# DAA Project – Transmission Line Fault Detection and Classification

**BT23CSE001, BT23CSE016, BT23CSE038**

## Introduction

Electrical power transmission systems are prone to various types of faults such as single line-to-ground (LG), line-to-line (LL), double line-to-ground (LLG), and three-phase (LLL) faults. These faults, if not detected and cleared promptly, can cause severe damage to equipment, blackouts, and safety hazards.

In this project, we focus on the detection and classification of transmission line faults using Artificial Neural Networks (ANN). The use of ANN models provides a robust and efficient approach for analyzing fault data and accurately identifying fault types based on input parameters like voltage and current waveforms.

By leveraging machine learning techniques, particularly supervised learning via ANN architectures, the model can learn to distinguish between different fault types, enhancing the reliability and automation of fault analysis in power systems.

## Objective

This notebook implements and analyzes various ANN models to detect and classify faults in transmission lines. It includes:

- Training and testing of ANN models
- Visualization of performance metrics through graphs
- Evaluation based on accuracy, precision, recall, and other relevant metrics

The goal is to assess the effectiveness of ANN-based approaches in automating fault classification in power systems.

# Electrical Fault detection and Classification using ANN models

In [3]:

```
# Importing necessary packages
import pandas as pd
import numpy as np
import sklearn
```

```
from sklearn import linear_model
import matplotlib.pyplot as plt

from sklearn.metrics import mean_squared_error
from sklearn.metrics import accuracy_score,f1_score
from sklearn.linear_model import LinearRegression, LogisticRegression
from sklearn.preprocessing import PolynomialFeatures
from sklearn.pipeline import make_pipeline

from sklearn.neural_network import MLPClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
from sklearn.svm import LinearSVC,SVC
from sklearn.neighbors import KNeighborsClassifier
```

In [4]:
```
#Importing the data
detection_train = pd.read_excel('detect_dataset.xlsx').dropna(axis=1)
class_train = pd.read_csv('classData.csv').dropna(axis=1)

features=['Ia','Ib','Ic','Va','Vb','Vc']
class_target = ['G','C','B','A']
```

In [5]:
```
#Defining the inputs and outputs
detection_data_X = detection_train[features]
class_data_X = class_train[features]
detection_data_Y = detection_train['Output (S)']
class_data_Y = class_train[class_target]

#Defining accuracy and error vectors
detect_accuracy = list()
detect_error = list()
class_accuracy = list()
class_error = list()
```

In [6]:
```
#Splitting the data
class_train_X,class_test_X,class_train_Y,class_test_Y= train_test_split(clas
detection_train_X,detection_test_X,detection_train_Y,detection_test_Y = trai
```

# Linear regression

In [7]:
```
#Defining different Models for different classification problems
detection_model = linear_model.Lasso(alpha = 2.0)
class_model = LinearRegression()
```

In [8]:
```
#Fitting the data in different models
detection_model.fit(detection_train_X,detection_train_Y)
class_Y = np.array([class_train_Y['G']*1+class_train_Y['A']*2+class_train_Y[
class_Y= class_Y.transpose().ravel()
class_model.fit(class_train_X,class_Y)
```

Out[8]:

▾ LinearRegression

LinearRegression()

## Results

In [9]:

```
#Predicting test values and printing out Mean Squared Error
detection_preds = detection_model.predict(detection_test_X)
print('The Error of our Detection Model is: ',mean_squared_error(detection_t

class_Y = np.array([class_test_Y['G']*1+class_test_Y['A']*2+class_test_Y['B'
class_Y= class_Y.transpose().ravel()
class_preds = class_model.predict(class_test_X)
print('The Error of our Classification Model is: ',mean_squared_error(class_

#storing error values
detect_error.append(mean_squared_error(detection_test_Y,detection_preds))
class_error.append(mean_squared_error(class_Y,class_preds))
```

```
The Error of our Detection Model is:  0.24375743622444437
The Error of our Classification Model is:  17.301569015218817
```

In [10]:

```
# Printing out accuracy scores of our models
print('The accuracy score of our Detection Model is: ',(detection_model.scor
print('The accuracy score of our Classification Model is: ',(class_model.sco

#Storing accuracy values
detect_accuracy.append((detection_model.score(detection_test_X,detection_tes
class_accuracy.append((class_model.score(class_test_X,class_Y)))
```

```
The accuracy score of our Detection Model is:  0.017945755271112085
The accuracy score of our Classification Model is:  0.03349707430965532
```

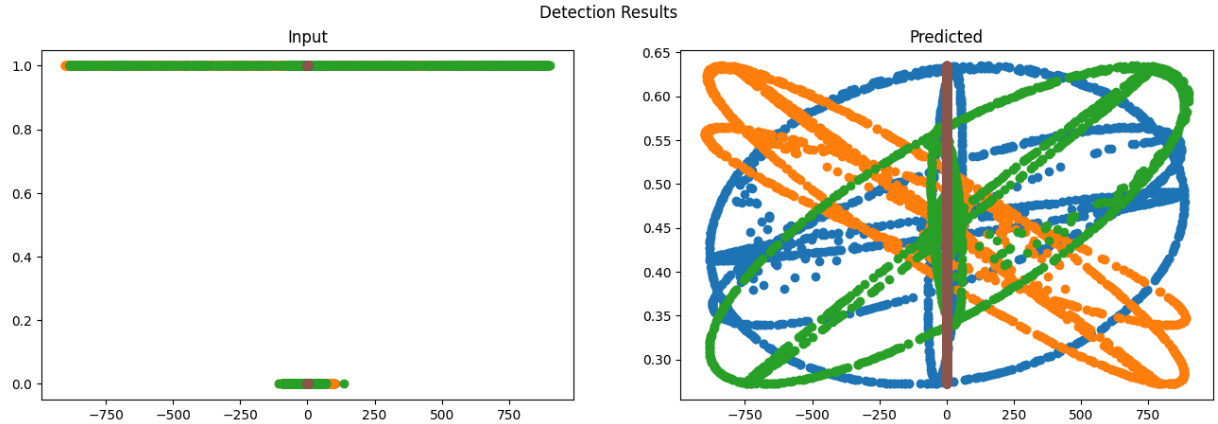
## Graphs

In [11]:

```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Detection Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(detection_test_X, detection_test_Y,'o')
axs[1].plot(detection_test_X, detection_preds,'o')
```

