In [44]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn import preprocessing
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import precision_score, classification_report, confusion_mat
from sklearn.metrics import accuracy_score
from sklearn.ensemble import RandomForestClassifier
```

In [45]:
```
df = pd.read_csv("worldCup_dataset.csv" , sep = "," , encoding = 'utf-8')
```

In [46]:
```
df.head(10)
```

Out[46]:

| | Unnamed: 0 | date | home_team | away_team | home_score | away_score | tournament | city | c |
|---|---|---|---|---|---|---|---|---|---|
| **0** | 1311 | 1930-07-13 | Belgium | United States | 0.0 | 3.0 | FIFA World Cup | Montevideo | U |
| **1** | 1312 | 1930-07-13 | France | Mexico | 4.0 | 1.0 | FIFA World Cup | Montevideo | U |
| **2** | 1313 | 1930-07-14 | Brazil | Yugoslavia | 1.0 | 2.0 | FIFA World Cup | Montevideo | U |
| **3** | 1314 | 1930-07-14 | Peru | Romania | 1.0 | 3.0 | FIFA World Cup | Montevideo | U |
| **4** | 1315 | 1930-07-15 | Argentina | France | 1.0 | 0.0 | FIFA World Cup | Montevideo | U |
| **5** | 1316 | 1930-07-16 | Chile | Mexico | 3.0 | 0.0 | FIFA World Cup | Montevideo | U |
| **6** | 1317 | 1930-07-17 | Bolivia | Yugoslavia | 0.0 | 4.0 | FIFA World Cup | Montevideo | U |
| **7** | 1318 | 1930-07-17 | Paraguay | United States | 0.0 | 3.0 | FIFA World Cup | Montevideo | U |
| **8** | 1320 | 1930-07-18 | Uruguay | Peru | 1.0 | 0.0 | FIFA World Cup | Montevideo | U |
| **9** | 1321 | 1930-07-19 | Argentina | Mexico | 6.0 | 3.0 | FIFA World Cup | Montevideo | U |

In [47]:
```
df.tail(10)
```

Out[47]:

| | Unnamed: 0 | date | home_team | away_team | home_score | away_score | tournament | city |
|---|---|---|---|---|---|---|---|---|
| **890** | 40287 | 2018-07-03 | Sweden | Switzerland | 1.0 | 0.0 | FIFA World Cup | Saint Petersburg |
| **891** | 40288 | 2018-07-03 | Colombia | England | 1.0 | 1.0 | FIFA World Cup | Moscow |
| **892** | 40290 | 2018-07-06 | Uruguay | France | 0.0 | 2.0 | FIFA World Cup | Nizhny Novgorod |
| **893** | 40291 | 2018-07-06 | Brazil | Belgium | 1.0 | 2.0 | FIFA World Cup | Kazan |
| **894** | 40292 | 2018-07-07 | Sweden | England | 0.0 | 2.0 | FIFA World Cup | Samara |
| **895** | 40293 | 2018-07-07 | Russia | Croatia | 2.0 | 2.0 | FIFA World Cup | Sochi |
| **896** | 40294 | 2018-07-10 | France | Belgium | 1.0 | 0.0 | FIFA World Cup | Saint Petersburg |
| **897** | 40295 | 2018-07-11 | Croatia | England | 2.0 | 1.0 | FIFA World Cup | Moscow |
| **898** | 40296 | 2018-07-14 | Belgium | England | 2.0 | 0.0 | FIFA World Cup | Saint Petersburg |
| **899** | 40297 | 2018-07-15 | France | Croatia | 4.0 | 2.0 | FIFA World Cup | Moscow |

In [48]:
```
df.info()
```

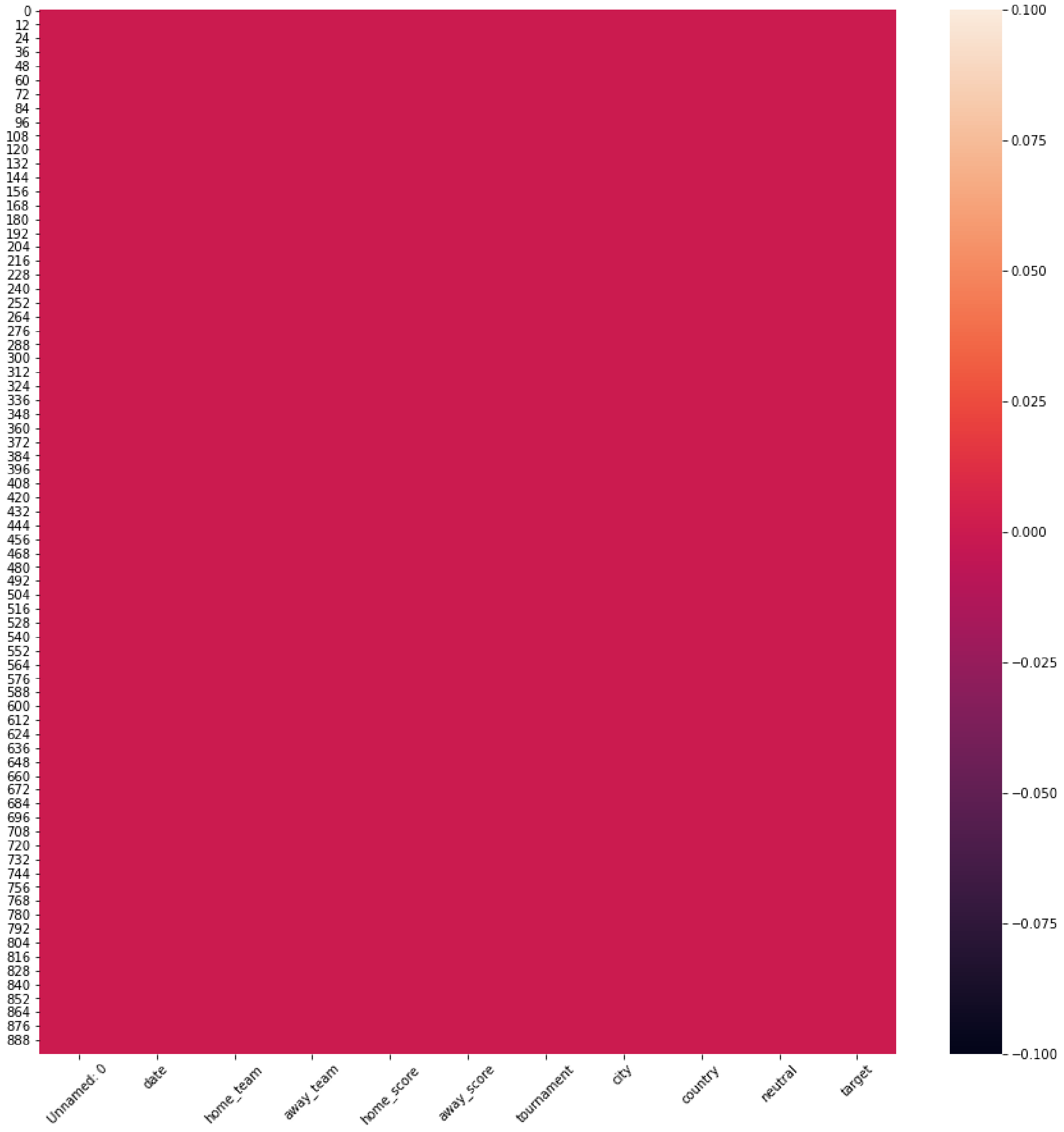
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 900 entries, 0 to 899
Data columns (total 11 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   Unnamed: 0   900 non-null    int64  
 1   date         900 non-null    object 
 2   home_team    900 non-null    object 
 3   away_team    900 non-null    object 
 4   home_score   900 non-null    float64
 5   away_score   900 non-null    float64
 6   tournament   900 non-null    object 
 7   city         900 non-null    object 
 8   country      900 non-null    object 
 9   neutral      900 non-null    bool   
 10  target       900 non-null    int64  
dtypes: bool(1), float64(2), int64(2), object(6)
memory usage: 71.3+ KB
```

In [49]:
```
df.isnull().sum()
```

Out[49]:
```
Unnamed: 0    0
date          0
home_team     0
away_team     0
home_score    0
away_score    0
tournament    0
city          0
country       0
neutral       0
target        0
dtype: int64
```

```
In [50]: plt.figure(figsize=(15,15))
         sns.heatmap(df.isnull())
         plt.xticks(rotation=45)

Out[50]: (array([ 0.5,  1.5,  2.5,  3.5,  4.5,  5.5,  6.5,  7.5,  8.5,  9.5, 10.5]),
          [Text(0.5, 0, 'Unnamed: 0'),
           Text(1.5, 0, 'date'),
           Text(2.5, 0, 'home_team'),
           Text(3.5, 0, 'away_team'),
           Text(4.5, 0, 'home_score'),
           Text(5.5, 0, 'away_score'),
           Text(6.5, 0, 'tournament'),
           Text(7.5, 0, 'city'),
           Text(8.5, 0, 'country'),
           Text(9.5, 0, 'neutral'),
           Text(10.5, 0, 'target')])
```



```
In [51]: df.nunique()

Out[51]: Unnamed: 0    900
         date          355
         home_team      78
         away_team      79
         home_score     11
         away_score      9
         tournament      1
         city          161
         country        17
         neutral         2
         target          3
         dtype: int64
```

```
In [52]: df['neutral'].unique()

Out[52]: array([ True, False])
```

```
In [53]: df['date'] = df["date"].str.split("-", n = 0, expand = True)
```

```
In [54]: df['date'] = df['date'].astype(int)
```

```
In [55]: df["neutral"] = df["neutral"].astype(int)
```

In [56]:
```
df
```

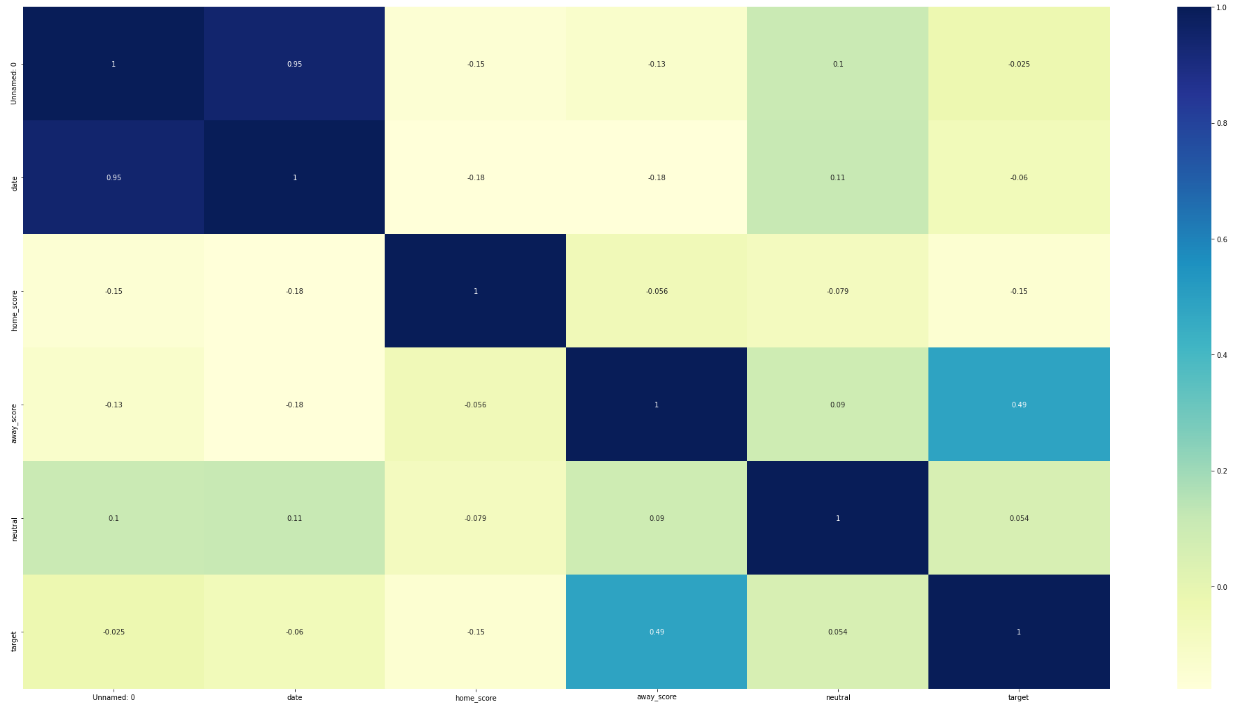
Out[56]:

| | Unnamed: 0 | date | home_team | away_team | home_score | away_score | tournament | city |
|---|---|---|---|---|---|---|---|---|
| **0** | 1311 | 1930 | Belgium | United States | 0.0 | 3.0 | FIFA World Cup | Montevideo |
| **1** | 1312 | 1930 | France | Mexico | 4.0 | 1.0 | FIFA World Cup | Montevideo |
| **2** | 1313 | 1930 | Brazil | Yugoslavia | 1.0 | 2.0 | FIFA World Cup | Montevideo |
| **3** | 1314 | 1930 | Peru | Romania | 1.0 | 3.0 | FIFA World Cup | Montevideo |
| **4** | 1315 | 1930 | Argentina | France | 1.0 | 0.0 | FIFA World Cup | Montevideo |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... |
| **895** | 40293 | 2018 | Russia | Croatia | 2.0 | 2.0 | FIFA World Cup | Sochi |
| **896** | 40294 | 2018 | France | Belgium | 1.0 | 0.0 | FIFA World Cup | Saint Petersburg |
| **897** | 40295 | 2018 | Croatia | England | 2.0 | 1.0 | FIFA World Cup | Moscow |
| **898** | 40296 | 2018 | Belgium | England | 2.0 | 0.0 | FIFA World Cup | Saint Petersburg |
| **899** | 40297 | 2018 | France | Croatia | 4.0 | 2.0 | FIFA World Cup | Moscow |

900 rows × 11 columns

In [57]:
```
plt.figure(figsize = (35,18))
sns.heatmap(df.corr() , annot = True , cmap = "YlGnBu")
```

Out[57]:
```
<AxesSubplot:>
```



In [58]:
```
home_team_encoder = preprocessing.LabelEncoder()
df['home_team'] = home_team_encoder.fit_transform(df['home_team'])


away_team_encoder = preprocessing.LabelEncoder()
df['away_team'] = away_team_encoder.fit_transform(df['away_team'])


city_encoder = preprocessing.LabelEncoder()
df['city'] = city_encoder.fit_transform(df['city'])


country_encoder = preprocessing.LabelEncoder()
df['country'] = country_encoder.fit_transform(df['country'])
```

In [59]:
```
df.head()
```

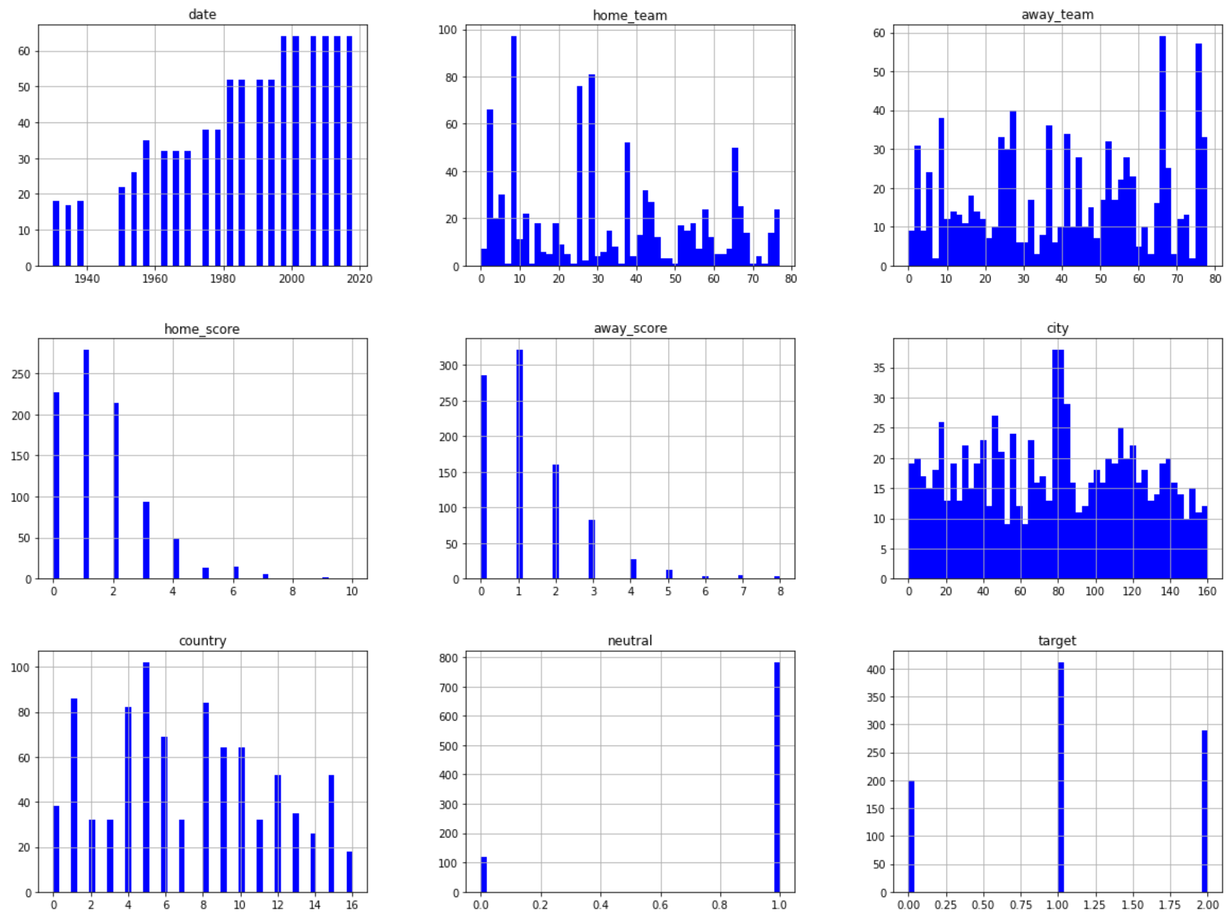
Out[59]:

| | Unnamed: 0 | date | home_team | away_team | home_score | away_score | tournament | city | country |
|---|---|---|---|---|---|---|---|---|---|
| **0** | 1311 | 1930 | 5 | 75 | 0.0 | 3.0 | FIFA World Cup | 83 | 16 |
| **1** | 1312 | 1930 | 26 | 42 | 4.0 | 1.0 | FIFA World Cup | 83 | 16 |
| **2** | 1313 | 1930 | 8 | 78 | 1.0 | 2.0 | FIFA World Cup | 83 | 16 |
| **3** | 1314 | 1930 | 52 | 56 | 1.0 | 3.0 | FIFA World Cup | 83 | 16 |
| **4** | 1315 | 1930 | 2 | 25 | 1.0 | 0.0 | FIFA World Cup | 83 | 16 |

In [60]:
```
df.drop('Unnamed: 0', inplace=True, axis=1)
df.drop('tournament', inplace=True, axis=1)
```

In [61]:
```
df_clean = df.copy()
df_clean.to_csv('fifa world cup clean.csv', encoding='utf-8',  index=False)
```

In [62]:
```
df.hist(bins=50, figsize=(20,15), color='b')
plt.show()
```



In [63]:
```
x = df.drop(['target'],axis=1).values
y = df['target'].values
```

In [64]:
```
sd_scaler = StandardScaler()
x = sd_scaler.fit_transform(x)
```

In [65]:
```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x, y,test_size=0.3, shuffle=T
```

In [66]:
```
print ("x train shape",x_train.shape)
print ("y train shape",y_train.shape)
print ("x test shape",x_test.shape)
print ("y test shape",x_test.shape)
```

```
x train shape (630, 8)
y train shape (630,)
x test shape (270, 8)
y test shape (270, 8)
```

In [67]:
```
rf = RandomForestClassifier(criterion='entropy',n_estimators=20)
rf.fit(x_train, y_train)
rf.score(x_train,y_train)
```

Out[67]:
```
1.0
```

In [68]:
```
y_pred = rf.predict(x_test)
print("Accuracy",accuracy_score(y_test,y_pred))
```

```
Accuracy 0.9740740740740741
```

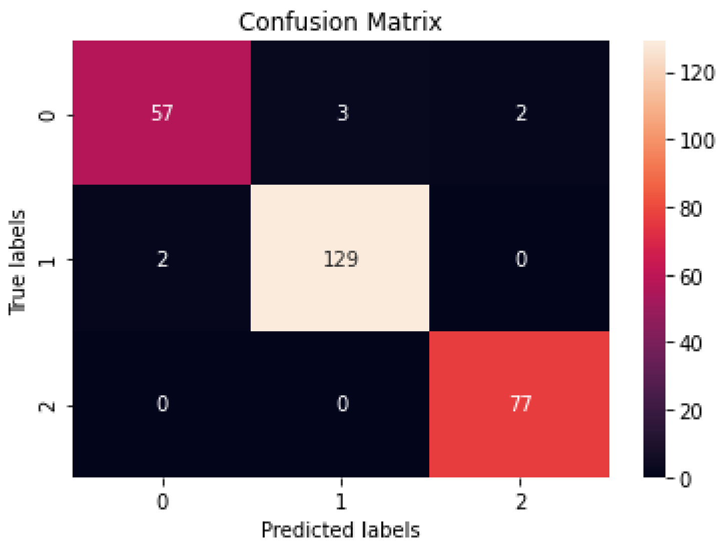
In [69]:
```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.97      0.92      0.94        62
           1       0.98      0.98      0.98       131
           2       0.97      1.00      0.99        77

    accuracy                           0.97       270
   macro avg       0.97      0.97      0.97       270
weighted avg       0.97      0.97      0.97       270
```

In [70]:
```
rf = confusion_matrix(y_test,y_pred)
ax= plt.subplot()
sns.heatmap(rf, annot=True, fmt='g', ax=ax);  #annot=True to annotate cells, ftm=
# labels, title and ticks
ax.set_xlabel('Predicted labels');ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');
```



In [109]:
```
from sklearn.tree import DecisionTreeClassifier
dt_clf = DecisionTreeClassifier(max_depth=4)
dt_clf.fit(x_train, y_train)
dt_clf.score(x_train,y_train)
```

Out[109]:
```
0.9952380952380953
```

In [110]:
```
y_pred = dt_clf.predict(x_test)
print("Accuracy",accuracy_score(y_test,y_pred))
```

```
Accuracy 0.9814814814814815
```

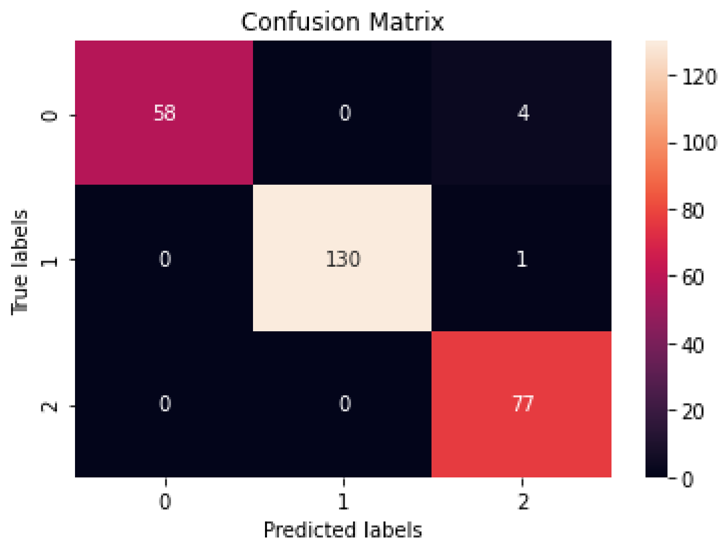
In [111]:
```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      0.94      0.97        62
           1       1.00      0.99      1.00       131
           2       0.94      1.00      0.97        77

    accuracy                           0.98       270
   macro avg       0.98      0.98      0.98       270
weighted avg       0.98      0.98      0.98       270
```

In [112]:
```
cm = confusion_matrix(y_test,y_pred)
ax= plt.subplot()
sns.heatmap(cm, annot=True, fmt='g', ax=ax);  #annot=True to annotate cells, ftm=
# labels, title and ticks
ax.set_xlabel('Predicted labels');ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');
```



In [75]:
```
from sklearn.neighbors import KNeighborsClassifier
```

In [96]:
```
knn = KNeighborsClassifier(n_neighbors=15)
```

In [97]:
```
knn.fit(x_train,y_train)
knn.score(x_train,y_train)
```

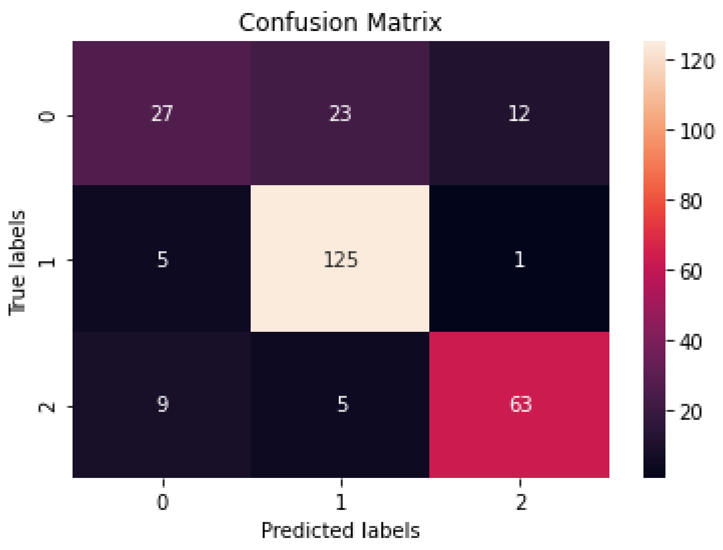
Out[97]:
```
0.8079365079365079
```

In [98]:
```
knn_pred = knn.predict(x_test)
print("Accuracy",accuracy_score(y_test,knn_pred))
```

```
Accuracy 0.7962962962962963
```

In [99]:
```
cm = confusion_matrix(y_test,knn_pred)
ax= plt.subplot()
sns.heatmap(cm, annot=True, fmt='g', ax=ax);  #annot=True to annotate cells, ftm=

# labels, title and ticks
ax.set_xlabel('Predicted labels');ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');
```



In [100]:
```
print(classification_report(y_test,knn_pred))
```

```
              precision    recall  f1-score   support

           0       0.66      0.44      0.52        62
           1       0.82      0.95      0.88       131
           2       0.83      0.82      0.82        77

    accuracy                           0.80       270
   macro avg       0.77      0.74      0.74       270
weighted avg       0.78      0.80      0.78       270
```

In [81]:
```
from sklearn.linear_model import LogisticRegression
```

In [82]:
```
lr = LogisticRegression()
lr.fit(x_train,y_train)
lr.score(x_train,y_train)
```

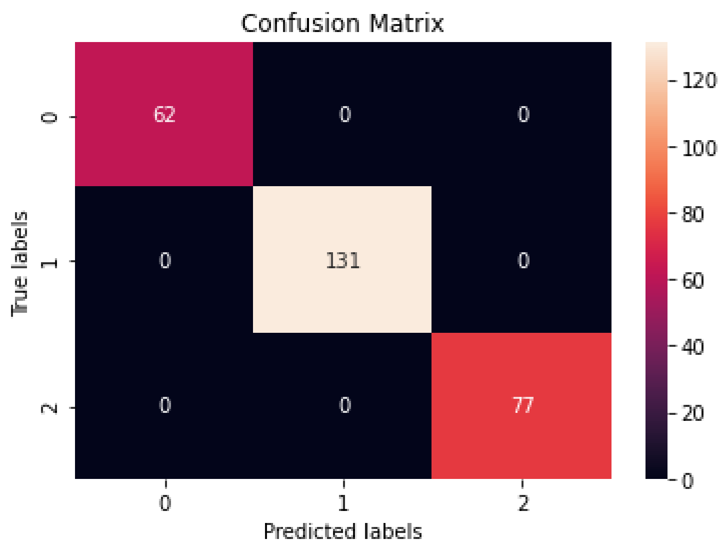
Out[82]:
```
1.0
```

In [83]:
```
lr_pred = lr.predict(x_test)
print("Accuracy",accuracy_score(y_test,lr_pred))
```

```
Accuracy 1.0
```

In [84]:
```
cm = confusion_matrix(y_test,lr_pred)
ax= plt.subplot()
sns.heatmap(cm, annot=True, fmt='g', ax=ax);  #annot=True to annotate cells, ftm=

# labels, title and ticks
ax.set_xlabel('Predicted labels');ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');
```



In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]: