```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
plt.rcParams['figure.dpi'] = 100
```

```
!wget -q -O /content/drive/MyDrive/Colab\ Notebooks/Diabetes.csv https://raw.
```

```
!head -5 /content/drive/MyDrive/Colab\ Notebooks/Diabetes.csv
```

```
Pregnancies,Glucose,BloodPressure,SkinThickness,Insulin,BMI,DiabetesPedigreeFunction,Age,Outcome
6,148,72,35,0,33.6,0.627,50,1
1,85,66,29,0,26.6,0.351,31,0
8,183,64,0,0,23.3,0.672,32,1
1,89,66,23,94,28.1,0.167,21,0
```

```
df = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/Diabetes.csv')
df.shape
df.head(5)
df.describe()
```

```
(768, 9)
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
count	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000
mean	3.845052	120.894531	69.105469	20.536458	79.799479	31.992578	0.471876	33.240885	0.348958
std	3.369578	31.972618	19.355807	15.952218	115.244002	7.884160	0.331329	11.760232	0.476951
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.078000	21.000000	0.000000
25%	1.000000	99.000000	62.000000	0.000000	0.000000	27.300000	0.243750	24.000000	0.000000
50%	3.000000	117.000000	72.000000	23.000000	30.500000	32.000000	0.372500	29.000000	0.000000
75%	6.000000	140.250000	80.000000	32.000000	127.250000	36.600000	0.626250	41.000000	1.000000
max	17.000000	199.000000	122.000000	99.000000	846.000000	67.100000	2.420000	81.000000	1.000000

```
!pip install -q -U keras_tuner
```

```
!cp -r /content/drive/MyDrive/Colab\ Notebooks/Diabetes.csv .
```

```
!ls -l
```

```
total 0
drwxr-xr-x 1 root root 4096 Jan  8 14:37 drive
drwxr-xr-x 1 root root 4096 Jan  8 14:37 sample_data
```

```
df.info()
```

```
<class'pandas.core.frame.DataFrame'>
RangeIndex:768 entries,0 to 767
Data columns(total 9 columns):
 #   Column                    Non-Nullcount  Dtype
---  ------                    --------------  -----
 0   Pregnancies               768 non-Null    int64
 1   Glucose                   768 non-Null    int64
 2   BloodPressure             768 non-Null    int64
 3   SkinThickness             768 non-Null    int64
 4   Insulin                   768 non-Null    int64
 5   BMI                       768 non-Null    float64
 6   DiabetesPedigreeFunction  768 non-Null    float64
 7   Age                       768 non-Null    int64
 8   Outcome                   768 non-Null    int64
dtypes:float64(2),int64(7)
memory usage:54.0 KB
```

```
df.isnull().sum()
```

```
Pregnancies               0
Glucose                   0
BloodPressure             0
SkinThickness             0
Insulin                   0
BMI                       0
DiabetesPedigreeFunction  0
Age                       0
Outcome                   0
dtypes:int64 0
```

```
df.isnull().any()
```

```
Pregnancies               False
Glucose                   False
BloodPressure             False
SkinThickness             False
Insulin                   False
BMI                       False
DiabetesPedigreeFunction  False
Age                       False
Outcome                   False
dtypes:bool False
```

```
df.duplicated().sum()
```

```
np.int64(0)
```

```
df.duplicated()
```

```
0    False
1    False
2    False
3    False
4    False
dtypes:bool False
```

```
df.nunique()
```

```
Pregnancies               17
Glucose                   136
BloodPressure             47
SkinThickness             51
Insulin                   186
BMI                       248
DiabetesPedigreeFunction  517
Age                       52
Outcome                   2
dtypes:int64 17
```

```
df.corr()
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
Pregnancies	1.000000	0.129459	0.141282	-0.081672	-0.073535	0.017683	-0.033523	0.544341	0.221898
Glucose	0.129459	1.000000	0.152590	0.057328	0.331357	0.221071	0.137337	0.263514	0.466581
BloodPressure	0.141282	0.152590	1.000000	0.207371	0.088933	0.281805	0.041265	0.239528	0.065068
SkinThickness	-0.081672	0.057328	0.207371	1.000000	0.436783	0.392573	0.183928	-0.113970	0.074752
Insulin	-0.073535	0.331357	0.088933	0.436783	1.000000	0.197859	0.185071	-0.042163	0.130548
BMI	0.017683	0.221071	0.281805	0.392573	0.197859	1.000000	0.140647	0.036242	0.292695
DiabetesPedigreeFunction	-0.033523	0.137337	0.041265	0.183928	0.185071	0.140647	1.000000	0.033561	0.173844
Age	0.544341	0.263514	0.239528	-0.113970	-0.042163	0.036242	0.033561	1.000000	0.238356
Outcome	0.221898	0.466581	0.065068	0.074752	0.130548	0.292695	0.173844	0.238356	1.000000

```
df.describe()
```

```
Shape: (1, 1, 1, 1)
Value: [[[[0.]]]]
Type: <class 'numpy.ndarray'>
```

```
```

```
Index: 1460 entries, 0 to 1459
Data columns (total 81):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Id             1460 non-null   int64
 1   MSSubClass     1460 non-null   int64
 2   MSZoning       1460 non-null   object
 3   LotFrontage    1201 non-null   float64
 4   LotArea        1460 non-null   int64
 5   Street         1460 non-null   object
 6   Alley          91 non-null     object
 7   LotShape       1460 non-null   object
 8   LandContour    1460 non-null   object
 9   Utilities      1460 non-null   object
 10  LotConfig      1460 non-null   object
 11  LandSlope      1460 non-null   object
 12  Neighborhood   1460 non-null   object
 13  Condition1     1460 non-null   object
 14  Condition2     1460 non-null   object
 15  BldgType       1460 non-null   object
 16  HouseStyle     1460 non-null   object
 17  OverallQual    1460 non-null   int64
 18  OverallCond    1460 non-null   int64
 19  YearBuilt      1460 non-null   int64
 20  YearRemodAdd   1460 non-null   int64
 21  RoofStyle      1460 non-null   object
 22  RoofMatl       1460 non-null   object
 23  Exterior1st    1460 non-null   object
 24  Exterior2nd    1460 non-null   object
 25  MasVnrType     1452 non-null   object
 26  MasVnrArea     1452 non-null   float64
 27  ExterQual      1460 non-null   object
 28  ExterCond      1460 non-null   object
 29  Foundation     1460 non-null   object
 30  BsmtQual       1423 non-null   object
 31  BsmtCond       1423 non-null   object
 32  BsmtExposure   1422 non-null   object
 33  BsmtFinType1   1423 non-null   object
 34  BsmtFinSF1     1460 non-null   int64
 35  BsmtFinType2   1422 non-null   object
 36  BsmtFinSF2     1460 non-null   int64
 37  BsmtUnfSF      1460 non-null   int64
 38  TotalBsmtSF    1460 non-null   int64
 39  Heating        1460 non-null   object
 40  HeatingQC      1460 non-null   object
 41  CentralAir     1460 non-null   object
 42  Electrical     1459 non-null   object
 43  1stFlrSF       1460 non-null   int64
 44  2ndFlrSF       1460 non-null   int64
 45  LowQualFinSF   1460 non-null   int64
 46  GrLivArea      1460 non-null   int64
 47  BsmtFullBath   1460 non-null   int64
 48  BsmtHalfBath   1460 non-null   int64
 49  FullBath       1460 non-null   int64
 50  HalfBath       1460 non-null   int64
 51  BedroomAbvGr   1460 non-null   int64
 52  KitchenAbvGr   1460 non-null   int64
 53  KitchenQual    1460 non-null   object
 54  TotRmsAbvGrd   1460 non-null   int64
 55  Functional     1460 non-null   object
 56  Fireplaces     1460 non-null   int64
 57  FireplaceQu    770 non-null    object
 58  GarageType     1379 non-null   object
 59  GarageYrBlt    1379 non-null   float64
 60  GarageFinish   1379 non-null   object
 61  GarageCars     1460 non-null   int64
 62  GarageArea     1460 non-null   int64
 63  GarageQual     1379 non-null   object
 64  GarageCond     1379 non-null   object
 65  PavedDrive     1460 non-null   object
 66  WoodDeckSF     1460 non-null   int64
 67  OpenPorchSF    1460 non-null   int64
 68  EnclosedPorch  1460 non-null   int64
 69  3SsnPorch      1460 non-null   int64
 70  ScreenPorch    1460 non-null   int64
 71  PoolArea       1460 non-null   int64
 72  PoolQC         7 non-null      object
 73  Fence          281 non-null    object
 74  MiscFeature    54 non-null     object
 75  MiscVal        1460 non-null   int64
 76  MoSold         1460 non-null   int64
 77  YrSold         1460 non-null   int64
 78  SaleType       1460 non-null   object
 79  SaleCondition  1460 non-null   object
 80  SalePrice      1460 non-null   int64
dtypes: float64(3), int64(38), object(40)
memory usage: 924.7 KB
```