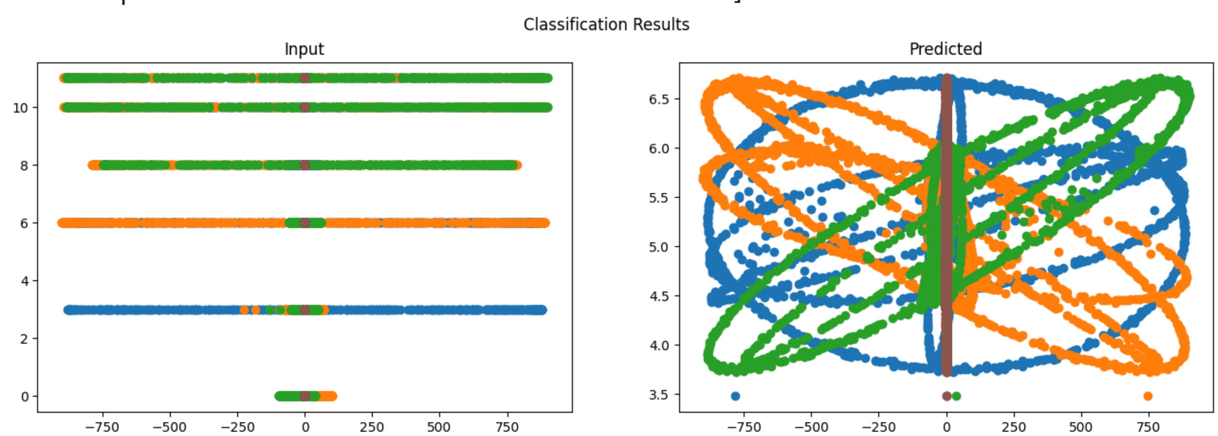
Out[11]:

```
[<matplotlib.lines.Line2D at 0x7fca5ab91810>,
 <matplotlib.lines.Line2D at 0x7fca5ab91950>,
 <matplotlib.lines.Line2D at 0x7fca5ab91a90>,
 <matplotlib.lines.Line2D at 0x7fca5ab91bd0>,
 <matplotlib.lines.Line2D at 0x7fca5ab91d10>,
 <matplotlib.lines.Line2D at 0x7fca5ab91e50>]
```




In [12]:
```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Classification Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(class_test_X, class_Y,'o')
axs[1].plot(class_test_X, class_preds,'o')
```

Out[12]:
```
[<matplotlib.lines.Line2D at 0x7fca5a629810>,
 <matplotlib.lines.Line2D at 0x7fca5a629950>,
 <matplotlib.lines.Line2D at 0x7fca5a629a90>,
 <matplotlib.lines.Line2D at 0x7fca5a629bd0>,
 <matplotlib.lines.Line2D at 0x7fca5a629d10>,
 <matplotlib.lines.Line2D at 0x7fca5a629e50>]
```




# Logistic regression

In [13]:
```
#Defining different Models for different classification problems
detection_model = LogisticRegression(max_iter=5000)
class_model = LogisticRegression(max_iter=5000)
```

In [14]:
```
#Fitting the data in different models
detection_model.fit(detection_train_X,detection_train_Y)
class_Y = np.array([class_train_Y['G']*1+class_train_Y['A']
                    *2+class_train_Y['B']*3+class_train_Y['C']*5])
```

```
class_Y= class_Y.transpose().ravel()
class_model.fit(class_train_X,class_Y)
```

Out[14]:

```
▾ LogisticRegression
LogisticRegression(max_iter=5000)
```

## Results

In [15]:

```
#Predicting test values and printing out Mean Squared Error
detection_preds = detection_model.predict(detection_test_X)
print('The Error of our Detection Model is: ',mean_squared_error(detection_t

class_Y = np.array([class_test_Y['G']*1+class_test_Y['A']*2+class_test_Y['B'
class_Y= class_Y.transpose().ravel()
class_preds = class_model.predict(class_test_X)
print('The Error of our Classification Model is: ',mean_squared_error(class_

#storing error values
detect_error.append(mean_squared_error(detection_test_Y,detection_preds))
class_error.append(mean_squared_error(class_Y,class_preds))
```

```
The Error of our Detection Model is:  0.26155011360767483
The Error of our Classification Model is:  42.65895953757225
```

In [16]:

```
# Printing out accuracy scores of our models
print('The accuracy score of our Detection Model is: ',(detection_model.scor
print('The accuracy score of our Classification Model is: ',(class_model.sco

#Storing accuracy values
detect_accuracy.append((detection_model.score(detection_test_X,detection_tes
class_accuracy.append((class_model.score(class_test_X,class_Y)))
```

```
The accuracy score of our Detection Model is:  0.7384498863923251
The accuracy score of our Classification Model is:  0.32524084778420037
```

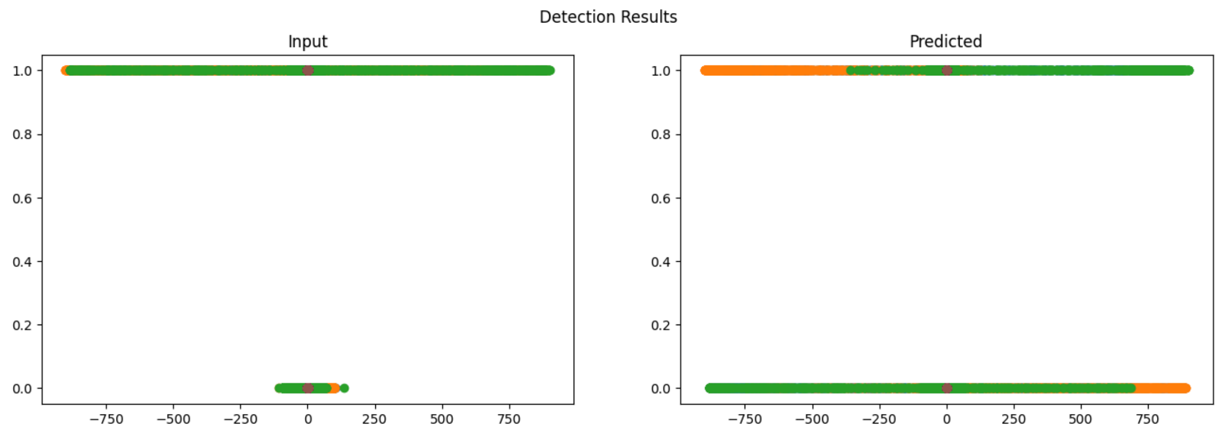
## Graphs

In [17]:

```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Detection Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(detection_test_X, detection_test_Y,'o')
axs[1].plot(detection_test_X, detection_preds,'o')
```

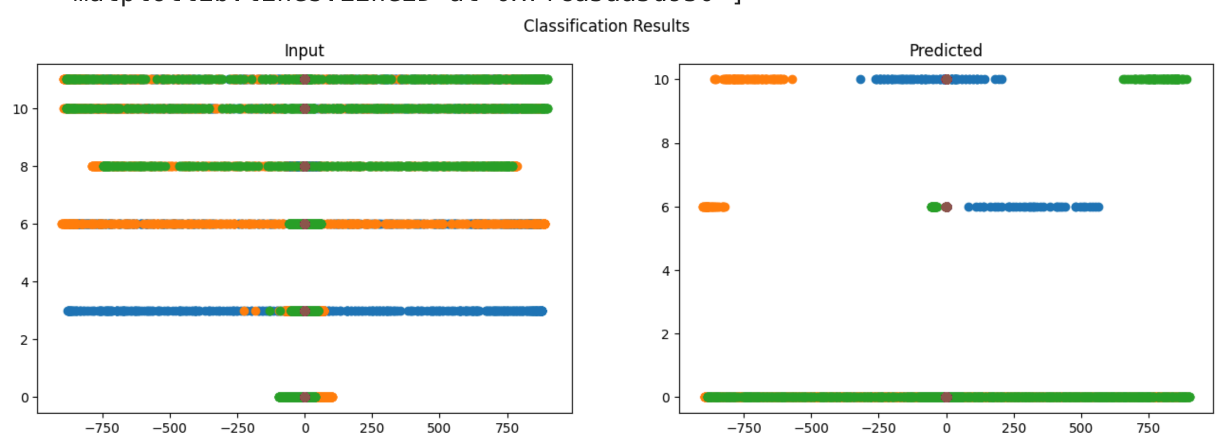
Out[17]:

```
[<matplotlib.lines.Line2D at 0x7fca5a6d4cd0>,
 <matplotlib.lines.Line2D at 0x7fca5a823d90>,
 <matplotlib.lines.Line2D at 0x7fca5a823ed0>,
 <matplotlib.lines.Line2D at 0x7fca5a878050>,
 <matplotlib.lines.Line2D at 0x7fca5a878190>,
 <matplotlib.lines.Line2D at 0x7fca5a8782d0>]
```




In [18]:
```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Classification Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(class_test_X, class_Y,'o')
axs[1].plot(class_test_X, class_preds,'o')
```

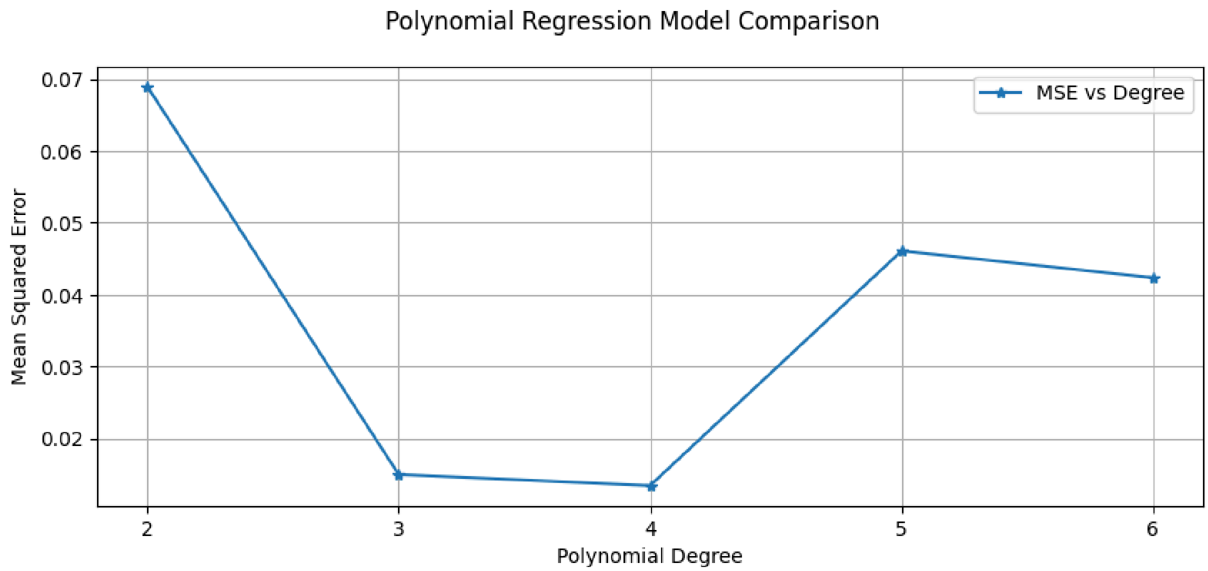
Out[18]:
```
[<matplotlib.lines.Line2D at 0x7fca5aa5d310>,
 <matplotlib.lines.Line2D at 0x7fca5aa5d450>,
 <matplotlib.lines.Line2D at 0x7fca5aa5d590>,
 <matplotlib.lines.Line2D at 0x7fca5aa5d6d0>,
 <matplotlib.lines.Line2D at 0x7fca5aa5d810>,
 <matplotlib.lines.Line2D at 0x7fca5aa5d950>]
```




# Polynomial regression

In [19]:
```
# Selection of suitable polynomial degree
errors = []
degrees = list(range(2, 7))  # Degrees 2 to 6

for i in degrees:
    poly = PolynomialFeatures(i)
    model = LinearRegression()
    model.fit(poly.fit_transform(class_train_X), class_train_Y)
    preds = model.predict(poly.fit_transform(class_test_X))
    errors.append(mean_squared_error(class_test_Y, preds))
```

```
# Plotting
fig, ax = plt.subplots(1, 1, figsize=(10, 4))
fig.suptitle('Polynomial Regression Model Comparison')

# Set ticks and labels to match degree indices
ax.set_xticks(range(len(degrees)))
ax.set_xticklabels([str(d) for d in degrees])

ax.plot(errors, '*-', label='MSE vs Degree')
ax.set_ylabel('Mean Squared Error')
ax.set_xlabel('Polynomial Degree')
ax.grid(True)
ax.legend()
plt.show()
```




In [20]:
```
#Defining different Models for different classification problems
detection_model = PolynomialFeatures(2)
class_model = PolynomialFeatures(4)
detect_linear = LinearRegression()
class_linear = LinearRegression()
```

In [21]:
```
#Fitting the data in different models
detect_linear.fit(detection_model.fit_transform(detection_train_X),detectior
class_linear.fit(class_model.fit_transform(class_train_X),class_train_Y)
```

Out[21]:
```
▾ LinearRegression
LinearRegression()
```

## Results

In [22]:
```
#Predicting test values and printing out Mean Squared Error
detection_preds = detect_linear.predict(detection_model.fit_transform(detect
print('The Error of our Detection Model is: ',mean_squared_error(detection_t
```

```
class_preds = class_linear.predict(class_model.fit_transform(class_test_X))
print('The Error of our Classification Model is: ',mean_squared_error(class_

#storing error values
detect_error.append(mean_squared_error(detection_test_Y,detection_preds))
class_error.append(mean_squared_error(class_test_Y,class_preds))
```

```
The Error of our Detection Model is:  0.03445426707454392
The Error of our Classification Model is:  0.013437887105488064
```

In [23]:

```
# Printing out accuracy scores of our models
print('The accuracy score of our Detection Model is: ',(detect_linear.score(
print('The accuracy score of our Classification Model is: ',(class_linear.sc

#Storing accuracy values
detect_accuracy.append((detect_linear.score(detection_model.fit_transform(de
class_accuracy.append((class_linear.score(class_model.fit_transform(class_te
```

```
The accuracy score of our Detection Model is:  0.8611900430458109
The accuracy score of our Classification Model is:  0.9451278131164605
```

