

In [34]:

```
# imports
import os
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
import sklearn
import scipy.io
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import StratifiedKFold
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis
from sklearn.svm import SVC
from xgboost import XGBClassifier
from catboost import CatBoostClassifier
```

In [35]:

```
# Sub 1
sub1Xtrain = scipy.io.loadmat('sub1Xtrain.mat')
sub1Ytrain = scipy.io.loadmat('sub1Ytrain.mat')
sub1Xtest = scipy.io.loadmat('sub1Xtest.mat')
sub1Ytest = scipy.io.loadmat('sub1Ytest.mat')
xtrain1 = sub1Xtrain['trainData']
xtrain1 = pd.DataFrame(xtrain1)
ytrain1 = sub1Ytrain['results']
ytrain1 = pd.DataFrame(ytrain1)
xtest1 = sub1Xtest['trainData']
xtest1 = pd.DataFrame(xtest1)
ytest1 = sub1Ytest['results']

# Sub 2
sub2Xtrain = scipy.io.loadmat('sub2Xtrain.mat')
sub2Ytrain = scipy.io.loadmat('sub2Ytrain.mat')
sub2Xtest = scipy.io.loadmat('sub2Xtest.mat')
sub2Ytest = scipy.io.loadmat('sub2Ytest.mat')
xtrain2 = sub2Xtrain['trainData']
xtrain2 = pd.DataFrame(xtrain2)
ytrain2 = sub2Ytrain['results']
ytrain2 = pd.DataFrame(ytrain2)
xtest2 = sub2Xtest['trainData']
xtest2 = pd.DataFrame(xtest2)
ytest2 = sub2Ytest['results']

# Sub 4
sub4Xtrain = scipy.io.loadmat('sub4Xtrain.mat')
sub4Ytrain = scipy.io.loadmat('sub4Ytrain.mat')
sub4Xtest = scipy.io.loadmat('sub4Xtest.mat')
sub4Ytest = scipy.io.loadmat('sub4Ytest.mat')
xtrain4 = sub4Xtrain['trainData']
xtrain4 = pd.DataFrame(xtrain4)
ytrain4 = sub4Ytrain['results']
ytrain4 = pd.DataFrame(ytrain4)
xtest4 = sub4Xtest['trainData']
xtest4 = pd.DataFrame(xtest4)
ytest4 = sub4Ytest['results']

# Sub 5
sub5Xtrain = scipy.io.loadmat('sub5Xtrain.mat')
sub5Ytrain = scipy.io.loadmat('sub5Ytrain.mat')
sub5Xtest = scipy.io.loadmat('sub5Xtest.mat')
sub5Ytest = scipy.io.loadmat('sub5Ytest.mat')
xtrain5 = sub5Xtrain['trainData']
xtrain5 = pd.DataFrame(xtrain5)
ytrain5 = sub5Ytrain['results']
ytrain5 = pd.DataFrame(ytrain5)
xtest5 = sub5Xtest['trainData']
xtest5 = pd.DataFrame(xtest5)
ytest5 = sub5Ytest['results']
```

In [36]:

```
def TestSetError(Yset, Yp):  
    correct = 0  
    n = len(Yset)  
    for i in range(n):  
        if(Yset[i] == Yp[i]):  
            correct += 1  
    accuracy=correct/len(Yset)  
    return accuracy
```

In [37]:

```

def evaluateModel(xtrain,ytrain,xtest,ytest):

    # LDA
    model = LinearDiscriminantAnalysis()
    cv = StratifiedKFold(n_splits=5, shuffle=False, random_state=None)
    # define grid
    grid = dict()
    grid['solver'] = ['svd', 'lsqr', 'eigen']
    # define search
    lda = GridSearchCV(model, grid, scoring='accuracy', cv=cv, n_jobs=-1)
    # perform the search
    results = lda.fit(xtrain, ytrain)
    # summarize
    print("LDA:")
    print('Mean Accuracy: %.3f' % results.best_score_)
    print('Config: %s' % results.best_params_)
    outputLDA = lda.predict(xtest)
    print("test accuracy =", TestSetError(ytest.ravel(), outputLDA))

    # SVM
    model = SVC()
    cv = StratifiedKFold(n_splits=5, shuffle=False, random_state=None)
    # define grid
    parameters = {'C': [1, 10], 'gamma': [0.001, 0.01, 1]}
    # define search
    svc = GridSearchCV(model, param_grid=parameters, scoring='accuracy', cv=cv, n_j
obs=-1)
    # perform the search
    results = svc.fit(xtrain, ytrain)
    # summarize
    print("SVM:")
    print('Mean Accuracy: %.3f' % results.best_score_)
    print('Config: %s' % results.best_params_)
    outputSVM = svc.predict(xtest)
    print("test accuracy =", TestSetError(ytest.ravel(), outputSVM))

    # XGB
    param_test1 = {
        'max_depth':range(3,11,2),
        'min_child_weight':range(1,7,2)
    }
    xgb = GridSearchCV(
        estimator = XGBClassifier(
            learning_rate = 0.1,
            n_estimators = 140,
            gamma = 0,
            subsample = 0.8,
            colsample_bytree = 0.8,
            objective = 'binary:logistic',
            scale_pos_weight = 1,
            seed=42),
        param_grid = param_test1,
        scoring='accuracy',
        n_jobs=-1,
        cv=StratifiedKFold(n_splits=5, shuffle=False, random_state=None)

```

```

    )

xgb.fit(xtrain,ytrain)
print("XGB:")
print(xgb.best_params_)
print('Mean Accuracy: %.3f' % xgb.best_score_)
outputXGB = xgb.predict(xtest)
print("test accuracy =", TestSetError(ytest.ravel(), outputXGB))

# CAT boost
cat_param_test1 = {
    'depth':range(1,10,2),
    'min_data_in_leaf': range(1,10,2)
}
cat_gsearch1 = GridSearchCV(
    estimator = CatBoostClassifier(
        learning_rate = 0.1,
        iterations = 200,
        loss_function = 'Logloss', # try crossEntropy later
        border_count = 32,
        eval_metric="AUC",
        random_seed=42),
    param_grid = cat_param_test1,
    scoring='accuracy',
    n_jobs=-1,
    # use shuffle to verify validity of hyperparameters
    cv= StratifiedKFold(n_splits=5, shuffle=False, random_state=None)
)

cat_gsearch1.fit(xtrain,ytrain)
print("CATboost:")
print(cat_gsearch1.best_params_)
print('Mean Accuracy: %.3f' % cat_gsearch1.best_score_)
outputCAT = cat_gsearch1.predict(xtest)
print("test accuracy =", TestSetError(ytest.ravel(), outputCAT))

