4, Accuracy: 0.6933333333333334
        Epoch: 5, Accuracy: 0.6866666666666666
        Epoch: 6, Accuracy: 0.6817777777777778
        Epoch: 7, Accuracy: 0.6831111111111111
        Epoch: 8, Accuracy: 0.696
        Epoch: 9, Accuracy: 0.6942222222222222
        Epoch: 10, Accuracy: 0.6933333333333334
        Epoch: 11, Accuracy: 0.6915555555555556
        Epoch: 12, Accuracy: 0.6853333333333333
        Epoch: 13, Accuracy: 0.6884444444444444
        Epoch: 14, Accuracy: 0.6911111111111111
        Epoch: 15, Accuracy: 0.6977777777777778
        Epoch: 16, Accuracy: 0.6946666666666667
        Epoch: 17, Accuracy: 0.6937777777777778
        Epoch: 18, Accuracy: 0.6862222222222222
        Epoch: 19, Accuracy: 0.684
        Epoch: 20, Accuracy: 0.6951111111111111
        Epoch: 21, Accuracy: 0.6746666666666666
        Epoch: 22, Accuracy: 0.6924444444444444
        Epoch: 23, Accuracy: 0.688
```

Epoch: 24, Accuracy: 0.6886666666666666
Epoch: 25, Accuracy: 0.6866666666666666
Epoch: 26, Accuracy: 0.6964444444444444
Epoch: 27, Accuracy: 0.6928888888888889
Epoch: 28, Accuracy: 0.6991111111111111
Epoch: 29, Accuracy: 0.6915555555555556
Epoch: 30, Accuracy: 0.6915555555555556
Epoch: 31, Accuracy: 0.6986666666666667
Epoch: 32, Accuracy: 0.6897777777777778
Epoch: 33, Accuracy: 0.6888888888888889
Epoch: 34, Accuracy: 0.6928888888888889
Epoch: 35, Accuracy: 0.6911111111111111
Epoch: 36, Accuracy: 0.6773333333333333
Epoch: 37, Accuracy: 0.6942222222222222
Epoch: 38, Accuracy: 0.6831111111111111
Epoch: 39, Accuracy: 0.6862222222222222
Epoch: 40, Accuracy: 0.6893333333333334
Epoch: 41, Accuracy: 0.6831111111111111
Epoch: 42, Accuracy: 0.692
Epoch: 43, Accuracy: 0.6875555555555556
Epoch: 44, Accuracy: 0.6964444444444444
Epoch: 45, Accuracy: 0.6835555555555556
Epoch: 46, Accuracy: 0.692
Epoch: 47, Accuracy: 0.6835555555555556

Epoch: 48, Accuracy: 0.688
Epoch: 49, Accuracy: 0.6791111111111111
Epoch: 50, Accuracy: 0.6817777777777778

Margin: 0.01
Epoch: 1, Accuracy: 0.6586666666666666
Epoch: 2, Accuracy: 0.6808888888888889
Epoch: 3, Accuracy: 0.6813333333333333
Epoch: 4, Accuracy: 0.6791111111111111
Epoch: 5, Accuracy: 0.6786666666666666
Epoch: 6, Accuracy: 0.68
Epoch: 7, Accuracy: 0.6848888888888889
Epoch: 8, Accuracy: 0.6826666666666666
Epoch: 9, Accuracy: 0.6906666666666667
Epoch: 10, Accuracy: 0.6742222222222222
Epoch: 11, Accuracy: 0.6804444444444444
Epoch: 12, Accuracy: 0.6848888888888889
Epoch: 13, Accuracy: 0.6728888888888889
Epoch: 14, Accuracy: 0.6888888888888889
Epoch: 15, Accuracy: 0.6808888888888889
Epoch: 16, Accuracy: 0.6977777777777778
Epoch: 17, Accuracy: 0.6875555555555556
Epoch: 18, Accuracy: 0.6982222222222222
Epoch: 19, Accuracy: 0.6884444444444444
Epoch: 20, Accuracy: 0.6902222222222222
Epoch: 21, Accuracy: 0.6937777777777778
Epoch: 22, Accuracy: 0.6928888888888889
Epoch: 23, Accuracy: 0.6791111111111111
Epoch: 24, Accuracy: 0.6866666666666666
Epoch: 25, Accuracy: 0.6773333333333333
Epoch: 26, Accuracy: 0.6871111111111111
Epoch: 27, Accuracy: 0.6857777777777778
Epoch: 28, Accuracy: 0.6791111111111111
Epoch: 29, Accuracy: 0.6911111111111111
Epoch: 30, Accuracy: 0.6848888888888889
Epoch: 31, Accuracy: 0.688
Epoch: 32, Accuracy: 0.6915555555555556

```
        Epoch: 33, Accuracy: 0.6768888888888889
        Epoch: 34, Accuracy: 0.6737777777777778
        Epoch: 35, Accuracy: 0.6871111111111111
        Epoch: 36, Accuracy: 0.6795555555555556
        Epoch: 37, Accuracy: 0.6844444444444444
        Epoch: 38, Accuracy: 0.6915555555555556
        Epoch: 39, Accuracy: 0.6875555555555556
        Epoch: 40, Accuracy: 0.6813333333333333
        Epoch: 41, Accuracy: 0.6893333333333334
        Epoch: 42, Accuracy: 0.6893333333333334
        Epoch: 43, Accuracy: 0.6835555555555556
        Epoch: 44, Accuracy: 0.6831111111111111
        Epoch: 45, Accuracy: 0.6786666666666666
        Epoch: 46, Accuracy: 0.6777777777777778
        Epoch: 47, Accuracy: 0.68
        Epoch: 48, Accuracy: 0.6822222222222222

        Epoch: 49, Accuracy: 0.6875555555555556
        Epoch: 50, Accuracy: 0.6928888888888889

Best parameter: 1 & test accuracy:  0.7071111111111111
TFIDF Dataset

Margin: 1
        Epoch: 1, Accuracy: 0.6982222222222222
        Epoch: 2, Accuracy: 0.7275555555555555
        Epoch: 3, Accuracy: 0.7164444444444444
        Epoch: 4, Accuracy: 0.7111111111111111
        Epoch: 5, Accuracy: 0.7088888888888889
        Epoch: 6, Accuracy: 0.7137777777777777
        Epoch: 7, Accuracy: 0.6831111111111111
        Epoch: 8, Accuracy: 0.6733333333333333
        Epoch: 9, Accuracy: 0.7128888888888889
        Epoch: 10, Accuracy: 0.716
        Epoch: 11, Accuracy: 0.7097777777777777
        Epoch: 12, Accuracy: 0.7048888888888889
        Epoch: 13, Accuracy: 0.7115555555555556
        Epoch: 14, Accuracy: 0.7013333333333334
        Epoch: 15, Accuracy: 0.6951111111111111
        Epoch: 16, Accuracy: 0.7057777777777777
        Epoch: 17, Accuracy: 0.7026666666666667
        Epoch: 18, Accuracy: 0.7097777777777777
        Epoch: 19, Accuracy: 0.708
        Epoch: 20, Accuracy: 0.7017777777777777
        Epoch: 21, Accuracy: 0.7106666666666667
        Epoch: 22, Accuracy: 0.7017777777777777
        Epoch: 23, Accuracy: 0.704
        Epoch: 24, Accuracy: 0.7035555555555556
        Epoch: 25, Accuracy: 0.7
        Epoch: 26, Accuracy: 0.7
        Epoch: 27, Accuracy: 0.7093333333333334
        Epoch: 28, Accuracy: 0.6831111111111111
        Epoch: 29, Accuracy: 0.7017777777777777
        Epoch: 30, Accuracy: 0.696
        Epoch: 31, Accuracy: 0.6933333333333334
        Epoch: 32, Accuracy: 0.6804444444444444
        Epoch: 33, Accuracy: 0.7044444444444444
        Epoch: 34, Accuracy: 0.6977777777777778
        Epoch: 35, Accuracy: 0.6808888888888889
        Epoch: 36, Accuracy: 0.7057777777777777
        Epoch: 37, Accuracy: 0.6982222222222222
```

```
        Epoch: 38, Accuracy: 0.6937777777777778
        Epoch: 39, Accuracy: 0.6768888888888889
        Epoch: 40, Accuracy: 0.7026666666666667
        Epoch: 41, Accuracy: 0.6915555555555556
        Epoch: 42, Accuracy: 0.6946666666666667
        Epoch: 43, Accuracy: 0.6915555555555556
        Epoch: 44, Accuracy: 0.6906666666666667
        Epoch: 45, Accuracy: 0.6906666666666667
        Epoch: 46, Accuracy: 0.6724444444444444

        Epoch: 47, Accuracy: 0.6951111111111111
        Epoch: 48, Accuracy: 0.6977777777777778
        Epoch: 49, Accuracy: 0.696
        Epoch: 50, Accuracy: 0.6862222222222222

Margin: 0.1
        Epoch: 1, Accuracy: 0.6786666666666666
        Epoch: 2, Accuracy: 0.716
        Epoch: 3, Accuracy: 0.708
        Epoch: 4, Accuracy: 0.6924444444444444
        Epoch: 5, Accuracy: 0.7088888888888889
        Epoch: 6, Accuracy: 0.7093333333333334
        Epoch: 7, Accuracy: 0.6502222222222223
        Epoch: 8, Accuracy: 0.7168888888888889
        Epoch: 9, Accuracy: 0.6915555555555556
        Epoch: 10, Accuracy: 0.708
        Epoch: 11, Accuracy: 0.7084444444444444
        Epoch: 12, Accuracy: 0.7013333333333334
        Epoch: 13, Accuracy: 0.7137777777777777
        Epoch: 14, Accuracy: 0.7071111111111111
        Epoch: 15, Accuracy: 0.7017777777777777
        Epoch: 16, Accuracy: 0.7008888888888889
        Epoch: 17, Accuracy: 0.6924444444444444
        Epoch: 18, Accuracy: 0.6764444444444444
        Epoch: 19, Accuracy: 0.696
        Epoch: 20, Accuracy: 0.7022222222222222
        Epoch: 21, Accuracy: 0.6648888888888889
        Epoch: 22, Accuracy: 0.7062222222222222
        Epoch: 23, Accuracy: 0.712
        Epoch: 24, Accuracy: 0.7008888888888889
        Epoch: 25, Accuracy: 0.7062222222222222
        Epoch: 26, Accuracy: 0.7053333333333334
        Epoch: 27, Accuracy: 0.7026666666666667
        Epoch: 28, Accuracy: 0.7053333333333334
        Epoch: 29, Accuracy: 0.7008888888888889
        Epoch: 30, Accuracy: 0.7044444444444444
        Epoch: 31, Accuracy: 0.7075555555555556
        Epoch: 32, Accuracy: 0.6862222222222222
        Epoch: 33, Accuracy: 0.7017777777777777
        Epoch: 34, Accuracy: 0.6991111111111111
        Epoch: 35, Accuracy: 0.7075555555555556
        Epoch: 36, Accuracy: 0.6848888888888889
        Epoch: 37, Accuracy: 0.6875555555555556
        Epoch: 38, Accuracy: 0.6911111111111111
        Epoch: 39, Accuracy: 0.7035555555555556
        Epoch: 40, Accuracy: 0.6991111111111111
        Epoch: 41, Accuracy: 0.7013333333333334
        Epoch: 42, Accuracy: 0.6977777777777778
        Epoch: 43, Accuracy: 0.692
        Epoch: 44, Accuracy: 0.6946666666666667
        Epoch: 45, Accuracy: 0.7004444444444444
        Epoch: 46, Accuracy: 0.6977777777777778
```

```
        Epoch: 46, Accuracy: 0.6937777777777778
        Epoch: 47, Accuracy: 0.6515555555555556

        Epoch: 48, Accuracy: 0.6933333333333334
        Epoch: 49, Accuracy: 0.692
        Epoch: 50, Accuracy: 0.6884444444444444

Margin: 0.01
        Epoch: 1, Accuracy: 0.6533333333333333
        Epoch: 2, Accuracy: 0.7146666666666667
        Epoch: 3, Accuracy: 0.6977777777777778
        Epoch: 4, Accuracy: 0.6844444444444444
        Epoch: 5, Accuracy: 0.6728888888888889
        Epoch: 6, Accuracy: 0.6982222222222222
        Epoch: 7, Accuracy: 0.6235555555555555
        Epoch: 8, Accuracy: 0.7066666666666667
        Epoch: 9, Accuracy: 0.6928888888888889
        Epoch: 10, Accuracy: 0.7035555555555556
        Epoch: 11, Accuracy: 0.6728888888888889
        Epoch: 12, Accuracy: 0.7048888888888889
        Epoch: 13, Accuracy: 0.6968888888888889
        Epoch: 14, Accuracy: 0.6897777777777778
        Epoch: 15, Accuracy: 0.7088888888888889
        Epoch: 16, Accuracy: 0.6973333333333334
        Epoch: 17, Accuracy: 0.7075555555555556
        Epoch: 18, Accuracy: 0.7097777777777777
        Epoch: 19, Accuracy: 0.7017777777777777
        Epoch: 20, Accuracy: 0.7115555555555556
        Epoch: 21, Accuracy: 0.7013333333333334
        Epoch: 22, Accuracy: 0.7004444444444444
        Epoch: 23, Accuracy: 0.7017777777777777
        Epoch: 24, Accuracy: 0.7017777777777777
        Epoch: 25, Accuracy: 0.6955555555555556
        Epoch: 26, Accuracy: 0.7062222222222222
        Epoch: 27, Accuracy: 0.664
        Epoch: 28, Accuracy: 0.6742222222222222
        Epoch: 29, Accuracy: 0.6995555555555556
        Epoch: 30, Accuracy: 0.696
        Epoch: 31, Accuracy: 0.6942222222222222
        Epoch: 32, Accuracy: 0.696
        Epoch: 33, Accuracy: 0.7
        Epoch: 34, Accuracy: 0.6986666666666667
        Epoch: 35, Accuracy: 0.6986666666666667
        Epoch: 36, Accuracy: 0.6973333333333334
        Epoch: 37, Accuracy: 0.7017777777777777
        Epoch: 38, Accuracy: 0.7
        Epoch: 39, Accuracy: 0.6964444444444444
        Epoch: 40, Accuracy: 0.6893333333333334
        Epoch: 41, Accuracy: 0.692
        Epoch: 42, Accuracy: 0.7008888888888889
        Epoch: 43, Accuracy: 0.6968888888888889
        Epoch: 44, Accuracy: 0.696
        Epoch: 45, Accuracy: 0.6955555555555556
        Epoch: 46, Accuracy: 0.6977777777777778
        Epoch: 47, Accuracy: 0.6933333333333334
        Epoch: 48, Accuracy: 0.6951111111111111

        Epoch: 49, Accuracy: 0.6964444444444444
        Epoch: 50, Accuracy: 0.6955555555555556

Best parameter: 1 & test accuracy:  0.7275555555555555
```