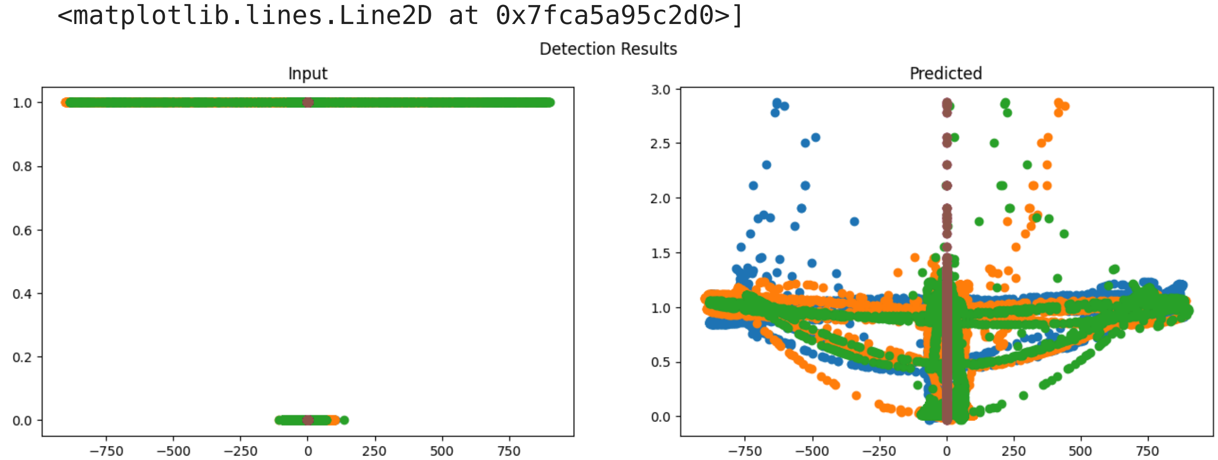
## Graphs

In [24]:

```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Detection Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(detection_test_X, detection_test_Y,'o')
axs[1].plot(detection_test_X, detection_preds,'o')
```

Out[24]:

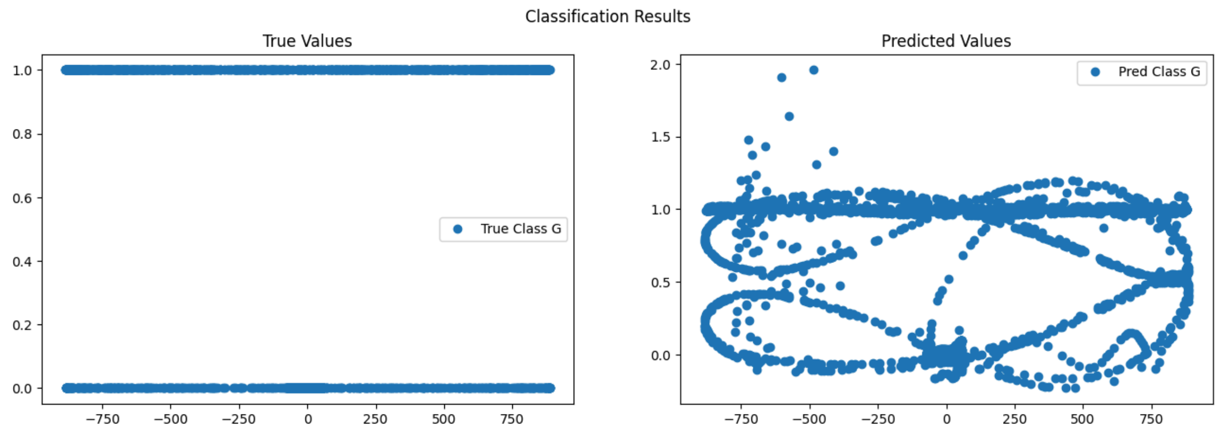
```
[<matplotlib.lines.Line2D at 0x7fca5a9bbc50>,
 <matplotlib.lines.Line2D at 0x7fca5a9bbd90>,
 <matplotlib.lines.Line2D at 0x7fca5a9bbed0>,
 <matplotlib.lines.Line2D at 0x7fca5a95c050>,
 <matplotlib.lines.Line2D at 0x7fca5a95c190>,
 <matplotlib.lines.Line2D at 0x7fca5a95c2d0>]
```




In [25]:

```
fig, axs = plt.subplots(1, 2)
fig.set_figwidth(16)
fig.suptitle('Classification Results')
```

```
axs[0].set_title('True Values')
axs[1].set_title('Predicted Values')

# Plot feature 0 vs class 0 (example)
axs[0].plot(class_test_X.iloc[:, 0], class_test_Y.iloc[:, 0], 'o', label='Tr
axs[1].plot(class_test_X.iloc[:, 0], class_preds[:, 0], 'o', label='Pred Cla

axs[0].legend()
axs[1].legend()
plt.show()
```




# Naive Bayes

In [26]:
```
#Defining different Models for different classification problems
detection_model = GaussianNB()
class_model = GaussianNB()
```

In [27]:
```
#Fitting the data in different models
detection_model.fit(detection_train_X,detection_train_Y)
class_Y = np.array([class_train_Y['G']*1+class_train_Y['A']
                    *2+class_train_Y['B']*3+class_train_Y['C']*5])
class_Y= class_Y.transpose().ravel()
class_model.fit(class_train_X,class_Y)
```

Out[27]:
```
▾ GaussianNB
GaussianNB()
```

## Results

In [28]:
```
#Predicting test values and printing out Mean Squared Error
detection_preds = detection_model.predict(detection_test_X)
print('The Error of our Detection Model is: ',mean_squared_error(detection_t

class_Y = np.array([class_test_Y['G']*1+class_test_Y['A']*2+class_test_Y['B'
class_Y= class_Y.transpose().ravel()
class_preds = class_model.predict(class_test_X)
print('The Error of our Classification Model is: ',mean_squared_error(class_
```

```
#storing error values
detect_error.append(mean_squared_error(detection_test_Y,detection_preds))
class_error.append(mean_squared_error(class_Y,class_preds))
```

```
The Error of our Detection Model is:  0.019439535470840697
The Error of our Classification Model is:  2.1078998073217727
```

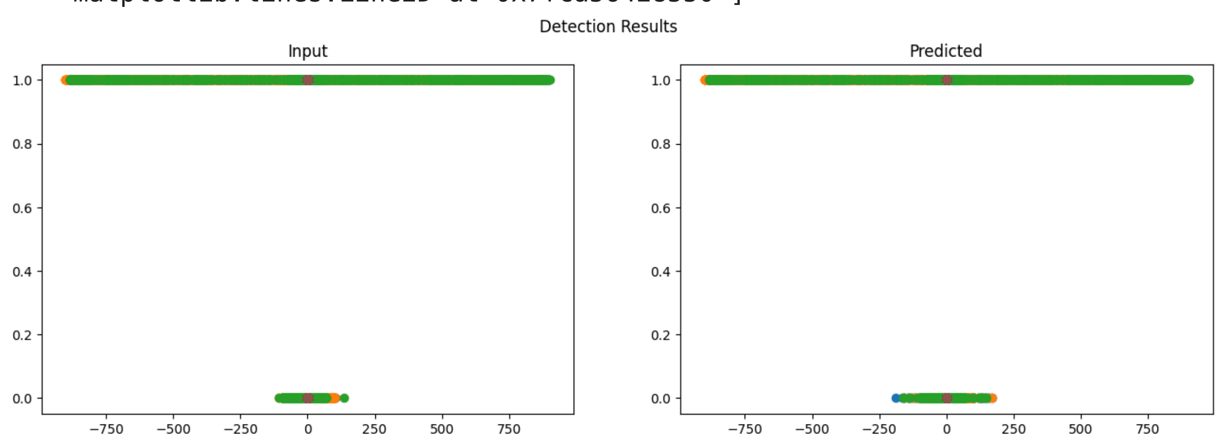
In [29]:
```
# Printing out accuracy scores of our models
print('The accuracy score of our Detection Model is: ',(detection_model.scor
print('The accuracy score of our Classification Model is: ',(class_model.sco

#Storing accuracy values
detect_accuracy.append((detection_model.score(detection_test_X,detection_tes
class_accuracy.append((class_model.score(class_test_X,class_Y)))
```

```
The accuracy score of our Detection Model is:  0.9805604645291593
The accuracy score of our Classification Model is:  0.796917148362235
```

