Carga Librerias

In [1]:
```
# Librerias
import warnings
import pandas as pd
import numpy as np
import matplotlib
import matplotlib.pyplot as plt
import plotly.express as px

import seaborn as sns

from sklearn.preprocessing import MinMaxScaler
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.decomposition import PCA

from sklearn import svm
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier, GradientBoostingClassifier
from sklearn.tree import DecisionTreeClassifier
from xgboost import XGBClassifier

from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay, accuracy_score, precision_score, recall_s
warnings.filterwarnings('ignore')
```

In [2]:
```
def plot_metrics(model, x, y, pred_y):
    print('Accuracy:\t', accuracy_score(y, pred_y))
    print('Precision:\t', precision_score(y, pred_y))
    print('Recall:\t\t', recall_score(y, pred_y))
    print('F1 score:\t', f1_score(y, pred_y))
    print('ROC AUC score:\t', roc_auc_score(y, model.predict_proba(x)[:, 1]))

    fig, ax = plt.subplots(1)
    matplotlib.rc('figure', figsize=(15, 5))
    ax.plot(y)
    ax.plot(pred_y)
    plot_roc_curve(model, x, y)
```

Carga Datos

In [3]:
```
DATA_DIR = "C:/Users/NetRunner/OneDrive/UOC/Semestre 6/TFM/MultipleDatasets"

train_data_cut = pd.read_csv(f"{DATA_DIR}/train_data.csv")
test_data_cut = pd.read_csv(f"{DATA_DIR}/test_data.csv")

train_data_uncut = pd.read_csv(f"{DATA_DIR}/train_data_uncut.csv")
test_data_uncut = pd.read_csv(f"{DATA_DIR}/test_data_uncut.csv")

# X_train = pd.read_csv(f"{DATA_DIR}/X_train.csv")
# y_train = pd.read_csv(f"{DATA_DIR}/y_train.csv")
# X_test = pd.read_csv(f"{DATA_DIR}/X_test.csv")
# y_test = pd.read_csv(f"{DATA_DIR}/y_test.csv")
```

In [4]:
```
data_cut = pd.concat([train_data_cut, test_data_cut])
data_uncut = pd.concat([train_data_uncut, test_data_uncut])

features = ['volt', 'rotate', 'pressure', 'vibration', 'error1', 'error2', 'error3',
            'error4', 'error5', 'volt_3h_mean', 'rotate_3h_mean',
            'pressure_3h_mean', 'vibration_3h_mean', 'volt_24h_mean',
            'rotate_24h_mean', 'pressure_24h_mean', 'vibration_24h_mean',
            'error1_count', 'error2_count', 'error3_count', 'error4_count',
            'error5_count']
label = ['State']

data_cut = data_cut[features+label]
data_uncut = data_uncut[features+label]
```

Normalización de datos MinMax

In [5]:
```
feature_scaler_cut = MinMaxScaler(feature_range=(0,1))
label_scaler_cut = MinMaxScaler(feature_range=(0,1))

feature_scaler_cut.fit(data_cut[features])
label_scaler_cut.fit(data_cut[label].values.reshape(-1,1))
```

Out[5]:
```
MinMaxScaler()
```

In [6]:
```
feature_scaler_uncut = MinMaxScaler(feature_range=(0,1))
label_scaler_uncut = MinMaxScaler(feature_range=(0,1))

feature_scaler_uncut.fit(data_uncut[features])
label_scaler_uncut.fit(data_uncut[label].values.reshape(-1,1))
```

Out[6]:
```
MinMaxScaler()
```

In [7]:
```
data_norm_cut = data_cut.copy()
data_norm_cut[features] = feature_scaler_cut.transform(data_cut[features])
data_norm_cut[label] = label_scaler_cut.transform(data_cut[label].values.reshape(-1,1))

data_norm_uncut = data_uncut.copy()
data_norm_uncut[features] = feature_scaler_uncut.transform(data_uncut[features])
data_norm_uncut[label] = label_scaler_uncut.transform(data_uncut[label].values.reshape(-1,1))
```

Dataset Train/Test

In [8]:
```
train_norm_cut = data_norm_cut[:len(train_data_cut)]
test_norm_cut = data_norm_cut[len(train_data_cut):(len(train_data_cut)+len(test_data_cut))]

X_train_cut = train_norm_cut.loc[:, train_norm_cut.columns != 'State']
y_train_cut = train_norm_cut['State'].values
X_test_cut = test_norm_cut.loc[:, test_norm_cut.columns != 'State']
y_test_cut = test_norm_cut['State'].astype(int)

print('X_train:\t', X_train_cut.shape)
print('y_train:\t', y_train_cut.shape)
print('X_test:\t\t', X_test_cut.shape)
print('y_test:\t\t', y_test_cut.shape)
```

```
X_train:         (17280, 22)
y_train:         (17280,)
X_test:          (3600, 22)
y_test:          (3600,)
```