```

In [38]:

```
evaluateModel(xtrain1,ytrain1,xtest1,ytest1)
```

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
```

```
    return f(**kwargs)
```

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
```

```
    return f(**kwargs)
```

LDA:

Mean Accuracy: 0.794

Config: {'solver': 'svd'}

test accuracy = 0.5919701213818861

SVM:

Mean Accuracy: 0.812

Config: {'C': 1, 'gamma': 0.001}

test accuracy = 0.5854341736694678

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
```

```
    return f(**kwargs)
```

XGB:

```
{'max_depth': 5, 'min_child_weight': 1}
```

Mean Accuracy: 0.796

test accuracy = 0.5779645191409897

0:	total: 4.92ms	remaining: 980ms
1:	total: 8.13ms	remaining: 805ms
2:	total: 11.7ms	remaining: 768ms
3:	total: 15.1ms	remaining: 741ms
4:	total: 18.1ms	remaining: 706ms
5:	total: 20.7ms	remaining: 670ms
6:	total: 23.6ms	remaining: 650ms
7:	total: 26.7ms	remaining: 641ms
8:	total: 30.3ms	remaining: 644ms
9:	total: 33.6ms	remaining: 639ms
10:	total: 36.4ms	remaining: 625ms
11:	total: 39.1ms	remaining: 613ms
12:	total: 43.9ms	remaining: 632ms
13:	total: 48.2ms	remaining: 641ms
14:	total: 51.3ms	remaining: 632ms
15:	total: 55.1ms	remaining: 633ms
16:	total: 58.6ms	remaining: 631ms
17:	total: 65ms	remaining: 657ms
18:	total: 67.9ms	remaining: 647ms
19:	total: 70.9ms	remaining: 638ms
20:	total: 73.8ms	remaining: 629ms
21:	total: 80.9ms	remaining: 655ms
22:	total: 85.6ms	remaining: 659ms
23:	total: 88.9ms	remaining: 652ms
24:	total: 96.1ms	remaining: 673ms
25:	total: 100ms	remaining: 672ms
26:	total: 104ms	remaining: 667ms
27:	total: 107ms	remaining: 660ms
28:	total: 115ms	remaining: 675ms
29:	total: 118ms	remaining: 668ms
30:	total: 121ms	remaining: 657ms
31:	total: 127ms	remaining: 669ms
32:	total: 130ms	remaining: 658ms
33:	total: 133ms	remaining: 652ms
34:	total: 136ms	remaining: 642ms
35:	total: 142ms	remaining: 648ms
36:	total: 145ms	remaining: 640ms
37:	total: 148ms	remaining: 631ms
38:	total: 151ms	remaining: 622ms
39:	total: 154ms	remaining: 615ms
40:	total: 159ms	remaining: 617ms
41:	total: 162ms	remaining: 609ms
42:	total: 165ms	remaining: 602ms
43:	total: 168ms	remaining: 595ms
44:	total: 174ms	remaining: 598ms
45:	total: 178ms	remaining: 596ms
46:	total: 181ms	remaining: 588ms
47:	total: 183ms	remaining: 580ms
48:	total: 190ms	remaining: 585ms
49:	total: 194ms	remaining: 582ms
50:	total: 200ms	remaining: 584ms
51:	total: 210ms	remaining: 598ms
52:	total: 214ms	remaining: 595ms



53:	total: 222ms	remaining: 600ms
54:	total: 227ms	remaining: 599ms
55:	total: 231ms	remaining: 594ms
56:	total: 238ms	remaining: 598ms
57:	total: 242ms	remaining: 593ms
58:	total: 246ms	remaining: 587ms
59:	total: 249ms	remaining: 581ms
60:	total: 255ms	remaining: 582ms
61:	total: 270ms	remaining: 600ms
62:	total: 274ms	remaining: 597ms
63:	total: 277ms	remaining: 589ms
64:	total: 280ms	remaining: 582ms
65:	total: 286ms	remaining: 580ms
66:	total: 289ms	remaining: 573ms
67:	total: 292ms	remaining: 566ms
68:	total: 300ms	remaining: 569ms
69:	total: 303ms	remaining: 563ms
70:	total: 307ms	remaining: 558ms
71:	total: 315ms	remaining: 559ms
72:	total: 318ms	remaining: 553ms
73:	total: 321ms	remaining: 547ms
74:	total: 326ms	remaining: 544ms
75:	total: 330ms	remaining: 539ms
76:	total: 333ms	remaining: 532ms
77:	total: 338ms	remaining: 528ms
78:	total: 342ms	remaining: 524ms
79:	total: 345ms	remaining: 518ms
80:	total: 348ms	remaining: 512ms
81:	total: 351ms	remaining: 506ms
82:	total: 354ms	remaining: 499ms
83:	total: 358ms	remaining: 494ms
84:	total: 360ms	remaining: 487ms
85:	total: 363ms	remaining: 482ms
86:	total: 366ms	remaining: 475ms
87:	total: 369ms	remaining: 470ms
88:	total: 374ms	remaining: 466ms
89:	total: 377ms	remaining: 460ms
90:	total: 381ms	remaining: 456ms
91:	total: 383ms	remaining: 450ms
92:	total: 391ms	remaining: 450ms
93:	total: 395ms	remaining: 446ms
94:	total: 398ms	remaining: 440ms
95:	total: 404ms	remaining: 438ms
96:	total: 411ms	remaining: 436ms
97:	total: 415ms	remaining: 432ms
98:	total: 422ms	remaining: 430ms
99:	total: 427ms	remaining: 427ms
100:	total: 429ms	remaining: 421ms
101:	total: 436ms	remaining: 418ms
102:	total: 440ms	remaining: 415ms
103:	total: 443ms	remaining: 409ms
104:	total: 446ms	remaining: 404ms
105:	total: 452ms	remaining: 401ms
106:	total: 457ms	remaining: 397ms
107:	total: 460ms	remaining: 392ms
108:	total: 463ms	remaining: 387ms
109:	total: 468ms	remaining: 383ms

110:	total: 471ms	remaining: 378ms
111:	total: 474ms	remaining: 372ms
112:	total: 477ms	remaining: 367ms
113:	total: 480ms	remaining: 362ms
114:	total: 484ms	remaining: 358ms
115:	total: 488ms	remaining: 353ms
116:	total: 491ms	remaining: 348ms
117:	total: 493ms	remaining: 343ms
118:	total: 500ms	remaining: 340ms
119:	total: 504ms	remaining: 336ms
120:	total: 507ms	remaining: 331ms
121:	total: 510ms	remaining: 326ms
122:	total: 518ms	remaining: 324ms
123:	total: 521ms	remaining: 319ms
124:	total: 524ms	remaining: 314ms
125:	total: 529ms	remaining: 311ms
126:	total: 534ms	remaining: 307ms
127:	total: 537ms	remaining: 302ms
128:	total: 540ms	remaining: 297ms
129:	total: 546ms	remaining: 294ms
130:	total: 551ms	remaining: 290ms
131:	total: 554ms	remaining: 286ms
132:	total: 559ms	remaining: 282ms
133:	total: 563ms	remaining: 277ms
134:	total: 567ms	remaining: 273ms
135:	total: 570ms	remaining: 268ms
136:	total: 577ms	remaining: 265ms
137:	total: 583ms	remaining: 262ms
138:	total: 586ms	remaining: 257ms
139:	total: 591ms	remaining: 253ms
140:	total: 597ms	remaining: 250ms
141:	total: 602ms	remaining: 246ms
142:	total: 608ms	remaining: 242ms
143:	total: 612ms	remaining: 238ms
144:	total: 615ms	remaining: 233ms
145:	total: 617ms	remaining: 228ms
146:	total: 623ms	remaining: 225ms
147:	total: 628ms	remaining: 221ms
148:	total: 631ms	remaining: 216ms
149:	total: 633ms	remaining: 211ms
150:	total: 639ms	remaining: 207ms
151:	total: 642ms	remaining: 203ms
152:	total: 645ms	remaining: 198ms
153:	total: 647ms	remaining: 193ms
154:	total: 650ms	remaining: 189ms
155:	total: 657ms	remaining: 185ms
156:	total: 664ms	remaining: 182ms
157:	total: 677ms	remaining: 180ms
158:	total: 682ms	remaining: 176ms
159:	total: 687ms	remaining: 172ms
160:	total: 690ms	remaining: 167ms
161:	total: 692ms	remaining: 162ms
162:	total: 696ms	remaining: 158ms
163:	total: 699ms	remaining: 153ms
164:	total: 702ms	remaining: 149ms
165:	total: 705ms	remaining: 144ms
166:	total: 708ms	remaining: 140ms

167:	total: 712ms	remaining: 136ms
168:	total: 714ms	remaining: 131ms
169:	total: 718ms	remaining: 127ms
170:	total: 721ms	remaining: 122ms
171:	total: 724ms	remaining: 118ms
172:	total: 727ms	remaining: 114ms
173:	total: 731ms	remaining: 109ms
174:	total: 734ms	remaining: 105ms
175:	total: 737ms	remaining: 101ms
176:	total: 741ms	remaining: 96.3ms
177:	total: 743ms	remaining: 91.9ms
178:	total: 747ms	remaining: 87.6ms
179:	total: 750ms	remaining: 83.3ms
180:	total: 752ms	remaining: 79ms
181:	total: 756ms	remaining: 74.8ms
182:	total: 758ms	remaining: 70.5ms
183:	total: 763ms	remaining: 66.3ms
184:	total: 766ms	remaining: 62.1ms
185:	total: 769ms	remaining: 57.8ms
186:	total: 773ms	remaining: 53.7ms
187:	total: 779ms	remaining: 49.7ms
188:	total: 787ms	remaining: 45.8ms
189:	total: 795ms	remaining: 41.8ms
190:	total: 800ms	remaining: 37.7ms
191:	total: 802ms	remaining: 33.4ms
192:	total: 805ms	remaining: 29.2ms
193:	total: 810ms	remaining: 25ms
194:	total: 813ms	remaining: 20.8ms
195:	total: 817ms	remaining: 16.7ms
196:	total: 819ms	remaining: 12.5ms
197:	total: 825ms	remaining: 8.34ms
198:	total: 832ms	remaining: 4.18ms
199:	total: 837ms	remaining: 0us

CATboost:

{'depth': 9, 'min\_data\_in\_leaf': 1}

Mean Accuracy: 0.804

test accuracy = 0.5835667600373483

In [39]:

```
evaluateModel(xtrain2,ytrain2,xtest2,ytest2)
```

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
    return f(**kwargs)
```

LDA:

Mean Accuracy: 0.790

Config: {'solver': 'svd'}

test accuracy = 0.6630434782608695

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
    return f(**kwargs)
```

SVM:

Mean Accuracy: 0.800

Config: {'C': 1, 'gamma': 0.001}

test accuracy = 0.644927536231884

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
    return f(**kwargs)
```

XGB:

```
{'max_depth': 7, 'min_child_weight': 3}
```

Mean Accuracy: 0.794

test accuracy = 0.6539855072463768

0:	total: 480us	remaining: 95.7ms
1:	total: 1.65ms	remaining: 164ms
2:	total: 2.13ms	remaining: 140ms
3:	total: 2.63ms	remaining: 129ms
4:	total: 3.12ms	remaining: 122ms
5:	total: 3.62ms	remaining: 117ms
6:	total: 4.11ms	remaining: 113ms
7:	total: 4.63ms	remaining: 111ms
8:	total: 5.12ms	remaining: 109ms
9:	total: 5.6ms	remaining: 106ms
10:	total: 6.1ms	remaining: 105ms
11:	total: 6.59ms	remaining: 103ms
12:	total: 7.12ms	remaining: 102ms
13:	total: 7.66ms	remaining: 102ms
14:	total: 8.14ms	remaining: 100ms
15:	total: 8.63ms	remaining: 99.3ms
16:	total: 9.12ms	remaining: 98.2ms
17:	total: 9.66ms	remaining: 97.7ms
18:	total: 10.2ms	remaining: 96.8ms
19:	total: 10.7ms	remaining: 96ms
20:	total: 11.2ms	remaining: 95.3ms
21:	total: 11.7ms	remaining: 94.4ms
22:	total: 12.2ms	remaining: 93.8ms
23:	total: 12.7ms	remaining: 93.3ms
24:	total: 13.2ms	remaining: 92.5ms
25:	total: 13.7ms	remaining: 91.8ms
26:	total: 14.2ms	remaining: 91ms
27:	total: 14.7ms	remaining: 90.4ms
28:	total: 15.2ms	remaining: 89.8ms
29:	total: 15.8ms	remaining: 89.5ms
30:	total: 16.4ms	remaining: 89.1ms
31:	total: 16.9ms	remaining: 88.6ms
32:	total: 17.6ms	remaining: 89.2ms
33:	total: 18.2ms	remaining: 88.7ms
34:	total: 18.8ms	remaining: 88.5ms
35:	total: 19.3ms	remaining: 88ms
36:	total: 19.9ms	remaining: 87.5ms
37:	total: 20.4ms	remaining: 86.8ms
38:	total: 20.9ms	remaining: 86.2ms
39:	total: 21.4ms	remaining: 85.4ms
40:	total: 21.8ms	remaining: 84.7ms
41:	total: 22.3ms	remaining: 84ms
42:	total: 22.8ms	remaining: 83.3ms
43:	total: 23.3ms	remaining: 82.7ms
44:	total: 23.8ms	remaining: 82ms
45:	total: 24.3ms	remaining: 81.3ms
46:	total: 24.8ms	remaining: 80.6ms
47:	total: 25.5ms	remaining: 80.7ms
48:	total: 26.1ms	remaining: 80.6ms
49:	total: 26.8ms	remaining: 80.3ms
50:	total: 27.3ms	remaining: 79.7ms
51:	total: 27.8ms	remaining: 79ms
52:	total: 28.3ms	remaining: 78.4ms

53:	total: 28.8ms	remaining: 77.8ms
54:	total: 29.2ms	remaining: 76.9ms
55:	total: 29.7ms	remaining: 76.4ms
56:	total: 30.2ms	remaining: 75.7ms
57:	total: 30.7ms	remaining: 75ms
58:	total: 31.1ms	remaining: 74.4ms
59:	total: 31.6ms	remaining: 73.8ms
60:	total: 32.1ms	remaining: 73.2ms
61:	total: 33.1ms	remaining: 73.7ms
62:	total: 33.7ms	remaining: 73.2ms
63:	total: 34.2ms	remaining: 72.6ms
64:	total: 34.7ms	remaining: 72.1ms
65:	total: 35.2ms	remaining: 71.5ms
66:	total: 35.6ms	remaining: 70.8ms
67:	total: 36.2ms	remaining: 70.2ms
68:	total: 36.7ms	remaining: 69.6ms
69:	total: 37.1ms	remaining: 69ms
70:	total: 37.8ms	remaining: 68.6ms
71:	total: 38.2ms	remaining: 68ms
72:	total: 38.8ms	remaining: 67.4ms
73:	total: 39.5ms	remaining: 67.3ms
74:	total: 40ms	remaining: 66.6ms
75:	total: 40.5ms	remaining: 66.1ms
76:	total: 41.1ms	remaining: 65.6ms
77:	total: 41.6ms	remaining: 65ms
78:	total: 42.1ms	remaining: 64.5ms
79:	total: 42.6ms	remaining: 63.9ms
80:	total: 43.1ms	remaining: 63.3ms
81:	total: 43.6ms	remaining: 62.8ms
82:	total: 44.1ms	remaining: 62.2ms
83:	total: 44.6ms	remaining: 61.6ms
84:	total: 45.1ms	remaining: 61ms
85:	total: 45.6ms	remaining: 60.5ms
86:	total: 46.3ms	remaining: 60.2ms
87:	total: 46.9ms	remaining: 59.7ms
88:	total: 47.4ms	remaining: 59.2ms
89:	total: 48ms	remaining: 58.6ms
90:	total: 48.4ms	remaining: 58ms
91:	total: 49ms	remaining: 57.5ms
92:	total: 49.5ms	remaining: 56.9ms
93:	total: 50ms	remaining: 56.4ms
94:	total: 50.5ms	remaining: 55.8ms
95:	total: 50.9ms	remaining: 55.2ms
96:	total: 51.3ms	remaining: 54.5ms
97:	total: 51.8ms	remaining: 53.9ms
98:	total: 52.3ms	remaining: 53.3ms
99:	total: 52.9ms	remaining: 52.9ms
100:	total: 53.4ms	remaining: 52.4ms
101:	total: 54ms	remaining: 51.8ms
102:	total: 54.5ms	remaining: 51.3ms
103:	total: 55ms	remaining: 50.8ms
104:	total: 55.5ms	remaining: 50.2ms
105:	total: 56.2ms	remaining: 49.8ms
106:	total: 56.7ms	remaining: 49.3ms
107:	total: 57.3ms	remaining: 48.8ms
108:	total: 57.9ms	remaining: 48.3ms
109:	total: 58.5ms	remaining: 47.8ms

110:	total: 59.1ms	remaining: 47.4ms
111:	total: 59.8ms	remaining: 47ms
112:	total: 60.4ms	remaining: 46.5ms
113:	total: 60.9ms	remaining: 46ms
114:	total: 61.5ms	remaining: 45.4ms
115:	total: 62ms	remaining: 44.9ms
116:	total: 62.5ms	remaining: 44.4ms
117:	total: 63ms	remaining: 43.8ms
118:	total: 63.5ms	remaining: 43.3ms
119:	total: 64.1ms	remaining: 42.7ms
120:	total: 64.6ms	remaining: 42.2ms
121:	total: 65.1ms	remaining: 41.6ms
122:	total: 65.6ms	remaining: 41.1ms
123:	total: 66.2ms	remaining: 40.5ms
124:	total: 66.6ms	remaining: 39.9ms
125:	total: 67.2ms	remaining: 39.4ms
126:	total: 67.6ms	remaining: 38.9ms
127:	total: 68.1ms	remaining: 38.3ms
128:	total: 68.6ms	remaining: 37.8ms
129:	total: 69.1ms	remaining: 37.2ms
130:	total: 69.6ms	remaining: 36.7ms
131:	total: 70.2ms	remaining: 36.2ms
132:	total: 70.7ms	remaining: 35.6ms
133:	total: 71.2ms	remaining: 35.1ms
134:	total: 71.7ms	remaining: 34.5ms
135:	total: 72.2ms	remaining: 34ms
136:	total: 72.9ms	remaining: 33.5ms
137:	total: 73.6ms	remaining: 33.1ms
138:	total: 74.3ms	remaining: 32.6ms
139:	total: 75ms	remaining: 32.1ms
140:	total: 75.6ms	remaining: 31.6ms
141:	total: 76.2ms	remaining: 31.1ms
142:	total: 76.7ms	remaining: 30.6ms
143:	total: 77.3ms	remaining: 30.1ms
144:	total: 77.8ms	remaining: 29.5ms
145:	total: 78.3ms	remaining: 29ms
146:	total: 79ms	remaining: 28.5ms
147:	total: 79.6ms	remaining: 28ms
148:	total: 80.1ms	remaining: 27.4ms
149:	total: 80.6ms	remaining: 26.9ms
150:	total: 81.2ms	remaining: 26.4ms
151:	total: 81.7ms	remaining: 25.8ms
152:	total: 82.2ms	remaining: 25.3ms
153:	total: 82.7ms	remaining: 24.7ms
154:	total: 83.2ms	remaining: 24.2ms
155:	total: 83.7ms	remaining: 23.6ms
156:	total: 84.3ms	remaining: 23.1ms
157:	total: 84.8ms	remaining: 22.5ms
158:	total: 85.3ms	remaining: 22ms
159:	total: 85.9ms	remaining: 21.5ms
160:	total: 86.4ms	remaining: 20.9ms
161:	total: 86.9ms	remaining: 20.4ms
162:	total: 87.4ms	remaining: 19.8ms
163:	total: 88ms	remaining: 19.3ms
164:	total: 88.5ms	remaining: 18.8ms
165:	total: 89ms	remaining: 18.2ms
166:	total: 89.5ms	remaining: 17.7ms



167:	total: 90ms	remaining: 17.1ms
168:	total: 90.6ms	remaining: 16.6ms
169:	total: 91.1ms	remaining: 16.1ms
170:	total: 91.6ms	remaining: 15.5ms
171:	total: 92.1ms	remaining: 15ms
172:	total: 92.7ms	remaining: 14.5ms
173:	total: 93.2ms	remaining: 13.9ms
174:	total: 93.8ms	remaining: 13.4ms
175:	total: 94.4ms	remaining: 12.9ms
176:	total: 94.9ms	remaining: 12.3ms
177:	total: 95.5ms	remaining: 11.8ms
178:	total: 96.1ms	remaining: 11.3ms
179:	total: 96.5ms	remaining: 10.7ms
180:	total: 97ms	remaining: 10.2ms
181:	total: 97.5ms	remaining: 9.64ms
182:	total: 98ms	remaining: 9.1ms
183:	total: 98.5ms	remaining: 8.56ms
184:	total: 99.1ms	remaining: 8.03ms
185:	total: 99.8ms	remaining: 7.51ms
186:	total: 100ms	remaining: 6.97ms
187:	total: 101ms	remaining: 6.44ms
188:	total: 101ms	remaining: 5.9ms
189:	total: 102ms	remaining: 5.36ms
190:	total: 102ms	remaining: 4.82ms
191:	total: 103ms	remaining: 4.29ms
192:	total: 103ms	remaining: 3.75ms
193:	total: 104ms	remaining: 3.21ms
194:	total: 104ms	remaining: 2.68ms
195:	total: 105ms	remaining: 2.14ms
196:	total: 106ms	remaining: 1.61ms
197:	total: 106ms	remaining: 1.07ms
198:	total: 107ms	remaining: 536us
199:	total: 107ms	remaining: 0us

CATboost:

{'depth': 1, 'min\_data\_in\_leaf': 1}

Mean Accuracy: 0.800

test accuracy = 0.6431159420289855

In [40]:

```
evaluateModel(xtrain4,ytrain4,xtest4,ytest4)
```

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
    return f(**kwargs)
```

LDA:

Mean Accuracy: 0.854

Config: {'solver': 'svd'}

test accuracy = 0.7598684210526315

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
    return f(**kwargs)
```

SVM:

Mean Accuracy: 0.778

Config: {'C': 1, 'gamma': 0.001}

test accuracy = 0.6398026315789473

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
    return f(**kwargs)
```

XGB:

{'max\_depth': 9, 'min\_child\_weight': 3}

Mean Accuracy: 0.844

test accuracy = 0.7516447368421053

0:	total: 2.02ms	remaining: 403ms
1:	total: 3.94ms	remaining: 391ms
2:	total: 5.82ms	remaining: 382ms
3:	total: 7.99ms	remaining: 391ms
4:	total: 11.6ms	remaining: 451ms
5:	total: 15.1ms	remaining: 489ms
6:	total: 17.4ms	remaining: 480ms
7:	total: 20.9ms	remaining: 501ms
8:	total: 23.2ms	remaining: 492ms
9:	total: 25.7ms	remaining: 488ms
10:	total: 27.9ms	remaining: 479ms
11:	total: 29.9ms	remaining: 468ms
12:	total: 32ms	remaining: 460ms
13:	total: 33.8ms	remaining: 449ms
14:	total: 35.3ms	remaining: 435ms
15:	total: 37ms	remaining: 425ms
16:	total: 38.5ms	remaining: 414ms
17:	total: 40ms	remaining: 405ms
18:	total: 41.7ms	remaining: 397ms
19:	total: 43.2ms	remaining: 389ms
20:	total: 44.7ms	remaining: 381ms
21:	total: 46.2ms	remaining: 374ms
22:	total: 47.7ms	remaining: 367ms
23:	total: 49.7ms	remaining: 364ms
24:	total: 51.7ms	remaining: 362ms
25:	total: 53.3ms	remaining: 357ms
26:	total: 55.1ms	remaining: 353ms
27:	total: 56.9ms	remaining: 350ms
28:	total: 58.8ms	remaining: 347ms
29:	total: 60.6ms	remaining: 344ms
30:	total: 62.2ms	remaining: 339ms
31:	total: 63.7ms	remaining: 335ms
32:	total: 65.2ms	remaining: 330ms
33:	total: 66.7ms	remaining: 326ms
34:	total: 69.1ms	remaining: 326ms
35:	total: 70.6ms	remaining: 322ms
36:	total: 72.5ms	remaining: 319ms
37:	total: 74.8ms	remaining: 319ms
38:	total: 76.7ms	remaining: 317ms
39:	total: 78.2ms	remaining: 313ms
40:	total: 79.8ms	remaining: 309ms
41:	total: 81.2ms	remaining: 306ms
42:	total: 82.8ms	remaining: 302ms
43:	total: 84.7ms	remaining: 300ms
44:	total: 86.2ms	remaining: 297ms
45:	total: 87.7ms	remaining: 294ms
46:	total: 89.2ms	remaining: 290ms
47:	total: 90.8ms	remaining: 288ms
48:	total: 92.5ms	remaining: 285ms
49:	total: 94.3ms	remaining: 283ms
50:	total: 95.7ms	remaining: 280ms
51:	total: 97.5ms	remaining: 277ms
52:	total: 100ms	remaining: 278ms

53:	total: 103ms	remaining: 279ms
54:	total: 105ms	remaining: 277ms
55:	total: 107ms	remaining: 276ms
56:	total: 110ms	remaining: 276ms
57:	total: 112ms	remaining: 275ms
58:	total: 115ms	remaining: 274ms
59:	total: 117ms	remaining: 273ms
60:	total: 119ms	remaining: 272ms
61:	total: 121ms	remaining: 270ms
62:	total: 123ms	remaining: 267ms
63:	total: 124ms	remaining: 264ms
64:	total: 126ms	remaining: 261ms
65:	total: 127ms	remaining: 259ms
66:	total: 129ms	remaining: 256ms
67:	total: 130ms	remaining: 253ms
68:	total: 132ms	remaining: 250ms
69:	total: 133ms	remaining: 247ms
70:	total: 135ms	remaining: 245ms
71:	total: 136ms	remaining: 243ms
72:	total: 138ms	remaining: 240ms
73:	total: 140ms	remaining: 238ms
74:	total: 141ms	remaining: 235ms
75:	total: 143ms	remaining: 233ms
76:	total: 144ms	remaining: 230ms
77:	total: 146ms	remaining: 228ms
78:	total: 147ms	remaining: 225ms
79:	total: 149ms	remaining: 223ms
80:	total: 150ms	remaining: 221ms
81:	total: 152ms	remaining: 218ms
82:	total: 153ms	remaining: 216ms
83:	total: 155ms	remaining: 214ms
84:	total: 157ms	remaining: 212ms
85:	total: 162ms	remaining: 215ms
86:	total: 165ms	remaining: 215ms
87:	total: 168ms	remaining: 213ms
88:	total: 169ms	remaining: 211ms
89:	total: 171ms	remaining: 209ms
90:	total: 172ms	remaining: 206ms
91:	total: 174ms	remaining: 205ms
92:	total: 176ms	remaining: 202ms
93:	total: 178ms	remaining: 200ms
94:	total: 179ms	remaining: 198ms
95:	total: 182ms	remaining: 197ms
96:	total: 185ms	remaining: 196ms
97:	total: 190ms	remaining: 197ms
98:	total: 193ms	remaining: 196ms
99:	total: 197ms	remaining: 197ms
100:	total: 200ms	remaining: 196ms
101:	total: 203ms	remaining: 195ms
102:	total: 207ms	remaining: 195ms
103:	total: 210ms	remaining: 194ms
104:	total: 213ms	remaining: 193ms
105:	total: 217ms	remaining: 192ms
106:	total: 225ms	remaining: 195ms
107:	total: 236ms	remaining: 201ms
108:	total: 243ms	remaining: 203ms
109:	total: 245ms	remaining: 201ms

110:	total: 248ms	remaining: 198ms
111:	total: 249ms	remaining: 196ms
112:	total: 251ms	remaining: 193ms
113:	total: 252ms	remaining: 190ms
114:	total: 254ms	remaining: 188ms
115:	total: 256ms	remaining: 186ms
116:	total: 260ms	remaining: 184ms
117:	total: 262ms	remaining: 182ms
118:	total: 264ms	remaining: 180ms
119:	total: 266ms	remaining: 177ms
120:	total: 267ms	remaining: 175ms
121:	total: 269ms	remaining: 172ms
122:	total: 270ms	remaining: 169ms
123:	total: 272ms	remaining: 167ms
124:	total: 274ms	remaining: 165ms
125:	total: 276ms	remaining: 162ms
126:	total: 279ms	remaining: 160ms
127:	total: 280ms	remaining: 158ms
128:	total: 282ms	remaining: 155ms
129:	total: 283ms	remaining: 153ms
130:	total: 285ms	remaining: 150ms
131:	total: 286ms	remaining: 148ms
132:	total: 288ms	remaining: 145ms
133:	total: 289ms	remaining: 143ms
134:	total: 291ms	remaining: 140ms
135:	total: 292ms	remaining: 138ms
136:	total: 294ms	remaining: 135ms
137:	total: 295ms	remaining: 133ms
138:	total: 297ms	remaining: 130ms
139:	total: 299ms	remaining: 128ms
140:	total: 300ms	remaining: 126ms
141:	total: 302ms	remaining: 123ms
142:	total: 304ms	remaining: 121ms
143:	total: 305ms	remaining: 119ms
144:	total: 307ms	remaining: 116ms
145:	total: 308ms	remaining: 114ms
146:	total: 310ms	remaining: 112ms
147:	total: 311ms	remaining: 109ms
148:	total: 313ms	remaining: 107ms
149:	total: 314ms	remaining: 105ms
150:	total: 316ms	remaining: 102ms
151:	total: 317ms	remaining: 100ms
152:	total: 319ms	remaining: 97.9ms
153:	total: 321ms	remaining: 95.8ms
154:	total: 322ms	remaining: 93.5ms
155:	total: 324ms	remaining: 91.2ms
156:	total: 325ms	remaining: 89ms
157:	total: 327ms	remaining: 87ms
158:	total: 329ms	remaining: 84.8ms
159:	total: 331ms	remaining: 82.7ms
160:	total: 333ms	remaining: 80.6ms
161:	total: 335ms	remaining: 78.6ms
162:	total: 337ms	remaining: 76.4ms
163:	total: 338ms	remaining: 74.3ms
164:	total: 340ms	remaining: 72.1ms
165:	total: 342ms	remaining: 70ms
166:	total: 343ms	remaining: 67.8ms

167:	total: 345ms	remaining: 65.6ms
168:	total: 346ms	remaining: 63.5ms
169:	total: 348ms	remaining: 61.4ms
170:	total: 349ms	remaining: 59.2ms
171:	total: 351ms	remaining: 57.1ms
172:	total: 352ms	remaining: 55ms
173:	total: 354ms	remaining: 52.9ms
174:	total: 355ms	remaining: 50.8ms
175:	total: 357ms	remaining: 48.7ms
176:	total: 359ms	remaining: 46.6ms
177:	total: 363ms	remaining: 44.8ms
178:	total: 371ms	remaining: 43.6ms
179:	total: 379ms	remaining: 42.1ms
180:	total: 381ms	remaining: 40ms
181:	total: 383ms	remaining: 37.9ms
182:	total: 386ms	remaining: 35.8ms
183:	total: 388ms	remaining: 33.7ms
184:	total: 390ms	remaining: 31.6ms
185:	total: 392ms	remaining: 29.5ms
186:	total: 394ms	remaining: 27.4ms
187:	total: 396ms	remaining: 25.3ms
188:	total: 398ms	remaining: 23.2ms
189:	total: 400ms	remaining: 21ms
190:	total: 402ms	remaining: 18.9ms
191:	total: 404ms	remaining: 16.8ms
192:	total: 406ms	remaining: 14.7ms
193:	total: 407ms	remaining: 12.6ms
194:	total: 409ms	remaining: 10.5ms
195:	total: 410ms	remaining: 8.37ms
196:	total: 412ms	remaining: 6.27ms
197:	total: 413ms	remaining: 4.17ms
198:	total: 415ms	remaining: 2.08ms
199:	total: 417ms	remaining: 0us

CATboost:

{'depth': 7, 'min\_data\_in\_leaf': 1}

Mean Accuracy: 0.834

test accuracy = 0.7549342105263158

In [41]:

```
evaluateModel(xtrain5,ytrain5,xtest5,ytest5)
```



**LDA:**

Mean Accuracy: 0.770

Config: {'solver': 'svd'}

test accuracy = 0.6139927623642943

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
```

```
    return f(**kwargs)
```

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
```

```
    return f(**kwargs)
```

**SVM:**

Mean Accuracy: 0.792

Config: {'C': 1, 'gamma': 0.001}

test accuracy = 0.5922798552472859

```
/Users/allan/anaconda3/lib/python3.8/site-packages/sklearn/utils/validation.py:73: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
```

```
    return f(**kwargs)
```

XGB:

```
{'max_depth': 7, 'min_child_weight': 1}
```

Mean Accuracy: 0.774

test accuracy = 0.6079613992762364

0:	total: 640us	remaining: 127ms
1:	total: 1.55ms	remaining: 154ms
2:	total: 2.18ms	remaining: 143ms
3:	total: 2.74ms	remaining: 134ms
4:	total: 3.32ms	remaining: 129ms
5:	total: 3.88ms	remaining: 125ms
6:	total: 4.43ms	remaining: 122ms
7:	total: 5.02ms	remaining: 120ms
8:	total: 5.56ms	remaining: 118ms
9:	total: 6.1ms	remaining: 116ms
10:	total: 6.65ms	remaining: 114ms
11:	total: 7.27ms	remaining: 114ms
12:	total: 7.83ms	remaining: 113ms
13:	total: 8.37ms	remaining: 111ms
14:	total: 8.96ms	remaining: 110ms
15:	total: 9.5ms	remaining: 109ms
16:	total: 10ms	remaining: 108ms
17:	total: 10.5ms	remaining: 106ms
18:	total: 11ms	remaining: 105ms
19:	total: 11.5ms	remaining: 104ms
20:	total: 12.2ms	remaining: 104ms
21:	total: 12.7ms	remaining: 103ms
22:	total: 13.3ms	remaining: 102ms
23:	total: 13.8ms	remaining: 101ms
24:	total: 14.3ms	remaining: 100ms
25:	total: 14.8ms	remaining: 99.3ms
26:	total: 15.4ms	remaining: 98.8ms
27:	total: 15.9ms	remaining: 97.7ms
28:	total: 16.4ms	remaining: 96.9ms
29:	total: 17ms	remaining: 96.3ms
30:	total: 17.5ms	remaining: 95.3ms
31:	total: 18.1ms	remaining: 94.8ms
32:	total: 18.6ms	remaining: 94ms
33:	total: 19.1ms	remaining: 93.3ms
34:	total: 19.6ms	remaining: 92.5ms
35:	total: 20.1ms	remaining: 91.8ms
36:	total: 20.7ms	remaining: 91.3ms
37:	total: 21.2ms	remaining: 90.6ms
38:	total: 21.8ms	remaining: 89.9ms
39:	total: 22.3ms	remaining: 89.1ms
40:	total: 22.8ms	remaining: 88.3ms
41:	total: 23.3ms	remaining: 87.6ms
42:	total: 23.8ms	remaining: 86.9ms
43:	total: 24.3ms	remaining: 86.2ms
44:	total: 24.8ms	remaining: 85.3ms
45:	total: 25.3ms	remaining: 84.5ms
46:	total: 25.8ms	remaining: 83.9ms
47:	total: 26.3ms	remaining: 83.3ms
48:	total: 26.8ms	remaining: 82.6ms
49:	total: 27.4ms	remaining: 82.1ms
50:	total: 27.9ms	remaining: 81.4ms
51:	total: 28.4ms	remaining: 80.7ms
52:	total: 28.9ms	remaining: 80ms

53:	total: 29.4ms	remaining: 79.4ms
54:	total: 29.9ms	remaining: 78.8ms
55:	total: 30.4ms	remaining: 78.2ms
56:	total: 30.9ms	remaining: 77.6ms
57:	total: 31.4ms	remaining: 77ms
58:	total: 32ms	remaining: 76.5ms
59:	total: 32.5ms	remaining: 75.9ms
60:	total: 33ms	remaining: 75.3ms
61:	total: 33.5ms	remaining: 74.6ms
62:	total: 34ms	remaining: 74ms
63:	total: 34.6ms	remaining: 73.6ms
64:	total: 35.1ms	remaining: 73ms
65:	total: 35.7ms	remaining: 72.4ms
66:	total: 36.2ms	remaining: 71.8ms
67:	total: 36.7ms	remaining: 71.2ms
68:	total: 37.2ms	remaining: 70.6ms
69:	total: 37.7ms	remaining: 70ms
70:	total: 38.3ms	remaining: 69.7ms
71:	total: 38.9ms	remaining: 69.2ms
72:	total: 39.4ms	remaining: 68.6ms
73:	total: 39.9ms	remaining: 68ms
74:	total: 40.4ms	remaining: 67.4ms
75:	total: 40.9ms	remaining: 66.8ms
76:	total: 41.4ms	remaining: 66.2ms
77:	total: 42ms	remaining: 65.6ms
78:	total: 42.4ms	remaining: 65ms
79:	total: 42.9ms	remaining: 64.4ms
80:	total: 43.4ms	remaining: 63.8ms
81:	total: 43.9ms	remaining: 63.2ms
82:	total: 44.4ms	remaining: 62.6ms
83:	total: 44.9ms	remaining: 62ms
84:	total: 45.4ms	remaining: 61.5ms
85:	total: 46ms	remaining: 60.9ms
86:	total: 46.5ms	remaining: 60.4ms
87:	total: 47.2ms	remaining: 60.1ms
88:	total: 47.7ms	remaining: 59.5ms
89:	total: 48.3ms	remaining: 59ms
90:	total: 48.8ms	remaining: 58.5ms
91:	total: 49.3ms	remaining: 57.9ms
92:	total: 49.8ms	remaining: 57.3ms
93:	total: 50.3ms	remaining: 56.7ms
94:	total: 50.8ms	remaining: 56.2ms
95:	total: 51.3ms	remaining: 55.6ms
96:	total: 52ms	remaining: 55.2ms
97:	total: 52.6ms	remaining: 54.8ms
98:	total: 53.2ms	remaining: 54.3ms
99:	total: 53.8ms	remaining: 53.8ms
100:	total: 54.3ms	remaining: 53.2ms
101:	total: 54.8ms	remaining: 52.7ms
102:	total: 55.3ms	remaining: 52.1ms
103:	total: 55.8ms	remaining: 51.5ms
104:	total: 56.3ms	remaining: 50.9ms
105:	total: 56.8ms	remaining: 50.4ms
106:	total: 57.3ms	remaining: 49.8ms
107:	total: 57.9ms	remaining: 49.3ms
108:	total: 58.4ms	remaining: 48.8ms
109:	total: 58.9ms	remaining: 48.2ms

110:	total: 59.4ms	remaining: 47.6ms
111:	total: 59.9ms	remaining: 47.1ms
112:	total: 60.5ms	remaining: 46.5ms
113:	total: 61ms	remaining: 46ms
114:	total: 61.5ms	remaining: 45.5ms
115:	total: 62ms	remaining: 44.9ms
116:	total: 62.5ms	remaining: 44.4ms
117:	total: 63.1ms	remaining: 43.8ms
118:	total: 63.6ms	remaining: 43.3ms
119:	total: 64.1ms	remaining: 42.7ms
120:	total: 64.6ms	remaining: 42.2ms
121:	total: 65.1ms	remaining: 41.6ms
122:	total: 65.7ms	remaining: 41.1ms
123:	total: 66.2ms	remaining: 40.6ms
124:	total: 66.7ms	remaining: 40ms
125:	total: 67.2ms	remaining: 39.5ms
126:	total: 67.7ms	remaining: 38.9ms
127:	total: 68.2ms	remaining: 38.4ms
128:	total: 68.7ms	remaining: 37.8ms
129:	total: 69.2ms	remaining: 37.3ms
130:	total: 69.8ms	remaining: 36.8ms
131:	total: 70.3ms	remaining: 36.2ms
132:	total: 70.8ms	remaining: 35.7ms
133:	total: 71.3ms	remaining: 35.1ms
134:	total: 72ms	remaining: 34.7ms
135:	total: 72.6ms	remaining: 34.2ms
136:	total: 73.2ms	remaining: 33.7ms
137:	total: 73.9ms	remaining: 33.2ms
138:	total: 74.4ms	remaining: 32.6ms
139:	total: 74.9ms	remaining: 32.1ms
140:	total: 75.4ms	remaining: 31.5ms
141:	total: 76ms	remaining: 31ms
142:	total: 76.5ms	remaining: 30.5ms
143:	total: 77ms	remaining: 29.9ms
144:	total: 77.5ms	remaining: 29.4ms
145:	total: 78ms	remaining: 28.8ms
146:	total: 78.6ms	remaining: 28.3ms
147:	total: 79.1ms	remaining: 27.8ms
148:	total: 79.6ms	remaining: 27.2ms
149:	total: 80.1ms	remaining: 26.7ms
150:	total: 80.6ms	remaining: 26.2ms
151:	total: 81.1ms	remaining: 25.6ms
152:	total: 81.7ms	remaining: 25.1ms
153:	total: 82.2ms	remaining: 24.5ms
154:	total: 82.7ms	remaining: 24ms
155:	total: 83.2ms	remaining: 23.5ms
156:	total: 83.8ms	remaining: 22.9ms
157:	total: 84.3ms	remaining: 22.4ms
158:	total: 84.8ms	remaining: 21.9ms
159:	total: 85.3ms	remaining: 21.3ms
160:	total: 85.8ms	remaining: 20.8ms
161:	total: 86.3ms	remaining: 20.2ms
162:	total: 86.9ms	remaining: 19.7ms
163:	total: 87.4ms	remaining: 19.2ms
164:	total: 87.9ms	remaining: 18.6ms
165:	total: 88.4ms	remaining: 18.1ms
166:	total: 89ms	remaining: 17.6ms

167:	total: 89.6ms	remaining: 17.1ms
168:	total: 90.1ms	remaining: 16.5ms
169:	total: 90.6ms	remaining: 16ms
170:	total: 91.1ms	remaining: 15.5ms
171:	total: 91.7ms	remaining: 14.9ms
172:	total: 92.2ms	remaining: 14.4ms
173:	total: 93.5ms	remaining: 14ms
174:	total: 94.1ms	remaining: 13.4ms
175:	total: 94.7ms	remaining: 12.9ms
176:	total: 95.2ms	remaining: 12.4ms
177:	total: 95.8ms	remaining: 11.8ms
178:	total: 96.3ms	remaining: 11.3ms
179:	total: 96.8ms	remaining: 10.8ms
180:	total: 97.3ms	remaining: 10.2ms
181:	total: 97.9ms	remaining: 9.68ms
182:	total: 98.4ms	remaining: 9.14ms
183:	total: 98.9ms	remaining: 8.6ms
184:	total: 99.4ms	remaining: 8.06ms
185:	total: 100ms	remaining: 7.52ms
186:	total: 100ms	remaining: 6.99ms
187:	total: 101ms	remaining: 6.45ms
188:	total: 101ms	remaining: 5.91ms
189:	total: 102ms	remaining: 5.37ms
190:	total: 103ms	remaining: 4.83ms
191:	total: 103ms	remaining: 4.29ms
192:	total: 104ms	remaining: 3.76ms
193:	total: 104ms	remaining: 3.22ms
194:	total: 105ms	remaining: 2.68ms
195:	total: 105ms	remaining: 2.15ms
196:	total: 106ms	remaining: 1.61ms
197:	total: 106ms	remaining: 1.07ms
198:	total: 107ms	remaining: 538us
199:	total: 108ms	remaining: 0us

CATboost:

{'depth': 1, 'min\_data\_in\_leaf': 1}

Mean Accuracy: 0.790

test accuracy = 0.5934861278648975