# Graphs

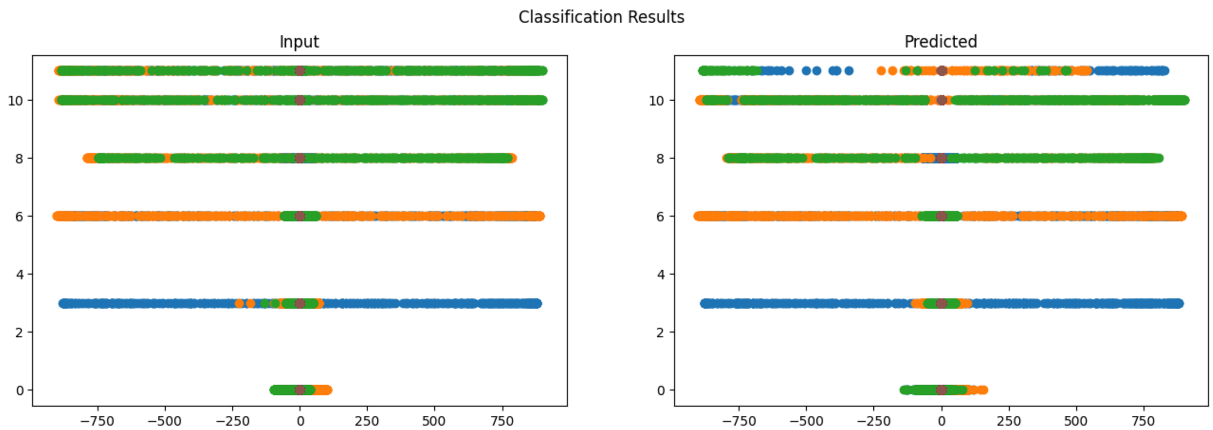
In [30]:
```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Detection Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(detection_test_X, detection_test_Y,'o')
axs[1].plot(detection_test_X, detection_preds,'o')
```

Out[30]:
```
[<matplotlib.lines.Line2D at 0x7fca563a91d0>,
 <matplotlib.lines.Line2D at 0x7fca56428050>,
 <matplotlib.lines.Line2D at 0x7fca56428190>,
 <matplotlib.lines.Line2D at 0x7fca564282d0>,
 <matplotlib.lines.Line2D at 0x7fca56428410>,
 <matplotlib.lines.Line2D at 0x7fca56428550>]
```



In [31]:
```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Classification Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(class_test_X, class_Y,'o')
axs[1].plot(class_test_X, class_preds,'o')
```

Out[31]:
```
[<matplotlib.lines.Line2D at 0x7fca547c9590>,
 <matplotlib.lines.Line2D at 0x7fca547c96d0>,
 <matplotlib.lines.Line2D at 0x7fca547c9810>,
 <matplotlib.lines.Line2D at 0x7fca547c9950>,
 <matplotlib.lines.Line2D at 0x7fca547c9a90>,
 <matplotlib.lines.Line2D at 0x7fca547c9bd0>]
```




# Decision Tree classifier

In [32]:
```
#Defining different Models for different classification problems
detection_model = DecisionTreeClassifier()
class_model = DecisionTreeClassifier()
```

In [33]:
```
#Fitting the data in different models
detection_model.fit(detection_train_X,detection_train_Y)
class_Y = np.array([class_train_Y['G']*1+class_train_Y['A']
                    *2+class_train_Y['B']*3+class_train_Y['C']*5])
class_Y= class_Y.transpose().ravel()
class_model.fit(class_train_X,class_Y)
```

Out[33]:
```
▾ DecisionTreeClassifier

DecisionTreeClassifier()
```

## Results

In [34]:
```
#Predicting test values and printing out Mean Squared Error
detection_preds = detection_model.predict(detection_test_X)
print('The Error of our Detection Model is: ',mean_squared_error(detection_t
```

```
class_Y = np.array([class_test_Y['G']*1+class_test_Y['A']*2+class_test_Y['B'
class_Y = class_Y.transpose().ravel()
class_preds = class_model.predict(class_test_X)
print('The Error of our Classification Model is: ',mean_squared_error(class_

#storing error values
detect_error.append(mean_squared_error(detection_test_Y,detection_preds))
class_error.append(mean_squared_error(class_Y,class_preds))
```

```
The Error of our Detection Model is:  0.005806614491290078
The Error of our Classification Model is:  0.3221579961464355
```

In [35]:

```
# Printing out accuracy scores of our models
print('The accuracy score of our Detection Model is: ',(detection_model.scor
print('The accuracy score of our Classification Model is: ',(class_model.sco

#Storing accuracy values
detect_accuracy.append((detection_model.score(detection_test_X,detection_tes
class_accuracy.append((class_model.score(class_test_X,class_Y)))
```

```
The accuracy score of our Detection Model is:  0.99419338550871
The accuracy score of our Classification Model is:  0.8639691714836224
```

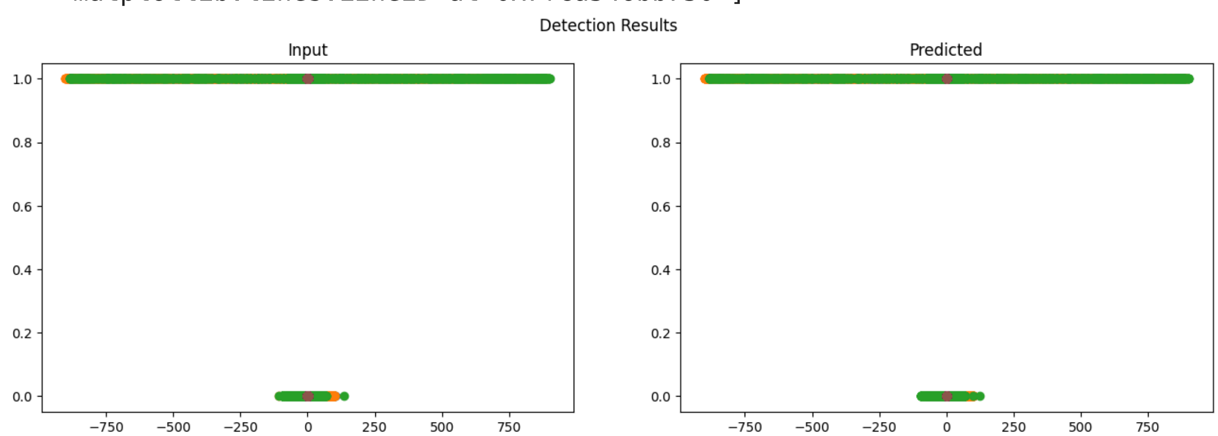
# Graphs

In [36]:

```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Detection Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(detection_test_X, detection_test_Y,'o')
axs[1].plot(detection_test_X, detection_preds,'o')
```

Out[36]:

```
[<matplotlib.lines.Line2D at 0x7fca546bb110>,
 <matplotlib.lines.Line2D at 0x7fca546bb250>,
 <matplotlib.lines.Line2D at 0x7fca546bb390>,
 <matplotlib.lines.Line2D at 0x7fca546bb4d0>,
 <matplotlib.lines.Line2D at 0x7fca546bb610>,
 <matplotlib.lines.Line2D at 0x7fca546bb750>]
```



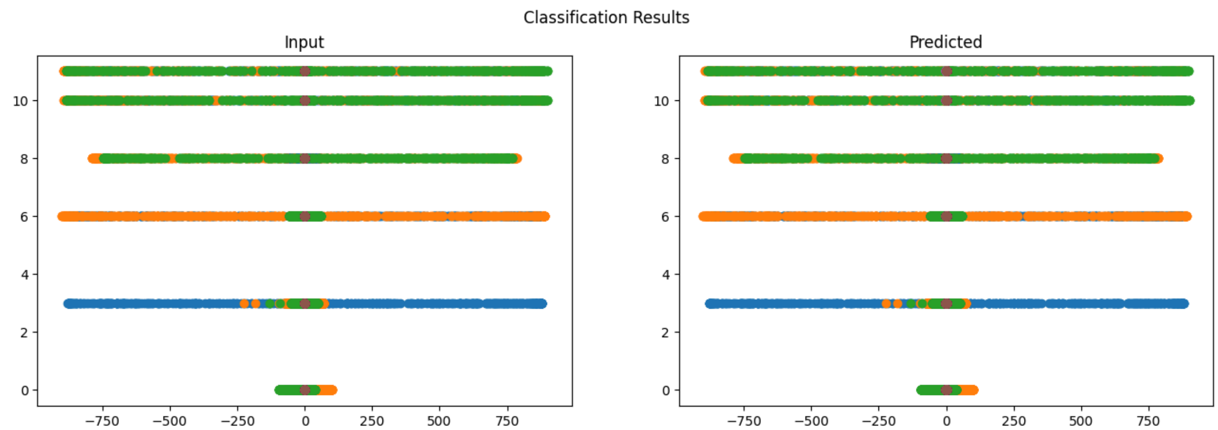

In [37]:

```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Classification Results')
```

```
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(class_test_X, class_Y,'o')
axs[1].plot(class_test_X, class_preds,'o')
```

Out[37]:

```
[<matplotlib.lines.Line2D at 0x7fca56364550>,
 <matplotlib.lines.Line2D at 0x7fca56364410>,
 <matplotlib.lines.Line2D at 0x7fca563642d0>,
 <matplotlib.lines.Line2D at 0x7fca56364910>,
 <matplotlib.lines.Line2D at 0x7fca56364f50>,
 <matplotlib.lines.Line2D at 0x7fca56364e10>]
```




# SVM

In [38]:

```
#Defining different Models for different classification problems
detection_model = SVC()
class_model = LinearSVC()
```

In [39]:

```
#Fitting the data in different models
detection_model.fit(detection_train_X,detection_train_Y)
class_Y = np.array([class_train_Y['G']*1+class_train_Y['A']
                    *2+class_train_Y['B']*3+class_train_Y['C']*5])
class_Y= class_Y.transpose().ravel()
class_model.fit(class_train_X,class_Y)
```

Out[39]:

```
▾ LinearSVC
LinearSVC()
```

## Results

In [40]:

```
#Predicting test values and printing out Mean Squared Error
detection_preds = detection_model.predict(detection_test_X)
print('The Error of our Detection Model is: ',mean_squared_error(detection_t

class_Y = np.array([class_test_Y['G']*1+class_test_Y['A']*2+class_test_Y['B'
class_Y = class_Y.transpose().ravel()
class_preds = class_model.predict(class_test_X)
```

```
print('The Error of our Classification Model is: ',mean_squared_error(class_

#storing error values
detect_error.append(mean_squared_error(detection_test_Y,detection_preds))
class_error.append(mean_squared_error(class_Y,class_preds))
```

```
The Error of our Detection Model is:  0.017924766473112 85
The Error of our Classification Model is:  41.223121387283236
```

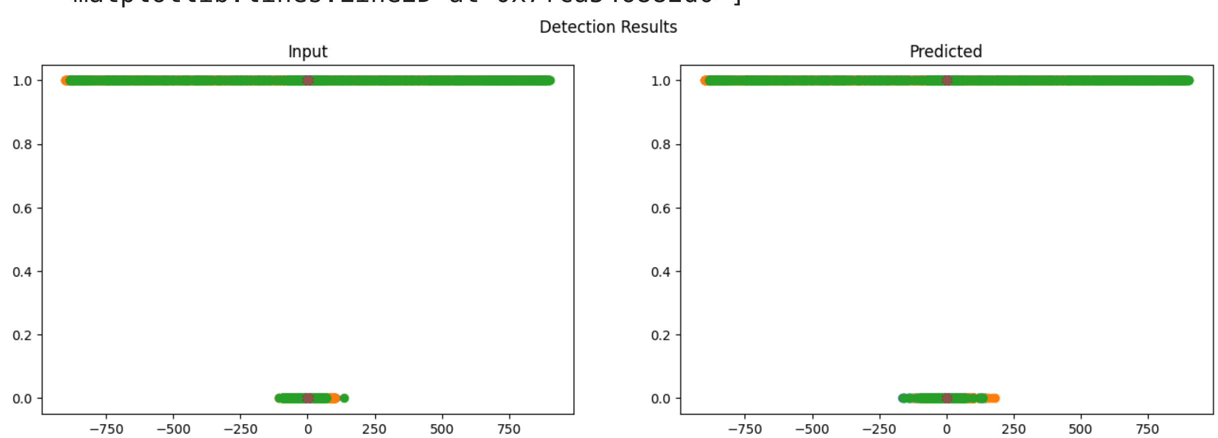
In [41]:
```
# Printing out accuracy scores of our models
print('The accuracy score of our Detection Model is: ',(detection_model.scor
print('The accuracy score of our Classification Model is: ',(class_model.scc

#Storing accuracy values
detect_accuracy.append((detection_model.score(detection_test_X,detection_tes
class_accuracy.append((class_model.score(class_test_X,class_Y)))
```

```
The accuracy score of our Detection Model is:  0.9820752335268872
The accuracy score of our Classification Model is:  0.31676300578034683
```

## Graphs

In [42]:
```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Detection Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(detection_test_X, detection_test_Y,'o')
axs[1].plot(detection_test_X, detection_preds,'o')
```

Out[42]:
```
[<matplotlib.lines.Line2D at 0x7fca545bb250>,
 <matplotlib.lines.Line2D at 0x7fca545bb390>,
 <matplotlib.lines.Line2D at 0x7fca545bb4d0>,
 <matplotlib.lines.Line2D at 0x7fca545bb610>,
 <matplotlib.lines.Line2D at 0x7fca545bb750>,
 <matplotlib.lines.Line2D at 0x7fca546882d0>]
```

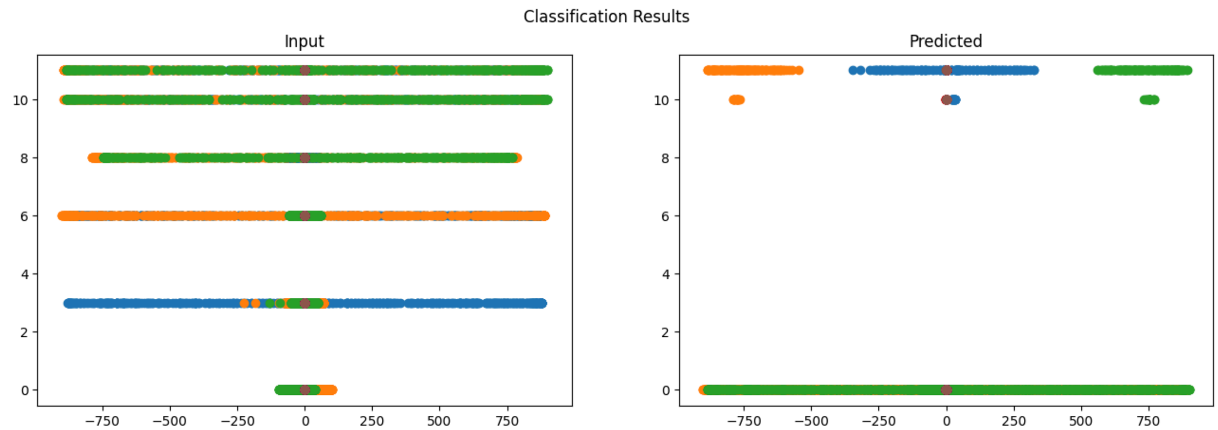



In [43]:
```
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Classification Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
```

```
axs[0].plot(class_test_X, class_Y,'o')
axs[1].plot(class_test_X, class_preds,'o')
```

Out[43]:

```
[<matplotlib.lines.Line2D at 0x7fca544d87d0>,
 <matplotlib.lines.Line2D at 0x7fca544d8910>,
 <matplotlib.lines.Line2D at 0x7fca544d8a50>,
 <matplotlib.lines.Line2D at 0x7fca544d8b90>,
 <matplotlib.lines.Line2D at 0x7fca544d8cd0>,
 <matplotlib.lines.Line2D at 0x7fca544d8e10>]
```




# KNN

In [44]:

```
#Defining different Models for different classification problems
detection_model = KNeighborsClassifier(n_neighbors=2)
class_model = KNeighborsClassifier(n_neighbors=6)
```

In [45]:

```
#Fitting the data in different models
detection_model.fit(detection_train_X,detection_train_Y)
class_Y = np.array([class_train_Y['G']*1+class_train_Y['A']
                    *2+class_train_Y['B']*3+class_train_Y['C']*5])
class_Y= class_Y.transpose().ravel()
class_model.fit(class_train_X,class_Y)
```

Out[45]:

```
KNeighborsClassifier
KNeighborsClassifier(n_neighbors=6)
```

## Results

In [46]:

```
#Predicting test values and printing out Mean Squared Error
detection_preds = detection_model.predict(detection_test_X)
print('The Error of our Detection Model is: ',mean_squared_error(detection_t

class_Y = np.array([class_test_Y['G']*1+class_test_Y['A']*2+class_test_Y['B'
class_Y = class_Y.transpose().ravel()
class_preds = class_model.predict(class_test_X)
print('The Error of our Classification Model is: ',mean_squared_error(class_
```

```python
#storing error values
detect_error.append(mean_squared_error(detection_test_Y,detection_preds))
class_error.append(mean_squared_error(class_Y,class_preds))
```

```
The Error of our Detection Model is:  0.007573844988639233
The Error of our Classification Model is:  0.9845857418111753
```

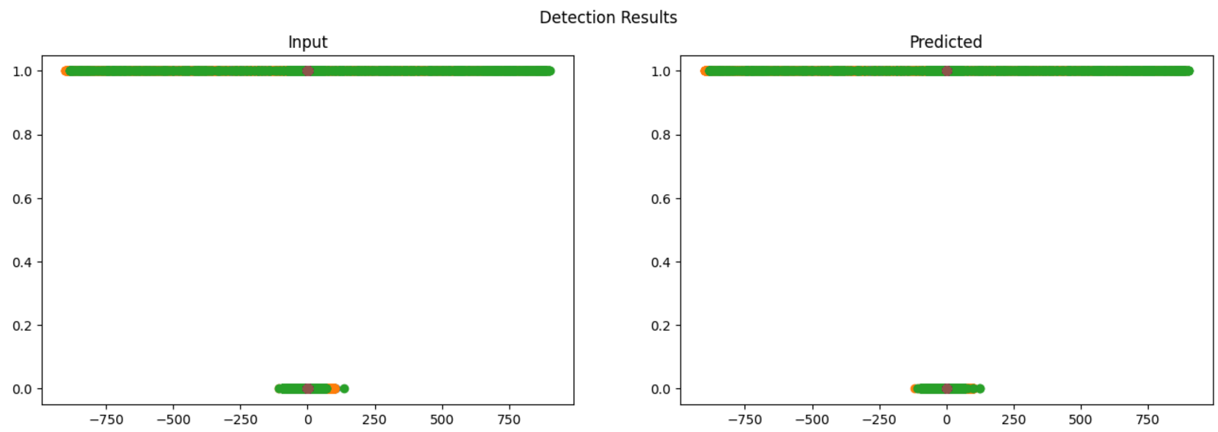
In [47]:
```python
# Printing out accuracy scores of our models
print('The accuracy score of our Detection Model is: ',(detection_model.scor
print('The accuracy score of our Classification Model is: ',(class_model.sco

#Storing accuracy values
detect_accuracy.append((detection_model.score(detection_test_X,detection_tes
class_accuracy.append((class_model.score(class_test_X,class_Y)))
```

```
The accuracy score of our Detection Model is:  0.9924261550113608
The accuracy score of our Classification Model is:  0.8246628131021194
```

# Graphs

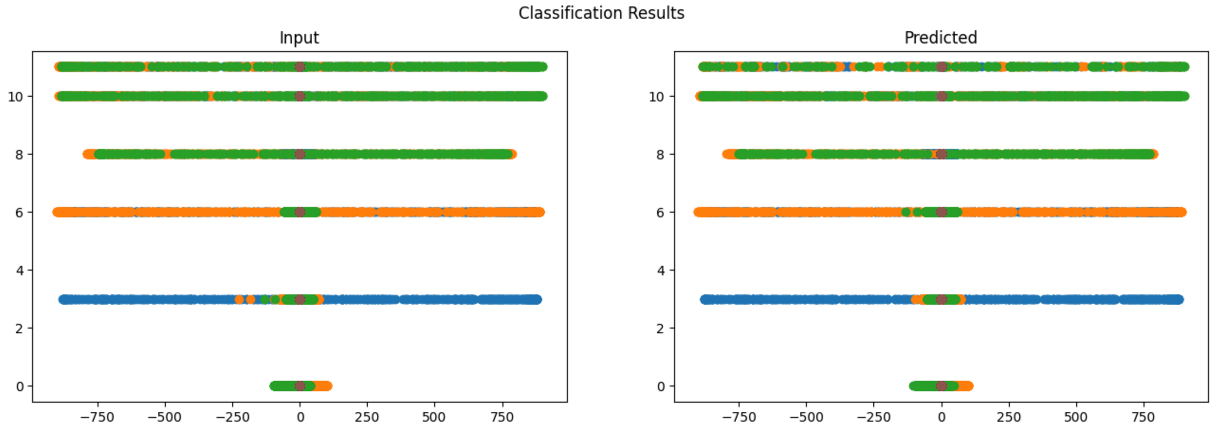
In [48]:
```python
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Detection Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(detection_test_X, detection_test_Y,'o')
axs[1].plot(detection_test_X, detection_preds,'o')
```

Out[48]:
```
[<matplotlib.lines.Line2D at 0x7fca543b9f90>,
 <matplotlib.lines.Line2D at 0x7fca543ba0d0>,
 <matplotlib.lines.Line2D at 0x7fca543ba210>,
 <matplotlib.lines.Line2D at 0x7fca543ba350>,
 <matplotlib.lines.Line2D at 0x7fca543ba490>,
 <matplotlib.lines.Line2D at 0x7fca543ba5d0>]
```



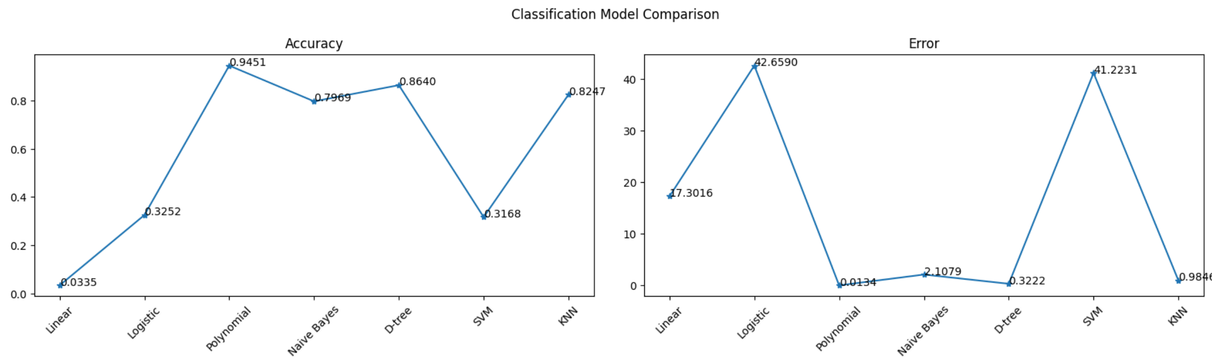

In [49]:
```python
fig, axs = plt.subplots(1,2)
fig.set_figwidth(16)
fig.suptitle('Classification Results')
axs[0].set_title('Input')
axs[1].set_title('Predicted')
axs[0].plot(class_test_X, class_Y,'o')
axs[1].plot(class_test_X, class_preds,'o')
```

```
Out[49]: [<matplotlib.lines.Line2D at 0x7fca542bb610>,
          <matplotlib.lines.Line2D at 0x7fca542bb750>,
          <matplotlib.lines.Line2D at 0x7fca542bb890>,
          <matplotlib.lines.Line2D at 0x7fca542bb9d0>,
          <matplotlib.lines.Line2D at 0x7fca542bbb10>,
          <matplotlib.lines.Line2D at 0x7fca542bbc50>]
```

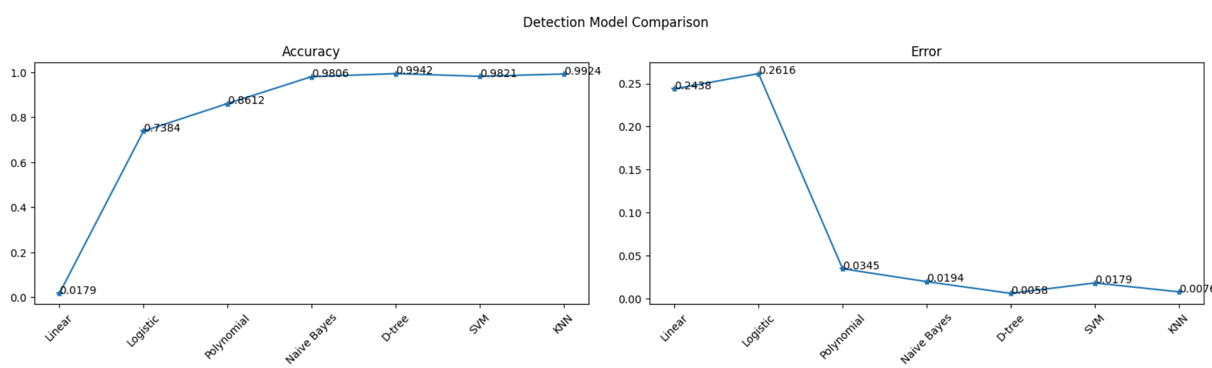



# Model selection

```
In [72]: fig, ax = plt.subplots(1, 2)
fig.set_figwidth(16)
fig.suptitle('Classification Model Comparison')

model_names = ['Linear', 'Logistic', 'Polynomial', 'Naive Bayes', 'D-tree',

x = list(range(len(model_names)))

# Plot Accuracy
ax[0].set_xticks(x)
ax[0].set_xticklabels(model_names, rotation=45)
ax[0].set_title('Accuracy')
ax[0].plot(class_accuracy, '*-')
for i, val in enumerate(class_accuracy):
    ax[0].annotate(f"{val:.4f}", xy=(i, val))

# Plot Error
ax[1].set_xticks(x)
ax[1].set_xticklabels(model_names, rotation=45)
ax[1].set_title('Error')
ax[1].plot(class_error, '*-')
for i, val in enumerate(class_error):
    ax[1].annotate(f"{val:.4f}", xy=(i, val))
plt.savefig('model_classification.png', dpi=300, bbox_inches='tight')
plt.tight_layout()
plt.show()
```




In [71]:
```
fig, ax = plt.subplots(1, 2)
fig.set_figwidth(16)
fig.suptitle('Detection Model Comparison')

model_names = ['Linear', 'Logistic', 'Polynomial', 'Naive Bayes', 'D-tree',

x = list(range(len(model_names)))

# Plot Accuracy
ax[0].set_xticks(x)
ax[0].set_xticklabels(model_names, rotation=45)
ax[0].set_title('Accuracy')
ax[0].plot(detect_accuracy, '*-')
for i, val in enumerate(detect_accuracy):
    ax[0].annotate(f"{val:.4f}", xy=(i, val))

# Plot Error
ax[1].set_xticks(x)
ax[1].set_xticklabels(model_names, rotation=45)
ax[1].set_title('Error')
ax[1].plot(detect_error, '*-')
for i, val in enumerate(detect_error):
    ax[1].annotate(f"{val:.4f}", xy=(i, val))
plt.savefig('model_detection.png', dpi=300, bbox_inches='tight')
plt.tight_layout()
plt.show()
```




This notebook was converted with convert.ploomber.io