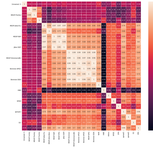
```
[Id, MSSubClass, MSZoning, LotFrontage, LotArea, Street, Alley, LotShape,
 LandContour, Utilities, LotConfig, LandSlope, Neighborhood, Condition1,
 Condition2, BldgType, HouseStyle, OverallQual, OverallCond, YearBuilt,
 YearRemodAdd, RoofStyle, RoofMatl, Exterior1st, Exterior2nd, MasVnrType,
 MasVnrArea, ExterQual, ExterCond, Foundation, BsmtQual, BsmtCond,
 BsmtExposure, BsmtFinType1, BsmtFinSF1, BsmtFinType2, BsmtFinSF2,
 BsmtUnfSF, TotalBsmtSF, Heating, HeatingQC, CentralAir, Electrical,
 1stFlrSF, 2ndFlrSF, LowQualFinSF, GrLivArea, BsmtFullBath, BsmtHalfBath,
 FullBath, HalfBath, BedroomAbvGr, KitchenAbvGr, KitchenQual, TotRmsAbvGrd,
 Functional, Fireplaces, FireplaceQu, GarageType, GarageYrBlt, GarageFinish,
 GarageCars, GarageArea, GarageQual, GarageCond, PavedDrive, WoodDeckSF,
 OpenPorchSF, EnclosedPorch, 3SsnPorch, ScreenPorch, PoolArea, PoolQC,
 Fence, MiscFeature, MiscVal, MoSold, YrSold, SaleType, SaleCondition,
 SalePrice]
```

```
Id               0
MSSubClass       0
MSZoning         0
LotFrontage    259
LotArea          0
Street           0
Alley         1369
LotShape         0
LandContour      0
Utilities        0
LotConfig        0
LandSlope        0
Neighborhood     0
Condition1       0
Condition2       0
BldgType         0
HouseStyle       0
OverallQual      0
OverallCond      0
YearBuilt        0
YearRemodAdd     0
RoofStyle        0
RoofMatl         0
Exterior1st      0
Exterior2nd      0
MasVnrType       8
MasVnrArea       8
ExterQual        0
ExterCond        0
Foundation       0
BsmtQual        37
BsmtCond        37
BsmtExposure    38
BsmtFinType1    37
BsmtFinSF1       0
BsmtFinType2    38
BsmtFinSF2       0
BsmtUnfSF        0
TotalBsmtSF      0
Heating          0
HeatingQC        0
CentralAir       0
Electrical       1
1stFlrSF         0
2ndFlrSF         0
LowQualFinSF     0
GrLivArea        0
BsmtFullBath     0
BsmtHalfBath     0
FullBath         0
HalfBath         0
BedroomAbvGr     0
KitchenAbvGr     0
KitchenQual      0
TotRmsAbvGrd     0
Functional       0
Fireplaces       0
FireplaceQu    690
GarageType      81
GarageYrBlt     81
GarageFinish    81
GarageCars       0
GarageArea       0
GarageQual      81
GarageCond      81
PavedDrive       0
WoodDeckSF       0
OpenPorchSF      0
EnclosedPorch    0
3SsnPorch        0
ScreenPorch      0
PoolArea         0
PoolQC        1453
Fence         1179
MiscFeature   1406
MiscVal          0
MoSold           0
YrSold           0
SaleType         0
SaleCondition    0
SalePrice        0
dtype: int64
```

```
Id               1460
MSSubClass         15
MSZoning            5
LotFrontage       110
LotArea          1073
Street              2
Alley               2
LotShape            4
LandContour         4
Utilities           2
LotConfig           5
LandSlope           3
Neighborhood       25
Condition1          9
Condition2          8
BldgType            5
HouseStyle          8
OverallQual        10
OverallCond         9
YearBuilt          112
YearRemodAdd        61
RoofStyle           6
RoofMatl            8
Exterior1st        15
Exterior2nd        16
MasVnrType          4
MasVnrArea        327
ExterQual           4
ExterCond           5
Foundation          6
BsmtQual            4
BsmtCond            4
BsmtExposure        4
BsmtFinType1        6
BsmtFinSF1        637
BsmtFinType2        6
BsmtFinSF2        144
BsmtUnfSF         780
TotalBsmtSF       721
Heating             6
HeatingQC           5
CentralAir          2
Electrical          5
1stFlrSF          753
2ndFlrSF          417
LowQualFinSF       24
GrLivArea         861
BsmtFullBath        4
BsmtHalfBath        3
FullBath            4
HalfBath            3
BedroomAbvGr        8
KitchenAbvGr        4
KitchenQual         4
TotRmsAbvGrd       12
Functional          7
Fireplaces          4
FireplaceQu         5
GarageType          6
GarageYrBlt       103
GarageFinish        3
GarageCars          5
GarageArea        441
GarageQual          5
GarageCond          5
PavedDrive          3
WoodDeckSF        274
OpenPorchSF       202
EnclosedPorch     120
3SsnPorch          24
ScreenPorch        76
PoolArea           8
PoolQC             3
Fence              4
MiscFeature        4
MiscVal           21
MoSold            12
YrSold             5
SaleType           9
SaleCondition      6
SalePrice        663
dtype: int64
```

```
Id               int64
MSSubClass       int64
LotFrontage    float64
LotArea          int64
OverallQual      int64
OverallCond      int64
YearBuilt        int64
YearRemodAdd     int64
MasVnrArea     float64
BsmtFinSF1       int64
BsmtFinSF2       int64
BsmtUnfSF        int64
TotalBsmtSF      int64
1stFlrSF         int64
2ndFlrSF         int64
LowQualFinSF     int64
GrLivArea        int64
BsmtFullBath     int64
BsmtHalfBath     int64
FullBath         int64
HalfBath         int64
BedroomAbvGr     int64
KitchenAbvGr     int64
TotRmsAbvGrd     int64
Fireplaces       int64
GarageYrBlt    float64
GarageCars       int64
GarageArea       int64
WoodDeckSF       int64
OpenPorchSF      int64
EnclosedPorch    int64
3SsnPorch        int64
ScreenPorch      int64
PoolArea         int64
MiscVal          int64
MoSold           int64
YrSold           int64
SalePrice        int64
dtype: int64
```

```
Id               object
MSSubClass       object
MSZoning         object
Street           object
Alley            object
LotShape         object
LandContour      object
Utilities        object
LotConfig        object
LandSlope        object
Neighborhood     object
Condition1       object
Condition2       object
BldgType         object
HouseStyle       object
OverallQual      object
OverallCond      object
YearBuilt        object
YearRemodAdd     object
RoofStyle        object
RoofMatl         object
Exterior1st      object
Exterior2nd      object
MasVnrType       object
ExterQual        object
ExterCond        object
Foundation       object
BsmtQual         object
BsmtCond         object
BsmtExposure     object
BsmtFinType1     object
BsmtFinType2     object
Heating          object
HeatingQC        object
CentralAir       object
Electrical       object
KitchenQual      object
Functional       object
FireplaceQu      object
GarageType       object
GarageFinish     object
GarageQual       object
GarageCond       object
PavedDrive       object
PoolQC           object
Fence            object
MiscFeature      object
SaleType         object
SaleCondition    object
dtype: object
```


Unknown
Mortgage
Rent
Own
Other
Unknown
Fully Paid
Charged Off
Current
Late (31-120)
Late (16-30)
In Grace Period
Default
Unknown
Verified
Source Verified
Not Verified
Unknown
Other
Medical
Home Improvement
Educational
Small Business
Vacation
Wedding
Car
Moving
Major Purchase
House
Renewable Energy
Unknown
Individual
Joint App
Unknown
Cash
Not Applicable
Unknown
Whole
Fractional
Unknown
Unknown
Unknown