In [9]:
```
train_norm_uncut = data_norm_uncut[:len(train_data_uncut)]
test_norm_uncut = data_norm_uncut[len(train_data_uncut):(len(train_data_uncut)+len(test_data_uncut))]

X_train_uncut = train_norm_uncut.loc[:, train_norm_uncut.columns != 'State']
y_train_uncut = train_norm_uncut['State'].astype(int)
X_test_uncut = test_norm_uncut.loc[:, test_norm_uncut.columns != 'State']
y_test_uncut = test_norm_uncut['State'].astype(int)

print('X_train_uncut:\t', X_train_uncut.shape)
print('y_train_uncut:\t', y_train_uncut.shape)
print('X_test_uncut:\t', X_test_uncut.shape)
print('y_test_uncut:\t', y_test_uncut.shape)
```

```
X_train_uncut:   (40397, 22)
y_train_uncut:   (40397,)
X_test_uncut:    (8305, 22)
y_test_uncut:    (8305,)
```

Train/Test variable control

In [10]:
```
# Cut cycles
X_train = X_train_cut
y_train = y_train_cut
X_test = X_test_cut
y_test = y_test_cut

# Uncut cycles
# X_train = X_train_uncut
# y_train = y_train_uncut
# X_test = X_test_uncut
# y_test = y_test_uncut
```

Logistic Regression

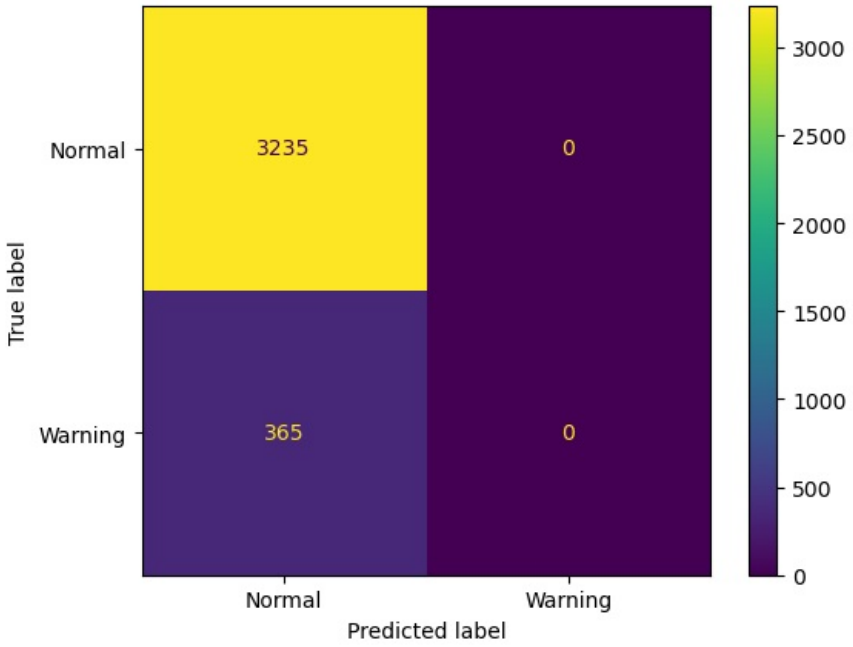
In [11]:
```
parameters = {'solver':['newton-cg', 'lbfgs', 'liblinear'],'C':[0.001, 0.01, 0.1, 1, 10]}
grid_search = GridSearchCV(LogisticRegression(), parameters, verbose=0)
grid_search.fit(X_train, y_train)
grid_df = pd.DataFrame(grid_search.cv_results_['params'])
grid_df['mean_test_score'] = grid_search.cv_results_['mean_test_score']
grid_df['rank'] =  grid_search.cv_results_['rank_test_score']
grid_df.sort_values(by='rank').head()
```

Out[11]:

	C	solver	mean_test_score	rank
3	0.010	newton-cg	0.899884	1
4	0.010	lbfgs	0.899884	1
5	0.010	liblinear	0.898958	3
0	0.001	newton-cg	0.898611	4
1	0.001	lbfgs	0.898611	4

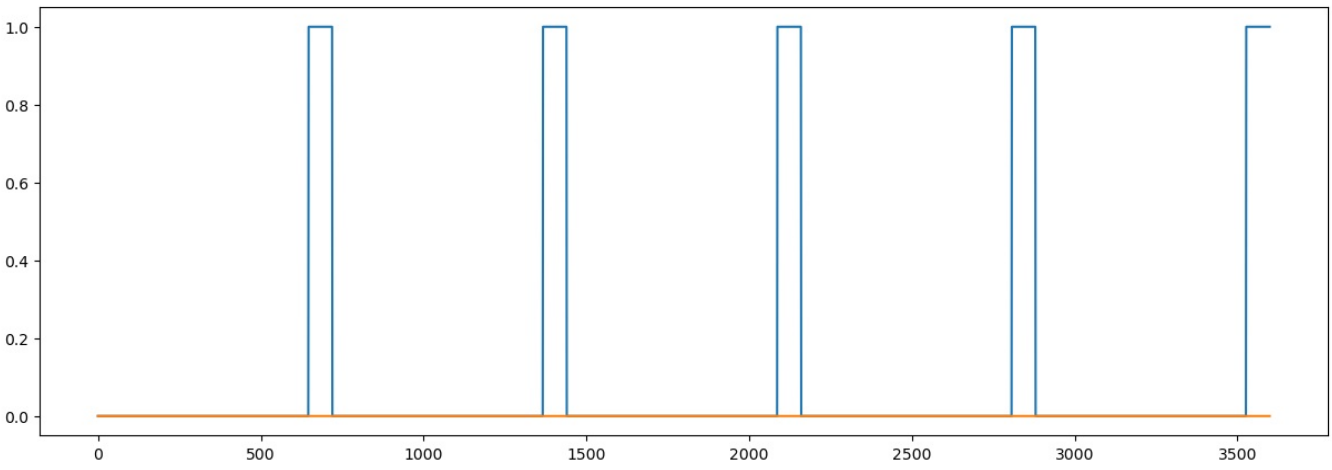
In [12]:
```
model_lr = LogisticRegression(solver='newton-cg', C=0.01).fit(X_train, y_train)
pred_lr = model_lr.predict(X_test)
lr_cm = confusion_matrix(y_test, pred_lr)
ConfusionMatrixDisplay(lr_cm, display_labels=['Normal', 'Warning']).plot()
```

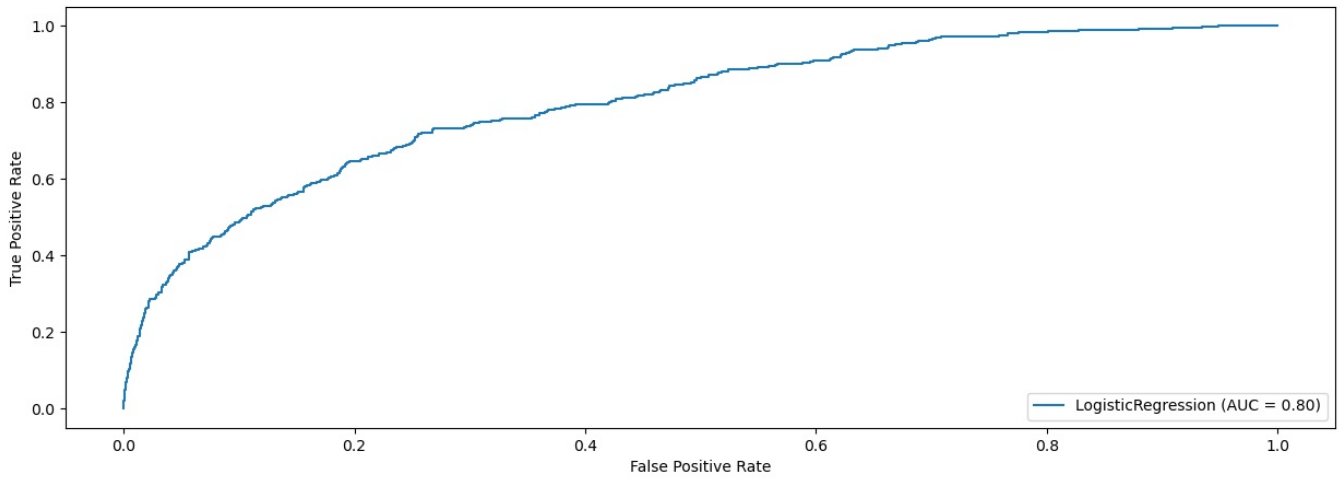
Out[12]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x1e09a866190>
```



In [14]:
```
plot_metrics(model_lr, X_test, y_test, pred_lr)
```

```
Accuracy:        0.8986111111111111
Precision:       0.0
Recall:          0.0
F1 score:        0.0
ROC AUC score:   0.7990040439541828
```





SVM

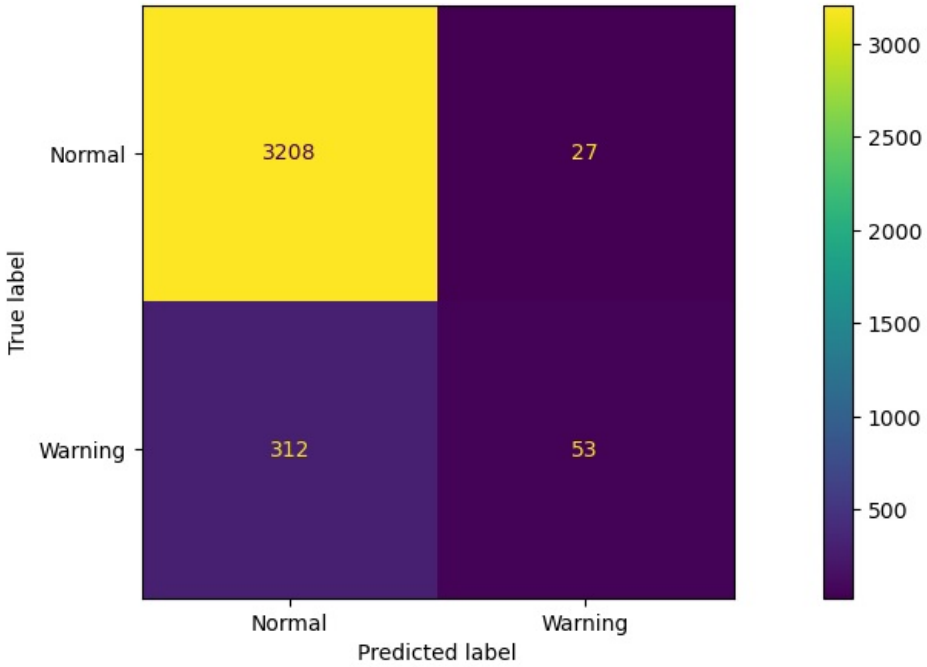
In [14]:
```
parameters = {'kernel': ['poly', 'rbf', 'sigmoid'], 'C':[0.001, 0.01, 0.1, 1, 10]}

grid_search = GridSearchCV(svm.SVC(), parameters, verbose=0)
grid_search.fit(X_train, y_train)
grid_df = pd.DataFrame(grid_search.cv_results_['params'])
grid_df['mean_test_score'] = grid_search.cv_results_['mean_test_score']
grid_df['rank'] =  grid_search.cv_results_['rank_test_score']
grid_df.head().sort_values(by='rank').head()
```

Out[14]:

	C	kernel	mean_test_score	rank
3	0.010	poly	0.904398	1
0	0.001	poly	0.899826	2
1	0.001	rbf	0.898611	3
2	0.001	sigmoid	0.898611	3
4	0.010	rbf	0.898611	3

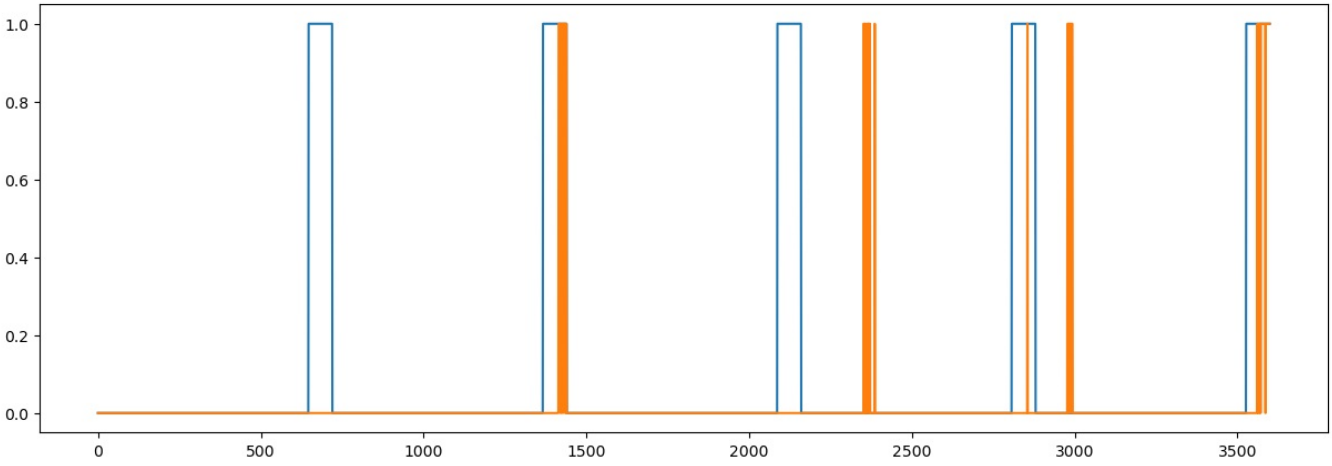
In [15]:
```
model_svm = svm.SVC(kernel='poly', C=0.01, probability=True).fit(X_train, y_train)
pred_svm = model_svm.predict(X_test)
svm_cm = confusion_matrix(y_test, pred_svm)
ConfusionMatrixDisplay(svm_cm, display_labels=['Normal', 'Warning']).plot()
```

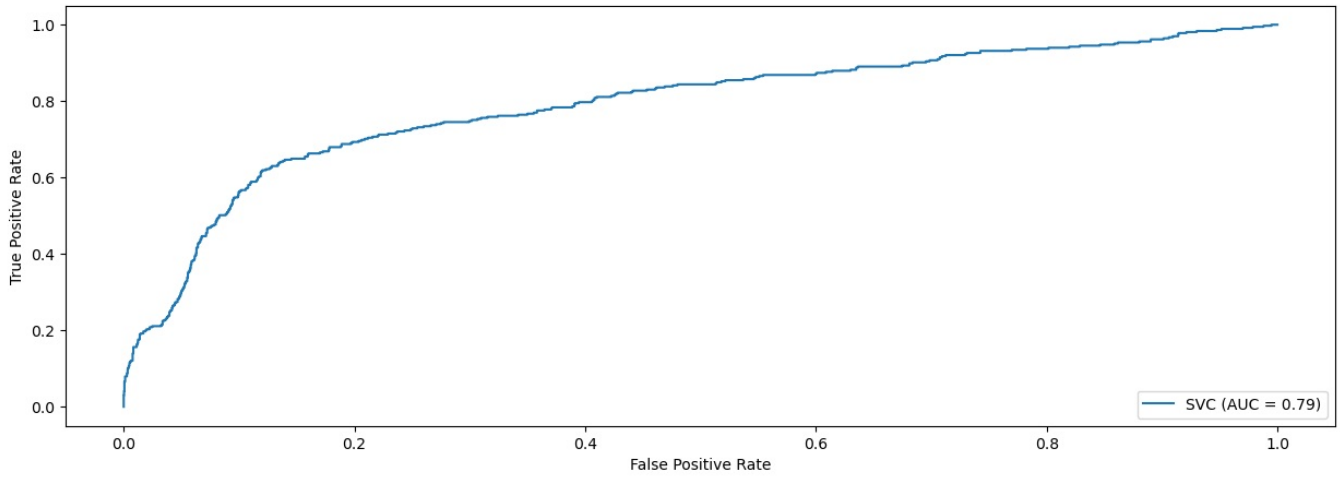
Out[15]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x1e09d30faf0>
```



In [16]:
```
plot_metrics(model_svm, X_test, y_test, pred_svm)
```

```
Accuracy:        0.9058333333333334
Precision:       0.6625
Recall:          0.14520547945205478
F1 score:        0.23820224719101124
ROC AUC score:   0.7900726217950075
```





Random Forest Classifier

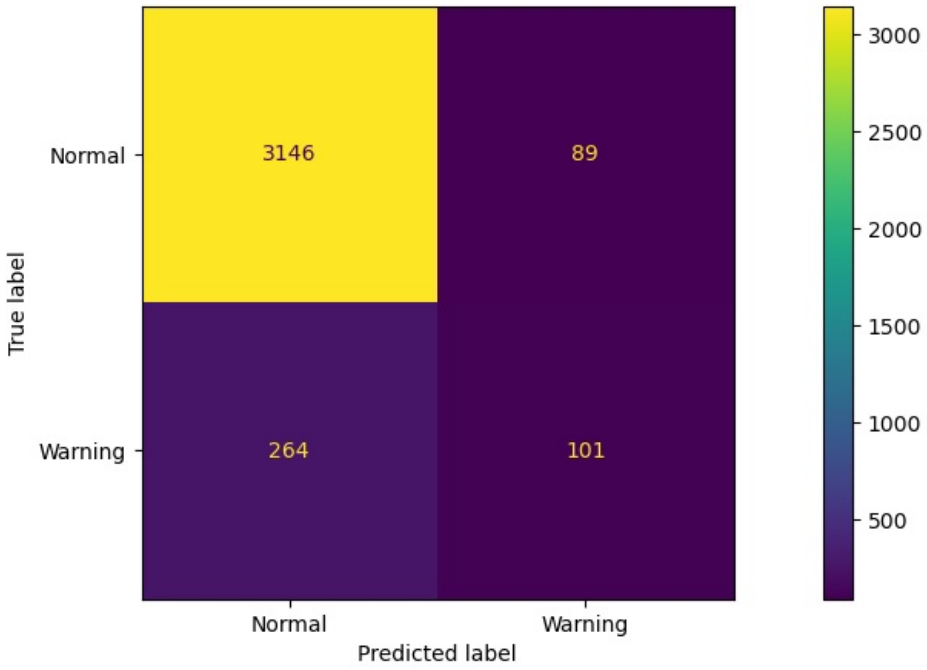
In [17]:
```
parameters = {'max_depth': [6,7,8,9,10,11,12], 'n_estimators': [10,50,100,200]}
grid_search = GridSearchCV(RandomForestClassifier(), parameters, verbose=0)
grid_search.fit(X_train, y_train)
grid_df = pd.DataFrame(grid_search.cv_results_['params'])
grid_df['mean_test_score'] = grid_search.cv_results_['mean_test_score']
grid_df['rank'] =  grid_search.cv_results_['rank_test_score']
grid_df.sort_values(by='rank').head()
```

Out[17]:

	max_depth	n_estimators	mean_test_score	rank
0	6	10	0.883275	1
2	6	100	0.882986	2
7	7	200	0.881539	3
3	6	200	0.881366	4
6	7	100	0.879919	5

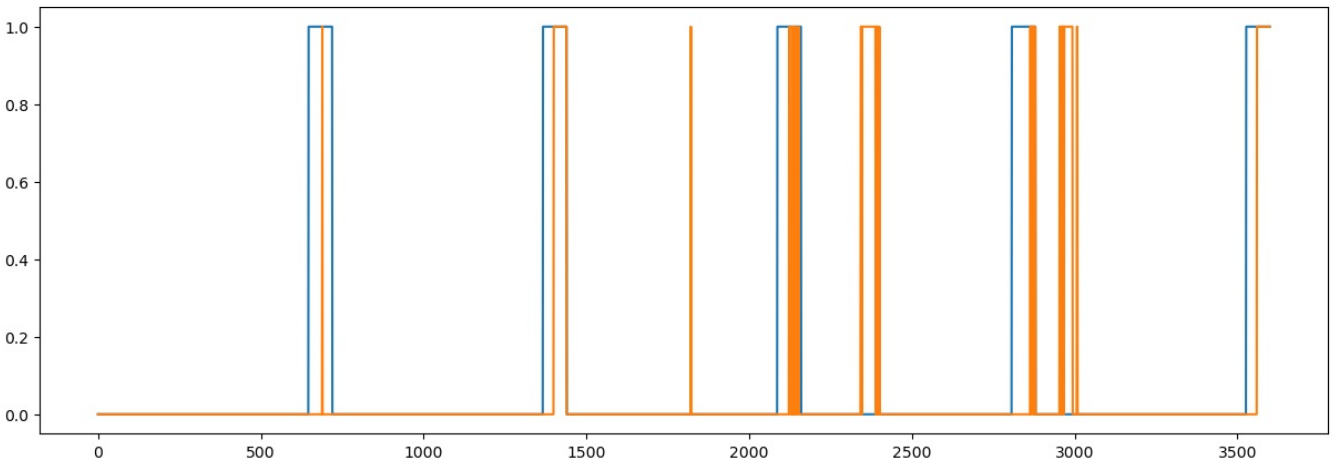
In [17]:
```
model_rf = RandomForestClassifier(max_depth=6, n_estimators=10).fit(X_train, y_train)
pred_rf = model_rf.predict(X_test)
rf_cm = confusion_matrix(y_test, pred_rf)
ConfusionMatrixDisplay(rf_cm, display_labels=['Normal', 'Warning']).plot()
```

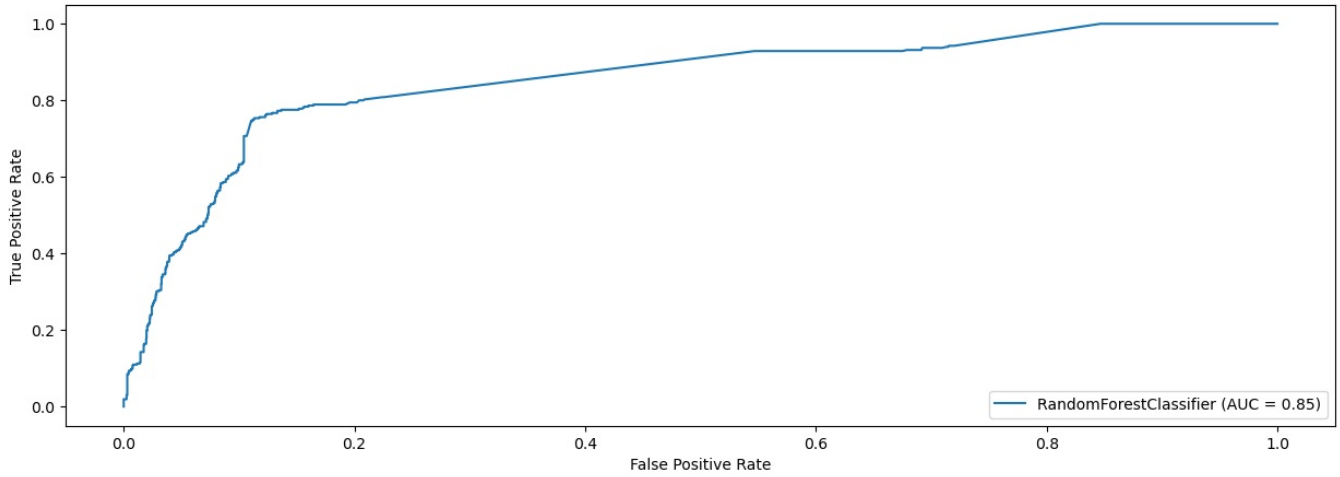
Out[17]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x1e09d406b50>
```



In [18]:
```
plot_metrics(model_rf, X_test, y_test, pred_rf)
```

```
Accuracy:        0.9019444444444444
Precision:       0.531578947368421
Recall:          0.27671232876712326
F1 score:        0.3639639639639639
ROC AUC score:   0.8521936863500666
```





Gradient boosting

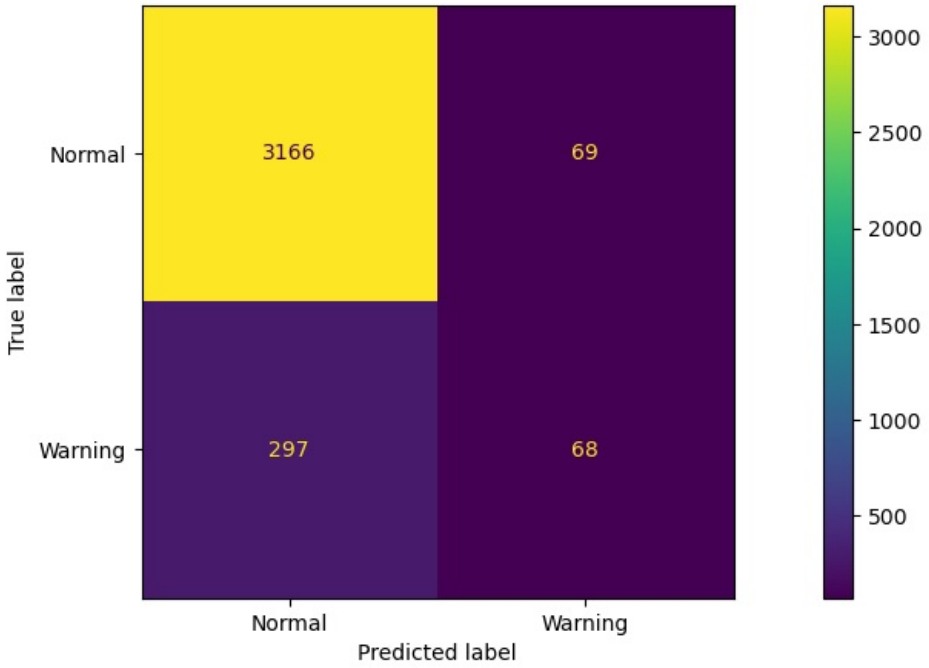
In [20]:
```
parameters = {'learning_rate': [0.001, 0.01,0.1,1,2], 'n_estimators': [10,50,100,200]}
grid_search = GridSearchCV(GradientBoostingClassifier(), parameters, verbose=0)
grid_search.fit(X_train, y_train)
grid_df = pd.DataFrame(grid_search.cv_results_['params'])
grid_df['mean_test_score'] = grid_search.cv_results_['mean_test_score']
grid_df['rank'] =  grid_search.cv_results_['rank_test_score']
grid_df.sort_values(by='rank').head()
```

Out[20]:

	learning_rate	n_estimators	mean_test_score	rank
6	0.010	100	0.908275	1
8	0.100	10	0.906192	2
7	0.010	200	0.903009	3
0	0.001	10	0.898611	4
1	0.001	50	0.898611	4

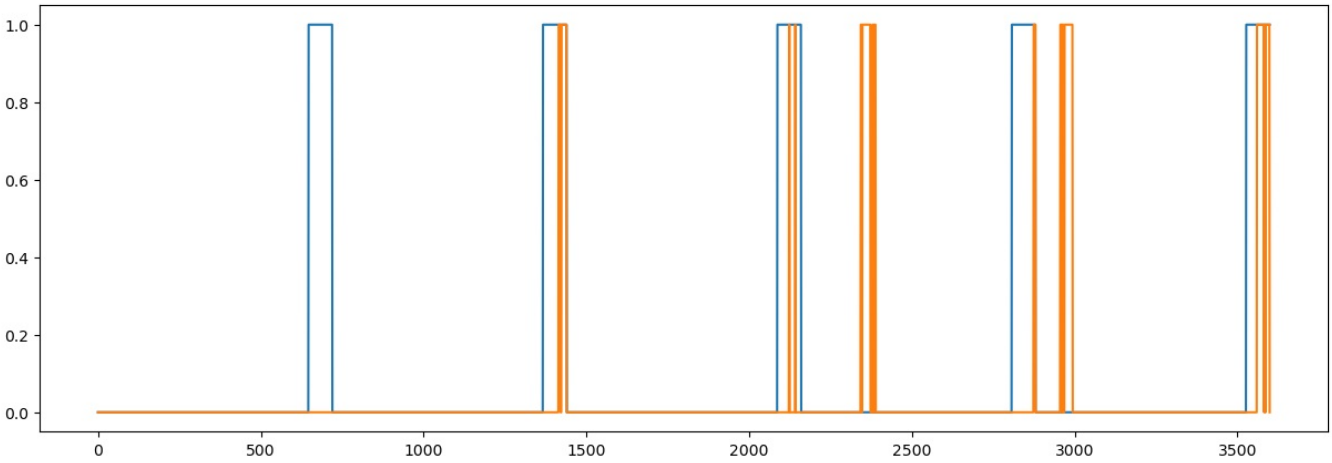
In [21]:
```
model_gb = GradientBoostingClassifier(learning_rate=0.010, n_estimators=100).fit(X_train, y_train)
pred_gb = model_gb.predict(X_test)
gb_cm = confusion_matrix(y_test, pred_gb)
ConfusionMatrixDisplay(gb_cm, display_labels=['Normal', 'Warning']).plot()
```

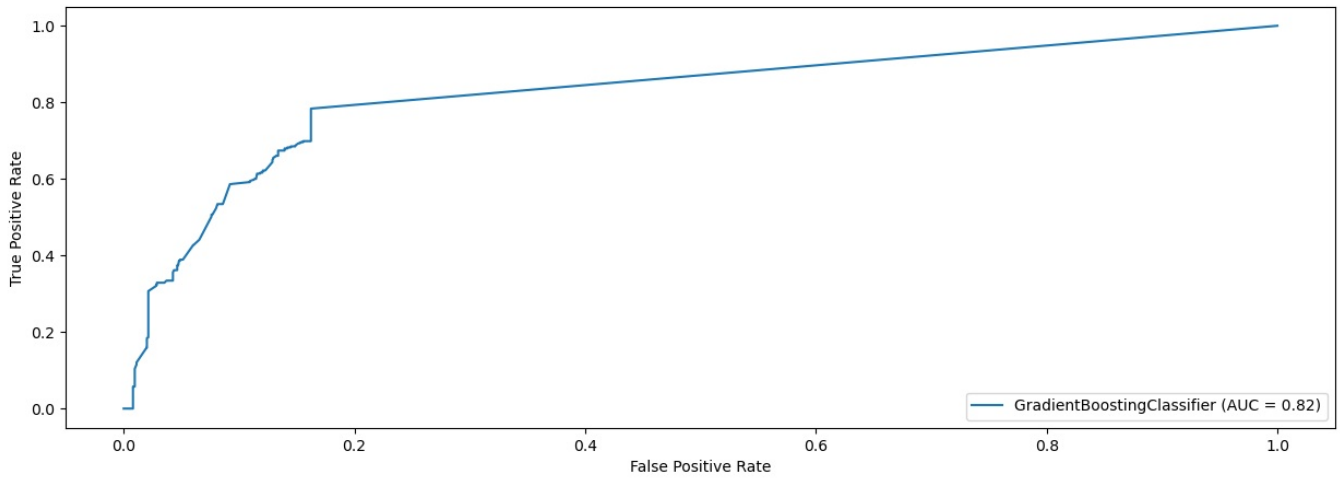
Out[21]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x1e09e1c4dc0>
```



In [22]:
```
plot_metrics(model_gb, X_test, y_test, pred_gb)
```

```
Accuracy:        0.8983333333333333
Precision:       0.49635036496350365
Recall:          0.1863013698630137
F1 score:        0.2709163346613546
ROC AUC score:   0.8235298850331352
```





XGBoosting

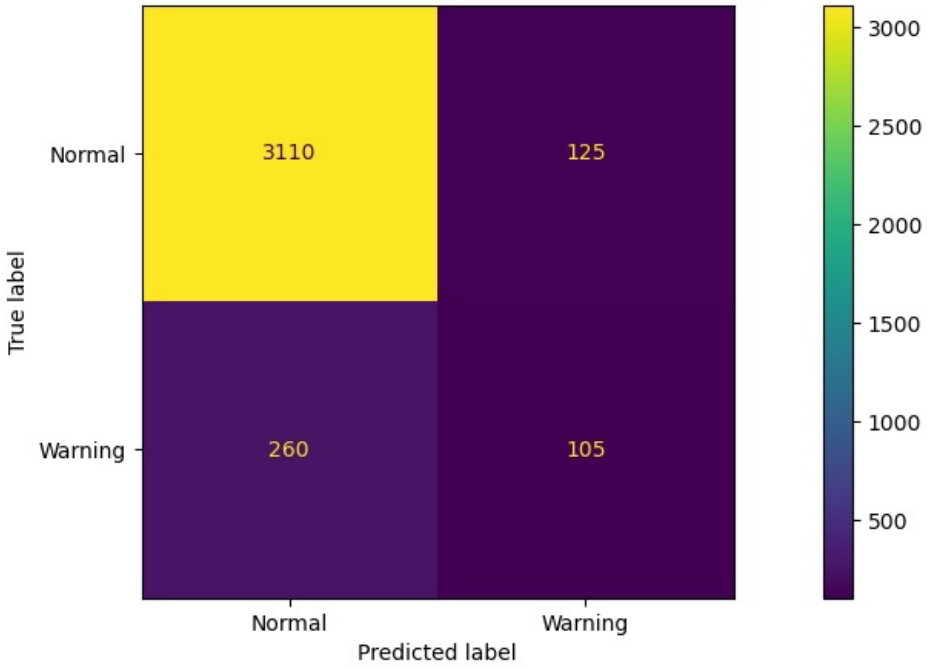
In [23]:
```
parameters = {'booster': ['gbtree', 'dart'], 'reg_alpha': [0, 0.5, 1, 5], 'reg_lambda': [0, 0.5, 1, 5], 'eval_m
grid_search = GridSearchCV(XGBClassifier(use_label_encoder=False), parameters, verbose=0)
grid_search.fit(X_train, y_train.astype(int))
grid_df = pd.DataFrame(grid_search.cv_results_['params'])
grid_df['mean_test_score'] = grid_search.cv_results_['mean_test_score']
grid_df['rank'] =  grid_search.cv_results_['rank_test_score']
grid_df.sort_values(by='rank').head()
```

Out[23]:

	booster	eval_metric	reg_alpha	reg_lambda	mean_test_score	rank
22	dart	mlogloss	0.5	1.0	0.874306	1
6	gbtree	mlogloss	0.5	1.0	0.874306	1
27	dart	mlogloss	1.0	5.0	0.868229	3
11	gbtree	mlogloss	1.0	5.0	0.868229	3
28	dart	mlogloss	5.0	0.0	0.867650	5

In [23]:
```
model_xgb = XGBClassifier(booster='dart', reg_alpha=0.5, reg_lambda=1, eval_metric='mlogloss').fit(X_train, y_t
pred_xgb = model_xgb.predict(X_test)
xgb_cm = confusion_matrix(y_test, pred_xgb)
ConfusionMatrixDisplay(xgb_cm, display_labels=['Normal', 'Warning']).plot()
```

Out[23]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x1e09e3d7d60>
```



In [24]:
```
plot_metrics(model_xgb, X_test, y_test, pred_xgb)
```

```
Accuracy:        0.8930555555555556
Precision:       0.45652173913043476
Recall:          0.2876712328767123
F1 score:        0.3529411764705882
ROC AUC score:   0.7902123605259256
```