SVM classifier trained on images (real and generated ones from 4 generators) from ELSA compressed in jpg with quality 40 and coming. The classifier is tested on images from synthbuster

In [ ]:
```
%load_ext autoreload
%autoreload 2
```

In [ ]:
```
import sys
sys.path.append("../tools")
from utils import load_data_features, load_synthbuster_balanced, map_synthbuster_classes
from sklearn.svm import LinearSVC
from datasets import load_from_disk
import open_clip
from IPython.display import clear_output
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
import matplotlib.pyplot as plt
```

In [ ]:
```
model, _, preprocess = open_clip.create_model_and_transforms('hf-hub:laion/CLIP-ViT-L-14-DataComp.XL-s13B-b90K',device="cuda")

model.eval()
clear_output()
```

In [ ]:
```
def label_conversion(e):
    e["label"] = 1 if e["label"] == "real" else 0
    return e
```

In [ ]:
```
X_sb, y_sb = load_synthbuster_balanced("../../data/synthbuster_test",
                                       balance_real_fake=True,
                                       binary_classification=True)
```

In [ ]:
```
X_40, y_40 = load_data_features("../../data/big_QF_40_features","train")
X_h, y_h = load_data_features("../../data/holistic","train")
```

Train on big_QF_40_features (1 generator) / Test on holistic (4 generators)

In [ ]:
```
clf = LinearSVC(dual="auto")
clf.fit(X_40,y_40).score(X_h,y_h)
```

Out[ ]:
```
0.641
```

Train on holistic (4 generators) / Test on big_QF_40_features (1 generator)

In [ ]:
```
clf = LinearSVC(dual="auto")
clf.fit(X_h,y_h).score(X_40,y_40)
```

Out[ ]:
```
0.9426
```

Train on holistic (4 generators) / Test on synthbuster

In [ ]:
```
clf.fit(X_h,y_h).score(X_sb,y_sb)
```

Out[ ]:
```
0.6444199116820554
```

Train on synthbuster (9 generators) / Test on holistic (4 generators)

In [ ]:
```
clf.fit(X_sb, y_sb).score(X_h,y_h)
```

Out[ ]:
```
0.6202
```

Train and test on synthbuster

In [ ]:
```
X_train, X_test, y_train, y_test = train_test_split(X_sb,y_sb,shuffle=True,test_size=.2)
print(X_train.shape)
clf.fit(X_train,y_train).score(X_test,y_test)
```

```
(7971, 768)
```

Out[ ]:
```
0.9839438033115906
```

Train and test on big_QF_40 (1 generator)

In [ ]:
```
X_train, X_test, y_train, y_test = train_test_split(X_40,y_40,shuffle=True,test_size=.2)

clf.fit(X_train,y_train).score(X_test,y_test)
```

Out[ ]:
```
0.981
```

Train on concatenation of synthbuster + holistic and test on holistic

train on synthbuster + holistic

In [ ]:
```
X_sb_train, X_sb_test, y_sb_train, y_sb_test = train_test_split(X_sb, y_sb,test_size=.2,shuffle=True,random_state=7)
X_h_train, y_h_train = load_data_features("../../data/holistic",split="train")
X_h_test, y_h_test = load_data_features("../../data/holistic/",split="test")

X_train = np.vstack((X_sb_train,X_h_train))
y_train = np.hstack((y_sb_train,y_h_train))

clf.fit(X_train,y_train)
```

Out[ ]:
```
▾    LinearSVC    i ?

LinearSVC(dual='auto')
```

test on holistic

In [ ]:
```
clf.score(X_h_test,y_h_test)
```

Out[ ]:
```
0.9508
```

test on synthbuster

In [ ]:
```
clf.score(X_sb_test,y_sb_test)
```

Out[ ]:
```
0.9668840943301555
```

test on big_QF_40

In [ ]:
```
X_40_test, y_40_test = load_data_features("../../data/big_QF_40_features",split="test")
clf.score(X_40,y_40)
```

Out[ ]:
```
0.9449
```

Multi class classifier

uniform distribution of data across all classes

In [ ]:
```
from sklearn.multiclass import OneVsOneClassifier, OneVsRestClassifier

ovo = OneVsOneClassifier(LinearSVC(dual="auto"))
ovr = OneVsRestClassifier(LinearSVC(dual="auto"))
X_sb, y_sb = load_synthbuster_balanced("../../data/synthbuster_test",
                                       binary_classification=False,
                                       balance_real_fake=False)
```

In [ ]:
```
from collections import Counter

X_train, X_test, y_train, y_test = train_test_split(X_sb,
                                                    y_sb,
                                                    test_size=.2,
                                                    shuffle=True,
                                                    random_state=7)
display(Counter(y_sb))
display(Counter(y_test))
```

```
Counter({1: 1000,
         2: 1000,
         3: 1000,
         4: 1000,
         5: 1000,
         6: 1000,
         7: 1000,
         8: 1000,
         9: 1000,
         0: 1000})
Counter({4: 220,
         9: 215,
         8: 209,
         5: 206,
         3: 205,
         6: 200,
         2: 192,
         7: 189,
         0: 183,
         1: 181})
```

1000 points per classes

In [ ]:
```
ovo.fit(X_train,y_train).score(X_test, y_test)
```

Out[ ]:
```
0.802
```

In [ ]:
```
ovr.fit(X_train, y_train).score(X_test,y_test)
```

Out[ ]:
```
0.793
```

50% real images and 50% generated (9 generators)

In [ ]:
```
X_sb, y_sb = load_synthbuster_balanced("../../data/synthbuster_test",
                                       binary_classification=False,
                                       balance_real_fake=True)

X_train, X_test2, y_train, y_test2 = train_test_split(X_sb,
                                          y_sb,
                                          shuffle=True,
                                          random_state=7,
                                          test_size=.2)

X_train_filtered = np.zeros_like(X_train)
y_train_filtered = np.zeros_like(y_train)
k = 0
for i, x in enumerate(X_train):
    if x not in X_test:
        X_train_filtered[k] = X_train[i]
        y_train_filtered[k] = y_train[i]
        k += 1
X_train_filtered = X_train_filtered[:k]
y_train_filtered = y_train_filtered[:k]

for x in X_train_filtered:
    if x in X_test:
        print("PROBLEM: SOME POINT ARE SHARED BETWEEN TRAIN AND TEST")
Counter(y_train_filtered)
```

Out[ ]:
```
Counter({0: 3730,
         2: 369,
         1: 368,
         9: 355,
         7: 347,
         3: 347,
         8: 338,
         6: 336,
         4: 334,
         5: 330})
```

In [ ]:
```
Counter(y_test)
```

Out[ ]:
```
Counter({4: 220,
         9: 215,
         8: 209,
         5: 206,
         3: 205,
         6: 200,
         2: 192,
         7: 189,
         0: 183,
         1: 181})
```

In [ ]:
```
ovo.fit(X_train_filtered,y_train_filtered).score(X_test,y_test)
```

```
/home/lsaland/micromamba/envs/clip/lib/python3.11/site-packages/sklearn/svm/_base.py:1237: ConvergenceWarning: Liblinear failed to converge, increase the number o
f iterations.
  warnings.warn(
Out[ ]: 0.7855
```

```
In [ ]: ovr.fit(X_train_filtered,y_train_filtered).score(X_test,y_test)
```

```
Out[ ]: 0.7465
```

Binary classification with multiclass classifier

```
In [ ]: y_test_hat_ovo = ovo.predict(X_test2)
        result = np.zeros_like(y_test)
        for i, y in enumerate(y_test_hat_ovo):
            if y == 0 and y_test2[i] == 0: # predicted real and was real
                result[i] = 1
            elif y > 0 and y_test2[i] > 0: # predicted fake and was really fake
                result[i] = 1
            else:
                result[i] = 0
        np.mean(result)
```

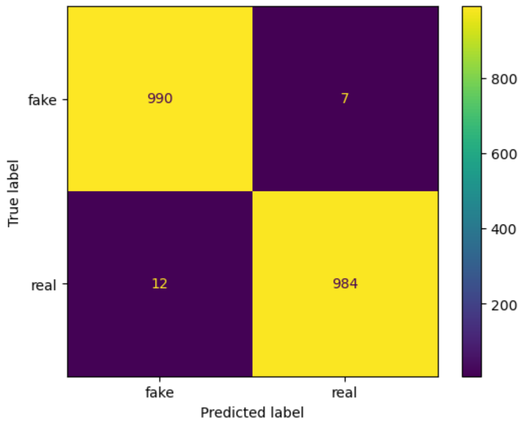
```
Out[ ]: 0.987
```

Confusion matrix for binary classification

```
In [ ]: y_test_map = np.zeros_like(y_test2)
        y_test_hat_map = np.zeros_like(y_test2)

        for i in range(len(y_test2)):
            if y_test2[i] == 0:
                y_test_map[i] = 1
            if y_test_hat_ovo[i] == 0:
                y_test_hat_map[i] = 1
        cm = confusion_matrix(y_test_map,y_test_hat_map)
        ConfusionMatrixDisplay(cm,display_labels=["fake","real"]).plot()
```

```
Out[ ]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x75fa896abf10>
```



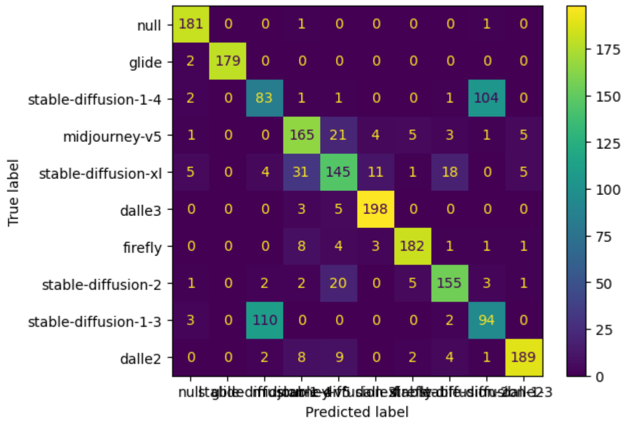
Confusion matrix for multiclass classification

```
In [ ]: y_test_hat_ovo = ovo.predict(X_test)

        cm = confusion_matrix(y_test,y_test_hat_ovo)
        labels = ['null',
                  'glide',
                  'stable-diffusion-1-4',
                  'midjourney-v5',
                  'stable-diffusion-xl',
                  'dalle3',
                  'firefly',
                  'stable-diffusion-2',
                  'stable-diffusion-1-3',
                  'dalle2']


        display = ConfusionMatrixDisplay(cm,display_labels=labels)
        display.plot()
```

```
Out[ ]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x75fa943e84d0>
```


True label
null 181 0 0 1 0 0 0 0 1 0
glide 2 179 0 0 0 0 0 0 0 0
stable-diffusion-1-4 2 0 83 1 1 0 0 1 104 0
midjourney-v5 1 0 0 165 21 4 5 3 1 5
stable-diffusion-xl 5 0 4 31 145 11 1 18 0 5
dalle3 0 0 0 3 5 198 0 0 0 0
firefly 0 0 0 8 4 3 182 1 1 1
stable-diffusion-2 1 0 2 2 20 0 5 155 3 1
stable-diffusion-1-3 3 0 110 0 0 0 0 2 94 0
dalle2 0 0 2 8 9 0 2 4 1 189
Predicted label