In [2]:

```
# import the data file

data = pd.read_csv('data.csv')
```

In [1]:

```
import pandas as pd
```

In [3]:

```
# display the first 5 data

data.head()
```

Out[3]:

	id	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	...	texture_worst	perimeter_wors
0	842302	M	17.99	10.38	122.80	1001.0	0.11840	0.27760	0.3001	0.14710	...	17.33	184.6
1	842517	M	20.57	17.77	132.90	1326.0	0.08474	0.07864	0.0869	0.07017	...	23.41	158.8
2	84300903	M	19.69	21.25	130.00	1203.0	0.10960	0.15990	0.1974	0.12790	...	25.53	152.5
3	84348301	M	11.42	20.38	77.58	386.1	0.14250	0.28390	0.2414	0.10520	...	26.50	98.8
4	84358402	M	20.29	14.34	135.10	1297.0	0.10030	0.13280	0.1980	0.10430	...	16.67	152.2

5 rows × 33 columns

In [4]:

```
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
```

In [5]:

```
# display tyhe last 5 data

data.tail()
```

Out[5]:

	id	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	...	texture_worst	perimeter_wors
564	926424	M	21.56	22.39	142.00	1479.0	0.11100	0.11590	0.24390	0.13890	...	26.40	166.1
565	926682	M	20.13	28.25	131.20	1261.0	0.09780	0.10340	0.14400	0.09791	...	38.25	155.0
566	926954	M	16.60	28.08	108.30	858.1	0.08455	0.10230	0.09251	0.05302	...	34.12	126.7
567	927241	M	20.60	29.33	140.10	1265.0	0.11780	0.27700	0.35140	0.15200	...	39.42	184.6
568	92751	B	7.76	24.54	47.92	181.0	0.05263	0.04362	0.00000	0.00000	...	30.37	59.1

5 rows × 33 columns

In [6]:

```
# count the number of rows and columns in the dataset

data.shape
```

Out[6]: (569, 33)

In [7]:

```
# count the number of empty [NaN, NAN , na] values in each columns

data.isna().sum()
```

Out[7]:

```
id                           0
diagnosis                    0
radius_mean                  0
texture_mean                 0
perimeter_mean               0
area_mean                    0
smoothness_mean              0
compactness_mean             0
concavity_mean               0
concave points_mean          0
symmetry_mean                0
fractal_dimension_mean       0
radius_se                    0
texture_se                   0
perimeter_se                 0
area_se                      0
smoothness_se                0
compactness_se               0
concavity_se                 0
concave points_se            0
symmetry_se                  0
fractal_dimension_se         0
radius_worst                 0
texture_worst                0
perimeter_worst              0
area_worst                   0
smoothness_worst             0
compactness_worst            0
concavity_worst              0
concave points_worst         0
symmetry_worst               0
fractal_dimension_worst      0
Unnamed: 32                569
dtype: int64
```

In [8]:

```
# Drop the column with all missing values [Input can be 0 or 1 for Integer and 'index' or 'columns' for String]

data = data.dropna(axis=1)
```

In [9]:

```
# Get the new count all the number of rows and colums again

data.shape
```

Out[9]: (569, 32)

In [10]:

```
# Get a count of the number of Malognant(M) or Benign(B) cells

data['diagnosis'].value_counts()
```

Out[10]:

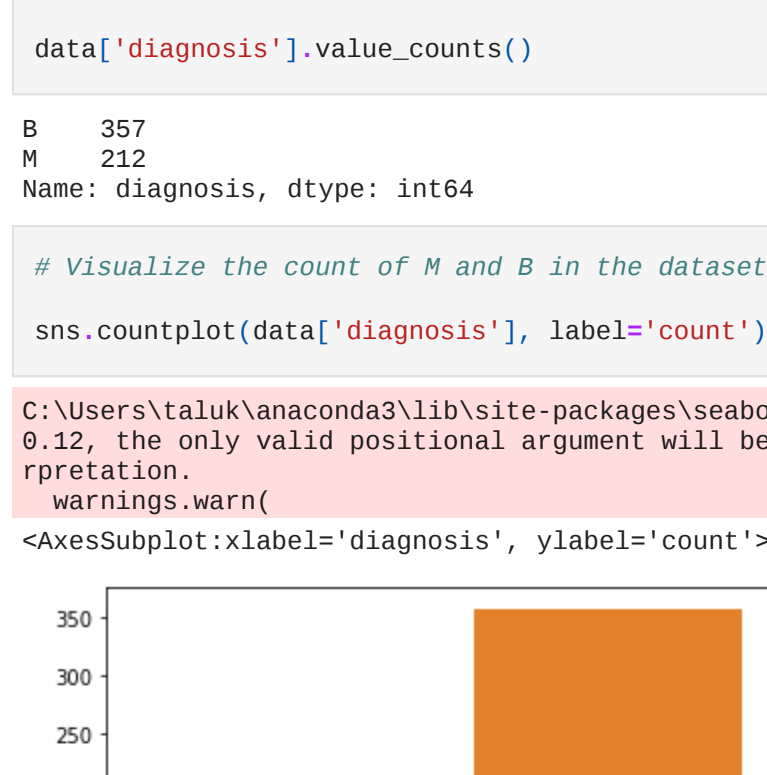
```
B    357
M    212
Name: diagnosis, dtype: int64
```

In [11]:

```
# Visualize the count of M and B in the dataset x => data['diagnosis'] , y => label='count'

sns.countplot(data['diagnosis'], label='count')
```

```
C:\Users\taluk\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinte
rpretation.
  warnings.warn(
```

Out[11]: <AxesSubplot:xlabel='diagnosis', ylabel='count'>



In [12]:

```
# Look at the data types to see which columns need to be encoded

data.dtypes
```

Out[12]:

```
id                           int64
diagnosis                   object
radius_mean                float64
texture_mean               float64
perimeter_mean             float64
area_mean                  float64
smoothness_mean            float64
compactness_mean           float64
concavity_mean             float64
concave points_mean        float64
symmetry_mean              float64
fractal_dimension_mean     float64
radius_se                  float64
texture_se                 float64
perimeter_se               float64
area_se                    float64
smoothness_se              float64
compactness_se             float64
concavity_se               float64
concave points_se          float64
symmetry_se                float64
fractal_dimension_se       float64
radius_worst               float64
texture_worst              float64
perimeter_worst            float64
area_worst                 float64
smoothness_worst           float64
compactness_worst          float64
concavity_worst            float64
concave points_worst       float64
symmetry_worst             float64
fractal_dimension_worst    float64
dtype: object
```

