In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib as mpl
import numpy as np
import statsmodels.api as sm
import scipy.cluster.hierarchy as sch
from sklearn import metrics
from sklearn.model_selection import train_test_split
from sklearn import tree
from sklearn.tree import export_graphviz
from sklearn.tree import DecisionTreeClassifier
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.naive_bayes import GaussianNB
from sklearn.model_selection import train_test_split
from six import StringIO
from IPython.display import Image
import pydotplus
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
from sklearn.metrics import silhouette_score
from sklearn.cluster import KMeans
from sklearn.cluster import AgglomerativeClustering
from sklearn.preprocessing import StandardScaler, normalize
from sklearn.decomposition import PCA
%matplotlib inline
```

In [2]:
```
data=pd.read_csv(r'C:\Users\Purpl3\Dataset.csv')
```

In [3]:
```
data.shape
```

Out[3]:
```
(306, 4)
```

In [4]:
```
data.head(15)
```

Out[4]:

	Age	Year	Axillary	Survival
0	30	64	1	Yes
1	30	62	3	Yes
2	30	65	0	Yes
3	31	59	2	Yes
4	31	65	4	Yes
5	33	58	10	Yes
6	33	60	0	Yes
7	34	59	0	No
8	34	66	9	No
9	34	58	30	Yes
10	34	60	1	Yes
11	34	31	10	Yes
12	34	67	7	Yes
13	34	60	0	Yes
14	35	64	13	Yes

In [5]:
```
data.dtypes
```

Out[5]:
```
Age          int64
Year         int64
Axillary     int64
Survival    object
dtype: object
```

In [6]:
```
data.describe().iloc[3:,:]
```

Out[6]:

	Age	Year	Axillary
min	30.00	31.00	0.0
25%	44.00	60.00	0.0
50%	52.00	63.00	1.0
75%	60.75	65.75	4.0
max	83.00	69.00	52.0

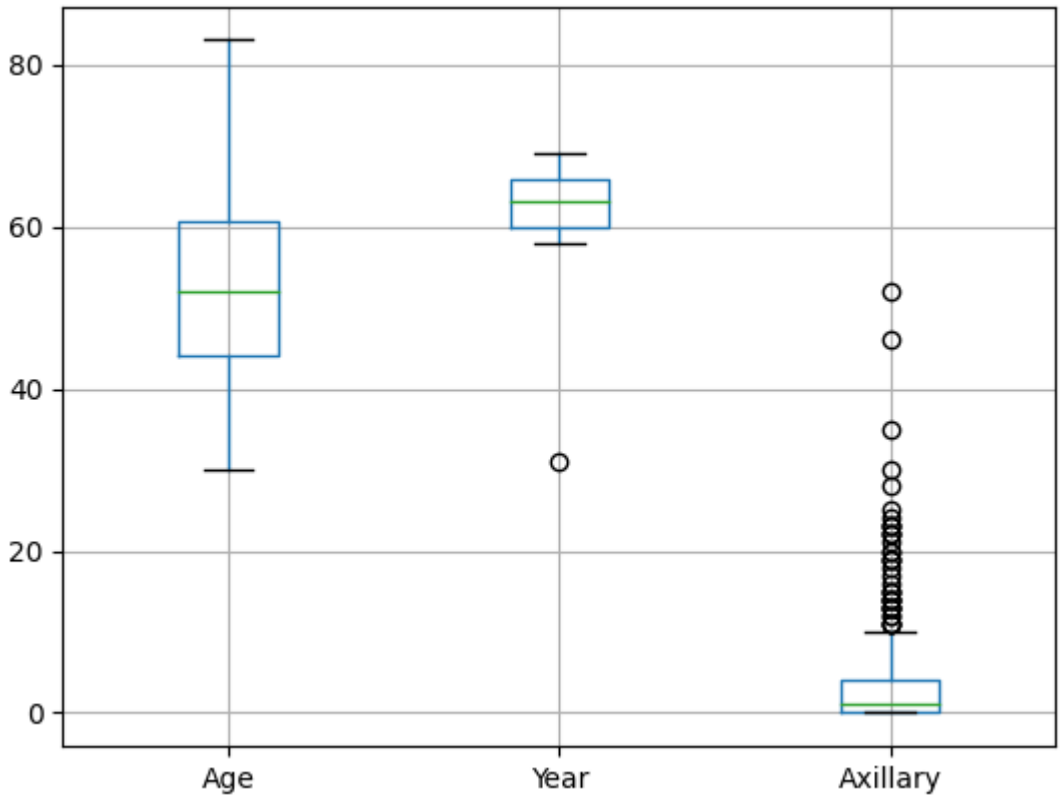
In [7]:
```
data.describe()
```

Out[7]:

	Age	Year	Axillary
count	306.000000	306.000000	306.000000
mean	52.457516	62.754902	3.980392
std	10.803452	3.723482	7.172324
min	30.000000	31.000000	0.000000
25%	44.000000	60.000000	0.000000
50%	52.000000	63.000000	1.000000
75%	60.750000	65.750000	4.000000
max	83.000000	69.000000	52.000000

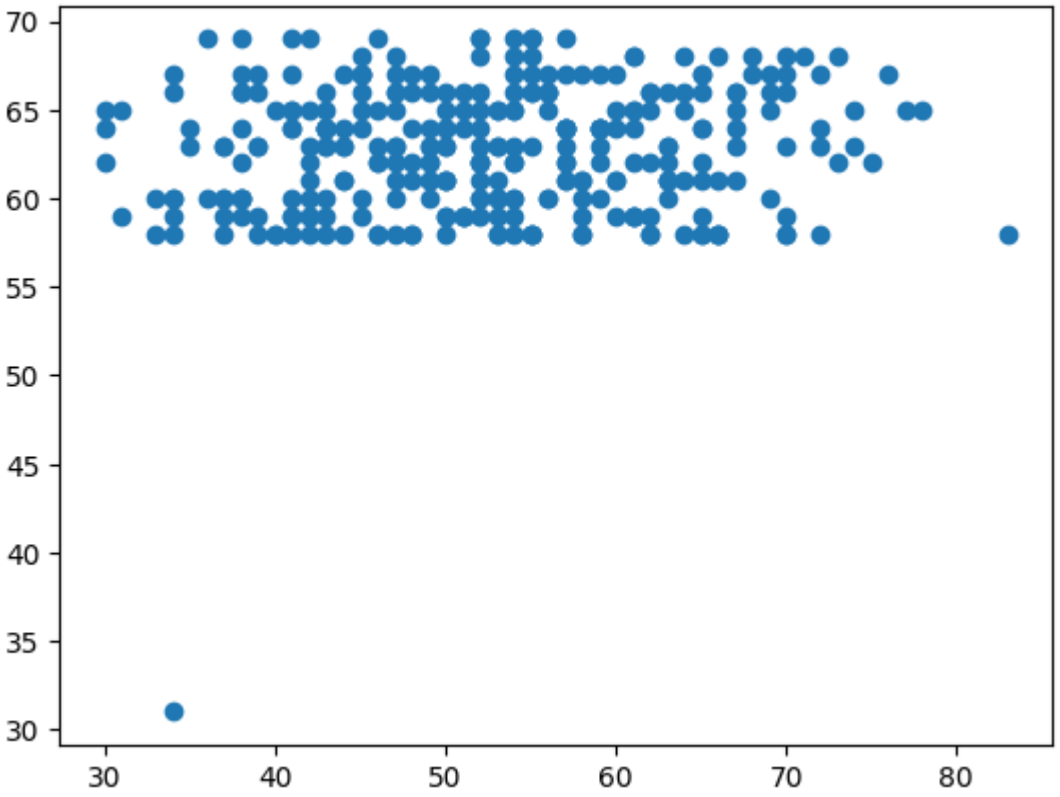
In [8]:
```
data.boxplot()
```

Out[8]: <Axes: >



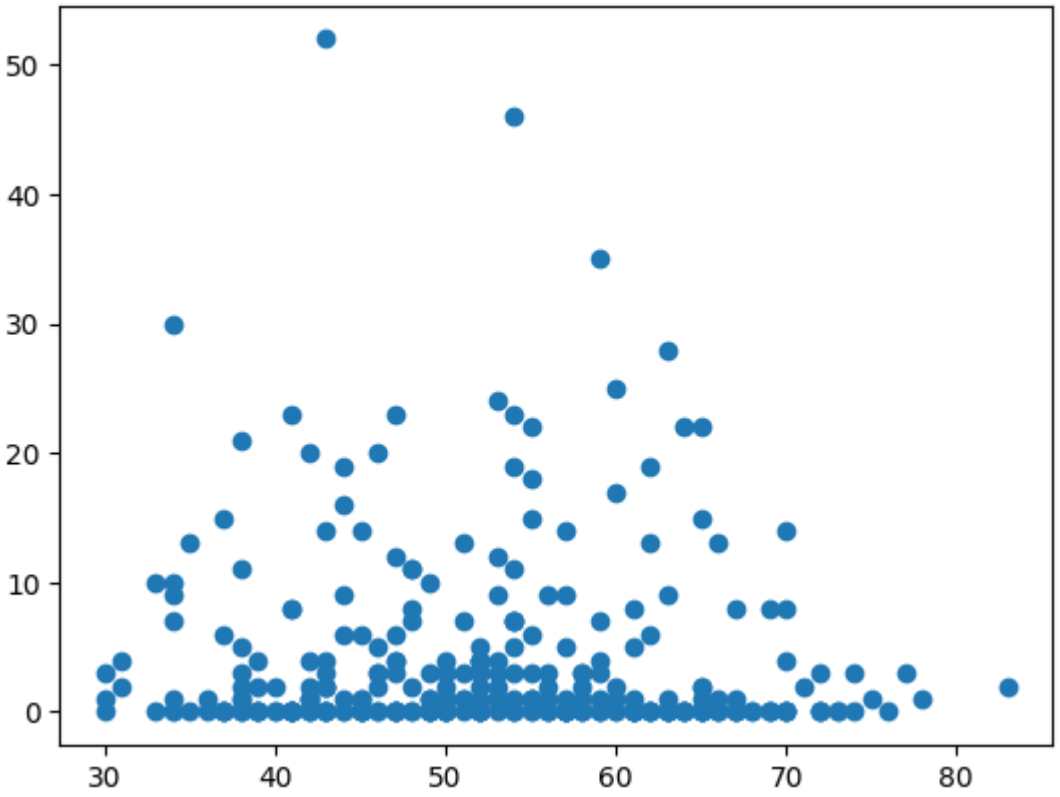
In [9]:
```
plt.scatter(data['Age'] , data['Year'])
```

Out[9]: <matplotlib.collections.PathCollection at 0x241c1d9e3d0>



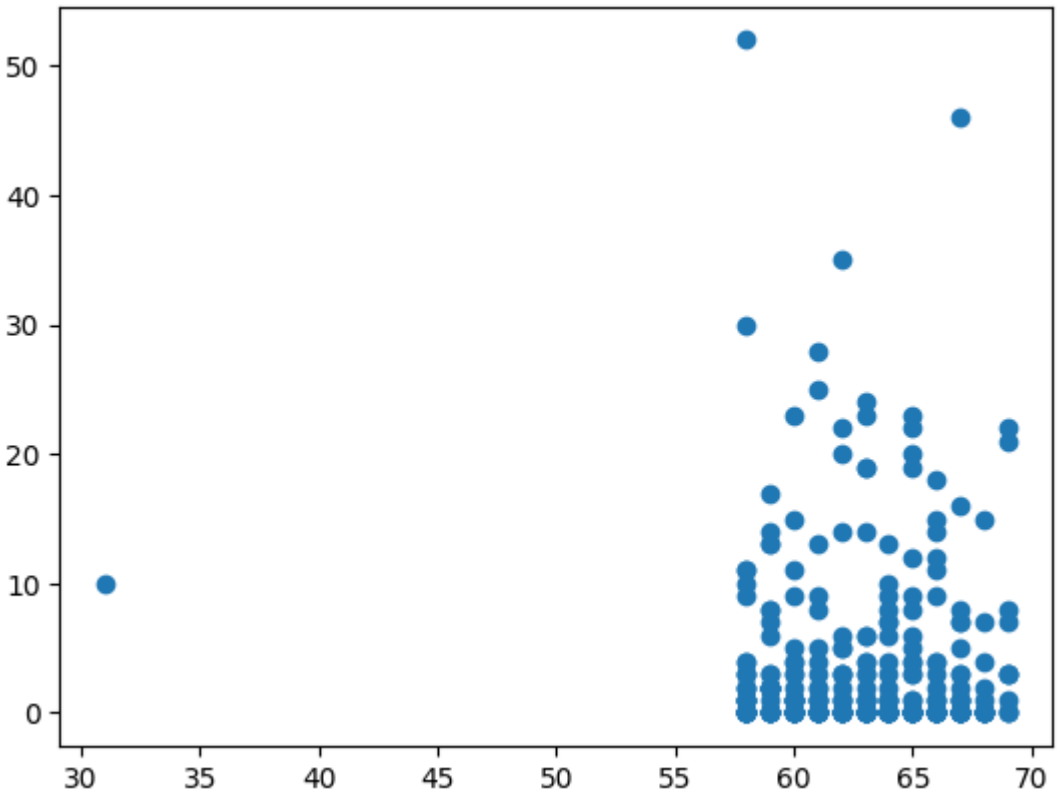
In [10]:
```
plt.scatter(data['Age'] , data['Axillary'])
```

Out[10]: <matplotlib.collections.PathCollection at 0x241c3fcb550>



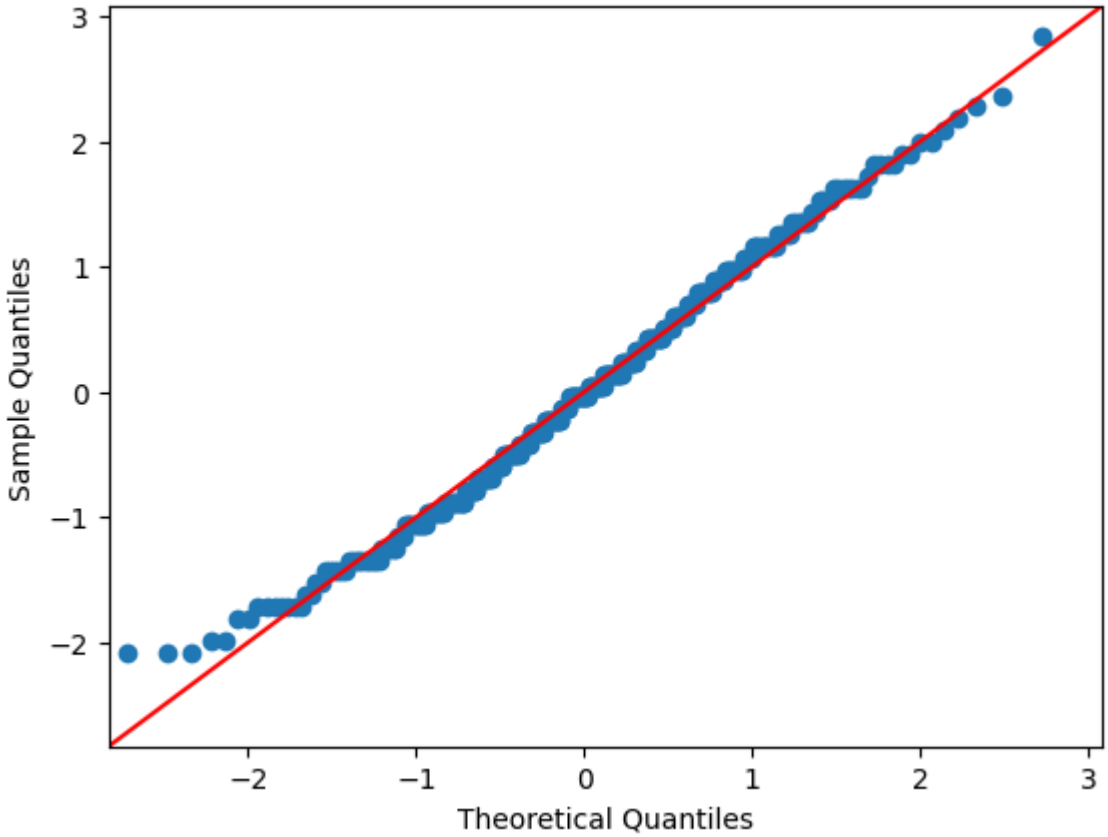
In [11]:
```
plt.scatter(data['Year'] , data['Axillary'])
```

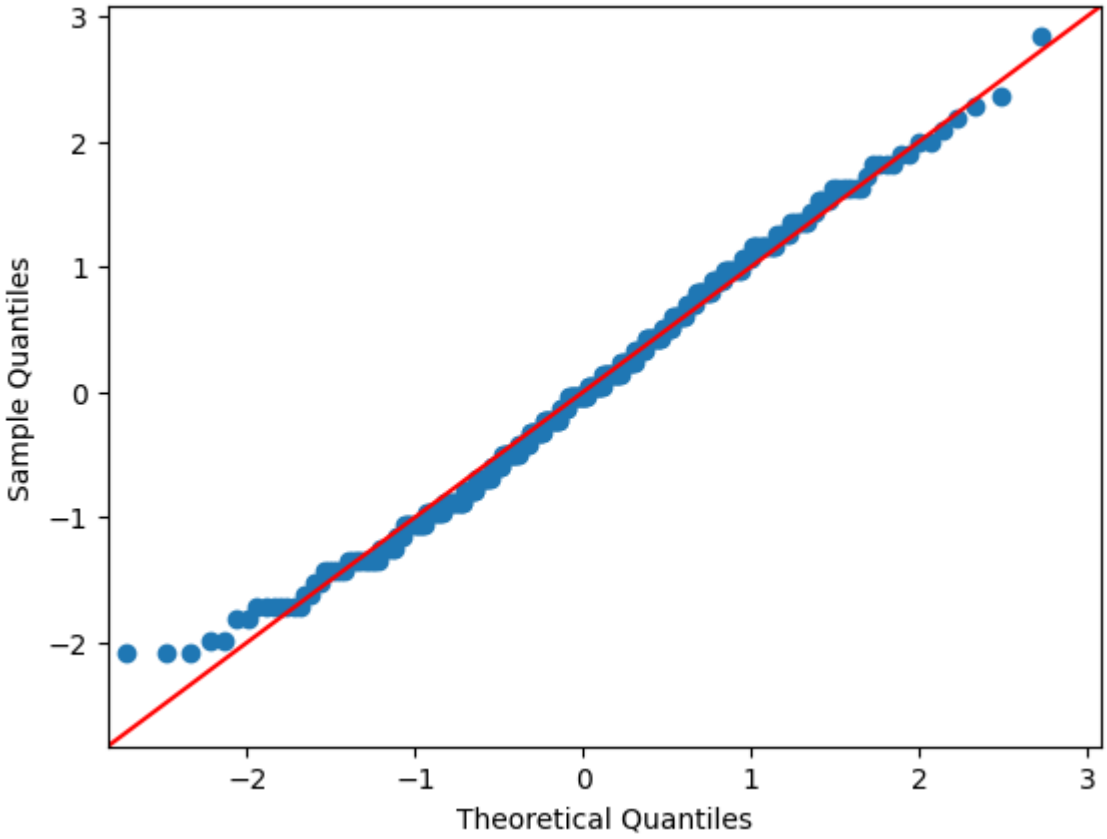
Out[11]: <matplotlib.collections.PathCollection at 0x241c4021c50>



In [12]:
```
sm.qqplot(data['Age'] , fit=True , line='45')
```

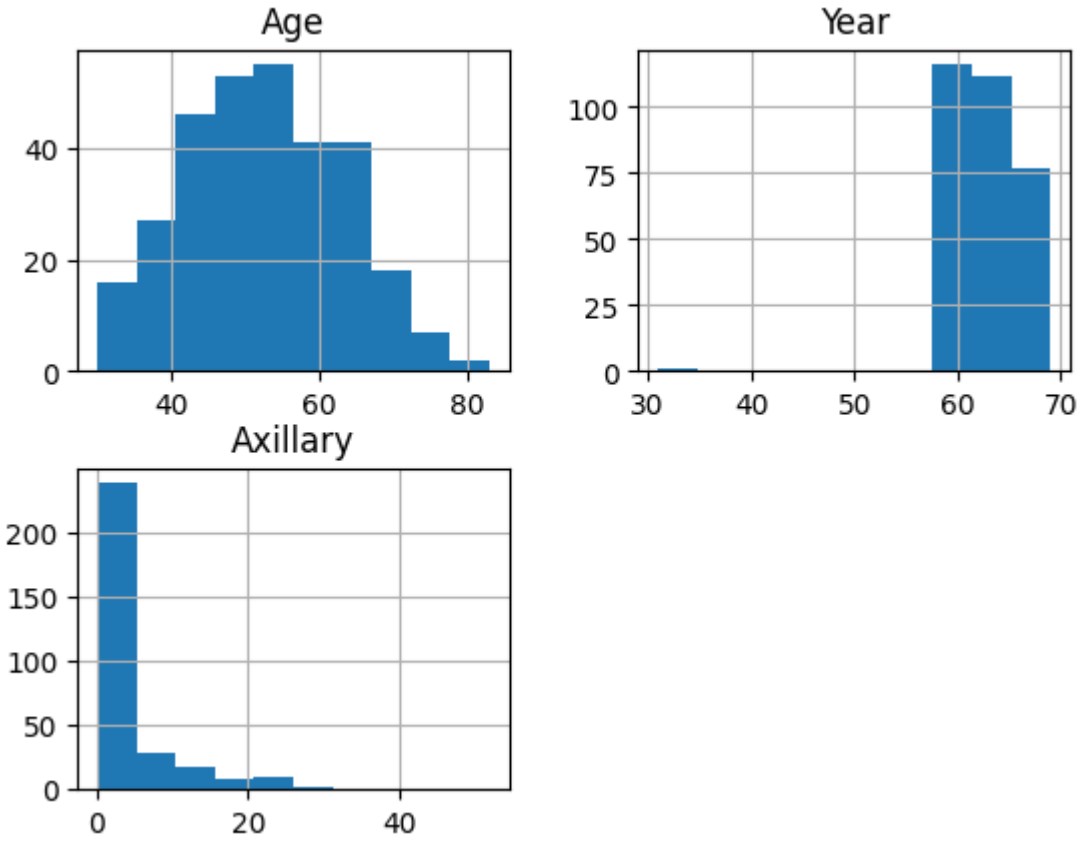
Out[12]:



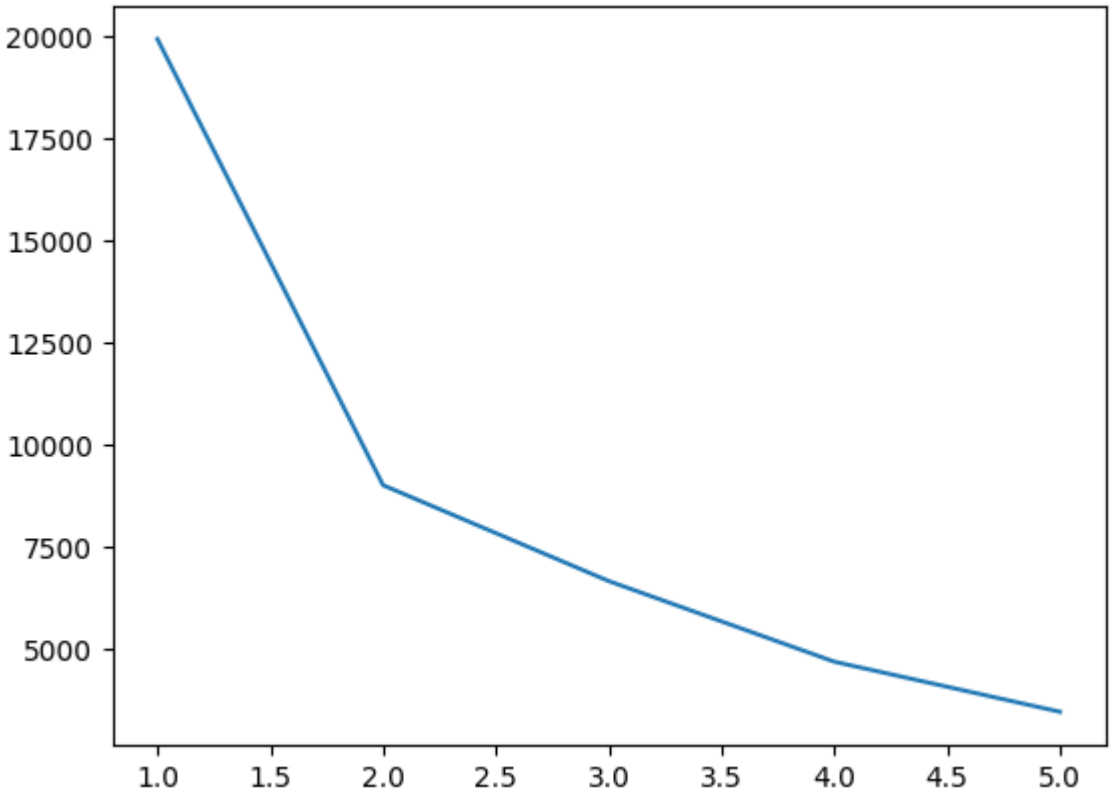


In [13]:
```
data.hist()
```

Out[13]:
```
array([[<Axes: title={'center': 'Age'}>,
        <Axes: title={'center': 'Year'}>],
       [<Axes: title={'center': 'Axillary'}>, <Axes: >]], dtype=object)
```



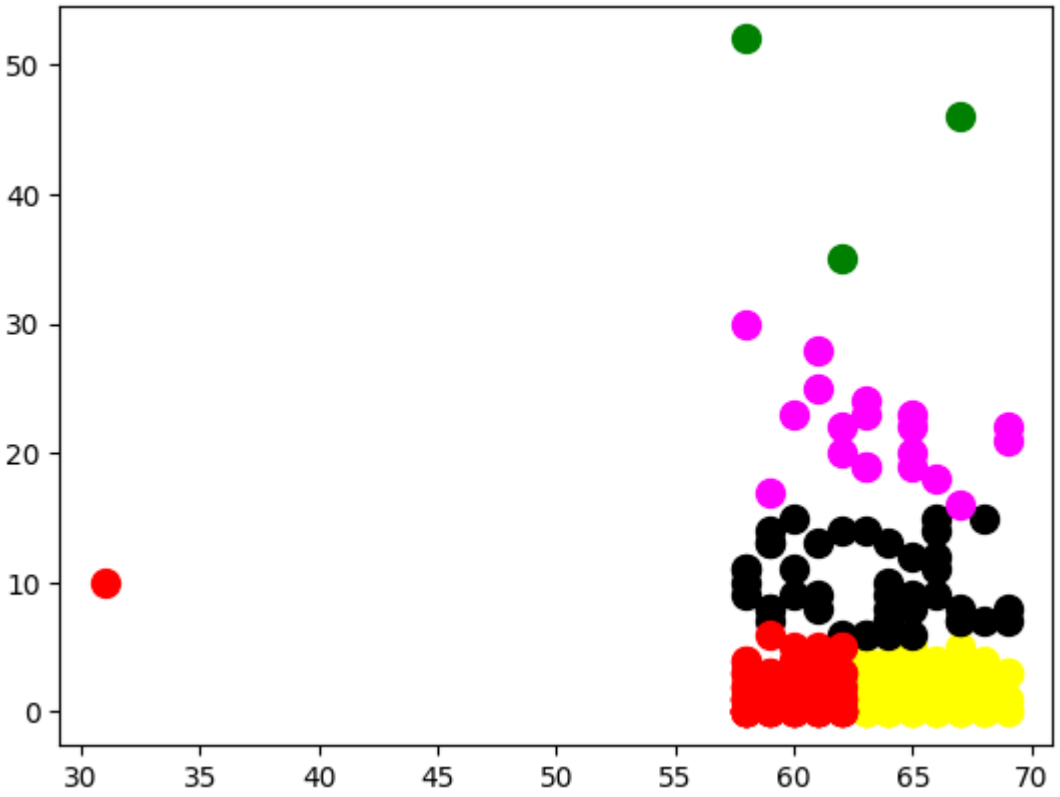
In [14]:
```
from sklearn.cluster import KMeans
x=data.iloc[:, [1,2]].values
WCSS=[]
for i in range(1,6):
    kmeans = KMeans(n_clusters=i, init='k-means++', max_iter=300, n_init=10, random
    kmeans.fit(x)
    WCSS.append(kmeans.inertia_)
plt.plot(range(1,6), WCSS)
plt.show()
```



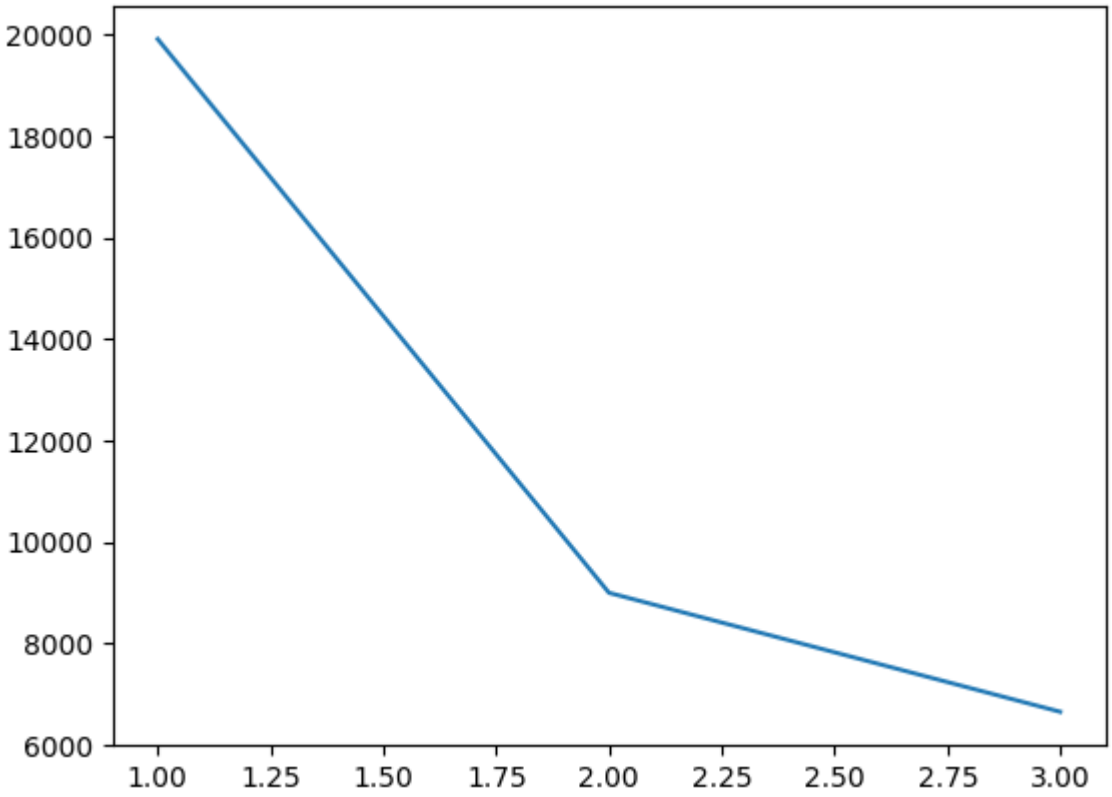
In [15]:
```
kmeans = KMeans(n_clusters=5, init='k-means++', max_iter=300, n_init=10,random_stat
y_kmeans = kmeans.fit_predict(x)

plt.scatter(x[y_kmeans==0, 0], x[y_kmeans==0, 1], s=100, c='yellow', label='Cluster
plt.scatter(x[y_kmeans==1, 0], x[y_kmeans==1, 1], s=100, c='black', label='Cluster
plt.scatter(x[y_kmeans==2, 0], x[y_kmeans==2, 1], s=100, c='green', label='Cluster
plt.scatter(x[y_kmeans==3, 0], x[y_kmeans==3, 1], s=100, c='red', label ='Cluster 4
plt.scatter(x[y_kmeans==4, 0], x[y_kmeans==4, 1], s=100, c='magenta', label='Cluste
```

Out[15]:
```
<matplotlib.collections.PathCollection at 0x241c83c3250>
```

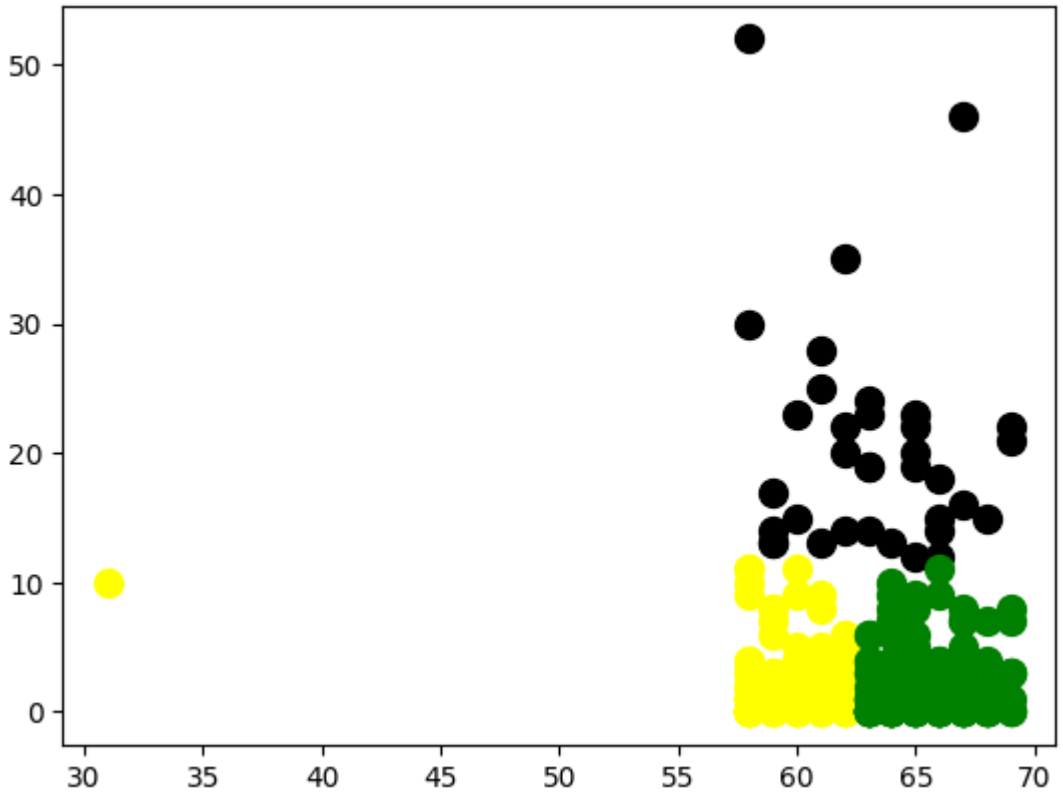


In [16]:
```
wcss = []
for I in range(1,4):
    kmeans = KMeans(n_clusters=I, init='k-means++', max_iter=300, n_init=10, random
    kmeans.fit(x)
    wcss.append(kmeans.inertia_)
plt.plot(range(1,4), wcss)
plt.show()
```



In [17]:
```
kmeans = KMeans(n_clusters=3, init='k-means++', max_iter=300, n_init=10,
random_state=0)
y_kmeans = kmeans.fit_predict(x)
plt.scatter(x[y_kmeans==0, 0], x[y_kmeans==0, 1], s=100, c='yellow', label='Cluster
plt.scatter(x[y_kmeans==1, 0], x[y_kmeans==1, 1], s=100, c='black', label='Cluster
plt.scatter(x[y_kmeans==2, 0], x[y_kmeans==2, 1], s=100, c='green', label='Cluster
```

Out[17]:
```
<matplotlib.collections.PathCollection at 0x241c1f2de90>
```

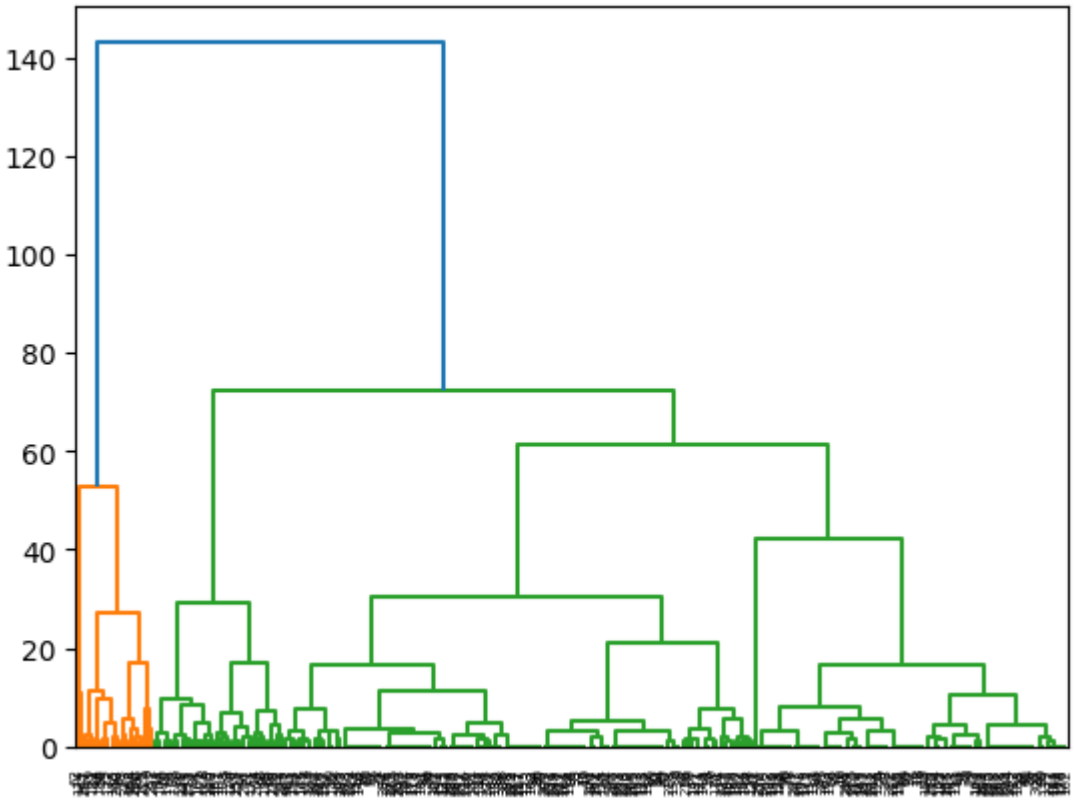


In [18]:
```
hc = AgglomerativeClustering(n_clusters=5)
y_hc = hc.fit_predict(x)
```

In [19]:
```
import sys
with np.printoptions(threshold=sys.maxsize) :
    print(y_hc)
```

```
[1 1 1 0 1 2 0 0 2 3 0 0 2 0 2 1 0 1 0 1 0 2 2 1 3 0 0 0 1 1 1 2 0 1 1 1 1
 0 0 1 0 0 1 3 1 1 0 2 0 1 2 1 1 1 0 0 0 0 1 3 1 1 4 0 1 1 2 1 1 0 1 1 1 2
 2 3 0 1 0 3 2 1 1 0 1 2 1 1 1 0 1 1 3 0 0 1 3 0 1 0 1 1 1 0 1 1 2 2 2 2 2
 1 1 1 1 2 0 0 1 0 1 1 0 1 1 1 0 1 0 1 0 0 0 1 1 1 2 0 2 0 1 1 1 0 1 1 0 1
 1 1 1 0 1 1 1 1 0 1 0 2 3 2 0 0 0 0 1 2 3 1 2 2 0 1 4 0 2 3 0 0 1 3 0 0 0
 3 1 1 3 1 2 1 0 1 1 1 0 1 2 1 2 1 0 0 1 1 1 1 0 0 0 1 0 0 0 3 0 1 1 1 1 2
 1 2 1 0 1 3 1 1 1 1 0 0 1 2 1 0 2 0 3 1 1 1 0 0 0 0 1 1 1 2 3 0 3 1 0 1 0
 0 3 3 0 1 1 0 1 1 0 2 0 0 1 2 1 1 1 0 1 1 1 2 0 1 1 0 0 3 1 1 2 1 1 1 0 1
 1 0 1 1 1 1 1 1 1 0]
```

In [20]:
```
dendogram = sch.dendrogram(sch.linkage(x, method='ward'))
```



In [21]:
```
x = data.iloc[:,[0,1]].values
y = data.iloc[:,-1].values

x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.25,
random_state=0)
```

In [22]:
```
tree=DecisionTreeClassifier()
classifier = DecisionTreeClassifier(criterion= 'entropy', random_state=0)
classifier.fit(x_train, y_train)
y_test
```

Out[22]:
```
array(['No', 'Yes', 'No', 'Yes', 'No', 'Yes', 'No', 'No', 'No', 'Yes',
       'Yes', 'Yes', 'No', 'Yes', 'No', 'Yes', 'Yes', 'No', 'Yes', 'Yes',
       'Yes', 'No', 'Yes', 'Yes', 'Yes', 'No', 'Yes', 'Yes', 'No', 'Yes',
       'Yes', 'Yes', 'No', 'No', 'No', 'No', 'No', 'Yes', 'No', 'Yes',
       'No', 'No', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'No', 'Yes', 'Yes',
       'Yes', 'Yes', 'Yes', 'No', 'Yes', 'Yes', 'Yes', 'Yes', 'No', 'No',
       'No', 'Yes', 'Yes', 'Yes', 'No', 'Yes', 'No', 'No', 'Yes', 'Yes',
       'No', 'Yes', 'Yes', 'No', 'Yes', 'No', 'Yes'], dtype=object)
```

In [23]:
```
y_predict = classifier.predict(x_test)
print (y_predict)
```

```
['No' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'No' 'No' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'No' 'No' 'No' 'Yes' 'Yes' 'No' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'No' 'No' 'Yes' 'No' 'Yes' 'Yes' 'Yes' 'No' 'No' 'Yes' 'Yes'
 'No' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'No' 'No' 'Yes' 'Yes' 'No' 'No' 'Yes' 'Yes' 'Yes' 'No' 'Yes' 'Yes' 'Yes'
 'No' 'Yes']
```

In [24]:
```
cm = confusion_matrix(y_test, y_predict)
cm
```

Out[24]:
```
array([[10, 21],
       [ 9, 37]], dtype=int64)
```

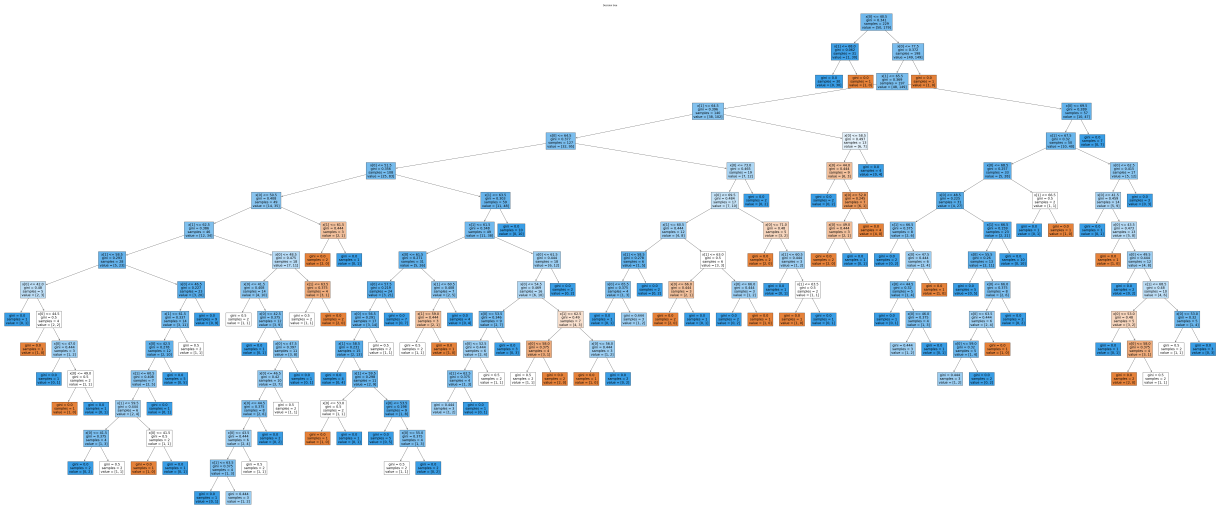
In [25]:
```
print("Accuracy:",metrics.accuracy_score(y_test, y_predict))
```

```
Accuracy: 0.6103896103896104
```

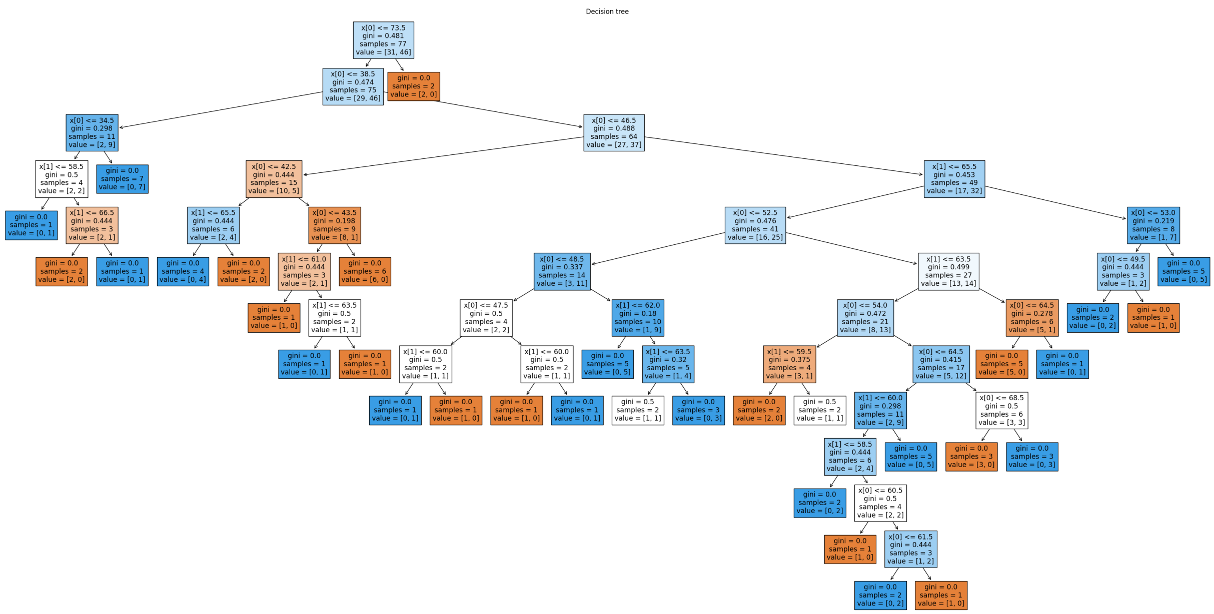
In [26]:
```
print(x_train.shape, x_test.shape, y_train.shape, y_test.shape)
```

```
(229, 2) (77, 2) (229,) (77,)
```

In [29]:
```
clf = DecisionTreeClassifier()
plt.figure(figsize=(120,50))
clf = clf.fit(x_train, y_train)
plot_tree(clf, filled=True)
plt.title("Decision tree")
plt.show()
```



In [30]:
```
clf = DecisionTreeClassifier()
plt.figure(figsize=(40,20))
clf = clf.fit(x_test, y_test)
plot_tree(clf, filled=True)
plt.title("Decision tree")
plt.show()
```



In [31]:
```
X = data.iloc[:, [0,1]].values
y = data.iloc[:, -1].values
X_train, X_test, y_train, y_test =train_test_split(X,y,test_size=0.25, random_state
```

In [32]:
```
classifer1 = GaussianNB()
classifer1.fit(X_train, y_train)
y_predict1 = classifer1.predict(X_test)
y_predict1
```

Out[32]:
```
array(['Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes',
       'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes',
       'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes',
       'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes',
       'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes',
       'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes',
       'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes',
       'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes',
       'Yes', 'Yes', 'Yes', 'Yes', 'Yes'], dtype='<U3')
```

In [33]:
```
print("Accuracy:",metrics.accuracy_score(y_test, y_predict1))
```

```
Accuracy: 0.5974025974025974
```

In [34]:
```
cm1 = confusion_matrix(y_test, y_predict1)
cm1
```

Out[34]:
```
array([[ 0, 31],
       [ 0, 46]], dtype=int64)
```