IMPORTING MODULES

In [1]:

```
import numpy as np

# dataa split
from sklearn.model_selection import train_test_split

# model Evaluation
from sklearn import metrics

#navie bayesian and accuracy
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import accuracy_score

#pandas
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
plt.style.use('seaborn')
```

In [2]:

```
import seaborn as sns
import plotly.express as px

# SMOTE
from imblearn.over_sampling import SMOTE

# scaling
from sklearn.preprocessing import StandardScaler

# tune
from sklearn.model_selection import RandomizedSearchCV
```

READING THE DATASET

In [3]:

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

Out[3]:

	id	gender	age	hypertension	heart_disease	ever_married	work_type	Residence_type
0	9046	Male	67	0	1	Yes	Private	Urban
1	31112	Male	80	0	1	Yes	Private	Rural
2	60182	Female	49	0	0	Yes	Private	Urban
3	1665	Female	79	1	0	Yes	Self-employed	Rural
4	56669	Male	81	0	0	Yes	Private	Urban
...	...	...	...	...	...	...	...	...
3421	68398	Male	82	1	0	Yes	Self-employed	Rural
3422	45010	Female	57	0	0	Yes	Private	Rural
3423	44873	Female	81	0	0	Yes	Self-employed	Urban

	id	gender	age	hypertension	heart_disease	ever_married	work_type	Residence_type
3424	19723	Female	35	0	0	Yes	Self-employed	Rural
3425	37544	Male	51	0	0	Yes	Private	Rural

3426 rows × 12 columns

DATA ENCODING (PREPARATION)

In [4]:

```
# convert string to numeric using map

# gender
data['gender'] = data['gender'].map({
'Male': int(0),
'Female':int(1),
'Other':int(2)})

# ever_married
data['ever_married'] =data['ever_married'].map({
'Yes':int(1),
'No':int(0)})

# work_type
data['work_type'] = data['work_type'].map({
'Private':int(3),
'Self-employed':int(4),
'Govt_job':int(2),
'children':int(1),
'Never_worked':int(0)})

# Residence_type
data['Residence_type'] = data['Residence_type'].map({
'Urban':int(2),
'Rural':int(1)})

# smoking_status
data['smoking_status'] = data['smoking_status'].map({
'formerly smoked':int(1),
'never smoked':int(2),
'smokes':int(3),
'Unknown':int(0)})
```

In [5]:

```
### attributes used in the classification
```

In [6]:

```
x=data[['gender','age','hypertension','heart_disease','ever_married','work_ty
y=data[['stroke']]
x=x.values
y=y.values
```

SPLIT DATASET

In [7]:

```
from sklearn.model_selection import train_test_split
```

```
from sklearn.datasets import load_iris
```

In [8]:
```
X_train, X_test, y_train, y_test = train_test_split(x, y, test_size = 0.20,ra
```

In [9]:
```
print(X_train.shape)
print(X_test.shape)
```

```
(2740, 10)
(686, 10)
```

In [10]:
```
y_train=y_train.flatten()
y_test=y_test.flatten()
print(y_train.shape)
print(y_test.shape)
```

```
(2740,)
(686,)
```

Different numbers of hidden nodes

In [11]:
```
import tensorflow as tf
from keras.models import Sequential
from keras.layers import Dense
import matplotlib.pyplot as plt
import math
```

In [12]:
```
testerr=[]
```

In [13]:
```
hiddennodes=[1,2,3,math.sqrt(11),(math.sqrt(11))/2]
```

In [14]:
```
# define keras model
model=tf.keras.Sequential()

model.add(tf.keras.layers.Dense(1,activation='relu'))

#compile keras model
model.compile('adam','binary_crossentropy',metrics=['accuracy'])

history = model.fit(X_train, y_train, validation_data=(X_test, y_test),verbos
test_loss = history.history['val_loss']
testerr.append(test_loss)
```

```
86/86 [==============================] - 1s 5ms/step - loss: 14.4723 - accura
cy: 0.0509 - val_loss: 14.2712 - val_accuracy: 0.0641
```

In [15]:
```
# define keras model
model=tf.keras.Sequential()

model.add(tf.keras.layers.Dense(2,activation='relu'))

#compile keras model
model.compile('adam','binary_crossentropy',metrics=['accuracy'])
```

```
history = model.fit(X_train, y_train, validation_data=(X_test, y_test),verbos
test_loss = history.history['val_loss']
testerr.append(test_loss)
```

```
86/86 [==============================] - 0s 2ms/step - loss: 14.4484 - accura
cy: 0.3214 - val_loss: 14.2156 - val_accuracy: 0.4082
```

In [16]:

```
# define keras model
model=tf.keras.Sequential()

model.add(tf.keras.layers.Dense(3,activation='relu'))

#compile keras model
model.compile('adam','binary_crossentropy',metrics=['accuracy'])

history = model.fit(X_train, y_train, validation_data=(X_test, y_test),verbos
test_loss = history.history['val_loss']
testerr.append(test_loss)
```

```
86/86 [==============================] - 0s 3ms/step - loss: 9.9244 - accurac
y: 0.0481 - val_loss: 9.8439 - val_accuracy: 0.0641
```

In [17]:

```
# define keras model
model=tf.keras.Sequential()

model.add(tf.keras.layers.Dense(math.sqrt(11),activation='relu'))

#compile keras model
model.compile('adam','binary_crossentropy',metrics=['accuracy'])

history = model.fit(X_train, y_train, validation_data=(X_test, y_test),verbos
test_loss = history.history['val_loss']
testerr.append(test_loss)
```

```
86/86 [==============================] - 0s 2ms/step - loss: 9.2727 - accurac
y: 0.9519 - val_loss: 8.3349 - val_accuracy: 0.9359
```

In [18]:

```
# define keras model
model=tf.keras.Sequential()

model.add(tf.keras.layers.Dense((math.sqrt(11))/2,activation='relu'))

#compile keras model
model.compile('adam','binary_crossentropy',metrics=['accuracy'])

history = model.fit(X_train, y_train, validation_data=(X_test, y_test),verbos
test_loss = history.history['val_loss']
testerr.append(test_loss)
```

```
86/86 [==============================] - 0s 2ms/step - loss: 0.7258 - accurac
y: 0.9530 - val_loss: 0.9894 - val_accuracy: 0.9359
```

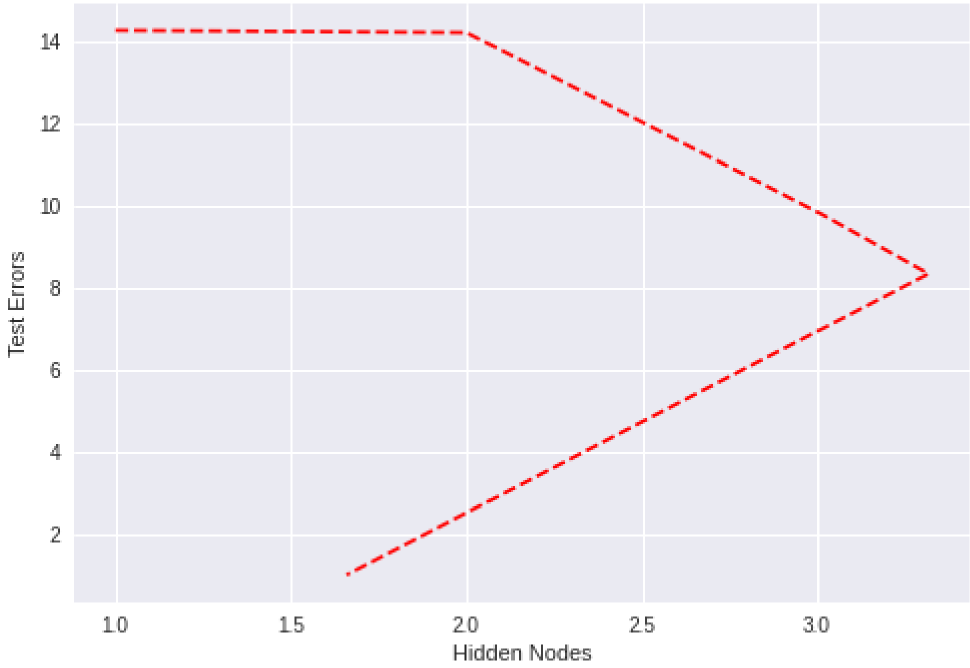
In [19]:

```
print(testerr)
```

```
[[14.27115249633789], [14.215579986572266], [9.843886375427246], [8.334875106
811523], [0.9893553256988525]]
```

In [20]:

```
plt.plot(hiddennodes, testerr, 'r--')
plt.xlabel('Hidden Nodes')
plt.ylabel('Test Errors')
plt.show();
```



INFERENCES

The above graph shows that Test error is high at Hidden node 1 and 2.

When it increases, the test error decreases.

When hidden node is half of sqrt(attributes), it even decreases.

As the process goes, the test error decreases.