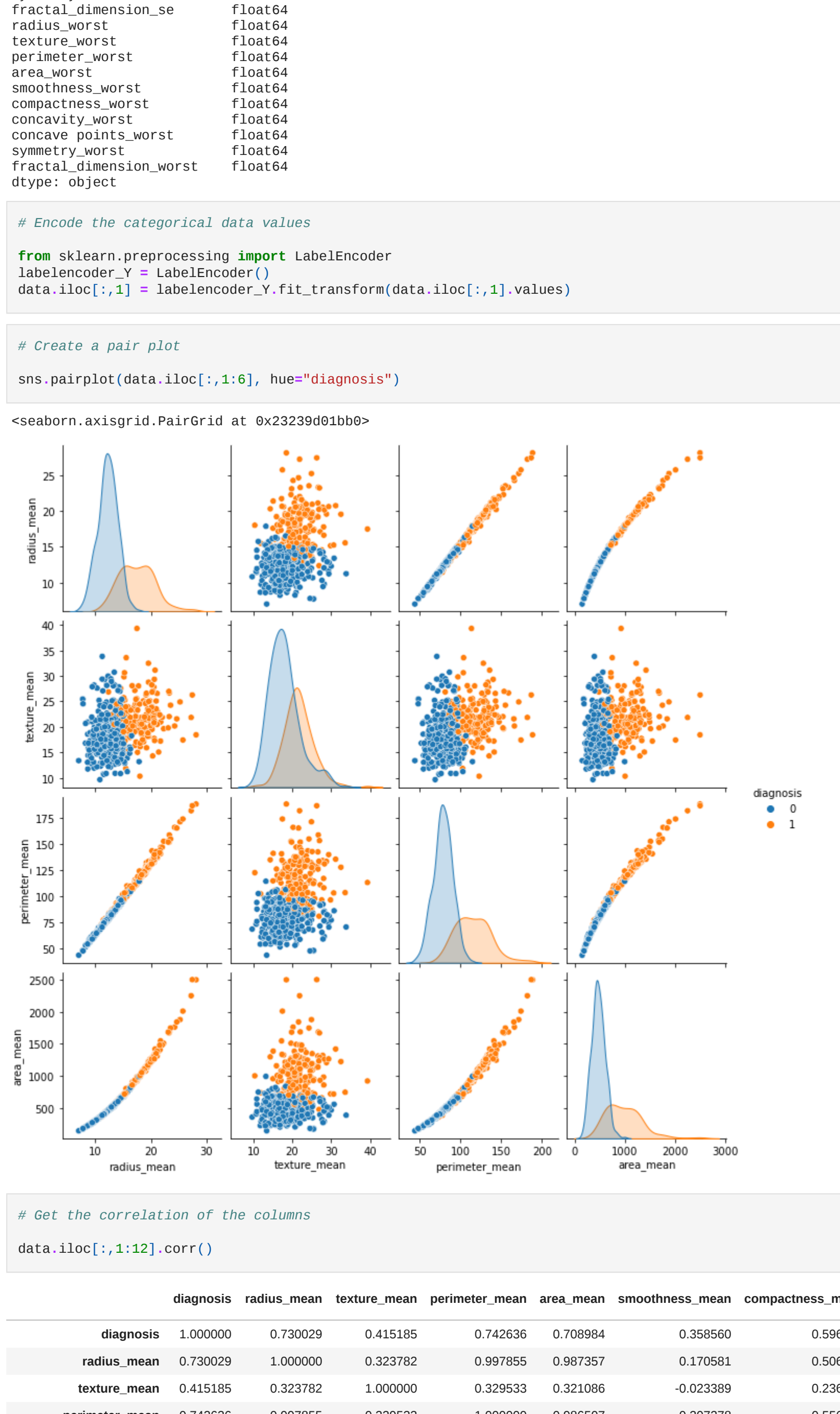
In [38]:

```
# Encode the categorical data values

from sklearn.preprocessing import LabelEncoder
labelencoder_Y = LabelEncoder()
data.iloc[:,1] = labelencoder_Y.fit_transform(data.iloc[:,1].values)
```

In [23]:

```
# Create a pair plot

sns.pairplot(data.iloc[:,1:6], hue="diagnosis")
```

Out[23]: <seaborn.axisgrid.PairGrid at 0x23239d01bb0>



In [24]:

```
# Get the correlation of the columns

data.iloc[:,1:12].corr()
```

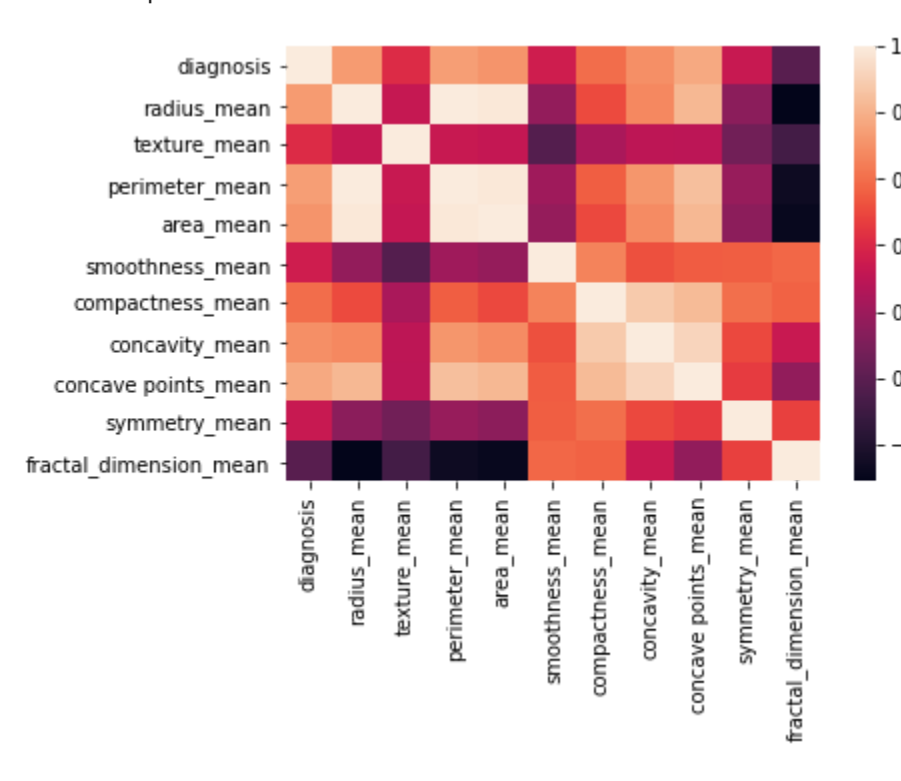
Out[24]:

	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	symmetry_mean	fract
diagnosis	1.000000	0.730029	0.415185	0.742636	0.708984	0.358560	0.596534	0.696360	0.776614	0.330499	
radius_mean	0.730029	1.000000	0.323782	0.997855	0.987357	0.170581	0.506124	0.676764	0.822529	0.147741	
texture_mean	0.415185	0.323782	1.000000	0.329533	0.321086	-0.023389	0.236702	0.302418	0.293464	0.071401	
perimeter_mean	0.742636	0.997855	0.329533	1.000000	0.986507	0.207278	0.556936	0.716136	0.850977	0.183027	
area_mean	0.708984	0.987357	0.321086	0.986507	1.000000	0.177028	0.498502	0.685983	0.823269	0.151293	
smoothness_mean	0.358560	0.170581	-0.023389	0.207278	0.177028	1.000000	0.659123	0.521984	0.553695	0.557775	
compactness_mean	0.596534	0.506124	0.236702	0.556936	0.498502	0.659123	1.000000	0.883121	0.831135	0.602641	
concavity_mean	0.696360	0.676764	0.302418	0.716136	0.685983	0.521984	0.883121	1.000000	0.921391	0.500667	
concave points_mean	0.776614	0.822529	0.293464	0.850977	0.823269	0.553695	0.831135	0.921391	1.000000	0.462497	
symmetry_mean	0.330499	0.147741	0.071401	0.183027	0.151293	0.557775	0.602641	0.500667	0.462497	1.000000	
fractal_dimension_mean	-0.012838	-0.311631	-0.076437	-0.261477	-0.283110	0.584792	0.565369	0.336783	0.166917	0.479921	

In [25]:

```
# Visualize the correlation

sns.heatmap(data.iloc[:,1:12].corr())
```

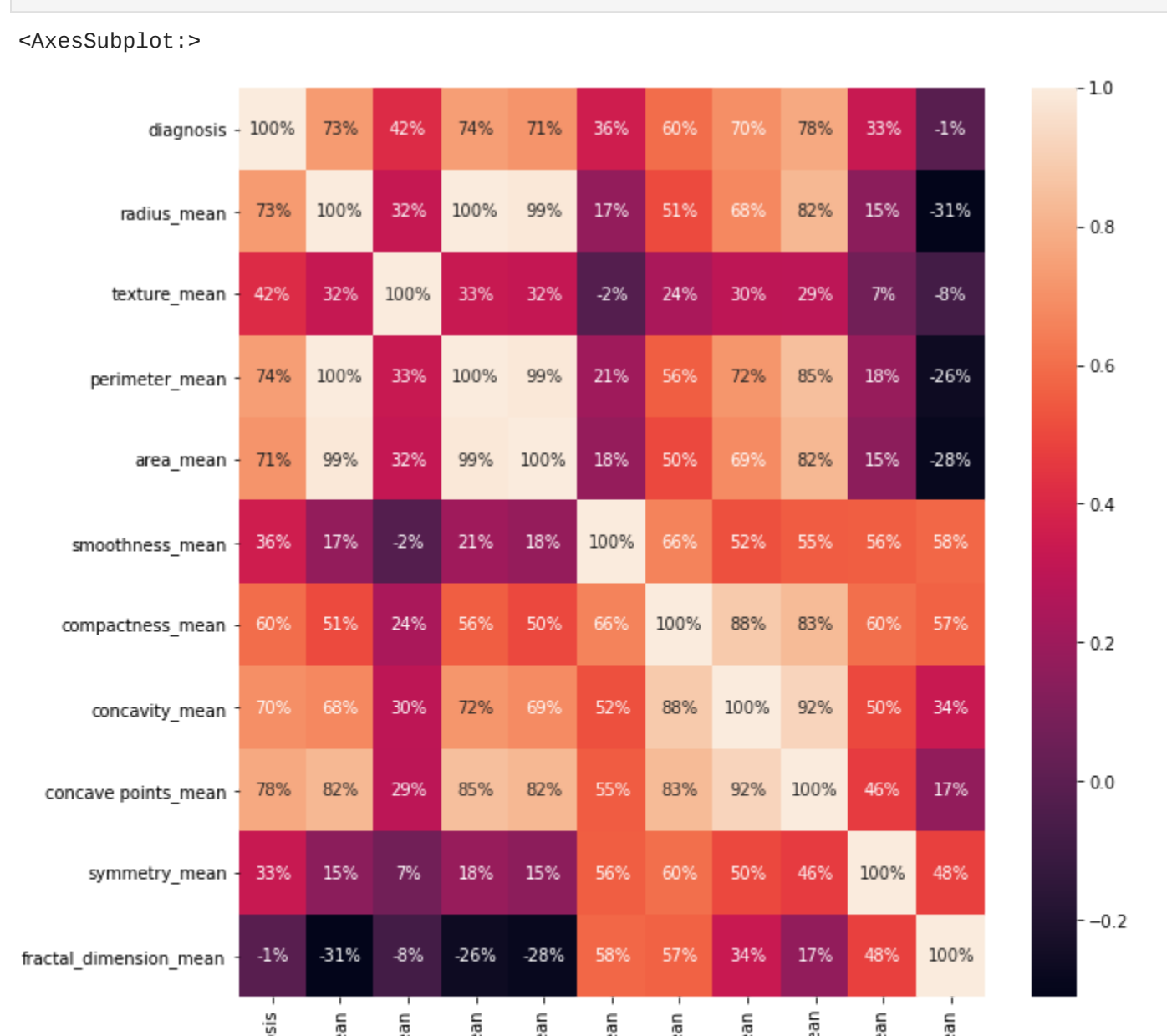
Out[25]: <AxesSubplot:>



In [29]:

```
plt.figure(figsize=(10,10))
sns.heatmap(data.iloc[:,1:12].corr(), annot=True, fmt='.0%')
```

Out[29]: <AxesSubplot:>



In [39]:

```
# Split the data set into independent (X) and dependent (Y) data sets

X = data.iloc[:,1:31].values
Y = data.iloc[:,1].values
```

In [40]:

```
# Split the data set into 75% training and 25% testing

from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size = 0.25, random_state = 0)
```

In [49]:

```
# Scale the data ( Feature Scaling )

from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train_sc = sc.fit_transform(X_train)
X_test_sc = sc.transform(X_test)

X_train
```

Out[49]:

```
array([[0.000e+00, 1.185e+01, 1.746e+01, ..., 1.316e-01, 9.140e-02,
        3.101e-01],
       [0.000e+00, 1.122e+01, 1.986e+01, ..., 1.335e-02, 2.022e-02,
        3.292e-01],
       [1.000e+00, 2.013e+01, 2.825e+01, ..., 3.215e-01, 1.628e-01,
        2.572e-01],
       ...,
       [0.000e+00, 9.436e+00, 1.832e+01, ..., 1.144e-01, 5.052e-02,
        2.454e-01],
       [0.000e+00, 9.720e+00, 1.822e+01, ..., 0.000e+00, 0.000e+00,
        1.909e-01],
       [0.000e+00, 1.151e+01, 2.393e+01, ..., 3.630e-01, 9.653e-02,
        2.112e-01]])
```

In [55]:

```
# Breast Cancer Detection Machine Learning Model Building
# Create a function for the model

def models(X_train, Y_train):

    # Logistic Regression
    from sklearn.linear_model import LogisticRegression
    logreg = LogisticRegression(random_state = 0)
    logreg.fit(X_train, Y_train)



    # Decision Tree Classifier
    from sklearn.tree import DecisionTreeClassifier
    dectree = DecisionTreeClassifier(criterion = 'entropy', random_state = 0)
    dectree.fit(X_train, Y_train)



    # Random Forest Classifier
    from sklearn.ensemble import RandomForestClassifier
    ranforest = RandomForestClassifier(n_estimators = 10, criterion = 'entropy', random_state = 0)
    ranforest.fit(X_train_sc, Y_train)




    # Print the models accuracy on the training data
    print('[0]Logistic Regression Training Accuracy:', logreg.score(X_train, Y_train))
    print('[1]Decision Tree Classifier Training Accuracy:', dectree.score(X_train, Y_train))
    print('[2]Random Forest Classifier Training Accuracy:', ranforest.score(X_train, Y_train))

    return logreg, dectree, ranforest
```

In [54]:

```
# Getting all of the models

model = models(X_train, Y_train)
```

```
[0]Logistic Regression Training Accuracy: 0.9953051643192489
[1]Decision Tree Classifier Training Accuracy: 1.0
[2]Random Forest Classifier Training Accuracy: 0.3732394366197183
```

```
C:\Users\taluk\anaconda3\lib\site-packages\sklearn\linear_model\_logistic.py:763: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

In [58]:

```
# Test model accuracy on test data on confusion matrix

from sklearn.metrics import confusion_matrix

for i in range(len(model)):
    print('Model ', i)
    cm = confusion_matrix(Y_test, model[i].predict(X_test))

    TP = cm[0][0]
    TN = cm[1][1]
    FN = cm[1][0]
    FP = cm[0][1]

    print(cm)
    print('Testing Accuracy = ', (TP + TN)/ (TP + TN + FN + FP))
    print()
```

```
Model  0
[[88  2]
 [ 0 53]]
Testing Accuracy =  0.986013986013986

Model  1
[[90  0]
 [ 0 53]]
Testing Accuracy =  1.0

Model  2
[[ 0 90]
 [ 0 53]]
Testing Accuracy =  0.3706293706293706
```

In [74]:

```
# Show another way to get metrics of the models

from sklearn.metrics import classification_report
from sklearn.metrics import accuracy_score

for i in range( len(model) ):
    print('Model ', i)
    print( classification_report(Y_test, model[i].predict(X_test)))
    print( accuracy_score(Y_test, model[i].predict(X_test)))
    print()
```

```
Model  0
              precision    recall  f1-score   support

           0       1.00      0.98      0.99        90
           1       0.96      1.00      0.98        53

    accuracy                           0.99       143
   macro avg       0.98      0.99      0.99       143
weighted avg       0.99      0.99      0.99       143

0.986013986013986

Model  1
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        90
           1       1.00      1.00      1.00        53

    accuracy                           1.00       143
   macro avg       1.00      1.00      1.00       143
weighted avg       1.00      1.00      1.00       143

1.0

Model  2
              precision    recall  f1-score   support

           0       0.00      0.00      0.00        90
           1       0.37      1.00      0.54        53

    accuracy                           0.37       143
   macro avg       0.19      0.50      0.27       143
weighted avg       0.14      0.37      0.20       143

0.3706293706293706
```

```
C:\Users\taluk\anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined a
nd being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\taluk\anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined a
nd being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\taluk\anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined a
nd being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

In [75]:

```
# Print the prediction of Random Forest Classifier Model

predict = model[2].predict(X_test)
print(predict)
print()
print(Y_test)
```

```
[1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1]

[1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 0 0 1 0 0 1 0 1 0 1 0 1 0 1 0
 1 0 1 1 0 1 0 0 1 0 0 0 1 1 1 1 0 0 0 0 0 0 1 1 1 0 0 1 0 1 1 1 0 0 1 0 1
 1 0 0 0 0 0 1 1 1 0 1 0 0 0 1 1 0 1 0 1 0 0 1 0 0 0 0 0 0 0 1 0 1 0 1 1 0
 1 1 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 1 0 0 0 0 0 0 1 1 0 0 0 1]
```

In [ ]:

In [ ]:

In [ ]:

In [ ]: