Neural-Network-PyTorch

December 17, 2022

0.1 Importing libraries

[55]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import Dataset, DataLoader,TensorDataset
import torch.nn.functional as F

from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix, classification_report
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import StratifiedKFold
from collections import Counter

from mpl_toolkits.mplot3d import axes3d
```

[56]:

```
device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
print(device)
```

```
cpu
```

0.2 Importing the Dataset

[57]:

```
# Adding column names
col_names = ['fLength', 'fWidth', 'fSize', 'fConc', 'fConc1', 'fAsym', ␣
 ↪'fM3Long', 'fM3Trans', 'fAlpha', 'fDist', 'class']
# Importing the dataset
df = pd.read_csv('magic04.data',names = col_names)
#df = df.sample(frac = 1)
df.head()
```

[57]:

```
    fLength    fWidth   fSize   fConc  fConc1     fAsym  fM3Long  fM3Trans  \
0   28.7967   16.0021  2.6449  0.3918  0.1982   27.7004  22.0110   -8.2027
1   31.6036   11.7235  2.5185  0.5303  0.3773   26.2722  23.8238   -9.9574
2  162.0520  136.0310  4.0612  0.0374  0.0187  116.7410 -64.8580  -45.2160
3   23.8172    9.5728  2.3385  0.6147  0.3922   27.2107  -6.4633   -7.1513
4   75.1362   30.9205  3.1611  0.3168  0.1832   -5.5277  28.5525   21.8393

    fAlpha     fDist class
0  40.0920   81.8828     g
1   6.3609  205.2610     g
2  76.9600  256.7880     g
3  10.4490  116.7370     g
4   4.6480  356.4620     g
```

[58]:

```
df.describe()
```

[58]:

```
            fLength        fWidth         fSize         fConc        fConc1  \
count  19020.000000  19020.000000  19020.000000  19020.000000  19020.000000
mean      53.250154     22.180966      2.825017      0.380327      0.214657
std       42.364855     18.346056      0.472599      0.182813      0.110511
min        4.283500      0.000000      1.941300      0.013100      0.000300
25%       24.336000     11.863800      2.477100      0.235800      0.128475
50%       37.147700     17.139900      2.739600      0.354150      0.196500
75%       70.122175     24.739475      3.101600      0.503700      0.285225
max      334.177000    256.382000      5.323300      0.893000      0.675200

              fAsym       fM3Long      fM3Trans        fAlpha         fDist
count  19020.000000  19020.000000  19020.000000  19020.000000  19020.000000
mean      -4.331745     10.545545      0.249726     27.645707    193.818026
std       59.206062     51.000118     20.827439     26.103621     74.731787
min     -457.916100   -331.780000   -205.894700      0.000000      1.282600
25%      -20.586550    -12.842775    -10.849375      5.547925    142.492250
50%        4.013050     15.314100      0.666200     17.679500    191.851450
75%       24.063700     35.837800     10.946425     45.883550    240.563825
max      575.240700    238.321000    179.851000     90.000000    495.561000
```

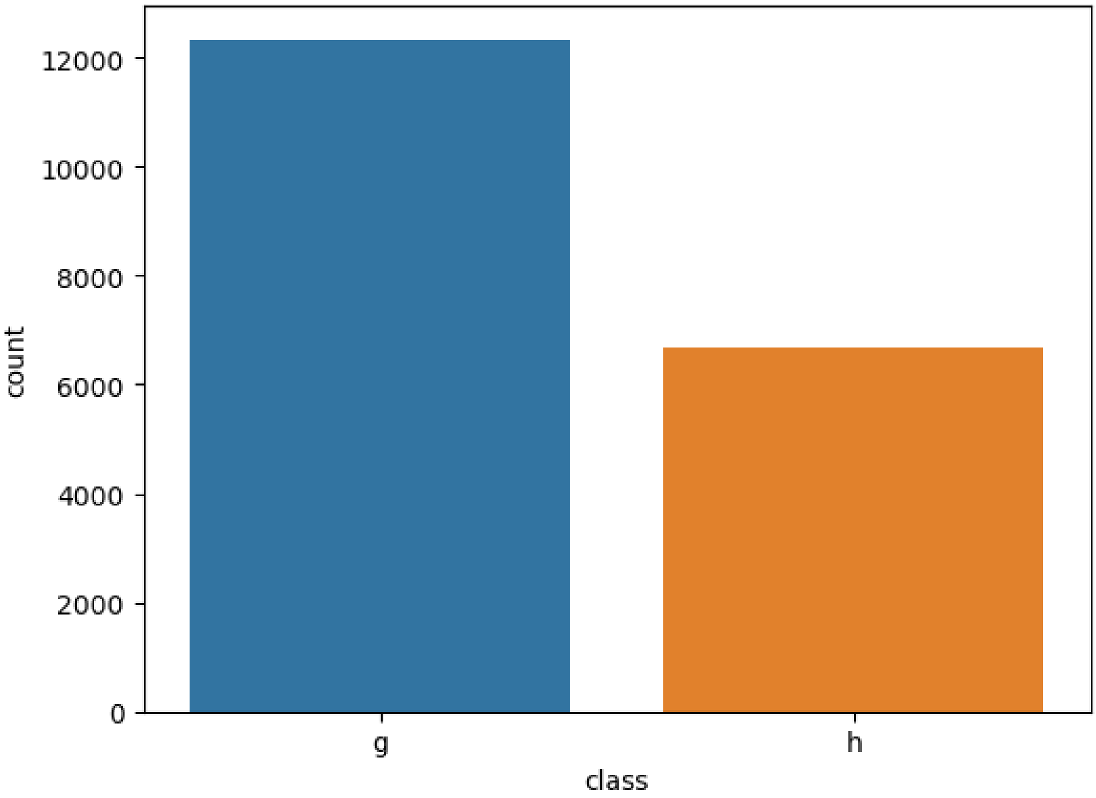
[59]:

```
print(df['class'].value_counts())
sns.countplot(x = 'class', data=df)
```

```
g    12332
h     6688
Name: class, dtype: int64
```

[59]:

```
<AxesSubplot: xlabel='class', ylabel='count'>
```



0.3 Data Balancing

[60]:
```
# Splitting dataset  by class label
df_g = df[df['class'] == 'g']
df_h = df[df['class'] == 'h']
df_g
```

[60]:
```
        fLength    fWidth   fSize   fConc  fConc1     fAsym  fM3Long  \
0       28.7967   16.0021  2.6449  0.3918  0.1982   27.7004  22.0110
1       31.6036   11.7235  2.5185  0.5303  0.3773   26.2722  23.8238
2      162.0520  136.0310  4.0612  0.0374  0.0187  116.7410 -64.8580
3       23.8172    9.5728  2.3385  0.6147  0.3922   27.2107  -6.4633
4       75.1362   30.9205  3.1611  0.3168  0.1832   -5.5277  28.5525
…         …       …     …     …     …       …      …
12327   12.8703   11.4444  2.3811  0.7360  0.3805  -15.0946   5.3032
12328   26.8595   20.5946  2.8754  0.3438  0.2152   -3.4556 -20.0014
12329   22.0913   10.8949  2.2945  0.5381  0.2919   15.2776  18.2296
12330   56.2216   18.7019  2.9297  0.2516  0.1393   96.5758 -41.2969
12331   31.5125   19.2867  2.9578  0.2975  0.1515   38.1833  21.6729

       fM3Trans   fAlpha     fDist class
```

```
0        -8.2027  40.0920   81.8828      g
1        -9.9574   6.3609  205.2610      g
2       -45.2160  76.9600  256.7880      g
3        -7.1513  10.4490  116.7370      g
4        21.8393   4.6480  356.4620      g
…           …        …          …   …
12327    11.6208  21.0120  204.0370      g
12328    -9.0535   3.9848  205.4980      g
12329     7.3975  21.0680  123.2810      g
12330    11.3764   5.9110  197.2090      g
12331   -12.0726  17.5809  171.2270      g

[12332 rows x 11 columns]
```

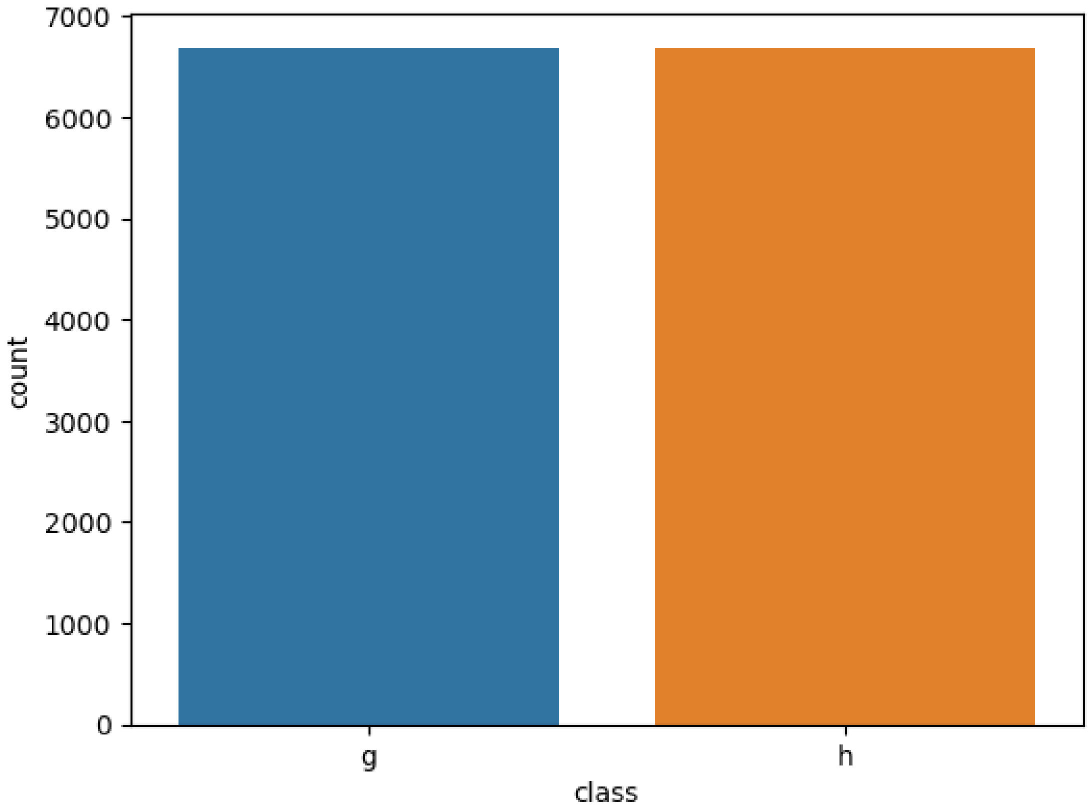
[61]:

```
# Balancing Data
#dfbalanced_g = df_g.sample(df_h.shape[0])
dfbalanced_g = df_g[:df_h.shape[0]]
df = pd.concat([dfbalanced_g, df_h], axis=0) # concatenate horizontally
print(df['class'].value_counts())
sns.countplot(x = 'class', data=df)
```

```
g    6688
h    6688
Name: class, dtype: int64
```

[61]:

```
<AxesSubplot: xlabel='class', ylabel='count'>
```



```
[62]: # Separating features and class
      X = df.iloc[:, :-1].values
      y = df.iloc[:, -1].values
      y
```

```
[62]: array(['g', 'g', 'g', …, 'h', 'h', 'h'], dtype=object)
```

0.4 Encoding Class Labels

```
[63]: # Encoding the Dependent Variable(y)
      le= LabelEncoder()
      y = le.fit_transform(y)
      print(y)
```

```
[0 0 0 … 1 1 1]
```

0.5 Splitting Dataset into train set and test set

[64]:

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2999,␣
  ↪random_state = 0,stratify=y)
print(f"Train set size: {X_train.shape[0]}\nTest set size: {X_test.shape[0]}")
print(Counter(y_train))
print(Counter(y_test))
```

```
Train set size: 9364
Test set size: 4012
Counter({1: 4682, 0: 4682})
Counter({0: 2006, 1: 2006})
```

0.6 Feature Scaling

[65]:

```
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
X_train
```

[65]:

```
array([[-0.80003316, -0.52172403, -0.96415184, …,  0.34172681,
         0.88934769, -0.35479185],
       [-0.33172252, -0.57364175, -0.4138196 , …, -0.31172628,
         1.70106983,  0.49487069],
       [ 0.20249025,  0.09986019,  1.14279238, …,  0.48458488,
        -1.04672703, -0.3034972 ],
       …,
       [-0.83631728, -0.64940233, -0.94733496, …, -0.29880401,
         0.79056201,  0.31416604],
       [-0.4899425 , -0.42189861, -0.79451161, …, -0.58252877,
         1.82963784, -1.62657799],
       [-0.76706189, -0.80618331, -1.68160176, …, -0.28070761,
        -0.32199777, -0.71243169]])
```

0.7 Building the neural network

[66]:

```
def load_data(X_train,y_train,X_test,y_test,batch_size):
    # define the data as a PyTorch tensor
    X_train_tensor=torch.from_numpy(X_train).float()
    y_train_tensor=torch.from_numpy(y_train).float()
    X_test_tensor=torch.from_numpy(X_test).float()
    y_test_tensor=torch.from_numpy(y_test).float()
    # To use the batches of the dataset we are required to put the data through␣
  ↪the Dataloader module of PyTorch
    train_loader = DataLoader(TensorDataset(X_train_tensor,y_train_tensor),␣
  ↪batch_size,shuffle=True)
```

```
    test_loader = DataLoader(TensorDataset(X_test_tensor, y_test_tensor),␣
↪batch_size,shuffle=True)
    #train_data = Dataset(torch.FloatTensor(X_train), torch.
↪FloatTensor(y_train))
    #test_data = Dataset(torch.FloatTensor(X_test))
    return train_loader, test_loader
```

[67]:

```
def get_accuracy(y_pred, y_test):
    y_pred_tag = torch.round(y_pred)

    correct_results_sum = (y_pred_tag == y_test).sum()
    acc = correct_results_sum/y_test.shape[0]
    #acc = torch.round(acc * 100)

    return acc
```

[68]:

```
def evaluate(test_loader, network):
    network.eval()
    correct = 0
    loss = 0
    total = 0
    current_loss = 0
    with torch.no_grad():
        for X_batch,y_batch in test_loader:
            y_pred = network(X_batch)
            loss = F.binary_cross_entropy(y_pred,y_batch.unsqueeze(1)).item()
            current_loss = (current_loss + loss)/2
            for index, i in enumerate(y_pred):
                i = 1 if i >= 0.5 else 0
                if  i == y_batch[index]:
                    correct += 1
                total += 1
    return round(correct/total,3), round(current_loss,3)
```

[75]:

```
def train(train_loader, network, optimizer, criterion, batch_size,epochs = 30):
    network.train()
    for epoch in range(1,epochs+1):
        for X_batch,y_batch in train_loader:
            X_batch, y_batch = X_batch, y_batch
            optimizer.zero_grad()
            # forward propagation
            y_pred = network(X_batch)
            # compute loss
            loss = criterion(y_pred, y_batch.unsqueeze(1))
            acc = get_accuracy(y_pred, y_batch.unsqueeze(1))
            # backward propagation
            loss.backward()
            # update parameters
            optimizer.step()
        #print(f'Epoch {epoch}: | Loss: {loss:.3f} | Accuracy: {acc:.3f}')
```

[70]:

```
class NeuralNet(nn.Module):
    def __init__(self,l1, l2, input_size = 10):
        super().__init__()
        self.hidden1 = nn.Linear(input_size, l1)
        self.hidden2 = nn.Linear(l1, l2)
        self.output_layer = nn.Linear(l2, 1)
        self.relu = nn.ReLU()
        self.sigmoid = nn.Sigmoid()

    def forward(self, inputs):
        activation1 = self.relu(self.hidden1(inputs))
        activation2 = self.relu(self.hidden2(activation1))
        output = self.sigmoid(self.output_layer(activation2))

        return output
```

[71]:

```
def reset_weights(m):
    # to avoid weight leakage
    if isinstance(m, nn.Linear):
        m.reset_parameters()
```

0.8 Hyperparameter tuning using cross validation

[85]:

```
EPOCHS = 30
BATCH_SIZE = 100
LEARNING_RATE = 0.001
def cross_validation(X_train,y_train,l1_nodes, l2_nodes, lr = LEARNING_RATE,␣
 ↪epochs = EPOCHS, batch_size = BATCH_SIZE,cv=10):
    skf = StratifiedKFold(n_splits=cv, shuffle=True)
    network = NeuralNet(l1_nodes,l2_nodes)
    #network = network.to(device)
    optimizer = optim.Adam(network.parameters(),lr = lr)
    criterion= nn.BCELoss()
    avg_accuracy = 0
    fold = 1
    for train_index, test_index in skf.split(X_train, y_train):
        train_loader_folds, test_loader_fold =␣
 ↪load_data(X_train[train_index],y_train[train_index],X_train[test_index],y_train[test_index]
        network.apply(reset_weights)
        print(f"Fold {fold} / {cv}:")
           ␣
 ↪print("----------------------------------------------------------------------------------
        train(train_loader_folds, network,optimizer,criterion,batch_size,␣
↪epochs = epochs)
        accuracy, loss = evaluate(test_loader_fold, network)
        avg_accuracy = (avg_accuracy + accuracy) / 2
        fold += 1
        print(f"Accuracy = {accuracy}, Loss = {loss}")
       ␣
↪print("------------------------------------------------------------------------------------
    return avg_accuracy
```

[86]:
```
def annot_max(x,y, ax=None):
    xmax = x[np.argmax(y)]
    ymax = y.max()
    text= "x={:.3f}, acc={:.3f}".format(xmax, ymax)
    if not ax:
        ax=plt.gca()
    bbox_props = dict(boxstyle="square,pad=0.3", fc="w", ec="k", lw=0.72)
    arrowprops=dict(arrowstyle="->",connectionstyle="angle,angleA=0,angleB=60")
    kw = dict(xycoords='data',textcoords="axes fraction",
              arrowprops=arrowprops, bbox=bbox_props, ha="right", va="top")
    ax.annotate(text, xy=(xmax, ymax), xytext=(0.94,0.96), **kw)
```

0.9 Tuning the hidden nodes in each layer

l1: hidden nodes in first layer

l2: hidden nodes in second layer

[91]:
```
l1 = np.arange(10,100,10)
l2 = np.arange(10,100,10)
l_combination = []
avg_accuracies = []
for n in l1:
    for m in l2:
        l_combination.append((n,m))
        acc_score = cross_validation(X_train,y_train,n,m,lr=0.01,epochs =␣
↪25,batch_size = 128,cv=10)
        print(f"============================= l1 = {n}, l2 = {m}, average␣
↪accuracy = {round(acc_score,3)} ============================= ")
        avg_accuracies.append(acc_score)

```

```
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.827, Loss = 0.339
--------------------------------------------------------------------------------
----
```

```
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.343
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.351
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.319
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.351
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.36
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.433
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.378
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.327
--------------------------------------------------------------------------------
----
```

```
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.329
--------------------------------------------------------------------------------
----
============================= l1 = 10, l2 = 10, average accuracy = 0.847
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.339
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.349
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.367
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.307
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.39
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.294
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.397
```

```
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.276
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.35
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.393
--------------------------------------------------------------------------------
----
============================= l1 = 10, l2 = 20, average accuracy = 0.846
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.824, Loss = 0.375
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.314
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.334
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.338
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.819, Loss = 0.361
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.327
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.478
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.381
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.322
--------------------------------------------------------------------------------
----
============================= l1 = 10, l2 = 30, average accuracy = 0.854
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.305
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.415
--------------------------------------------------------------------------------
----
```

```
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.289
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.391
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.292
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.271
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.823, Loss = 0.423
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.302
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.39
--------------------------------------------------------------------------------
----
```

```
============================= l1 = 10, l2 = 40, average accuracy = 0.838
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.351
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.371
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.269
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.351
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.304
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.352
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.402
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.304
```

```
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.341
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.822, Loss = 0.389
--------------------------------------------------------------------------------
----
============================= l1 = 10, l2 = 50, average accuracy = 0.834
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.353
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.308
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.264
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.334
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.842, Loss = 0.321
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.316
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.266
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.824, Loss = 0.405
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.367
--------------------------------------------------------------------------------
----
============================= l1 = 10, l2 = 60, average accuracy = 0.841
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.371
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.353
--------------------------------------------------------------------------------
----
```

```
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.342
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.362
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.408
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.31
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.406
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.302
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.27
--------------------------------------------------------------------------------
----
============================= l1 = 10, l2 = 70, average accuracy = 0.841
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.309
```

```
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.29
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.823, Loss = 0.367
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.389
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.3
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.864, Loss = 0.338
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.377
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.398
```

```
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.327
--------------------------------------------------------------------------------
----
============================= l1 = 10, l2 = 80, average accuracy = 0.842
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.275
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.324
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.41
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.29
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.316
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.309
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.841, Loss = 0.441
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.318
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.355
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.377
--------------------------------------------------------------------------------
----
============================= l1 = 10, l2 = 90, average accuracy = 0.852
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.312
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.336
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.362
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.29
--------------------------------------------------------------------------------
----
```

```
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.358
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.874, Loss = 0.362
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.348
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.321
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.393
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.383
--------------------------------------------------------------------------------
----
============================= l1 = 20, l2 = 10, average accuracy = 0.851
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.286
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.826, Loss = 0.397
```

```
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.347
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.377
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.416
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.371
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.305
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.363
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.438
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.877, Loss = 0.267
```

```
--------------------------------------------------------------------------------
----
============================= l1 = 20, l2 = 20, average accuracy = 0.859
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.867, Loss = 0.358
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.291
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.313
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.38
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.35
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.843, Loss = 0.399
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.29
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.411
--------------------------------------------------------------------------------
----
============================= l1 = 20, l2 = 30, average accuracy = 0.848
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.485
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.472
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.302
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.319
--------------------------------------------------------------------------------
----
```

```
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.395
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.321
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.536
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.279
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.313
--------------------------------------------------------------------------------
----
============================= l1 = 20, l2 = 40, average accuracy = 0.847
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.322
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.38
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.34
```

```
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.305
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.373
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.348
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.862, Loss = 0.306
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.405
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.307
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.321
--------------------------------------------------------------------------------
----
============================= l1 = 20, l2 = 50, average accuracy = 0.848
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.852, Loss = 0.304
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.324
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.285
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.403
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.868, Loss = 0.268
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.312
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.862, Loss = 0.345
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.826, Loss = 0.413
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.369
--------------------------------------------------------------------------------
----
============================= l1 = 20, l2 = 60, average accuracy = 0.843
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.285
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.358
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.276
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.824, Loss = 0.401
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.865, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.383
--------------------------------------------------------------------------------
----
```

```
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.412
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.372
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.311
--------------------------------------------------------------------------------
----
============================= l1 = 20, l2 = 70, average accuracy = 0.837
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.349
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.386
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.318
```

```
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.265
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.398
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.321
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.403
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.313
--------------------------------------------------------------------------------
----
============================= l1 = 20, l2 = 80, average accuracy = 0.848
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.295
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.844, Loss = 0.37
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.412
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.343
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.309
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.32
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.292
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.355
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.319
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.864, Loss = 0.277
--------------------------------------------------------------------------------
----
============================= l1 = 20, l2 = 90, average accuracy = 0.857
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.827, Loss = 0.374
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.825, Loss = 0.372
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.313
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.307
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.279
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.341
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.294
--------------------------------------------------------------------------------
----
```

```
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.865, Loss = 0.266
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.304
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.862, Loss = 0.351
--------------------------------------------------------------------------------
----
============================= l1 = 30, l2 = 10, average accuracy = 0.854
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.309
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.343
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.38
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.344
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.866, Loss = 0.272
```

```
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.346
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.316
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.314
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.869, Loss = 0.25
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.819, Loss = 0.296
--------------------------------------------------------------------------------
----
============================= l1 = 30, l2 = 20, average accuracy = 0.837
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.347
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.845, Loss = 0.308
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.877, Loss = 0.346
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.273
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.309
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.336
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.386
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.351
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.348
--------------------------------------------------------------------------------
----
============================= l1 = 30, l2 = 30, average accuracy = 0.851
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.268
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.261
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.305
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.427
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.283
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.297
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.299
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.324
--------------------------------------------------------------------------------
----
```

```
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.868, Loss = 0.266
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.824, Loss = 0.329
--------------------------------------------------------------------------------
----
============================= l1 = 30, l2 = 40, average accuracy = 0.839
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.397
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.458
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.371
```

```
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.3
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.295
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.865, Loss = 0.412
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.827, Loss = 0.357
--------------------------------------------------------------------------------
----
============================= l1 = 30, l2 = 50, average accuracy = 0.841
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.325
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.345
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.271
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.86, Loss = 0.294
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.359
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.322
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.337
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.318
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.296
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.334
--------------------------------------------------------------------------------
----
============================= l1 = 30, l2 = 60, average accuracy = 0.848
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.875, Loss = 0.255
--------------------------------------------------------------------------------
----
```

```
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.385
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.334
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.335
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.376
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.348
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.399
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.53
--------------------------------------------------------------------------------
----
```

```
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.373
--------------------------------------------------------------------------------
----
============================= l1 = 30, l2 = 70, average accuracy = 0.839
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.311
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.368
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.268
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.344
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.287
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.362
```

```
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.365
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.282
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.251
--------------------------------------------------------------------------------
----
============================= l1 = 30, l2 = 80, average accuracy = 0.852
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.836, Loss = 0.341
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.825, Loss = 0.405
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.869, Loss = 0.488
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.331
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.847, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.443
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.268
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.327
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.315
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.341
--------------------------------------------------------------------------------
----
============================= l1 = 30, l2 = 90, average accuracy = 0.846
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.826, Loss = 0.394
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.243
--------------------------------------------------------------------------------
----
```

```
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.337
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.291
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.292
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.318
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.297
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.384
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.341
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.372
--------------------------------------------------------------------------------
----
```

```
============================= l1 = 40, l2 = 10, average accuracy = 0.846
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.269
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.311
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.388
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.243
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.303
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.37
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.352
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.366
```

```
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.826, Loss = 0.27
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.373
--------------------------------------------------------------------------------
----
============================= l1 = 40, l2 = 20, average accuracy = 0.841
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.375
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.265
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.359
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.296
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.286
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.841, Loss = 0.243
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.866, Loss = 0.279
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.326
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.411
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.386
--------------------------------------------------------------------------------
----
============================= l1 = 40, l2 = 30, average accuracy = 0.839
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.248
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.295
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.875, Loss = 0.269
--------------------------------------------------------------------------------
----
```

```
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.825, Loss = 0.392
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.305
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.258
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.372
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.282
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.386
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.352
--------------------------------------------------------------------------------
----
============================= l1 = 40, l2 = 40, average accuracy = 0.838
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.352
```

```
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.311
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.256
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.269
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.393
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.362
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.324
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.278
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.378
```

```
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.362
--------------------------------------------------------------------------------
----
============================= l1 = 40, l2 = 50, average accuracy = 0.847
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.377
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.358
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.444
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.312
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.288
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.353
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.845, Loss = 0.384
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.404
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.868, Loss = 0.32
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.415
--------------------------------------------------------------------------------
----
============================= l1 = 40, l2 = 60, average accuracy = 0.847
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.294
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.28
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.383
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.391
--------------------------------------------------------------------------------
----
```

```
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.44
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.826, Loss = 0.48
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.335
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.326
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.415
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.352
--------------------------------------------------------------------------------
----
============================= l1 = 40, l2 = 70, average accuracy = 0.85
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.302
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.372
```

```
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.826, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.866, Loss = 0.382
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.395
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.416
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.377
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.313
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.373
```

```
--------------------------------------------------------------------------------
----
============================= l1 = 40, l2 = 80, average accuracy = 0.844
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.407
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.425
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.393
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.293
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.39
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.268
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.296
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.843, Loss = 0.392
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.338
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.295
--------------------------------------------------------------------------------
----
============================= l1 = 40, l2 = 90, average accuracy = 0.848
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.325
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.359
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.864, Loss = 0.253
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.4
--------------------------------------------------------------------------------
----
```

```
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.336
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.414
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.4
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.352
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.433
--------------------------------------------------------------------------------
----
============================= l1 = 50, l2 = 10, average accuracy = 0.855
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.396
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.331
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.274
```

```
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.426
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.351
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.387
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.318
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.335
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.383
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.382
--------------------------------------------------------------------------------
----
============================= l1 = 50, l2 = 20, average accuracy = 0.841
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.85, Loss = 0.401
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.342
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.269
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.307
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.337
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.392
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.305
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.345
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.828, Loss = 0.337
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.26
--------------------------------------------------------------------------------
----
============================= l1 = 50, l2 = 30, average accuracy = 0.84
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.391
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.869, Loss = 0.326
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.376
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.278
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.353
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.376
--------------------------------------------------------------------------------
----
```

```
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.358
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.869, Loss = 0.334
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.384
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.416
--------------------------------------------------------------------------------
----
============================= l1 = 50, l2 = 40, average accuracy = 0.845
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.327
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.378
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.337
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.3
```

```
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.328
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.356
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.864, Loss = 0.405
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.872, Loss = 0.366
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.342
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.449
--------------------------------------------------------------------------------
----
============================= l1 = 50, l2 = 50, average accuracy = 0.844
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.818, Loss = 0.316
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.835, Loss = 0.278
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.284
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.381
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.363
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.348
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.25
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.313
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.832, Loss = 0.304
--------------------------------------------------------------------------------
----
============================= l1 = 50, l2 = 60, average accuracy = 0.84
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.383
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.307
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.361
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.321
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.325
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.396
--------------------------------------------------------------------------------
----
```

```
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.352
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.358
--------------------------------------------------------------------------------
----
============================= l1 = 50, l2 = 70, average accuracy = 0.847
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.482
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.437
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.295
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.866, Loss = 0.303
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.308
```

```
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.868, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.323
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.382
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.309
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.396
--------------------------------------------------------------------------------
----
============================= l1 = 50, l2 = 80, average accuracy = 0.844
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.527
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.407
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.835, Loss = 0.307
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.462
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.285
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.423
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.865, Loss = 0.352
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.866, Loss = 0.281
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.468
--------------------------------------------------------------------------------
----
============================= l1 = 50, l2 = 90, average accuracy = 0.845
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.325
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.247
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.349
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.869, Loss = 0.387
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.316
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.865, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.813, Loss = 0.362
--------------------------------------------------------------------------------
----
```

```
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.871, Loss = 0.351
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.429
--------------------------------------------------------------------------------
----
============================= l1 = 60, l2 = 10, average accuracy = 0.849
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.349
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.318
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.377
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.87, Loss = 0.389
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.354
```

```
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.412
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.379
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.326
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.378
--------------------------------------------------------------------------------
----
============================= l1 = 60, l2 = 20, average accuracy = 0.851
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.423
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.322
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.866, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.83, Loss = 0.377
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.348
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.514
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.878, Loss = 0.236
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.414
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.362
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.365
--------------------------------------------------------------------------------
----
============================= l1 = 60, l2 = 30, average accuracy = 0.838
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.334
--------------------------------------------------------------------------------
----
```

```
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.315
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.374
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.326
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.305
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.37
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.231
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.374
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.362
--------------------------------------------------------------------------------
----
```

```
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.866, Loss = 0.228
--------------------------------------------------------------------------------
----
============================= l1 = 60, l2 = 40, average accuracy = 0.853
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.27
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.338
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.32
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.399
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.365
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.351
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.3
```

```
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.267
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.328
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.347
--------------------------------------------------------------------------------
----
============================= l1 = 60, l2 = 50, average accuracy = 0.854
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.429
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.286
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.345
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.29
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.86, Loss = 0.356
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.388
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.344
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.352
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.864, Loss = 0.236
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.326
--------------------------------------------------------------------------------
----
============================= l1 = 60, l2 = 60, average accuracy = 0.852
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.868, Loss = 0.302
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.823, Loss = 0.532
--------------------------------------------------------------------------------
----
```

```
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.257
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.535
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.308
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.328
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.373
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.356
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.387
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.314
--------------------------------------------------------------------------------
----
```

```
============================= l1 = 60, l2 = 70, average accuracy = 0.836
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.862, Loss = 0.414
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.331
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.304
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.323
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.383
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.277
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.419
```

```
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.819, Loss = 0.431
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.865, Loss = 0.3
--------------------------------------------------------------------------------
----
============================= l1 = 60, l2 = 80, average accuracy = 0.85
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.38
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.339
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.378
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.405
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.3
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.86, Loss = 0.284
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.334
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.383
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.313
--------------------------------------------------------------------------------
----
============================= l1 = 60, l2 = 90, average accuracy = 0.847
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.312
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.327
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.374
--------------------------------------------------------------------------------
----
```

```
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.249
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.307
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.376
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.283
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.299
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.425
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.283
--------------------------------------------------------------------------------
----
============================= l1 = 70, l2 = 10, average accuracy = 0.849
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.363
```

```
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.825, Loss = 0.402
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.352
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.328
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.463
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.262
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.336
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.868, Loss = 0.383
```

```
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.351
--------------------------------------------------------------------------------
----
============================= l1 = 70, l2 = 20, average accuracy = 0.849
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.363
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.268
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.836, Loss = 0.328
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.334
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.853, Loss = 0.29
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.352
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.361
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.401
--------------------------------------------------------------------------------
----
============================= l1 = 70, l2 = 30, average accuracy = 0.843
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.339
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.403
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.369
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.346
--------------------------------------------------------------------------------
----
```

```
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.457
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.343
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.295
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.441
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.287
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.322
--------------------------------------------------------------------------------
----
============================= l1 = 70, l2 = 40, average accuracy = 0.844
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.341
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.306
```

```
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.333
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.348
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.374
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.266
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.298
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.349
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.277
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.862, Loss = 0.299
```

```
--------------------------------------------------------------------------------
----
============================= l1 = 70, l2 = 50, average accuracy = 0.857
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.291
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.343
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.345
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.293
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.276
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.821, Loss = 0.345
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.388
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.845, Loss = 0.323
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.871, Loss = 0.414
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.381
--------------------------------------------------------------------------------
----
============================= l1 = 70, l2 = 60, average accuracy = 0.842
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.323
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.454
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.317
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.455
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.316
--------------------------------------------------------------------------------
----
```

```
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.377
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.268
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.346
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.822, Loss = 0.424
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.341
--------------------------------------------------------------------------------
----
============================= l1 = 70, l2 = 70, average accuracy = 0.849
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.299
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.324
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.336
```

```
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.282
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.35
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.371
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.38
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.874, Loss = 0.3
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.312
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.818, Loss = 0.407
--------------------------------------------------------------------------------
----
============================= l1 = 70, l2 = 80, average accuracy = 0.834
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.848, Loss = 0.457
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.866, Loss = 0.368
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.323
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.821, Loss = 0.327
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.459
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.446
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.352
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.296
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.847, Loss = 0.254
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.448
--------------------------------------------------------------------------------
----
============================= l1 = 70, l2 = 90, average accuracy = 0.85
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.338
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.419
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.349
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.348
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.275
--------------------------------------------------------------------------------
----
```

```
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.306
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.434
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.87, Loss = 0.306
--------------------------------------------------------------------------------
----
============================= l1 = 80, l2 = 10, average accuracy = 0.86
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.27
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.346
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.39
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.333
```

```
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.392
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.823, Loss = 0.474
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.272
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.31
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.365
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.391
--------------------------------------------------------------------------------
----
============================= l1 = 80, l2 = 20, average accuracy = 0.852
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.256
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.855, Loss = 0.303
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.308
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.348
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.328
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.472
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.354
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.363
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.399
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.838, Loss = 0.358
--------------------------------------------------------------------------------
----
============================= l1 = 80, l2 = 30, average accuracy = 0.838
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.395
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.274
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.402
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.298
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.427
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.375
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.279
--------------------------------------------------------------------------------
----
```

```
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.351
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.32
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.357
--------------------------------------------------------------------------------
----
============================= l1 = 80, l2 = 40, average accuracy = 0.845
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.864, Loss = 0.255
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.273
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.375
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.836, Loss = 0.392
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.862, Loss = 0.249
```

```
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.249
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.355
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.821, Loss = 0.421
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.3
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.315
--------------------------------------------------------------------------------
----
============================= l1 = 80, l2 = 50, average accuracy = 0.844
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.872, Loss = 0.298
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.827, Loss = 0.446
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.38
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.278
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.323
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.342
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.264
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.323
--------------------------------------------------------------------------------
----
============================= l1 = 80, l2 = 60, average accuracy = 0.852
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.286
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.421
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.36
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.869, Loss = 0.295
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.35
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.827, Loss = 0.364
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.281
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.259
--------------------------------------------------------------------------------
----
```

```
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.28
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.338
--------------------------------------------------------------------------------
----
============================= l1 = 80, l2 = 70, average accuracy = 0.852
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.348
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.321
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.383
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.412
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.827, Loss = 0.388
```

```
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.291
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.461
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.367
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.531
--------------------------------------------------------------------------------
----
============================= l1 = 80, l2 = 80, average accuracy = 0.838
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.395
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.274
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.406
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.848, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.375
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.385
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.42
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.401
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.377
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.429
--------------------------------------------------------------------------------
----
============================= l1 = 80, l2 = 90, average accuracy = 0.849
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.33
--------------------------------------------------------------------------------
----
```

```
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.486
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.297
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.327
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.318
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.323
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.325
--------------------------------------------------------------------------------
----
```

```
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.862, Loss = 0.255
--------------------------------------------------------------------------------
----
============================= l1 = 90, l2 = 10, average accuracy = 0.857
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.341
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.425
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.836, Loss = 0.319
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.326
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.309
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.3
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.371
```

```
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.342
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.265
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.314
--------------------------------------------------------------------------------
----
============================= l1 = 90, l2 = 20, average accuracy = 0.853
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.295
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.322
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.338
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.302
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.86, Loss = 0.409
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.345
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.338
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.814, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.327
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.435
--------------------------------------------------------------------------------
----
============================= l1 = 90, l2 = 30, average accuracy = 0.844
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.312
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.836, Loss = 0.528
--------------------------------------------------------------------------------
----
```

```
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.414
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.459
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.303
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.865, Loss = 0.313
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.353
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.325
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.373
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.295
--------------------------------------------------------------------------------
----
```

```
============================= l1 = 90, l2 = 40, average accuracy = 0.844
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.417
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.813, Loss = 0.323
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.366
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.417
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.386
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.295
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.42
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.866, Loss = 0.279
```

```
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.364
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.308
--------------------------------------------------------------------------------
----
============================= l1 = 90, l2 = 50, average accuracy = 0.852
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.461
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.358
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.267
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.362
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.825, Loss = 0.349
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.858, Loss = 0.286
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.38
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.533
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.379
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.447
--------------------------------------------------------------------------------
----
============================= l1 = 90, l2 = 60, average accuracy = 0.847
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.393
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.282
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.334
--------------------------------------------------------------------------------
----
```

```
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.352
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.362
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.414
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.374
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.864, Loss = 0.363
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.291
--------------------------------------------------------------------------------
----
============================= l1 = 90, l2 = 70, average accuracy = 0.849
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.417
```

```
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.398
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.309
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.37
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.29
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.868, Loss = 0.365
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.363
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.406
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.308
```

```
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.292
--------------------------------------------------------------------------------
----
============================= l1 = 90, l2 = 80, average accuracy = 0.852
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.866, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.38
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.36
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 1.584
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.415
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.313
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.837, Loss = 0.419
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.285
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.337
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.368
--------------------------------------------------------------------------------
----
============================= l1 = 90, l2 = 90, average accuracy = 0.851
=============================
```

[92]:

```
max_accuracy = max(avg_accuracies)
max_index = avg_accuracies.index(max_accuracy)
print(f" maximum accuracy = {max_accuracy}\thidden nodes in layer1 =␣
 ↪{l_combination[max_index][0]}\thidden nodes in layer2 =␣
 ↪{l_combination[max_index][1]}")
```

```
 maximum accuracy = 0.8603095703124999  hidden nodes in layer1 = 80     hidden
nodes in layer2 = 10
```

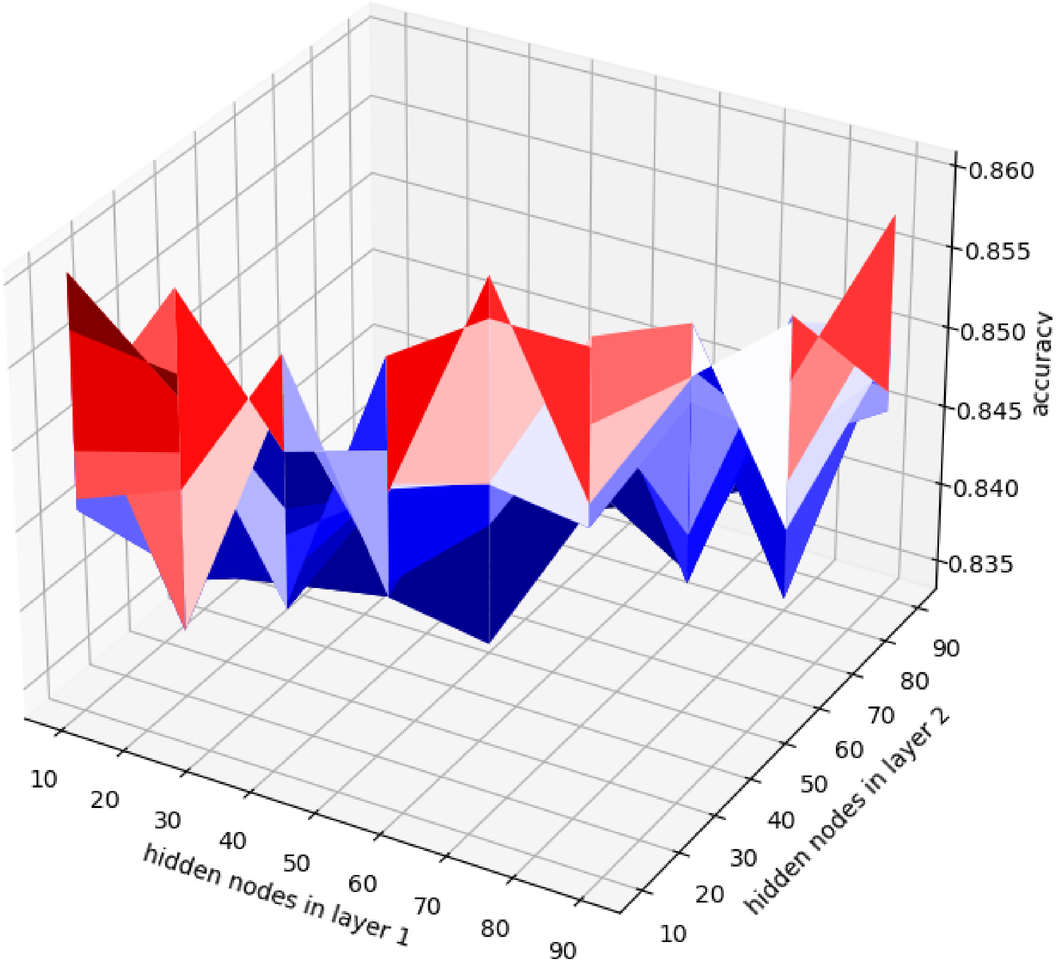
[93]:

```
def plot(ax1, ax2, ax3):
    fig = plt.figure(figsize=(8,8))
    ax = fig.add_subplot(projection='3d')

    # Plot a basic wireframe.
    ax.plot_surface(ax1, ax2, ax3, cmap = 'seismic')
    ax.set_xlabel('hidden nodes in layer 1')
    ax.set_ylabel('hidden nodes in layer 2')
    ax.set_zlabel('accuracy')

    plt.show()
```

[95]:
```
l1 = np.arange(10,100,10)
l2 = np.arange(10,100,10)
z = np.array(avg_accuracies).reshape(l1.shape[0], -1)
plot(l1, l2, z)
```



Final values after tuning:

`l1`: 80 nodes `l2`: 10 nodes

0.10 Tuning `learning_rate` hyperparameter

[96]:
```
learning_rates = [0.0001,0.001,0.01,0.1,1]
l1 = 80
l2 = 10
```

```
avg_accuracies = []
for l in learning_rates:
        acc_score = cross_validation(X_train,y_train,l1,l2,lr=l,epochs = 30␣
 ↪,batch_size = 128,cv=10)
        print(f"============================= learning_rate = {l}, average␣
 ↪accuracy = {round(acc_score,3)} ============================= ")
        avg_accuracies.append(acc_score)
```

```
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.812, Loss = 0.426
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.377
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.808, Loss = 0.355
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.792, Loss = 0.392
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.821, Loss = 0.417
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.803, Loss = 0.428
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.783, Loss = 0.42
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.787, Loss = 0.396
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.813, Loss = 0.353
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.824, Loss = 0.412
--------------------------------------------------------------------------------
----
============================= learning_rate = 0.0001, average accuracy = 0.812
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.338
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.379
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.824, Loss = 0.334
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.284
--------------------------------------------------------------------------------
----
```

```
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.299
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.294
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.869, Loss = 0.368
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.439
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.308
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.332
--------------------------------------------------------------------------------
----
============================= learning_rate = 0.001, average accuracy = 0.838
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.287
```

```
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.82, Loss = 0.387
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.836, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.864, Loss = 0.368
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.371
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.265
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.346
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.393
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.869, Loss = 0.436
```

```
--------------------------------------------------------------------------------
----
============================= learning_rate = 0.01, average accuracy = 0.851
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.825, Loss = 0.382
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.501, Loss = 0.689
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.499, Loss = 0.697
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.499, Loss = 0.688
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 0.692
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 0.69
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 0.69
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.5, Loss = 0.691
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 0.69
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 0.691
--------------------------------------------------------------------------------
----
============================= learning_rate = 0.1, average accuracy = 0.5
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.501, Loss = 47.667
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.501, Loss = 51.572
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.499, Loss = 47.324
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.499, Loss = 51.259
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 49.066
--------------------------------------------------------------------------------
----
```

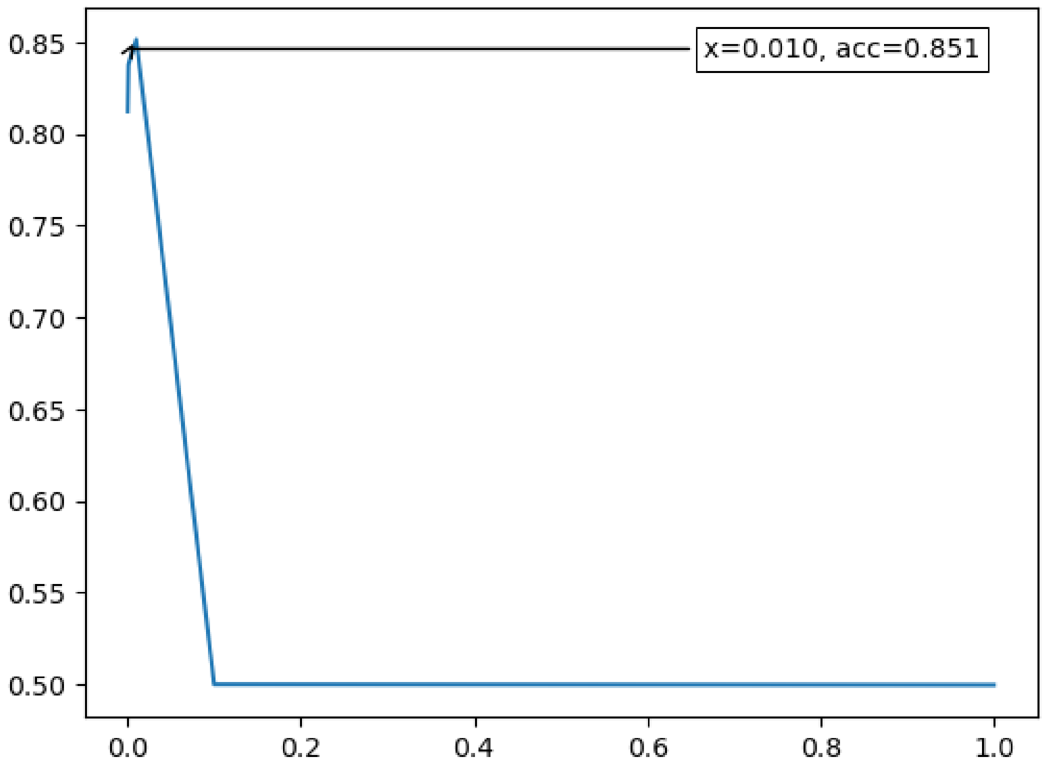
```
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 48.231
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 53.619
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 46.382
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 47.401
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.5, Loss = 56.63
--------------------------------------------------------------------------------
----
============================= learning_rate = 1, average accuracy = 0.5
=============================
```

[97]:

```
plt.plot(learning_rates,np.array(avg_accuracies))
annot_max(learning_rates,np.array(avg_accuracies))
plt.show()
```

[97]:

```
[<matplotlib.lines.Line2D at 0x7fa68e4e9270>]
```



0.11 Tuning batch_size hyperparameter

[99]:
```
lr= 0.01
l1 = 80
l2 = 10
batch_size = [16,32,64,128,256,512]
avg_accuracies = []
for b in batch_size:
        acc_score = cross_validation(X_train,y_train,l1,l2,lr=lr,epochs =␣
 ↪30,batch_size = b,cv=10)
        print(f"============================= batch_size = {b}, average␣
 ↪accuracy = {round(acc_score,3)} ============================= ")
        avg_accuracies.append(acc_score)
```

```
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.264
--------------------------------------------------------------------------------
----
Fold 2 / 10:
```

```
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.274
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.396
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.321
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.822, Loss = 0.428
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.331
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.229
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.381
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.484
--------------------------------------------------------------------------------
----
Fold 10 / 10:
```

```
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.375
--------------------------------------------------------------------------------
----
============================= batch_size = 16, average accuracy = 0.845
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.33
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.294
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.388
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.468
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.395
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.325
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.637
--------------------------------------------------------------------------------
```

```
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.358
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.372
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.343
--------------------------------------------------------------------------------
----
============================= batch_size = 32, average accuracy = 0.851
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.829, Loss = 0.351
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.824, Loss = 0.342
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.257
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.332
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
```

```
Accuracy = 0.853, Loss = 0.338
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.363
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.319
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.333
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.246
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.306
--------------------------------------------------------------------------------
----
============================= batch_size = 64, average accuracy = 0.849
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.367
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.42
--------------------------------------------------------------------------------
----
Fold 3 / 10:
```

```
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.251
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.302
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.329
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.336
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.263
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.474
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.399
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.291
--------------------------------------------------------------------------------
----
============================= batch_size = 128, average accuracy = 0.848
```

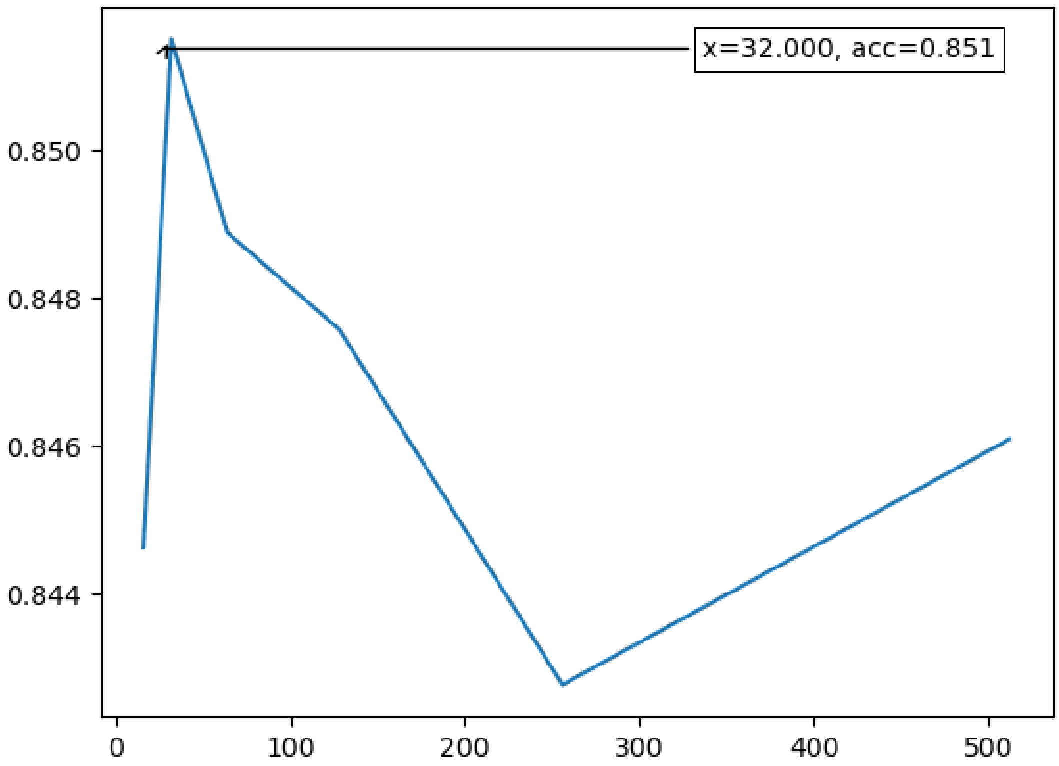
```
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.867, Loss = 0.288
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.303
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.343
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.298
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.824, Loss = 0.366
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.337
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.326
--------------------------------------------------------------------------------
```

```
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.322
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.327
--------------------------------------------------------------------------------
----
============================= batch_size = 256, average accuracy = 0.843
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.259
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.248
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.266
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.249
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.258
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
```

```
Accuracy = 0.837, Loss = 0.253
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.264
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.833, Loss = 0.293
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.263
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.241
--------------------------------------------------------------------------------
----
============================= batch_size = 512, average accuracy = 0.846
=============================
```

[100]:
```
plt.plot(batch_size,np.array(avg_accuracies))
annot_max(batch_size,np.array(avg_accuracies))
plt.show()
```

[100]:
```
[<matplotlib.lines.Line2D at 0x7fa68f2e8af0>]
```



0.12 Tuning epoch hyperparameter

[101]:

```
lr= 0.01
l1 = 80
l2 = 10
batch_size = 32
epochs = np.arange(20,51,10)
avg_accuracies = []
for epoch in epochs:
        acc_score = cross_validation(X_train,y_train,l1,l2,lr=lr,epochs =␣
  ↪epoch,batch_size = batch_size,cv=10)
        print(f"============================= epochs = {epoch}, average␣
  ↪accuracy = {round(acc_score,3)} ============================= ")
        avg_accuracies.append(acc_score)
```

```
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.61
--------------------------------------------------------------------------------
----
```

```
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.331
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.243
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.269
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.386
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.304
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.864, Loss = 0.273
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.491
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.365
--------------------------------------------------------------------------------
----
```

```
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.268
--------------------------------------------------------------------------------
----
============================= epochs = 20, average accuracy = 0.853
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.328
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.249
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.823, Loss = 0.221
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.391
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.39
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.328
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.368
```

```
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.868, Loss = 0.467
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.293
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.388
--------------------------------------------------------------------------------
----
============================= epochs = 30, average accuracy = 0.84
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.365
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.859, Loss = 0.417
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.245
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.322
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.842, Loss = 0.284
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.185
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.293
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.507
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.318
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.341
--------------------------------------------------------------------------------
----
============================= epochs = 40, average accuracy = 0.837
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.421
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.258
--------------------------------------------------------------------------------
----
```

```
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.206
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.836, Loss = 0.325
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.454
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.405
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.842, Loss = 0.315
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.44
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.313
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.843, Loss = 0.735
--------------------------------------------------------------------------------
----
```

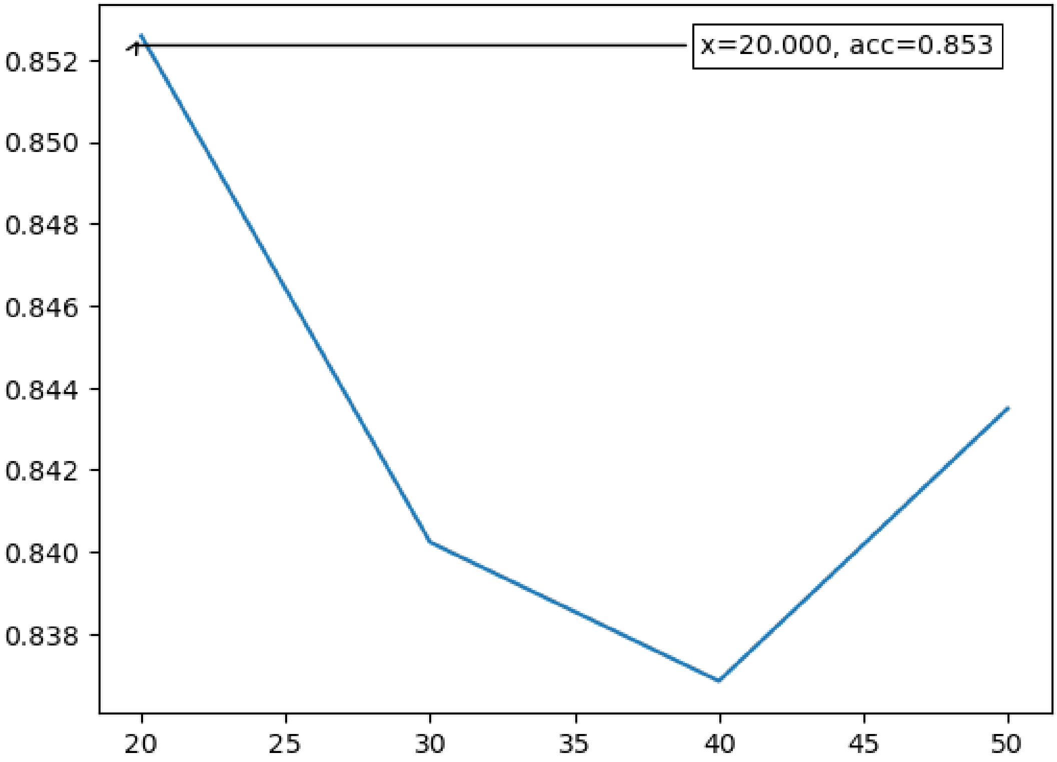
```
============================= epochs = 50, average accuracy = 0.843
=============================
```

[102]:

```
plt.plot(epochs,np.array(avg_accuracies))
annot_max(epochs,np.array(avg_accuracies))
plt.show()
```

[102]:

```
[<matplotlib.lines.Line2D at 0x7fa68f592ce0>]
```



[103]:

```
lr= 0.01
l1 = 80
l2 = 10
batch_size = 32
epochs = np.arange(20,30,1)
avg_accuracies = []
for epoch in epochs:
        acc_score = cross_validation(X_train,y_train,l1,l2,lr=lr,epochs =␣
 ↪epoch,batch_size = batch_size,cv=10)
        print(f"============================= epochs = {epoch}, average␣
 ↪accuracy = {round(acc_score,3)} ============================= ")
        avg_accuracies.append(acc_score)
```

```
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.404
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.831, Loss = 0.49
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.279
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.877, Loss = 0.404
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.355
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.425
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.414
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.326
--------------------------------------------------------------------------------
----
```

```
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.394
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.826, Loss = 0.302
--------------------------------------------------------------------------------
----
============================= epochs = 20, average accuracy = 0.837
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.413
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.366
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.296
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.42
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.253
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.873, Loss = 0.158
```

```
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.162
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.328
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.417
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.822, Loss = 0.334
--------------------------------------------------------------------------------
----
============================= epochs = 21, average accuracy = 0.835
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.339
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.184
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.43
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.848, Loss = 0.326
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.856, Loss = 0.347
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.398
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.341
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.322
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.828, Loss = 0.472
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.393
--------------------------------------------------------------------------------
----
============================= epochs = 22, average accuracy = 0.838
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.308
--------------------------------------------------------------------------------
----
```

```
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.544
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.86, Loss = 0.302
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.197
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.388
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.425
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.365
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.216
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.878, Loss = 0.309
--------------------------------------------------------------------------------
----
```

```
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.83, Loss = 0.451
--------------------------------------------------------------------------------
----
============================= epochs = 23, average accuracy = 0.843
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 5.97
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.286
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.236
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.301
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.297
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.832, Loss = 0.417
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.43
```

```
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.372
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.336
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.397
--------------------------------------------------------------------------------
----
============================= epochs = 24, average accuracy = 0.848
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.275
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.863, Loss = 0.34
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.267
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.818, Loss = 0.372
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.845, Loss = 0.519
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.433
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.427
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.353
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.818, Loss = 0.577
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.551
--------------------------------------------------------------------------------
----
============================= epochs = 25, average accuracy = 0.835
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.363
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.834, Loss = 0.448
--------------------------------------------------------------------------------
----
```

```
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.292
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.835, Loss = 0.473
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.876, Loss = 0.194
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.841, Loss = 0.185
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.874, Loss = 0.257
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.452
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.327
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.844, Loss = 0.353
--------------------------------------------------------------------------------
----
```

```
============================= epochs = 26, average accuracy = 0.845
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.847, Loss = 0.226
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.241
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.857, Loss = 0.261
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.861, Loss = 0.357
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.412
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.855, Loss = 0.307
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.854, Loss = 0.388
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 1.311
```

```
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.868, Loss = 0.408
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.823, Loss = 0.518
--------------------------------------------------------------------------------
----
============================= epochs = 27, average accuracy = 0.839
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.837, Loss = 0.312
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.846, Loss = 0.308
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.852, Loss = 0.439
--------------------------------------------------------------------------------
----
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.845, Loss = 0.32
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.378
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
```

```
----
Accuracy = 0.85, Loss = 0.256
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.853, Loss = 0.613
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.587
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.84, Loss = 0.465
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.849, Loss = 0.224
--------------------------------------------------------------------------------
----
============================= epochs = 28, average accuracy = 0.846
=============================
Fold 1 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.291
--------------------------------------------------------------------------------
----
Fold 2 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.848, Loss = 0.313
--------------------------------------------------------------------------------
----
Fold 3 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.341
--------------------------------------------------------------------------------
----
```

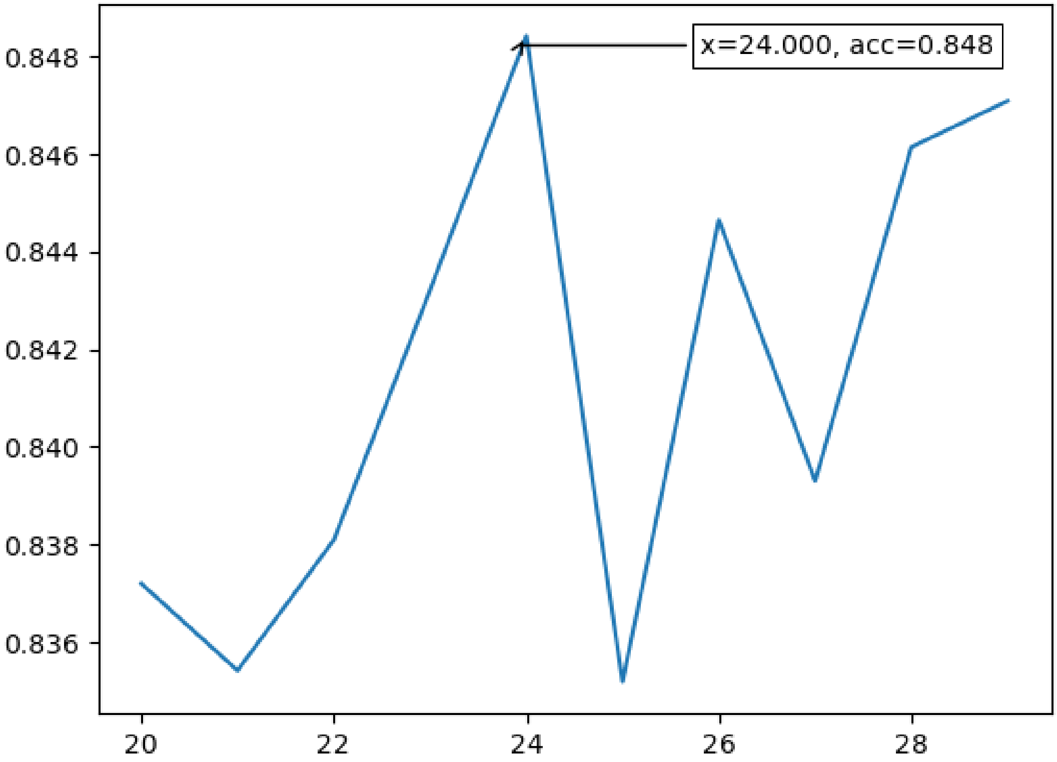
```
Fold 4 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.271
--------------------------------------------------------------------------------
----
Fold 5 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.64
--------------------------------------------------------------------------------
----
Fold 6 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.838, Loss = 0.404
--------------------------------------------------------------------------------
----
Fold 7 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.858, Loss = 0.762
--------------------------------------------------------------------------------
----
Fold 8 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.85, Loss = 0.306
--------------------------------------------------------------------------------
----
Fold 9 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.839, Loss = 0.22
--------------------------------------------------------------------------------
----
Fold 10 / 10:
--------------------------------------------------------------------------------
----
Accuracy = 0.851, Loss = 0.546
--------------------------------------------------------------------------------
----
============================= epochs = 29, average accuracy = 0.847
=============================
```

[104]:

```
plt.plot(epochs,np.array(avg_accuracies))
annot_max(epochs,np.array(avg_accuracies))
```

```
plt.show()
```

```
[104]: [<matplotlib.lines.Line2D at 0x7fa6a6e60400>]
```



0.13 Hyperparameter tuning results:

hidden nodes in layer 1 `l1`: 80

hidden nodes in layer 2 `l2`: 10

`batch_size`: 32

`epoch`: 24

0.14 Testing the Neural Network

[105]:

```
lr = 0.01
l1 = 80
l2 = 10
batch_size = 32
epoch = 24

network = NeuralNet(l1,l2)
optimizer = optim.Adam(network.parameters(),lr = lr)
```

```
criterion= nn.BCELoss()
train_loader, test_loader = load_data(X_train,y_train,X_test,y_test,batch_size␣
  ↪= batch_size)
#network.apply(reset_weights)
train(train_loader, network,optimizer, criterion, batch_size, epochs = epoch)
accuracy, loss = evaluate(test_loader, network)
print(f"Accuracy = {accuracy}\t Loss = {loss}")
```

```
Accuracy = 0.853         Loss = 0.306
```

[106]:

```
y_pred = network(torch.from_numpy(X_test).float())
for i, val in enumerate(y_pred):
    if val >= 0.5:
        y_pred[i] = 1
    else:
        y_pred[i] = 0
```

[107]:

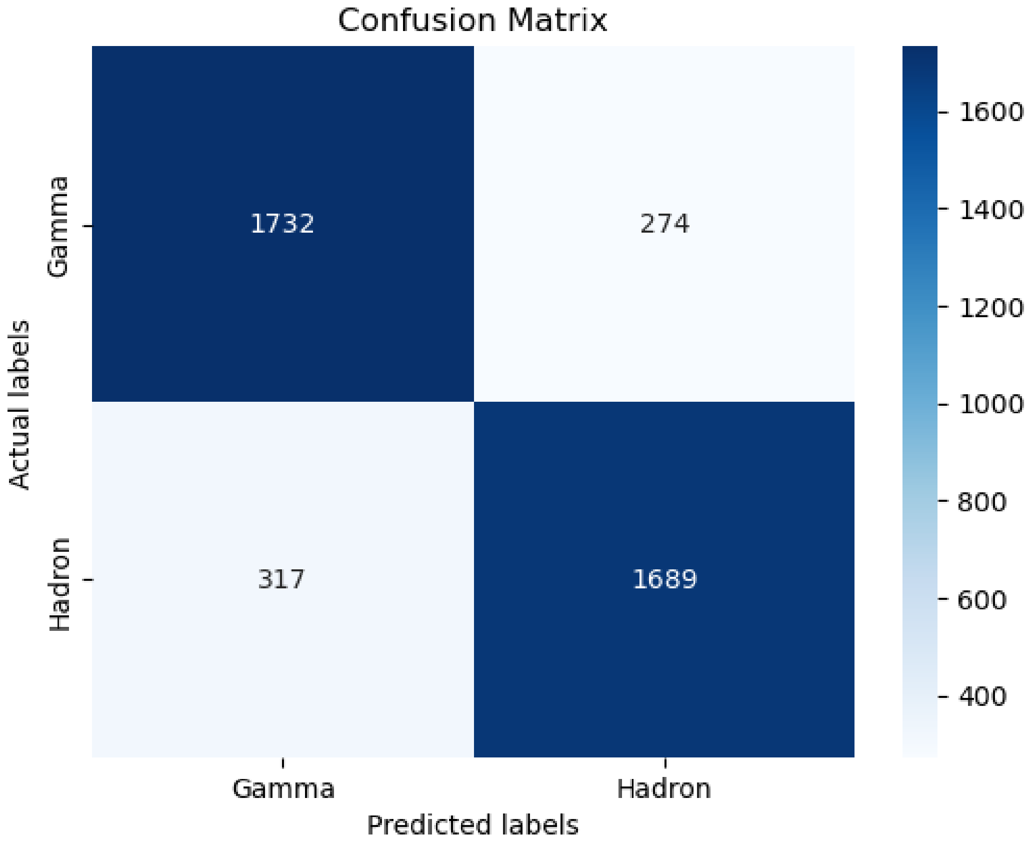
```
from sklearn.metrics import f1_score,␣
  ↪accuracy_score,recall_score,precision_score
f1 = f1_score(y_test, y_pred.detach().numpy())
acc = accuracy_score(y_test, y_pred.detach().numpy())
prec = precision_score(y_test, y_pred.detach().numpy())
recall = recall_score(y_test, y_pred.detach().numpy())
print(f"Neural network accuracy: {acc}")
print(f"Neural network f1 score: {f1}")
print(f"Neural network precision: {prec}")
print(f"Neural network recall: {recall}")
```

```
Neural network accuracy: 0.8526919242273181
Neural network f1 score: 0.8510959939531367
Neural network precision: 0.8604177279673968
Neural network recall: 0.8419740777666999
```

[108]:

```
cf_matrix = confusion_matrix(y_test, y_pred.detach().numpy())
print(cf_matrix)
ax= plt.subplot()
sns.heatmap(cf_matrix, annot=True,fmt='g',ax=ax,cmap='Blues')
ax.set_xlabel('Predicted labels');ax.set_ylabel('Actual labels');
ax.set_title('Confusion Matrix');
ax.xaxis.set_ticklabels(['Gamma', 'Hadron']); ax.yaxis.set_ticklabels(['Gamma',␣
  ↪'Hadron']);
```

```
[[1732  274]
 [ 317 1689]]
```


Confusion Matrix
1732
274
317
1689
Gamma
Hadron
Actual labels
Gamma
Hadron
Predicted labels
1600
1400
1200
1000
800
600
400

[ ]: