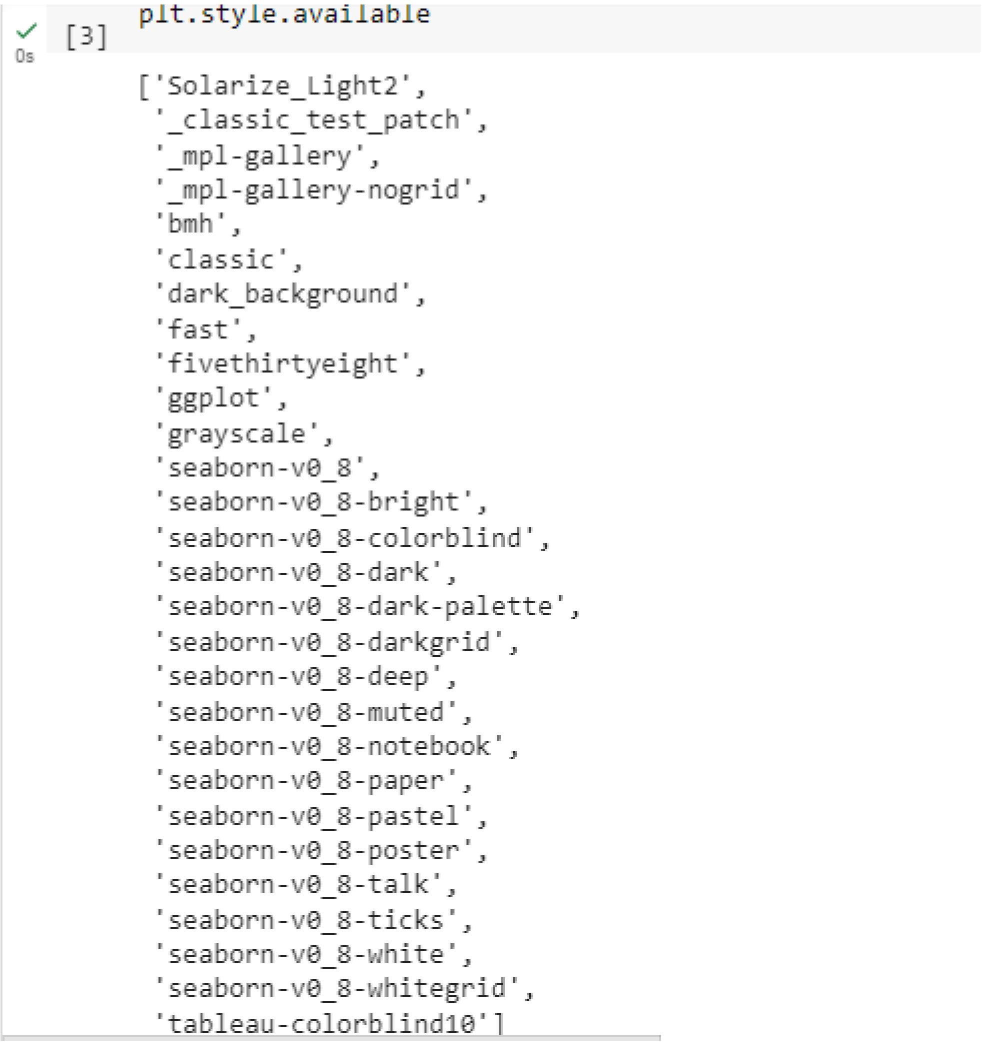
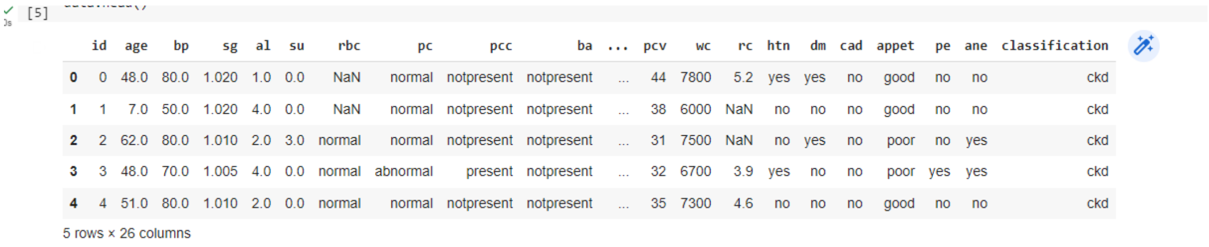
3 RESULT



```
[3]  plt.style.available

['Solarize_Light2',
 '_classic_test_patch',
 '_mpl-gallery',
 '_mpl-gallery-nogrid',
 'bmh',
 'classic',
 'dark_background',
 'fast',
 'fivethirtyeight',
 'ggplot',
 'grayscale',
 'seaborn-v0_8',
 'seaborn-v0_8-bright',
 'seaborn-v0_8-colorblind',
 'seaborn-v0_8-dark',
 'seaborn-v0_8-dark-palette',
 'seaborn-v0_8-darkgrid',
 'seaborn-v0_8-deep',
 'seaborn-v0_8-muted',
 'seaborn-v0_8-notebook',
 'seaborn-v0_8-paper',
 'seaborn-v0_8-pastel',
 'seaborn-v0_8-poster',
 'seaborn-v0_8-talk',
 'seaborn-v0_8-ticks',
 'seaborn-v0_8-white',
 'seaborn-v0_8-whitegrid',
 'tableau-colorblind10']
```

Read the Dataset

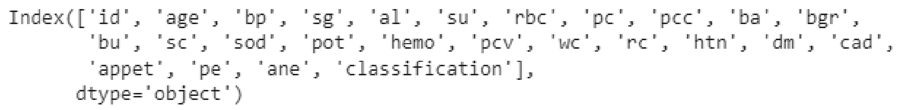


```
[5]  data.head()
```

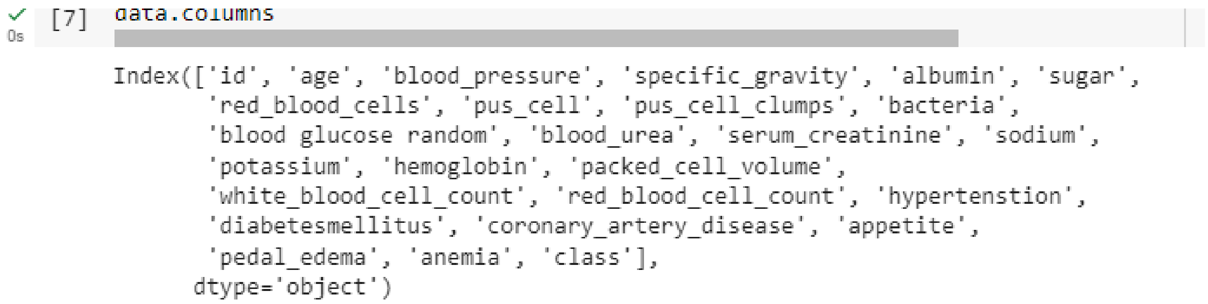
	id	age	bp	sg	al	su	rbc	pc	pcc	ba	...	pcv	wc	rc	htn	dm	cad	appet	pe	ane	classification
0	0	48.0	80.0	1.020	1.0	0.0	NaN	normal	notpresent	notpresent	...	44	7800	5.2	yes	yes	no	good	no	no	ckd
1	1	7.0	50.0	1.020	4.0	0.0	NaN	normal	notpresent	notpresent	...	38	6000	NaN	no	no	no	good	no	no	ckd
2	2	62.0	80.0	1.010	2.0	3.0	normal	normal	notpresent	notpresent	...	31	7500	NaN	no	yes	no	poor	no	yes	ckd
3	3	48.0	70.0	1.005	4.0	0.0	normal	abnormal	present	notpresent	...	32	6700	3.9	yes	no	no	poor	yes	yes	ckd
4	4	51.0	80.0	1.010	2.0	0.0	normal	normal	notpresent	notpresent	...	35	7300	4.6	no	no	no	good	no	no	ckd

5 rows × 26 columns

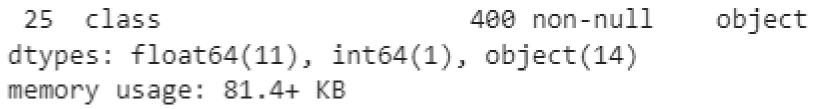
Rename the column



```
Index(['id', 'age', 'bp', 'sg', 'al', 'su', 'rbc', 'pc', 'pcc', 'ba', 'bgr',
       'bu', 'sc', 'sod', 'pot', 'hemo', 'pcv', 'wc', 'rc', 'htn', 'dm', 'cad',
       'appet', 'pe', 'ane', 'classification'],
      dtype='object')
```

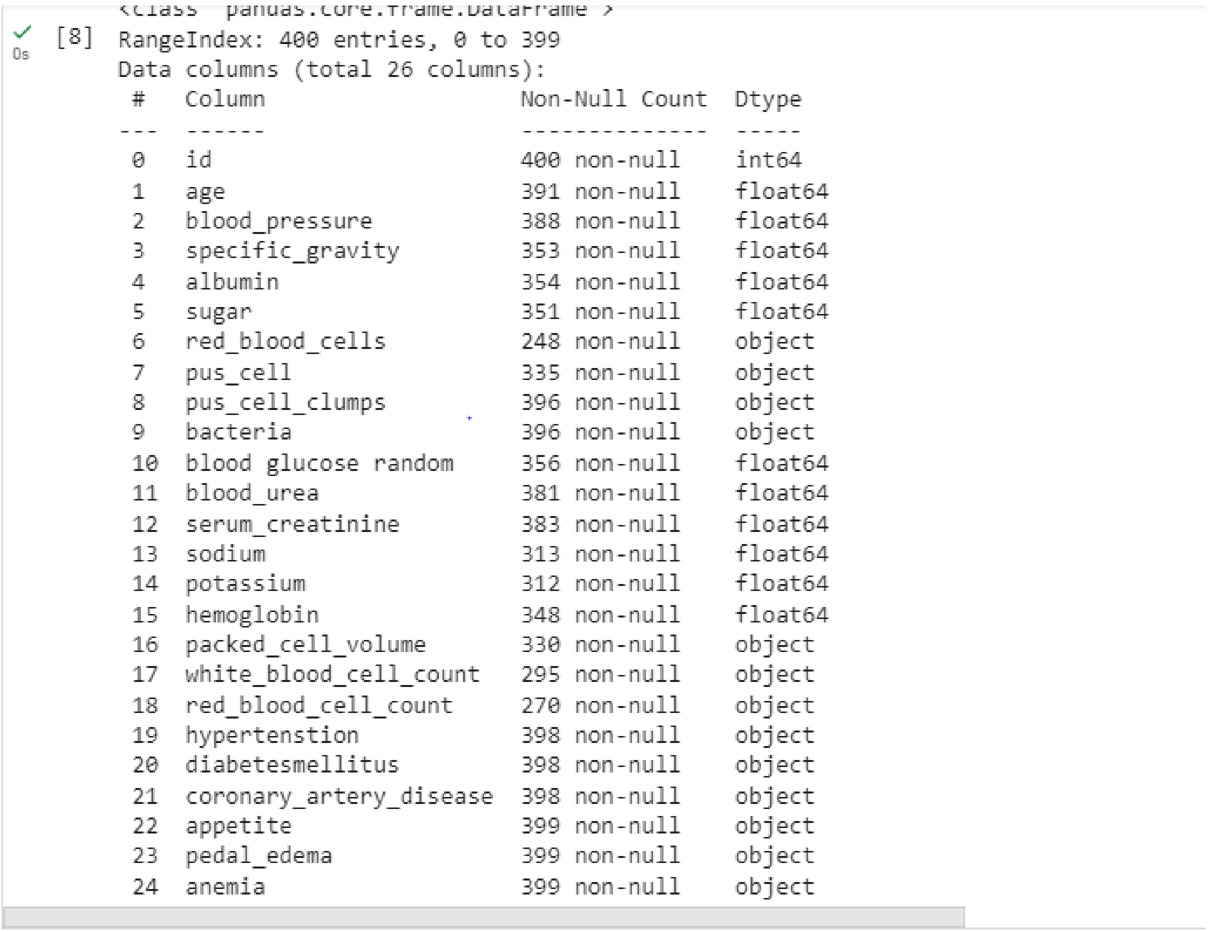


```
[7] data.columns

Index(['id', 'age', 'blood_pressure', 'specific_gravity', 'albumin', 'sugar',
       'red_blood_cells', 'pus_cell', 'pus_cell_clumps', 'bacteria',
       'blood glucose random', 'blood_urea', 'serum_creatinine', 'sodium',
       'potassium', 'hemoglobin', 'packed_cell_volume',
       'white_blood_cell_count', 'red_blood_cell_count', 'hypertenstion',
       'diabetesmellitus', 'coronary_artery_disease', 'appetite',
       'pedal_edema', 'anemia', 'class'],
      dtype='object')
```

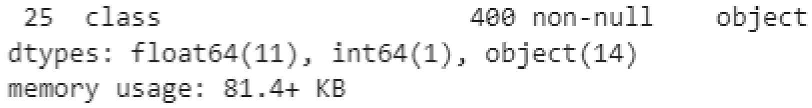


```
 25  class                    400 non-null    object
dtypes: float64(11), int64(1), object(14)
memory usage: 81.4+ KB
```

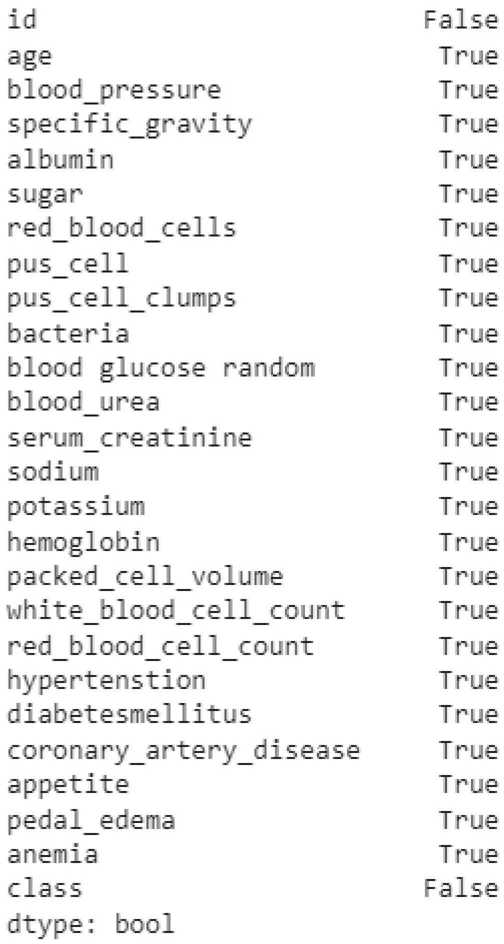
Handling missing values



```
[8] <class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 26 columns):
 #   Column                   Non-Null Count  Dtype  
---  ------                   --------------  -----  
 0   id                       400 non-null    int64  
 1   age                      391 non-null    float64
 2   blood_pressure           388 non-null    float64
 3   specific_gravity         353 non-null    float64
 4   albumin                  354 non-null    float64
 5   sugar                    351 non-null    float64
 6   red_blood_cells          248 non-null    object 
 7   pus_cell                 335 non-null    object 
 8   pus_cell_clumps          396 non-null    object 
 9   bacteria                 396 non-null    object 
 10  blood glucose random     356 non-null    float64
 11  blood_urea               381 non-null    float64
 12  serum_creatinine         383 non-null    float64
 13  sodium                   313 non-null    float64
 14  potassium                312 non-null    float64
 15  hemoglobin               348 non-null    float64
 16  packed_cell_volume       330 non-null    object 
 17  white_blood_cell_count   295 non-null    object 
 18  red_blood_cell_count     270 non-null    object 
 19  hypertenstion            398 non-null    object 
 20  diabetesmellitus         398 non-null    object 
 21  coronary_artery_disease  398 non-null    object 
 22  appetite                 399 non-null    object 
 23  pedal_edema              399 non-null    object 
 24  anemia                   399 non-null    object 
```

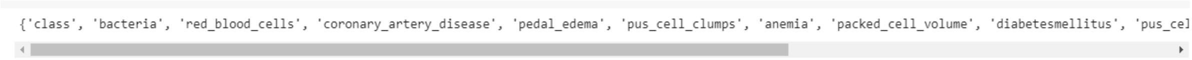


```
 25  class                    400 non-null    object
dtypes: float64(11), int64(1), object(14)
memory usage: 81.4+ KB
```

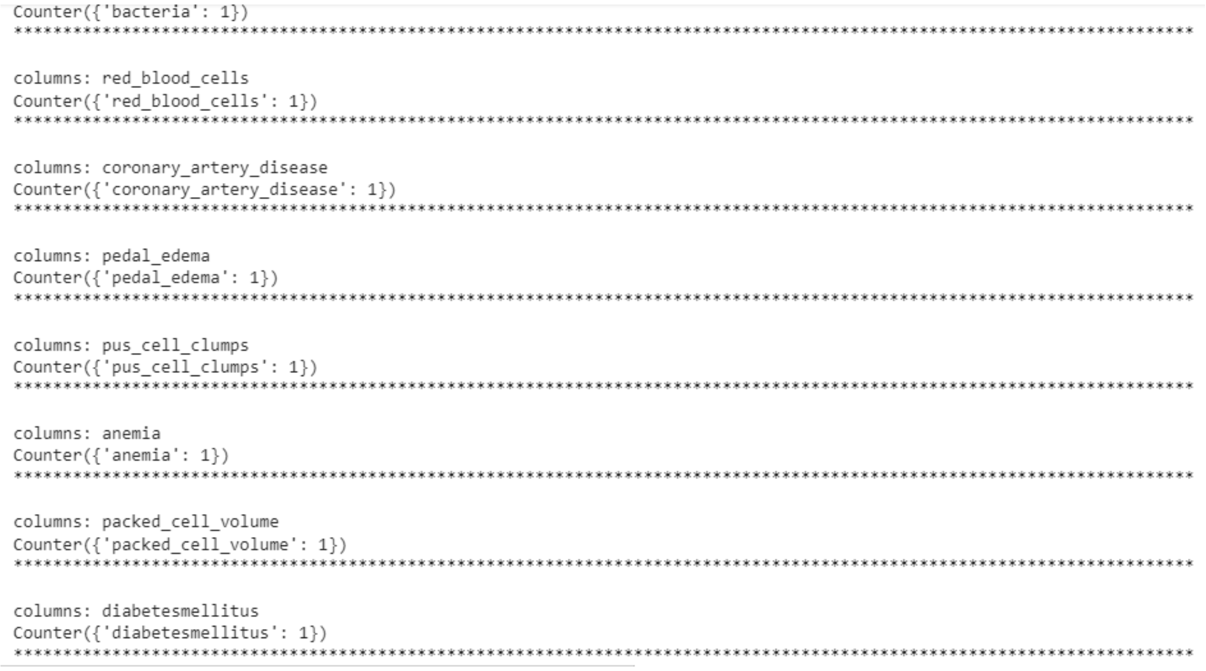


```
id                          False
age                          True
blood_pressure               True
specific_gravity             True
albumin                      True
sugar                        True
red_blood_cells              True
pus_cell                     True
pus_cell_clumps              True
bacteria                     True
blood glucose random         True
blood_urea                   True
serum_creatinine             True
sodium                       True
potassium                    True
hemoglobin                   True
packed_cell_volume           True
white_blood_cell_count       True
red_blood_cell_count         True
hypertenstion                True
diabetesmellitus             True
coronary_artery_disease      True
appetite                     True
pedal_edema                  True
anemia                       True
class                       False
dtype: bool
```

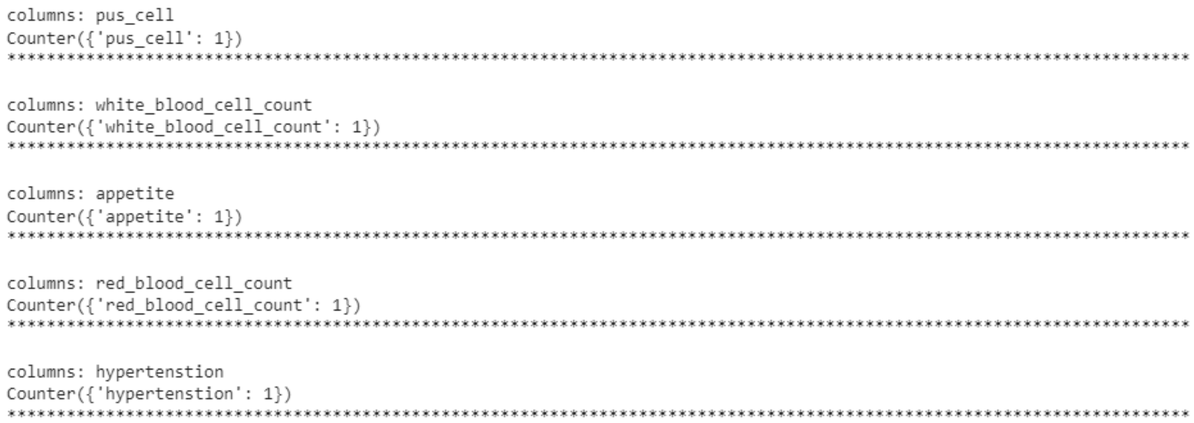
Handling Categorical columns



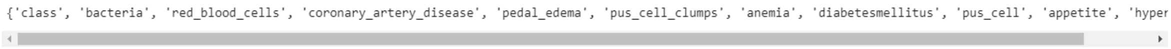
```
{'class', 'bacteria', 'red_blood_cells', 'coronary_artery_disease', 'pedal_edema', 'pus_cell_clumps', 'anemia', 'packed_cell_volume', 'diabetesmellitus', 'pus_cel
```



```
Counter({'bacteria': 1})
************************************************************************************************************************

columns: red_blood_cells
Counter({'red_blood_cells': 1})
************************************************************************************************************************

columns: coronary_artery_disease
Counter({'coronary_artery_disease': 1})
************************************************************************************************************************

columns: pedal_edema
Counter({'pedal_edema': 1})
************************************************************************************************************************

columns: pus_cell_clumps
Counter({'pus_cell_clumps': 1})
************************************************************************************************************************

columns: anemia
Counter({'anemia': 1})
************************************************************************************************************************

columns: packed_cell_volume
Counter({'packed_cell_volume': 1})
************************************************************************************************************************

columns: diabetesmellitus
Counter({'diabetesmellitus': 1})
************************************************************************************************************************
```

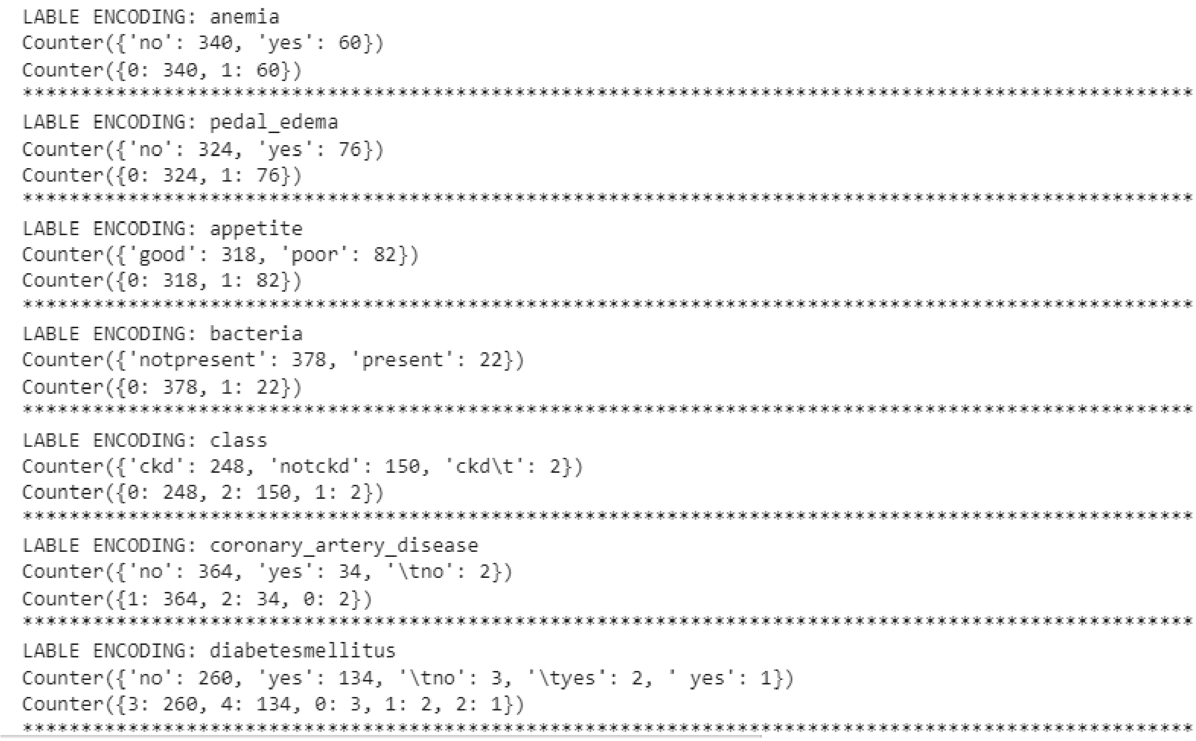


```
columns: pus_cell
Counter({'pus_cell': 1})
************************************************************************************************************************

columns: white_blood_cell_count
Counter({'white_blood_cell_count': 1})
************************************************************************************************************************

columns: appetite
Counter({'appetite': 1})
************************************************************************************************************************

columns: red_blood_cell_count
Counter({'red_blood_cell_count': 1})
************************************************************************************************************************

columns: hypertenstion
Counter({'hypertenstion': 1})
************************************************************************************************************************
```

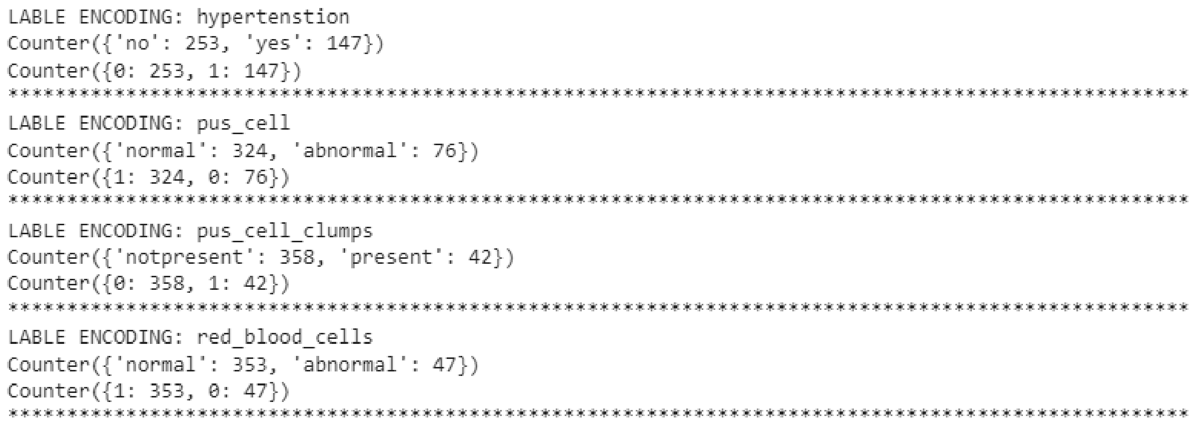


```
{'class', 'bacteria', 'red_blood_cells', 'coronary_artery_disease', 'pedal_edema', 'pus_cell_clumps', 'anemia', 'diabetesmellitus', 'pus_cell', 'appetite', 'hyper
```

Label Encoding for categorical columns

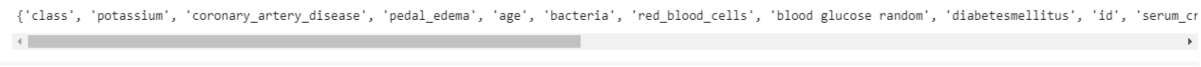


```
LABLE ENCODING: anemia
Counter({'no': 340, 'yes': 60})
Counter({0: 340, 1: 60})
****************************************************************************************************
LABLE ENCODING: pedal_edema
Counter({'no': 324, 'yes': 76})
Counter({0: 324, 1: 76})
****************************************************************************************************
LABLE ENCODING: appetite
Counter({'good': 318, 'poor': 82})
Counter({0: 318, 1: 82})
****************************************************************************************************
LABLE ENCODING: bacteria
Counter({'notpresent': 378, 'present': 22})
Counter({0: 378, 1: 22})
****************************************************************************************************
LABLE ENCODING: class
Counter({'ckd': 248, 'notckd': 150, 'ckd\t': 2})
Counter({0: 248, 2: 150, 1: 2})
****************************************************************************************************
LABLE ENCODING: coronary_artery_disease
Counter({'no': 364, 'yes': 34, '\tno': 2})
Counter({1: 364, 2: 34, 0: 2})
****************************************************************************************************
LABLE ENCODING: diabetesmellitus
Counter({'no': 260, 'yes': 134, '\tno': 3, '\tyes': 2, ' yes': 1})
Counter({3: 260, 4: 134, 0: 3, 1: 2, 2: 1})
****************************************************************************************************
```

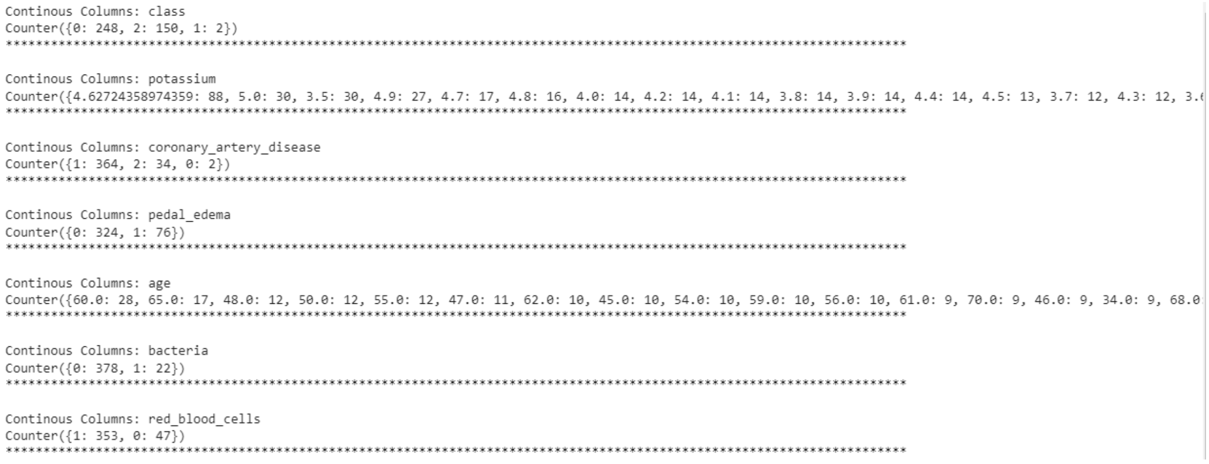


```
LABLE ENCODING: hypertenstion
Counter({'no': 253, 'yes': 147})
Counter({0: 253, 1: 147})
****************************************************************************************************
LABLE ENCODING: pus_cell
Counter({'normal': 324, 'abnormal': 76})
Counter({1: 324, 0: 76})
****************************************************************************************************
LABLE ENCODING: pus_cell_clumps
Counter({'notpresent': 358, 'present': 42})
Counter({0: 358, 1: 42})
****************************************************************************************************
LABLE ENCODING: red_blood_cells
Counter({'normal': 353, 'abnormal': 47})
Counter({1: 353, 0: 47})
****************************************************************************************************
```

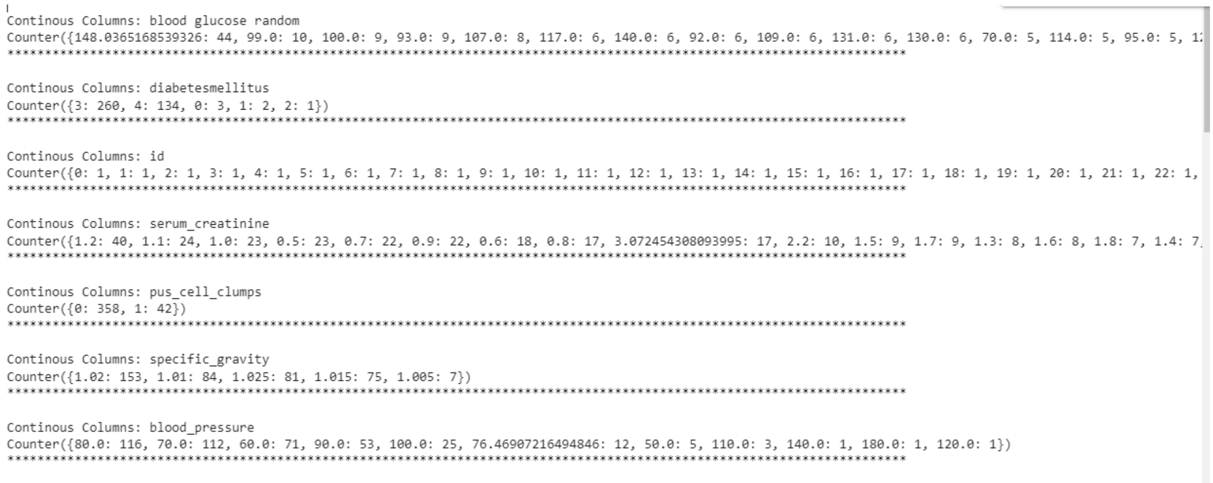
Handling Numrical columns



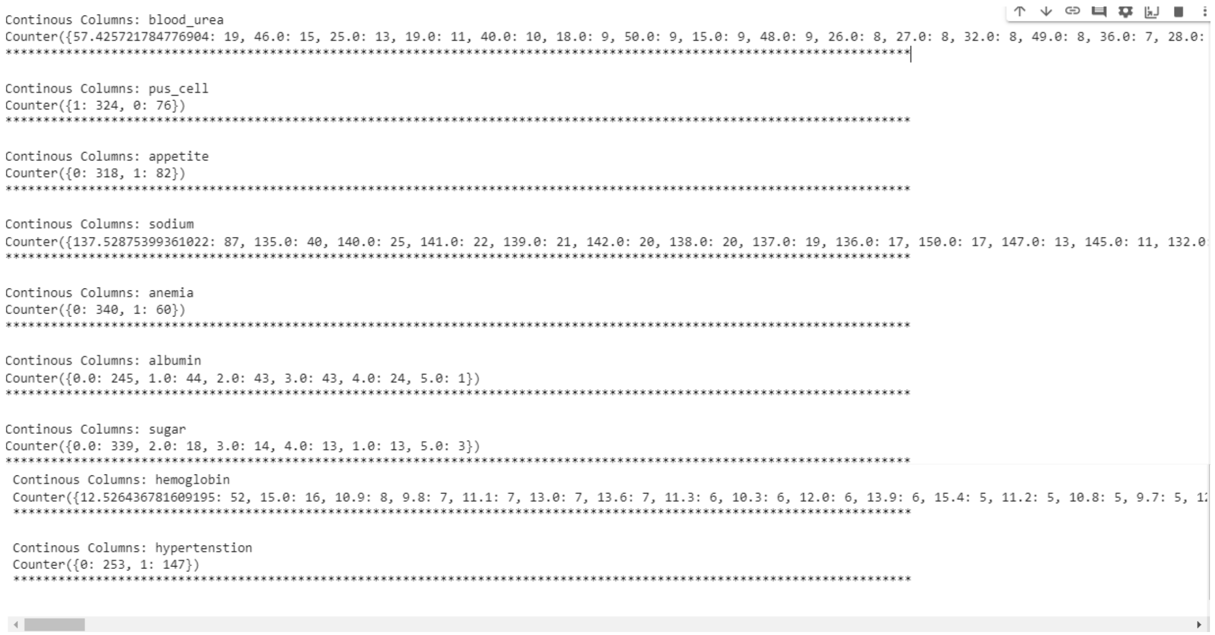
```
{'class', 'potassium', 'coronary_artery_disease', 'pedal_edema', 'age', 'bacteria', 'red_blood_cells', 'blood glucose random', 'diabetesmellitus', 'id', 'serum_cr
```



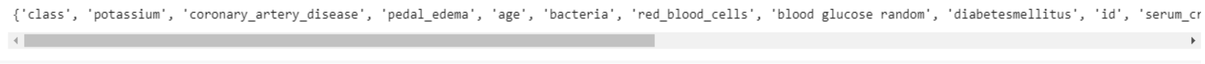
```
Continous Columns: class
Counter({0: 248, 2: 150, 1: 2})
************************************************************************************************************************

Continous Columns: potassium
Counter({4.62724358974359: 88, 5.0: 30, 3.5: 30, 4.9: 27, 4.7: 17, 4.8: 16, 4.0: 14, 4.2: 14, 4.1: 14, 3.8: 14, 3.9: 14, 4.4: 14, 4.5: 13, 3.7: 12, 4.3: 12, 3.
************************************************************************************************************************

Continous Columns: coronary_artery_disease
Counter({1: 364, 2: 34, 0: 2})
************************************************************************************************************************

Continous Columns: pedal_edema
Counter({0: 324, 1: 76})
************************************************************************************************************************

Continous Columns: age
Counter({60.0: 28, 65.0: 17, 48.0: 12, 50.0: 12, 55.0: 12, 47.0: 11, 62.0: 10, 45.0: 10, 54.0: 10, 59.0: 10, 56.0: 10, 61.0: 9, 70.0: 9, 46.0: 9, 34.0: 9, 68.0
************************************************************************************************************************

Continous Columns: bacteria
Counter({0: 378, 1: 22})
************************************************************************************************************************

Continous Columns: red_blood_cells
Counter({1: 353, 0: 47})
************************************************************************************************************************
```



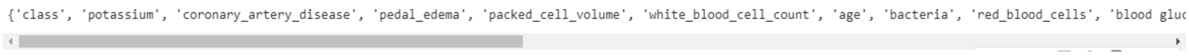
```
Continous Columns: blood glucose random
Counter({148.0365168539326: 44, 99.0: 10, 100.0: 9, 93.0: 9, 107.0: 8, 117.0: 6, 140.0: 6, 92.0: 6, 109.0: 6, 131.0: 6, 130.0: 6, 70.0: 5, 114.0: 5, 95.0: 5, 1
************************************************************************************************************************

Continous Columns: diabetesmellitus
Counter({3: 260, 4: 134, 0: 3, 1: 2, 2: 1})
************************************************************************************************************************

Continous Columns: id
Counter({0: 1, 1: 1, 2: 1, 3: 1, 4: 1, 5: 1, 6: 1, 7: 1, 8: 1, 9: 1, 10: 1, 11: 1, 12: 1, 13: 1, 14: 1, 15: 1, 16: 1, 17: 1, 18: 1, 19: 1, 20: 1, 21: 1, 22: 1,
************************************************************************************************************************

Continous Columns: serum_creatinine
Counter({1.2: 40, 1.1: 24, 1.0: 23, 0.5: 23, 0.7: 22, 0.9: 22, 0.6: 18, 0.8: 17, 3.072454308093995: 17, 2.2: 10, 1.5: 9, 1.7: 9, 1.3: 8, 1.6: 8, 1.8: 7, 1.4: 7,
************************************************************************************************************************

Continous Columns: pus_cell_clumps
Counter({0: 358, 1: 42})
************************************************************************************************************************

Continous Columns: specific_gravity
Counter({1.02: 153, 1.01: 84, 1.025: 81, 1.015: 75, 1.005: 7})
************************************************************************************************************************

Continous Columns: blood_pressure
Counter({80.0: 116, 70.0: 112, 60.0: 71, 90.0: 53, 100.0: 25, 76.46907216494846: 12, 50.0: 5, 110.0: 3, 140.0: 1, 180.0: 1, 120.0: 1})
************************************************************************************************************************
```



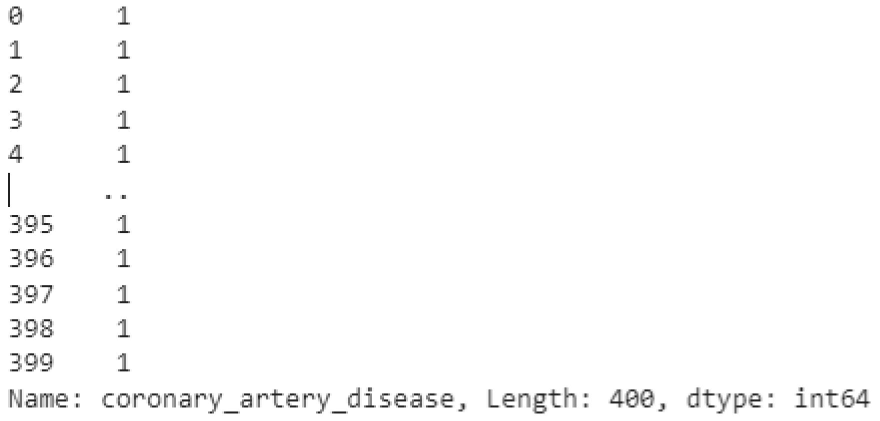
```
Continous Columns: blood_urea
Counter({57.425721784776904: 19, 46.0: 15, 25.0: 13, 19.0: 11, 40.0: 10, 18.0: 9, 50.0: 9, 15.0: 9, 48.0: 9, 26.0: 8, 27.0: 8, 32.0: 8, 49.0: 8, 36.0: 7, 28.0:
************************************************************************************************************************

Continous Columns: pus_cell
Counter({1: 324, 0: 76})
************************************************************************************************************************

Continous Columns: appetite
Counter({0: 318, 1: 82})
************************************************************************************************************************

Continous Columns: sodium
Counter({137.52875399361022: 87, 135.0: 40, 140.0: 25, 141.0: 22, 139.0: 21, 142.0: 20, 138.0: 20, 137.0: 19, 136.0: 17, 150.0: 17, 147.0: 13, 145.0: 11, 132.0
************************************************************************************************************************

Continous Columns: anemia
Counter({0: 340, 1: 60})
************************************************************************************************************************

Continous Columns: albumin
Counter({0.0: 245, 1.0: 44, 2.0: 43, 3.0: 43, 4.0: 24, 5.0: 1})
************************************************************************************************************************

Continous Columns: sugar
Counter({0.0: 339, 2.0: 18, 3.0: 14, 4.0: 13, 1.0: 13, 5.0: 3})
************************************************************************************************************************
 Continous Columns: hemoglobin
 Counter({12.526436781609195: 52, 15.0: 16, 10.9: 8, 9.8: 7, 11.1: 7, 13.0: 7, 13.6: 7, 11.3: 6, 10.3: 6, 12.0: 6, 13.9: 6, 15.4: 5, 11.2: 5, 10.8: 5, 9.7: 5, 1
 ***********************************************************************************************************************

 Continous Columns: hypertenstion
 Counter({0: 253, 1: 147})
 ***********************************************************************************************************************
```



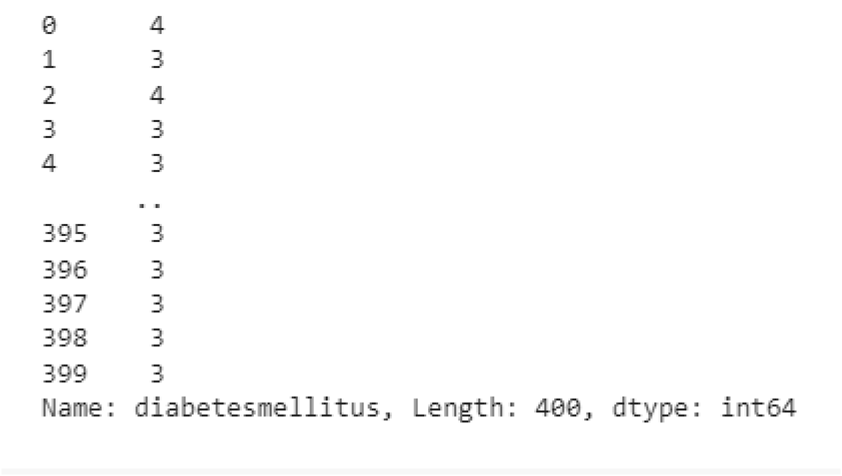
```
{'class', 'potassium', 'coronary_artery_disease', 'pedal_edema', 'age', 'bacteria', 'red_blood_cells', 'blood glucose random', 'diabetesmellitus', 'id', 'serum_cr
```



```
{'class', 'potassium', 'coronary_artery_disease', 'pedal_edema', 'packed_cell_volume', 'white_blood_cell_count', 'age', 'bacteria', 'red_blood_cells', 'blood gluc
```

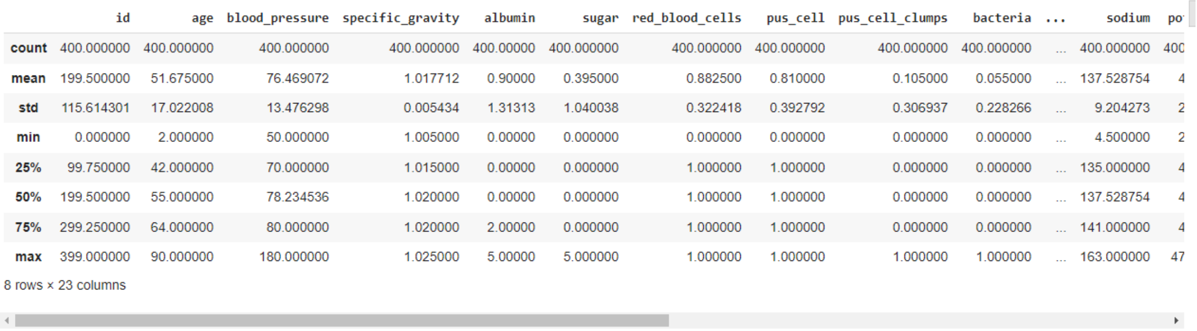


```
0      1
1      1
2      1
3      1
4      1
      ..
395    1
396    1
397    1
398    1
399    1
Name: coronary_artery_disease, Length: 400, dtype: int64
```



```
0      4
1      3
2      4
3      3
4      3
      ..
395    3
396    3
397    3
398    3
399    3
Name: diabetesmellitus, Length: 400, dtype: int64
```

Exploratory Data Analys

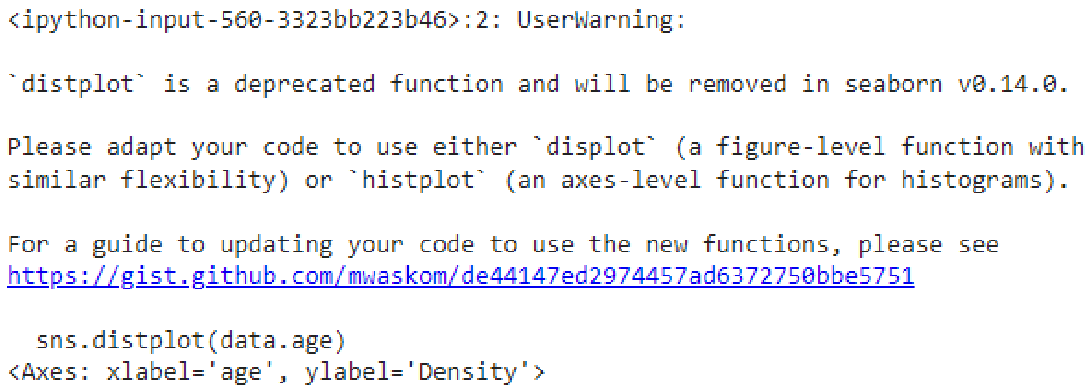


	id	age	blood_pressure	specific_gravity	albumin	sugar	red_blood_cells	pus_cell	pus_cell_clumps	bacteria	...	sodium	po
count	400.000000	400.000000	400.000000	400.000000	400.00000	400.000000	400.000000	400.000000	400.000000	400.000000	...	400.000000	400
mean	199.500000	51.675000	76.469072	1.017712	0.90000	0.395000	0.882500	0.810000	0.105000	0.055000	...	137.528754	4
std	115.614301	17.022008	13.476298	0.005434	1.31313	1.040038	0.322418	0.392792	0.306937	0.228266	...	9.204273	2
min	0.000000	2.000000	50.000000	1.005000	0.00000	0.000000	0.000000	0.000000	0.000000	0.000000	...	4.500000	2
25%	99.750000	42.000000	70.000000	1.015000	0.00000	0.000000	1.000000	1.000000	0.000000	0.000000	...	135.000000	4
50%	199.500000	55.000000	78.234536	1.020000	0.00000	0.000000	1.000000	1.000000	0.000000	0.000000	...	137.528754	4
75%	299.250000	64.000000	80.000000	1.020000	2.00000	0.000000	1.000000	1.000000	0.000000	0.000000	...	141.000000	4
max	399.000000	90.000000	180.000000	1.025000	5.00000	5.000000	1.000000	1.000000	1.000000	1.000000	...	163.000000	47

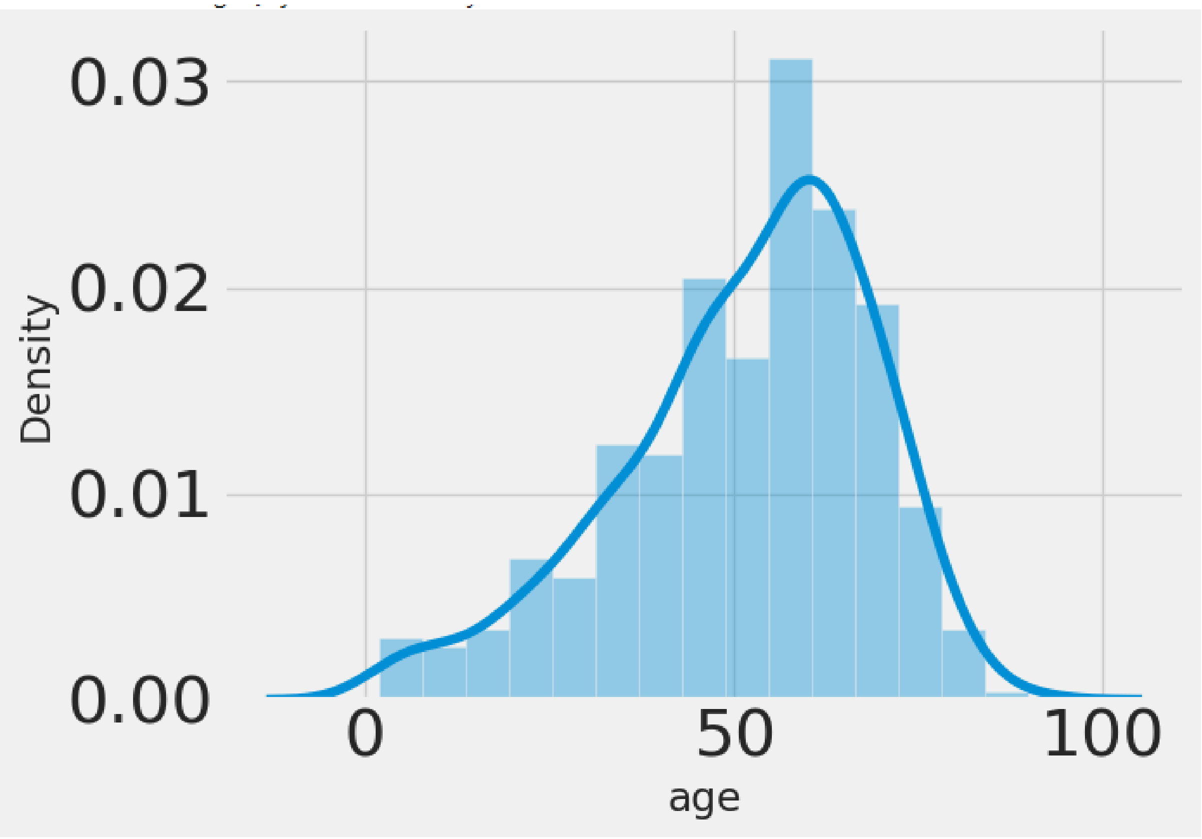
8 rows × 23 columns

Visual analysis

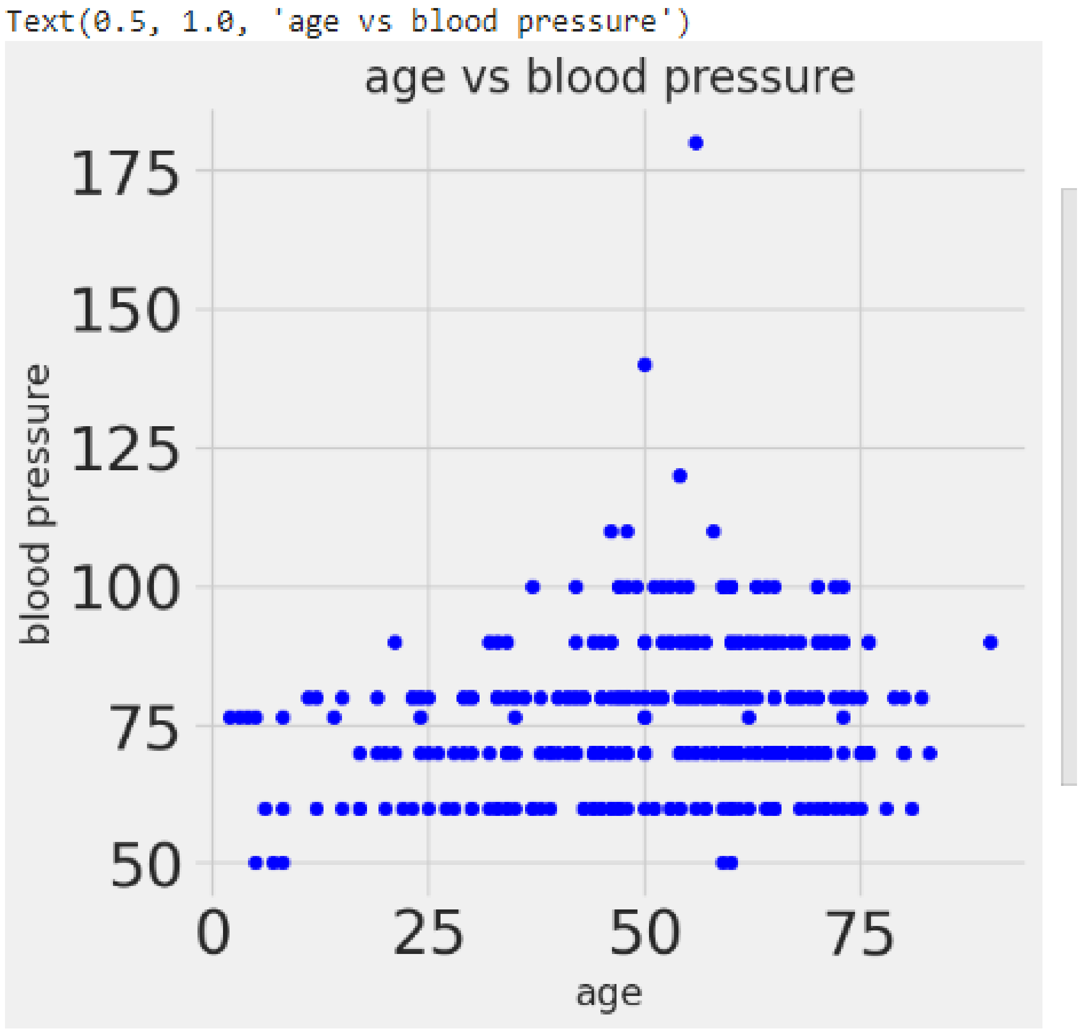
Univariate analysis



```
<ipython-input-560-3323bb223b46>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data.age)
<Axes: xlabel='age', ylabel='Density'>
```

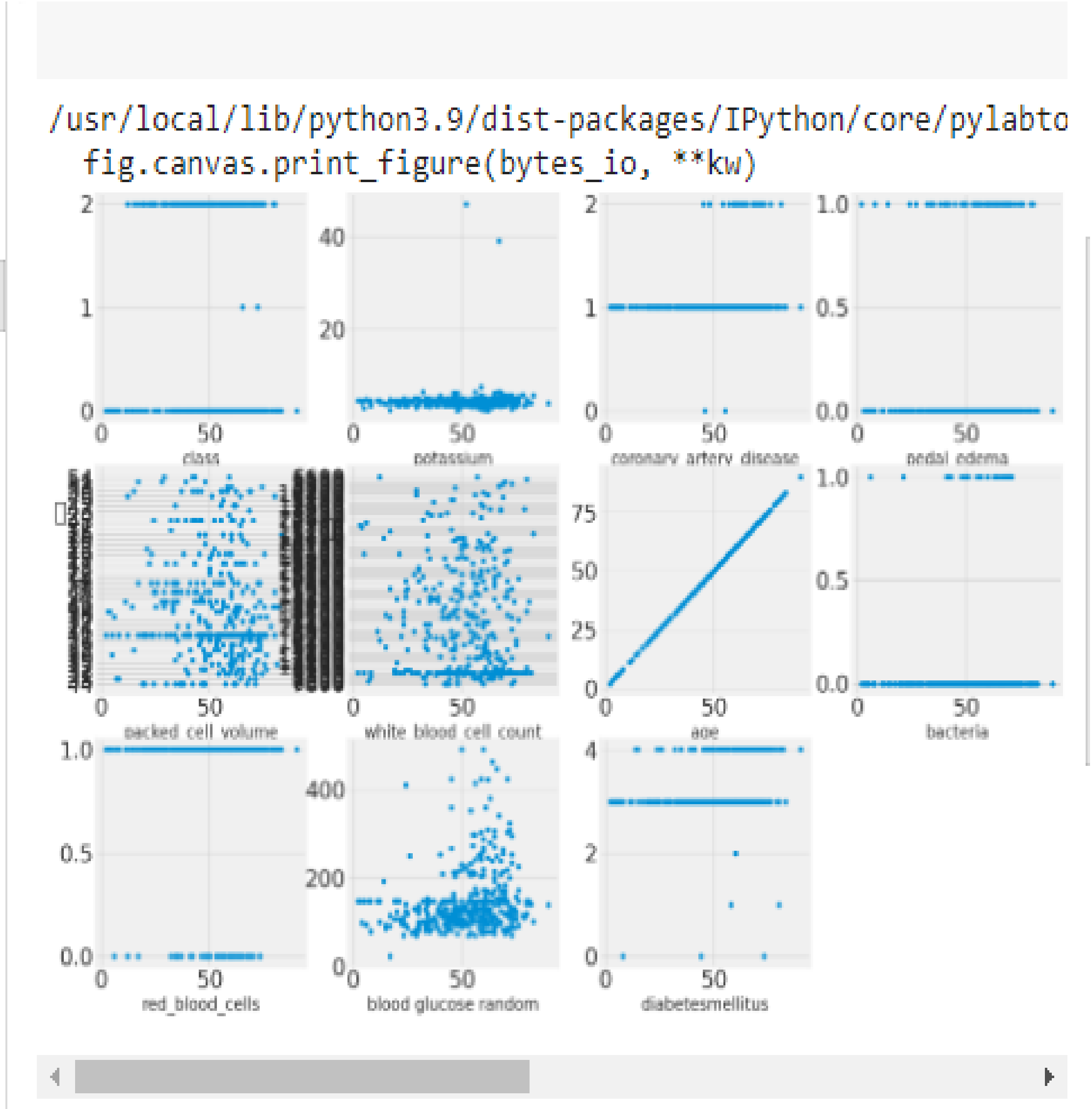


Bivariate analysis



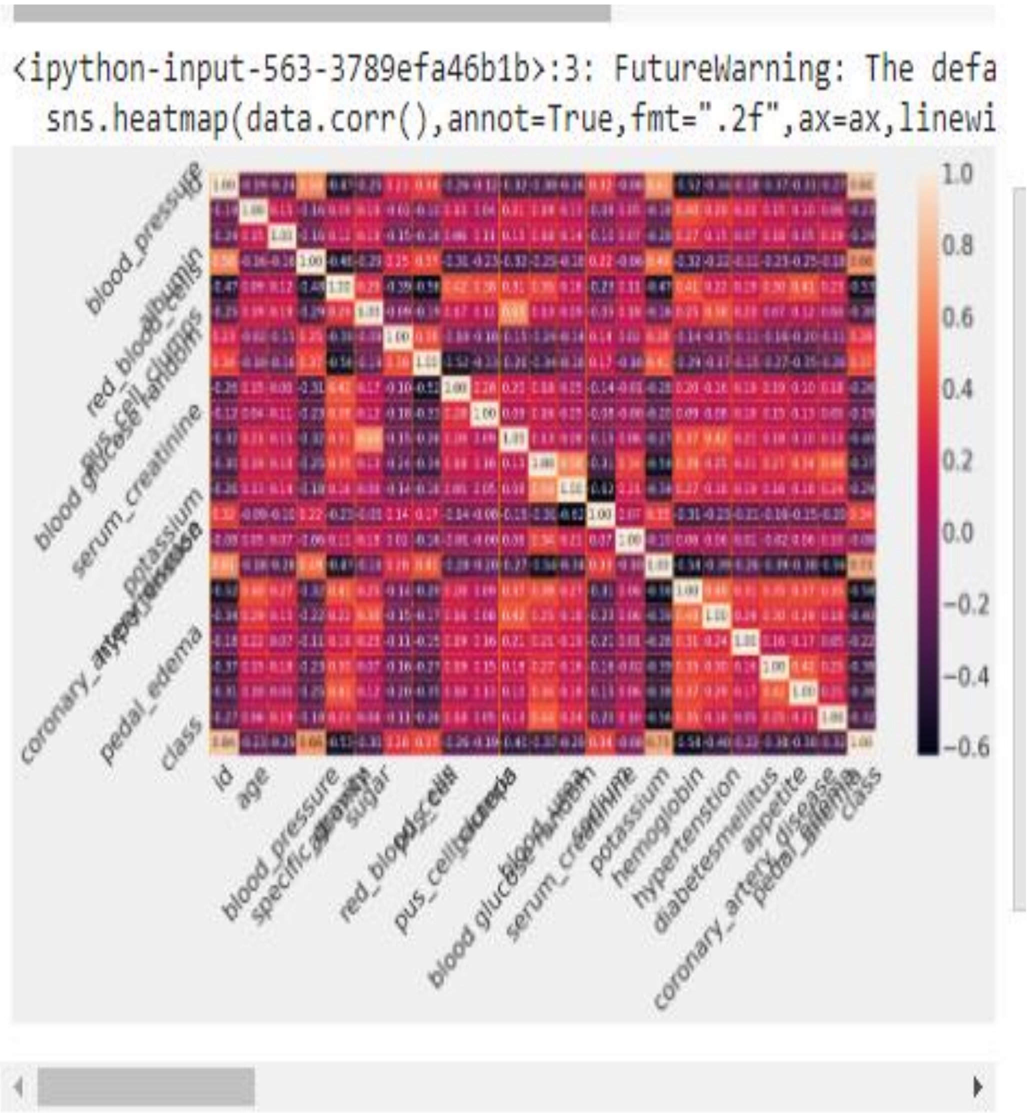
```
Text(0.5, 1.0, 'age vs blood pressure')
```

Multivariate analysis

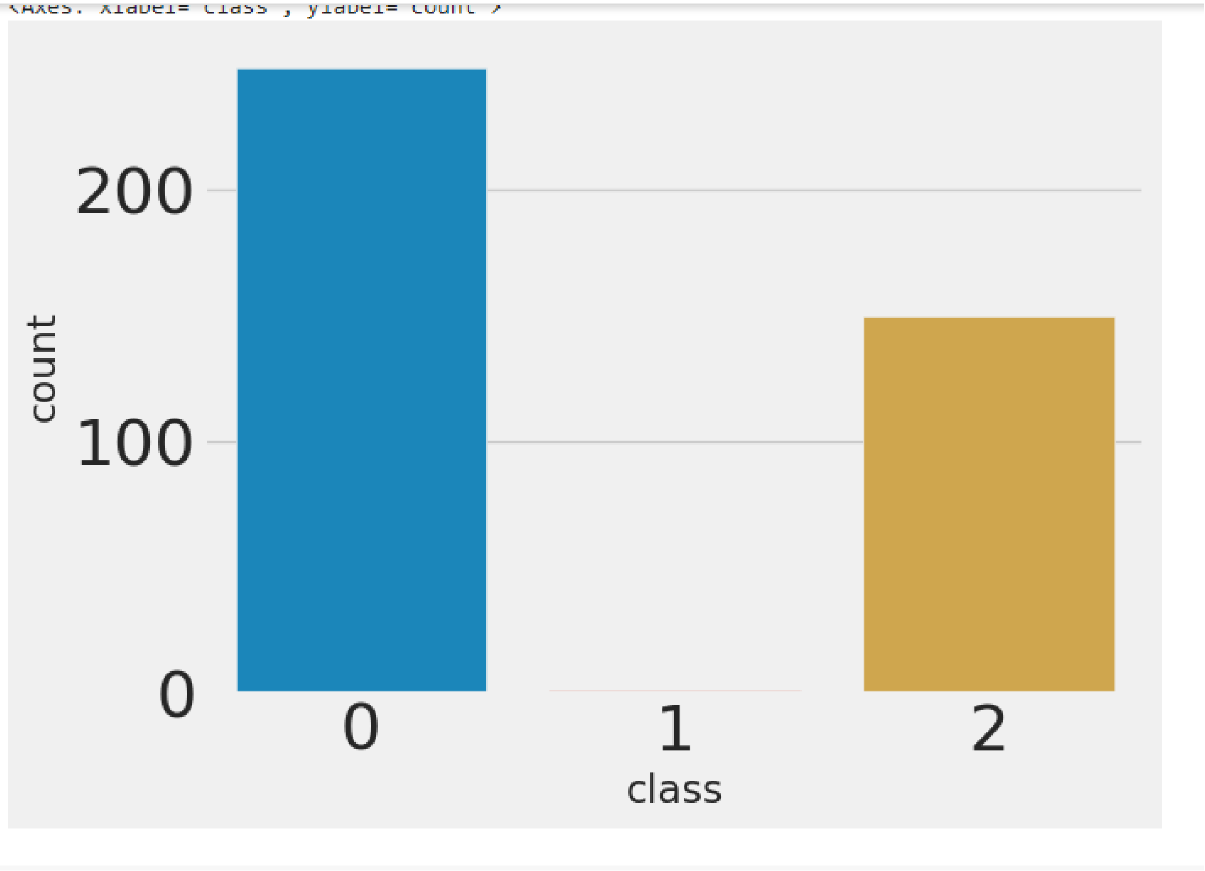


```
/usr/local/lib/python3.9/dist-packages/IPython/core/pylabto
  fig.canvas.print_figure(bytes_io, **kw)
```

Finding correlation between the independent Columns

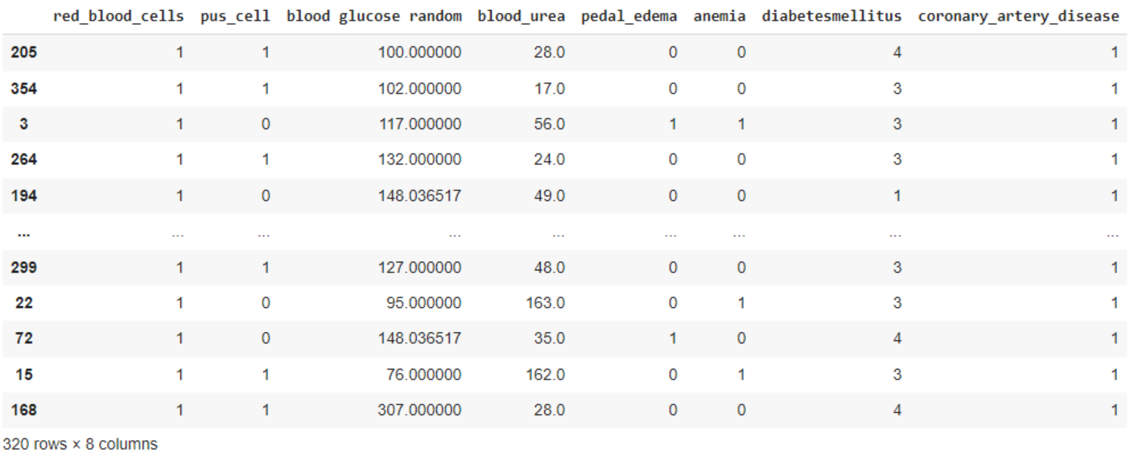


```
<ipython-input-563-3789efa46b1b>:3: FutureWarning: The defa
  sns.heatmap(data.corr(),annot=True,fmt=".2f",ax=ax,linewi
```



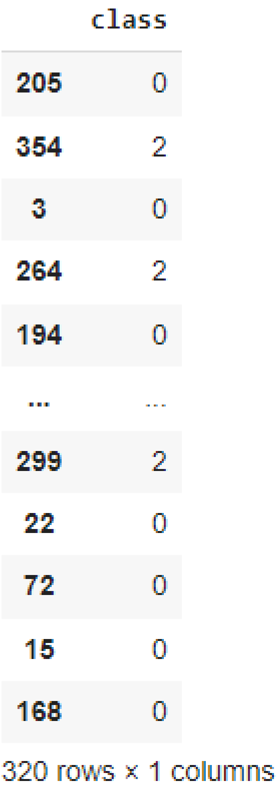
```
<Axes: xlabel='class', ylabel='count'>
```

```
0      0
1      0
2      0
3      0
4      0
      ..
395    2
396    2
397    2
398    2
399    2
Name: class, Length: 400, dtype: int64
```



	red_blood_cells	pus_cell	blood glucose random	blood_urea	pedal_edema	anemia	diabetesmellitus	coronary_artery_disease
205	1	1	100.000000	28.0	0	0	4	1
354	1	1	102.000000	17.0	0	0	3	1
3	1	0	117.000000	56.0	1	1	3	1
264	1	1	132.000000	24.0	0	0	3	1
194	1	0	148.036517	49.0	0	0	1	1
...	...	...	...	...	...	...	...	...
299	1	1	127.000000	48.0	0	0	3	1
22	1	0	95.000000	163.0	0	1	3	1
72	1	0	148.036517	35.0	1	0	4	1
15	1	1	76.000000	162.0	0	1	3	1
168	1	1	307.000000	28.0	0	0	4	1

320 rows × 8 columns

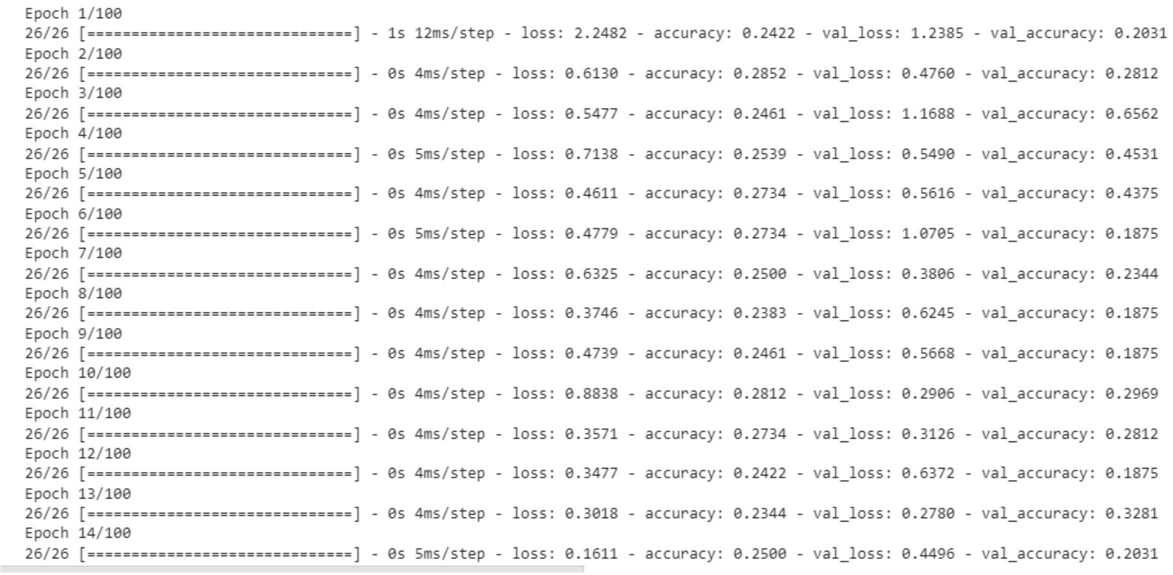


	class
205	0
354	2
3	0
264	2
194	0
...	...
299	2
22	0
72	0
15	0
168	0

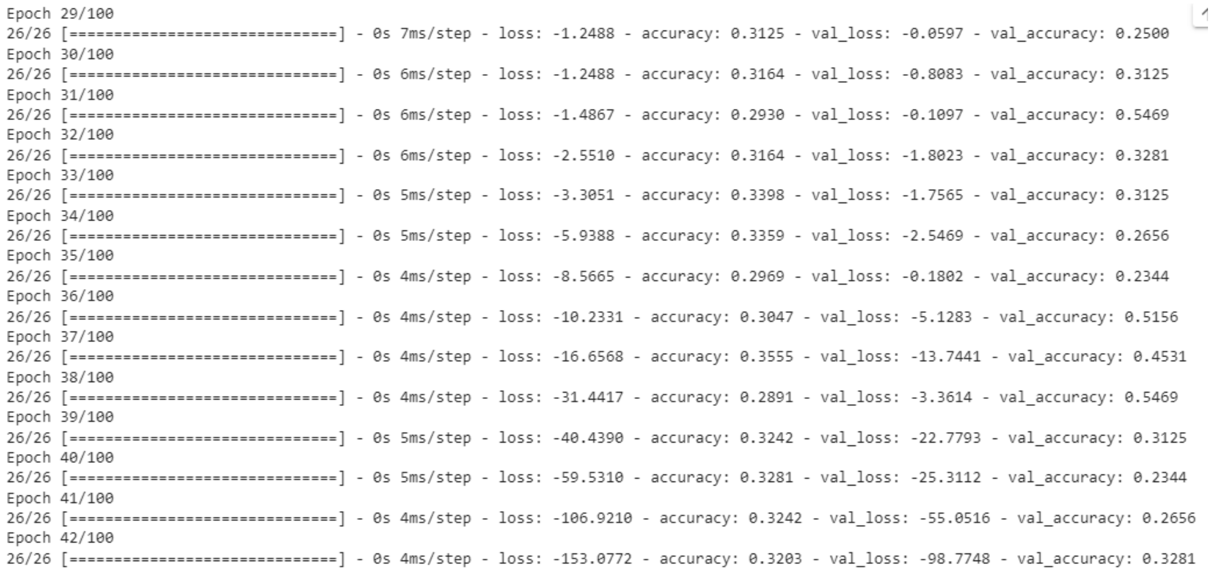
320 rows × 1 columns

Model Building

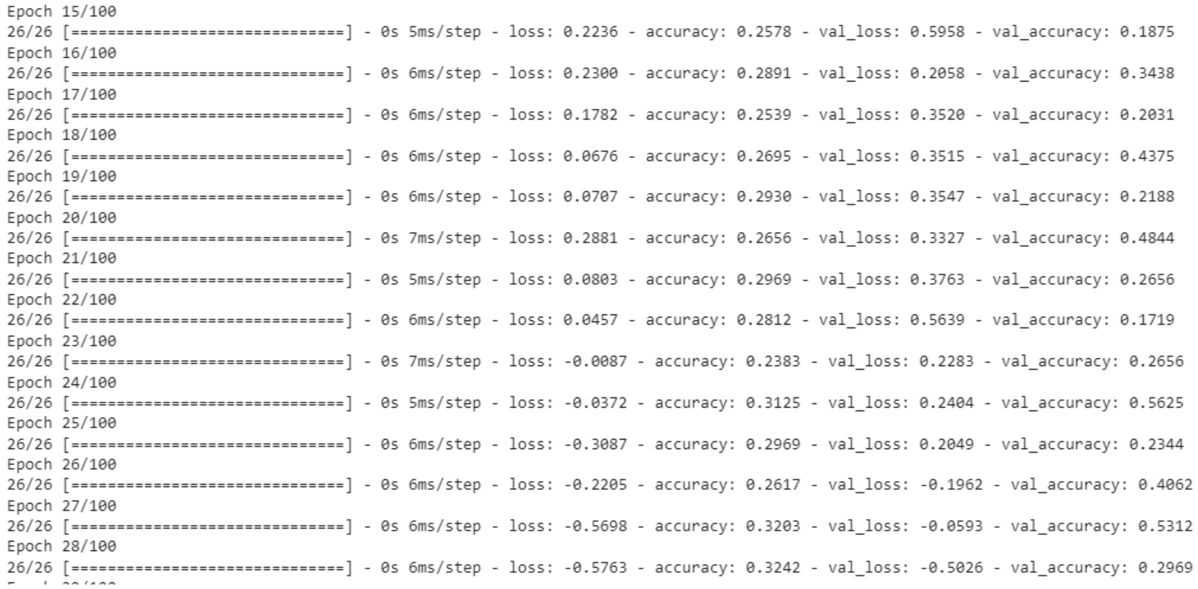
ANN Model



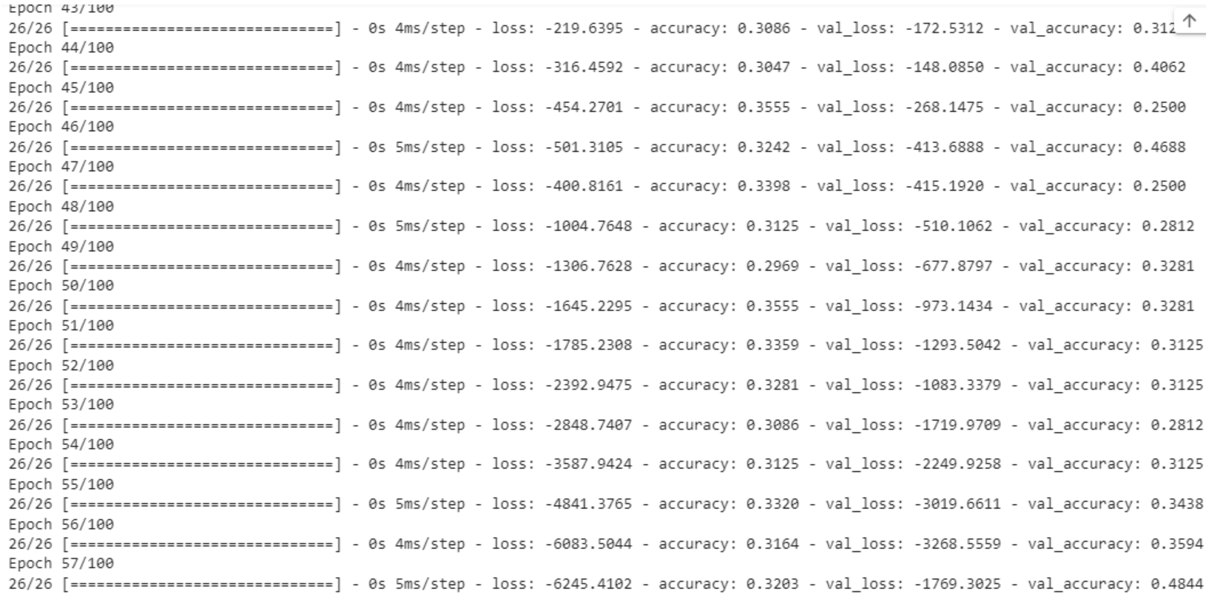
```
Epoch 1/100
26/26 [==============================] - 1s 12ms/step - loss: 2.2482 - accuracy: 0.2422 - val_loss: 1.2385 - val_accuracy: 0.2031
Epoch 2/100
26/26 [==============================] - 0s 4ms/step - loss: 0.6130 - accuracy: 0.2852 - val_loss: 0.4760 - val_accuracy: 0.2812
Epoch 3/100
26/26 [==============================] - 0s 4ms/step - loss: 0.5477 - accuracy: 0.2461 - val_loss: 1.1688 - val_accuracy: 0.6562
Epoch 4/100
26/26 [==============================] - 0s 5ms/step - loss: 0.7138 - accuracy: 0.2539 - val_loss: 0.5490 - val_accuracy: 0.4531
Epoch 5/100
26/26 [==============================] - 0s 4ms/step - loss: 0.4611 - accuracy: 0.2734 - val_loss: 0.5616 - val_accuracy: 0.4375
Epoch 6/100
26/26 [==============================] - 0s 5ms/step - loss: 0.4779 - accuracy: 0.2734 - val_loss: 1.0705 - val_accuracy: 0.1875
Epoch 7/100
26/26 [==============================] - 0s 4ms/step - loss: 0.6325 - accuracy: 0.2500 - val_loss: 0.3806 - val_accuracy: 0.2344
Epoch 8/100
26/26 [==============================] - 0s 4ms/step - loss: 0.3746 - accuracy: 0.2383 - val_loss: 0.6245 - val_accuracy: 0.1875
Epoch 9/100
26/26 [==============================] - 0s 4ms/step - loss: 0.4739 - accuracy: 0.2461 - val_loss: 0.5668 - val_accuracy: 0.1875
Epoch 10/100
26/26 [==============================] - 0s 4ms/step - loss: 0.8838 - accuracy: 0.2812 - val_loss: 0.2906 - val_accuracy: 0.2969
Epoch 11/100
26/26 [==============================] - 0s 4ms/step - loss: 0.3571 - accuracy: 0.2734 - val_loss: 0.3126 - val_accuracy: 0.2812
Epoch 12/100
26/26 [==============================] - 0s 4ms/step - loss: 0.3477 - accuracy: 0.2422 - val_loss: 0.6372 - val_accuracy: 0.1875
Epoch 13/100
26/26 [==============================] - 0s 4ms/step - loss: 0.3018 - accuracy: 0.2344 - val_loss: 0.2780 - val_accuracy: 0.3281
Epoch 14/100
26/26 [==============================] - 0s 5ms/step - loss: 0.1611 - accuracy: 0.2500 - val_loss: 0.4496 - val_accuracy: 0.2031
```



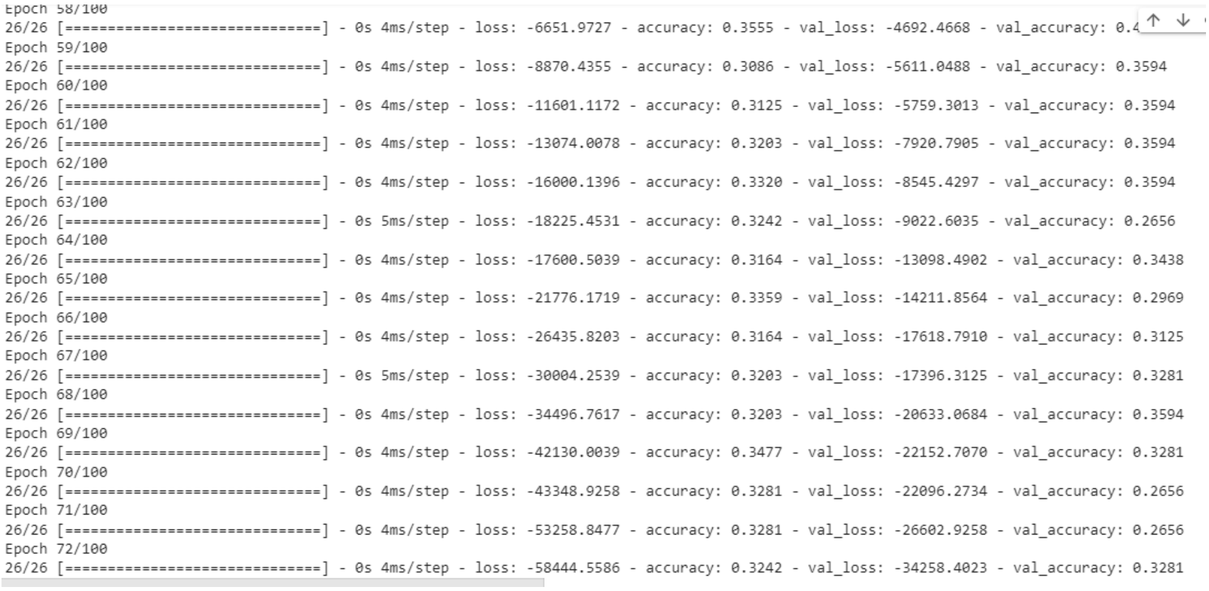
```
Epoch 29/100
26/26 [==============================] - 0s 7ms/step - loss: -1.2488 - accuracy: 0.3125 - val_loss: -0.0597 - val_accuracy: 0.2500
Epoch 30/100
26/26 [==============================] - 0s 6ms/step - loss: -1.2488 - accuracy: 0.3164 - val_loss: -0.8083 - val_accuracy: 0.3125
Epoch 31/100
26/26 [==============================] - 0s 6ms/step - loss: -1.4867 - accuracy: 0.2930 - val_loss: -0.1097 - val_accuracy: 0.5469
Epoch 32/100
26/26 [==============================] - 0s 6ms/step - loss: -2.5510 - accuracy: 0.3164 - val_loss: -1.8023 - val_accuracy: 0.3281
Epoch 33/100
26/26 [==============================] - 0s 5ms/step - loss: -3.3051 - accuracy: 0.3398 - val_loss: -1.7565 - val_accuracy: 0.3125
Epoch 34/100
26/26 [==============================] - 0s 5ms/step - loss: -5.9388 - accuracy: 0.3359 - val_loss: -2.5469 - val_accuracy: 0.2656
Epoch 35/100
26/26 [==============================] - 0s 4ms/step - loss: -8.5665 - accuracy: 0.2969 - val_loss: -0.1802 - val_accuracy: 0.2344
Epoch 36/100
26/26 [==============================] - 0s 4ms/step - loss: -10.2331 - accuracy: 0.3047 - val_loss: -5.1283 - val_accuracy: 0.5156
Epoch 37/100
26/26 [==============================] - 0s 4ms/step - loss: -16.6568 - accuracy: 0.3555 - val_loss: -13.7441 - val_accuracy: 0.4531
Epoch 38/100
26/26 [==============================] - 0s 4ms/step - loss: -31.4417 - accuracy: 0.2891 - val_loss: -3.3614 - val_accuracy: 0.5469
Epoch 39/100
26/26 [==============================] - 0s 5ms/step - loss: -40.4390 - accuracy: 0.3242 - val_loss: -22.7793 - val_accuracy: 0.3125
Epoch 40/100
26/26 [==============================] - 0s 5ms/step - loss: -59.5310 - accuracy: 0.3281 - val_loss: -25.3112 - val_accuracy: 0.2344
Epoch 41/100
26/26 [==============================] - 0s 4ms/step - loss: -106.9210 - accuracy: 0.3242 - val_loss: -55.0516 - val_accuracy: 0.2656
Epoch 42/100
26/26 [==============================] - 0s 4ms/step - loss: -153.0772 - accuracy: 0.3203 - val_loss: -98.7748 - val_accuracy: 0.3281
```



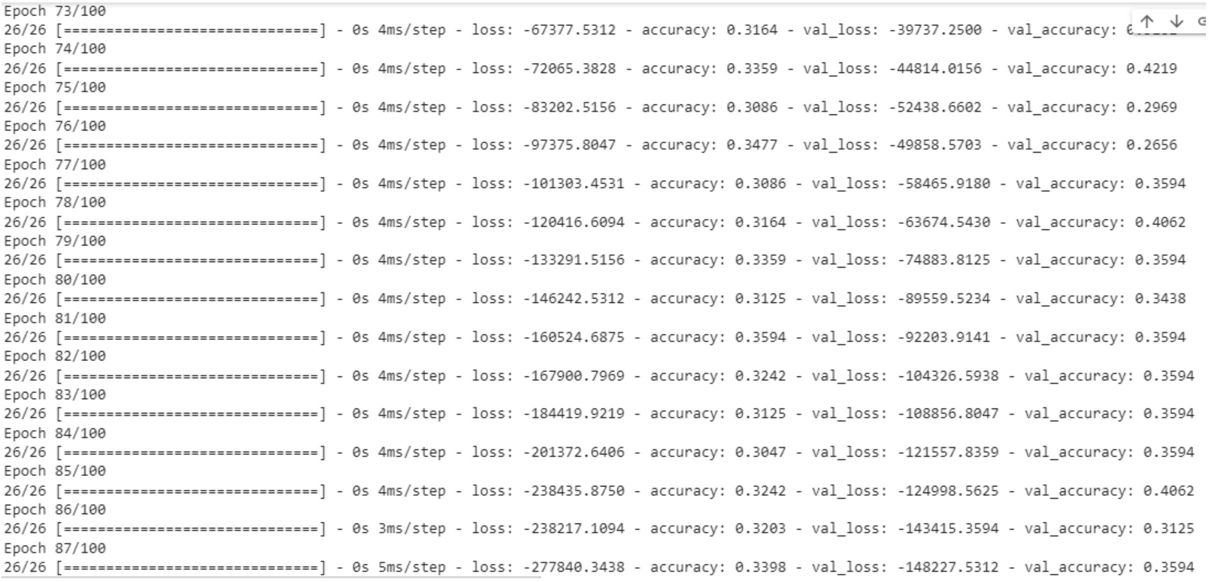
```
Epoch 15/100
26/26 [==============================] - 0s 5ms/step - loss: 0.2236 - accuracy: 0.2578 - val_loss: 0.5958 - val_accuracy: 0.1875
Epoch 16/100
26/26 [==============================] - 0s 6ms/step - loss: 0.2300 - accuracy: 0.2891 - val_loss: 0.2058 - val_accuracy: 0.3438
Epoch 17/100
26/26 [==============================] - 0s 6ms/step - loss: 0.1782 - accuracy: 0.2539 - val_loss: 0.3520 - val_accuracy: 0.2031
Epoch 18/100
26/26 [==============================] - 0s 6ms/step - loss: 0.0676 - accuracy: 0.2695 - val_loss: 0.3515 - val_accuracy: 0.4375
Epoch 19/100
26/26 [==============================] - 0s 6ms/step - loss: 0.0707 - accuracy: 0.2930 - val_loss: 0.3547 - val_accuracy: 0.2188
Epoch 20/100
26/26 [==============================] - 0s 7ms/step - loss: 0.2881 - accuracy: 0.2656 - val_loss: 0.3327 - val_accuracy: 0.4844
Epoch 21/100
26/26 [==============================] - 0s 5ms/step - loss: 0.0803 - accuracy: 0.2969 - val_loss: 0.3763 - val_accuracy: 0.2656
Epoch 22/100
26/26 [==============================] - 0s 6ms/step - loss: 0.0457 - accuracy: 0.2812 - val_loss: 0.5639 - val_accuracy: 0.1719
Epoch 23/100
26/26 [==============================] - 0s 7ms/step - loss: -0.0087 - accuracy: 0.2383 - val_loss: 0.2283 - val_accuracy: 0.2656
Epoch 24/100
26/26 [==============================] - 0s 5ms/step - loss: -0.0372 - accuracy: 0.3125 - val_loss: 0.2404 - val_accuracy: 0.5625
Epoch 25/100
26/26 [==============================] - 0s 6ms/step - loss: -0.3087 - accuracy: 0.2969 - val_loss: 0.2049 - val_accuracy: 0.2344
Epoch 26/100
26/26 [==============================] - 0s 6ms/step - loss: -0.2205 - accuracy: 0.2617 - val_loss: -0.1962 - val_accuracy: 0.4062
Epoch 27/100
26/26 [==============================] - 0s 6ms/step - loss: -0.5698 - accuracy: 0.3203 - val_loss: -0.0593 - val_accuracy: 0.5312
Epoch 28/100
26/26 [==============================] - 0s 6ms/step - loss: -0.5763 - accuracy: 0.3242 - val_loss: -0.5026 - val_accuracy: 0.2969
```



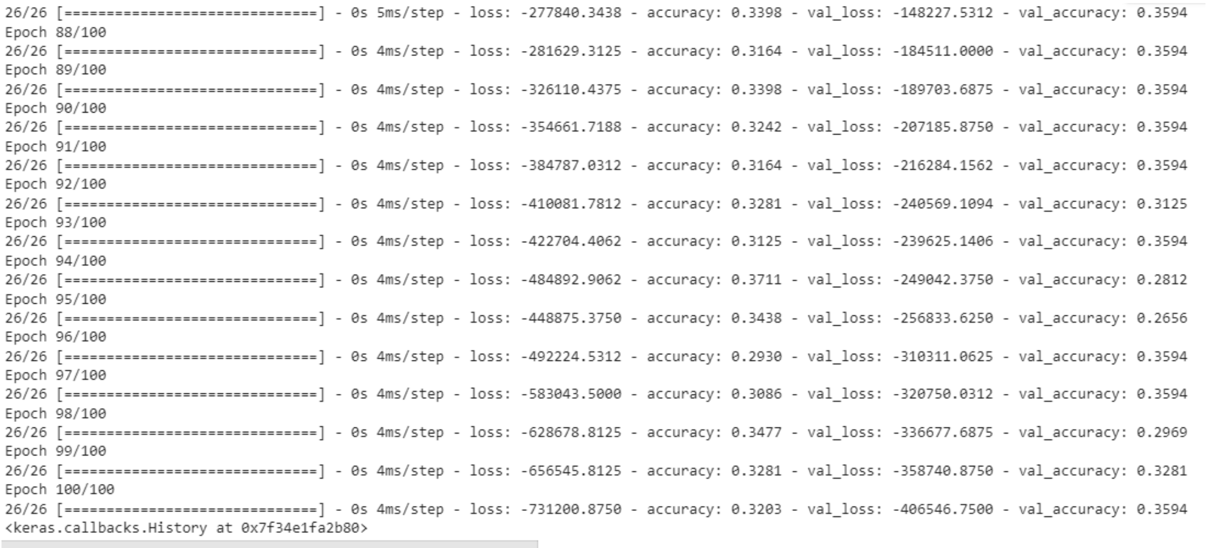
```
Epoch 43/100
26/26 [==============================] - 0s 4ms/step - loss: -219.6395 - accuracy: 0.3086 - val_loss: -172.5312 - val_accuracy: 0.312
Epoch 44/100
26/26 [==============================] - 0s 4ms/step - loss: -316.4592 - accuracy: 0.3047 - val_loss: -148.0850 - val_accuracy: 0.4062
Epoch 45/100
26/26 [==============================] - 0s 4ms/step - loss: -454.2701 - accuracy: 0.3555 - val_loss: -268.1475 - val_accuracy: 0.2500
Epoch 46/100
26/26 [==============================] - 0s 5ms/step - loss: -501.3105 - accuracy: 0.3242 - val_loss: -413.6888 - val_accuracy: 0.4688
Epoch 47/100
26/26 [==============================] - 0s 4ms/step - loss: -400.8161 - accuracy: 0.3398 - val_loss: -415.1920 - val_accuracy: 0.2500
Epoch 48/100
26/26 [==============================] - 0s 5ms/step - loss: -1004.7648 - accuracy: 0.3125 - val_loss: -510.1062 - val_accuracy: 0.2812
Epoch 49/100
26/26 [==============================] - 0s 4ms/step - loss: -1306.7628 - accuracy: 0.2969 - val_loss: -677.8797 - val_accuracy: 0.3281
Epoch 50/100
26/26 [==============================] - 0s 4ms/step - loss: -1645.2295 - accuracy: 0.3555 - val_loss: -973.1434 - val_accuracy: 0.3281
Epoch 51/100
26/26 [==============================] - 0s 4ms/step - loss: -1785.2308 - accuracy: 0.3359 - val_loss: -1293.5042 - val_accuracy: 0.3125
Epoch 52/100
26/26 [==============================] - 0s 4ms/step - loss: -2392.9475 - accuracy: 0.3281 - val_loss: -1083.3379 - val_accuracy: 0.3125
Epoch 53/100
26/26 [==============================] - 0s 4ms/step - loss: -2848.7407 - accuracy: 0.3086 - val_loss: -1719.9709 - val_accuracy: 0.2812
Epoch 54/100
26/26 [==============================] - 0s 4ms/step - loss: -3587.9424 - accuracy: 0.3125 - val_loss: -2249.9258 - val_accuracy: 0.3125
Epoch 55/100
26/26 [==============================] - 0s 5ms/step - loss: -4841.3765 - accuracy: 0.3320 - val_loss: -3019.6611 - val_accuracy: 0.3438
Epoch 56/100
26/26 [==============================] - 0s 4ms/step - loss: -6083.5044 - accuracy: 0.3164 - val_loss: -3268.5559 - val_accuracy: 0.3594
Epoch 57/100
26/26 [==============================] - 0s 5ms/step - loss: -6245.4102 - accuracy: 0.3203 - val_loss: -1769.3025 - val_accuracy: 0.4844
```



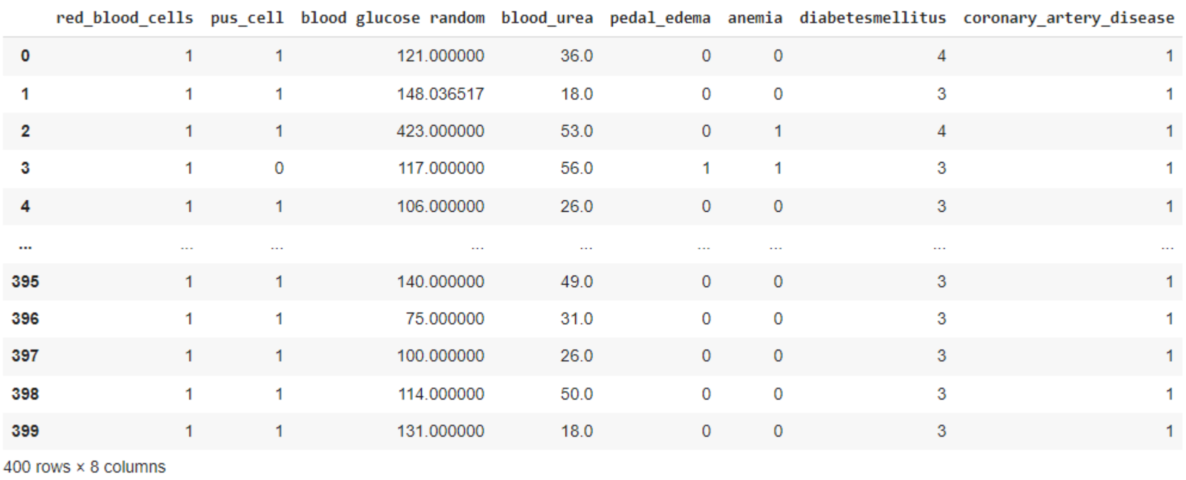
```
Epoch 58/100
26/26 [==============================] - 0s 4ms/step - loss: -6651.9727 - accuracy: 0.3555 - val_loss: -4692.4668 - val_accuracy: 0.4
Epoch 59/100
26/26 [==============================] - 0s 4ms/step - loss: -8870.4355 - accuracy: 0.3086 - val_loss: -5611.0488 - val_accuracy: 0.3594
Epoch 60/100
26/26 [==============================] - 0s 4ms/step - loss: -11601.1172 - accuracy: 0.3125 - val_loss: -5759.3013 - val_accuracy: 0.3594
Epoch 61/100
26/26 [==============================] - 0s 4ms/step - loss: -13074.0078 - accuracy: 0.3203 - val_loss: -7920.7905 - val_accuracy: 0.3594
Epoch 62/100
26/26 [==============================] - 0s 4ms/step - loss: -16000.1396 - accuracy: 0.3320 - val_loss: -8545.4297 - val_accuracy: 0.3594
Epoch 63/100
26/26 [==============================] - 0s 5ms/step - loss: -18225.4531 - accuracy: 0.3242 - val_loss: -9022.6035 - val_accuracy: 0.2656
Epoch 64/100
26/26 [==============================] - 0s 4ms/step - loss: -17600.5039 - accuracy: 0.3164 - val_loss: -13098.4902 - val_accuracy: 0.3438
Epoch 65/100
26/26 [==============================] - 0s 4ms/step - loss: -21776.1719 - accuracy: 0.3359 - val_loss: -14211.8564 - val_accuracy: 0.2969
Epoch 66/100
26/26 [==============================] - 0s 4ms/step - loss: -26435.8203 - accuracy: 0.3164 - val_loss: -17618.7910 - val_accuracy: 0.3125
Epoch 67/100
26/26 [==============================] - 0s 5ms/step - loss: -30004.2539 - accuracy: 0.3203 - val_loss: -17396.3125 - val_accuracy: 0.3281
Epoch 68/100
26/26 [==============================] - 0s 4ms/step - loss: -34496.7617 - accuracy: 0.3203 - val_loss: -20633.0684 - val_accuracy: 0.3594
Epoch 69/100
26/26 [==============================] - 0s 4ms/step - loss: -42130.0039 - accuracy: 0.3477 - val_loss: -22152.7070 - val_accuracy: 0.3281
Epoch 70/100
26/26 [==============================] - 0s 4ms/step - loss: -43348.9258 - accuracy: 0.3281 - val_loss: -22096.2734 - val_accuracy: 0.2656
Epoch 71/100
26/26 [==============================] - 0s 4ms/step - loss: -53258.8477 - accuracy: 0.3281 - val_loss: -26602.9258 - val_accuracy: 0.2656
Epoch 72/100
26/26 [==============================] - 0s 4ms/step - loss: -58444.5586 - accuracy: 0.3242 - val_loss: -34258.4023 - val_accuracy: 0.3281
```



```
Epoch 73/100
26/26 [==============================] - 0s 4ms/step - loss: -67377.5312 - accuracy: 0.3164 - val_loss: -39737.2500 - val_accuracy: 0
Epoch 74/100
26/26 [==============================] - 0s 4ms/step - loss: -72065.3828 - accuracy: 0.3359 - val_loss: -44814.0156 - val_accuracy: 0.4219
Epoch 75/100
26/26 [==============================] - 0s 4ms/step - loss: -83202.5156 - accuracy: 0.3086 - val_loss: -52438.6602 - val_accuracy: 0.2969
Epoch 76/100
26/26 [==============================] - 0s 4ms/step - loss: -97375.8047 - accuracy: 0.3477 - val_loss: -49858.5703 - val_accuracy: 0.2656
Epoch 77/100
26/26 [==============================] - 0s 4ms/step - loss: -101303.4531 - accuracy: 0.3086 - val_loss: -58465.9180 - val_accuracy: 0.3594
Epoch 78/100
26/26 [==============================] - 0s 4ms/step - loss: -120416.6094 - accuracy: 0.3164 - val_loss: -63674.5430 - val_accuracy: 0.4062
Epoch 79/100
26/26 [==============================] - 0s 4ms/step - loss: -133291.5156 - accuracy: 0.3359 - val_loss: -74883.8125 - val_accuracy: 0.3594
Epoch 80/100
26/26 [==============================] - 0s 4ms/step - loss: -146242.5312 - accuracy: 0.3125 - val_loss: -89559.5234 - val_accuracy: 0.3438
Epoch 81/100
26/26 [==============================] - 0s 4ms/step - loss: -160524.6875 - accuracy: 0.3594 - val_loss: -92203.9141 - val_accuracy: 0.3594
Epoch 82/100
26/26 [==============================] - 0s 4ms/step - loss: -167900.7969 - accuracy: 0.3242 - val_loss: -104326.5938 - val_accuracy: 0.3594
Epoch 83/100
26/26 [==============================] - 0s 4ms/step - loss: -184419.9219 - accuracy: 0.3125 - val_loss: -108856.8047 - val_accuracy: 0.3594
Epoch 84/100
26/26 [==============================] - 0s 4ms/step - loss: -201372.6406 - accuracy: 0.3047 - val_loss: -121557.8359 - val_accuracy: 0.3594
Epoch 85/100
26/26 [==============================] - 0s 4ms/step - loss: -238435.8750 - accuracy: 0.3242 - val_loss: -124998.5625 - val_accuracy: 0.4062
Epoch 86/100
26/26 [==============================] - 0s 3ms/step - loss: -238217.1094 - accuracy: 0.3203 - val_loss: -143415.3594 - val_accuracy: 0.3125
Epoch 87/100
26/26 [==============================] - 0s 5ms/step - loss: -277840.3438 - accuracy: 0.3398 - val_loss: -148227.5312 - val_accuracy: 0.3594
```

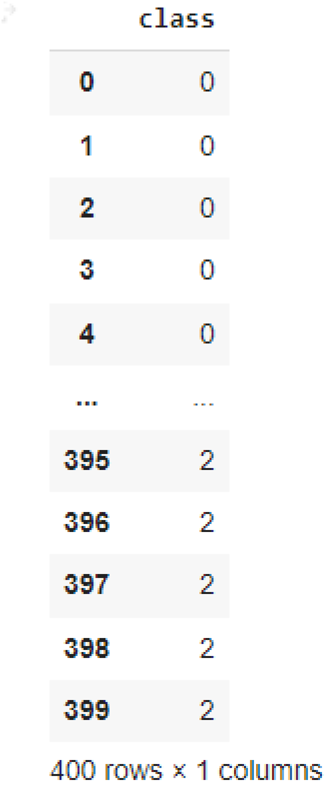


```
26/26 [==============================] - 0s 5ms/step - loss: -277840.3438 - accuracy: 0.3398 - val_loss: -148227.5312 - val_accuracy: 0.3594
Epoch 88/100
26/26 [==============================] - 0s 4ms/step - loss: -281629.3125 - accuracy: 0.3164 - val_loss: -184511.0000 - val_accuracy: 0.3594
Epoch 89/100
26/26 [==============================] - 0s 4ms/step - loss: -326110.4375 - accuracy: 0.3398 - val_loss: -189703.6875 - val_accuracy: 0.3594
Epoch 90/100
26/26 [==============================] - 0s 4ms/step - loss: -354661.7188 - accuracy: 0.3242 - val_loss: -207185.8750 - val_accuracy: 0.3594
Epoch 91/100
26/26 [==============================] - 0s 4ms/step - loss: -384787.0312 - accuracy: 0.3164 - val_loss: -216284.1562 - val_accuracy: 0.3594
Epoch 92/100
26/26 [==============================] - 0s 4ms/step - loss: -410081.7812 - accuracy: 0.3281 - val_loss: -240569.1094 - val_accuracy: 0.3125
Epoch 93/100
26/26 [==============================] - 0s 4ms/step - loss: -422704.4062 - accuracy: 0.3125 - val_loss: -239625.1406 - val_accuracy: 0.3594
Epoch 94/100
26/26 [==============================] - 0s 4ms/step - loss: -484892.9062 - accuracy: 0.3711 - val_loss: -249042.3750 - val_accuracy: 0.2812
Epoch 95/100
26/26 [==============================] - 0s 4ms/step - loss: -448875.3750 - accuracy: 0.3438 - val_loss: -256833.6250 - val_accuracy: 0.2656
Epoch 96/100
26/26 [==============================] - 0s 4ms/step - loss: -492224.5312 - accuracy: 0.2930 - val_loss: -310311.0625 - val_accuracy: 0.3594
Epoch 97/100
26/26 [==============================] - 0s 4ms/step - loss: -583043.5000 - accuracy: 0.3086 - val_loss: -320750.0312 - val_accuracy: 0.3594
Epoch 98/100
26/26 [==============================] - 0s 4ms/step - loss: -628678.8125 - accuracy: 0.3477 - val_loss: -336677.6875 - val_accuracy: 0.2969
Epoch 99/100
26/26 [==============================] - 0s 4ms/step - loss: -656545.8125 - accuracy: 0.3281 - val_loss: -358740.8750 - val_accuracy: 0.3281
Epoch 100/100
26/26 [==============================] - 0s 4ms/step - loss: -731200.8750 - accuracy: 0.3203 - val_loss: -406546.7500 - val_accuracy: 0.3594
<keras.callbacks.History at 0x7f34e1fa2b80>
```



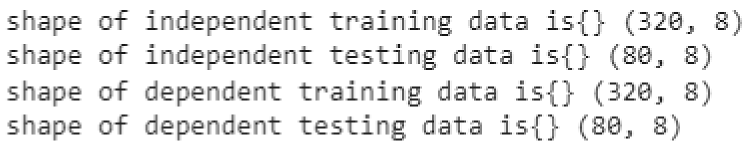
	red_blood_cells	pus_cell	blood glucose random	blood_urea	pedal_edema	anemia	diabetesmellitus	coronary_artery_disease
0	1	1	121.000000	36.0	0	0	4	1
1	1	1	148.036517	18.0	0	0	3	1
2	1	1	423.000000	53.0	0	1	4	1
3	1	0	117.000000	56.0	1	1	3	1
4	1	1	106.000000	26.0	0	0	3	1
...	...	...	...	...	...	...	...	...
395	1	1	140.000000	49.0	0	0	3	1
396	1	1	75.000000	31.0	0	0	3	1
397	1	1	100.000000	26.0	0	0	3	1
398	1	1	114.000000	50.0	0	0	3	1
399	1	1	131.000000	18.0	0	0	3	1

400 rows × 8 columns

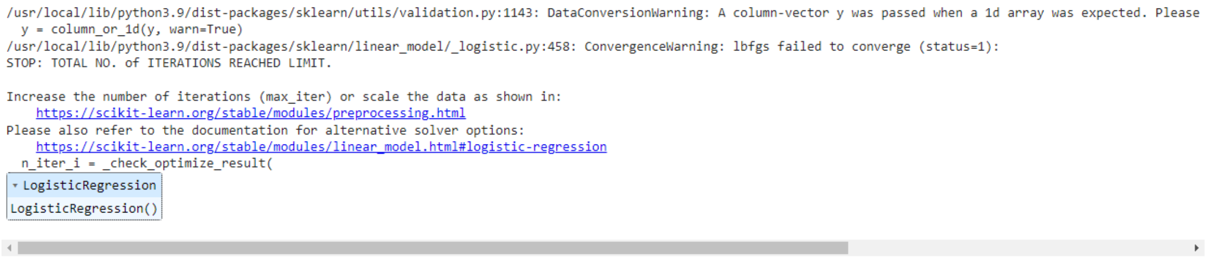


	class
0	0
1	0
2	0
3	0
4	0
...	...
395	2
396	2
397	2
398	2
399	2

400 rows × 1 columns



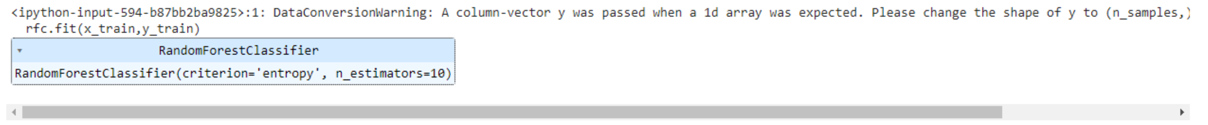
```
shape of independent training data is{} (320, 8)
shape of independent testing data is{} (80, 8)
shape of dependent training data is{} (320, 8)
shape of dependent testing data is{} (80, 8)
```



```
/usr/local/lib/python3.9/dist-packages/sklearn/utils/validation.py:1143: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.9/dist-packages/sklearn/linear_model/_logistic.py:458: 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(
```

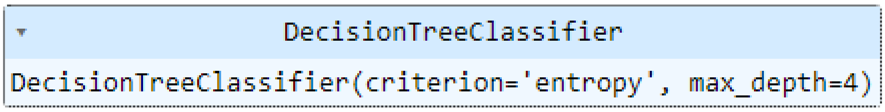
```
LogisticRegression()
```

```
#RandomForestmodel
```

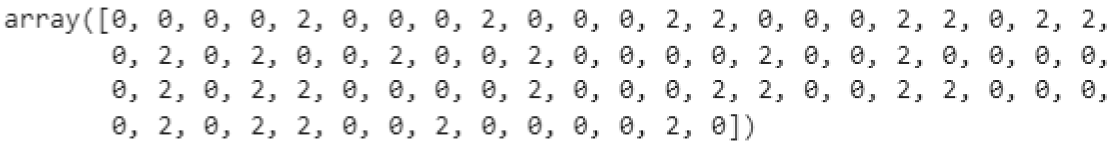


```
<ipython-input-594-b87bb2ba9825>:1: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,)
  rfc.fit(x_train,y_train)
```

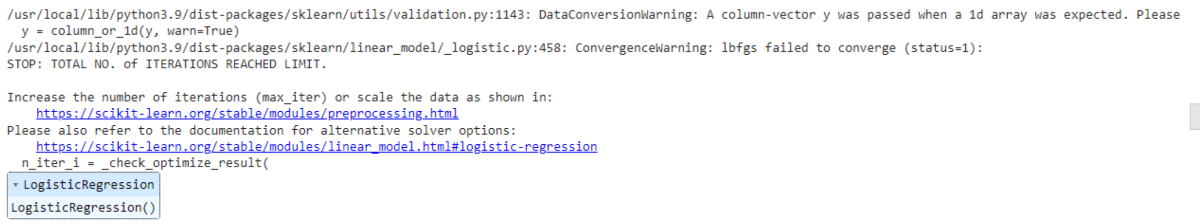
```
RandomForestClassifier(criterion='entropy', n_estimators=10)
```



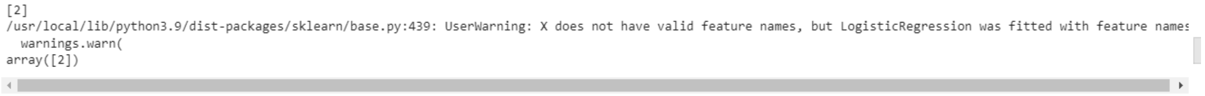
```
▾ DecisionTreeClassifier
DecisionTreeClassifier(criterion='entropy', max_depth=4)
```



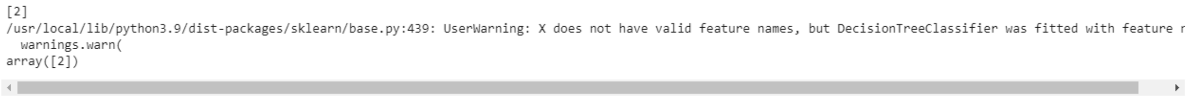
```
array([0, 0, 0, 0, 2, 0, 0, 0, 2, 0, 0, 0, 2, 2, 0, 0, 0, 2, 2, 0, 2, 2,
       0, 2, 0, 2, 0, 0, 2, 0, 0, 2, 0, 0, 0, 0, 2, 0, 0, 2, 0, 0, 0, 0,
       0, 2, 0, 2, 2, 0, 0, 0, 0, 2, 0, 0, 0, 2, 2, 0, 0, 2, 2, 0, 0, 0,
       0, 2, 0, 2, 2, 0, 0, 2, 0, 0, 0, 0, 2, 0])
```



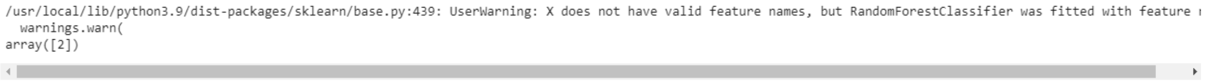
```
/usr/local/lib/python3.9/dist-packages/sklearn/utils/validation.py:1143: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.9/dist-packages/sklearn/linear_model/_logistic.py:458: ConvergenceWarning: lbfgs 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(
▾ LogisticRegression
LogisticRegression()
```



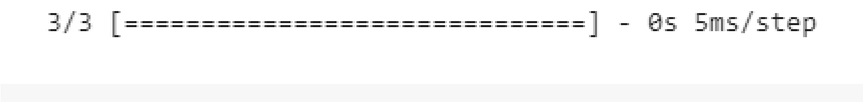
```
[2]
/usr/local/lib/python3.9/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but LogisticRegression was fitted with feature names
  warnings.warn(
array([2])
```



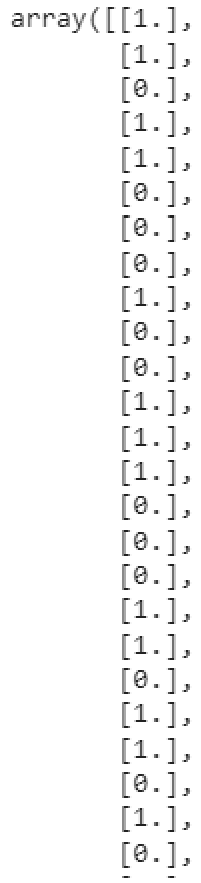
```
[2]
/usr/local/lib/python3.9/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but DecisionTreeClassifier was fitted with feature r
  warnings.warn(
array([2])
```



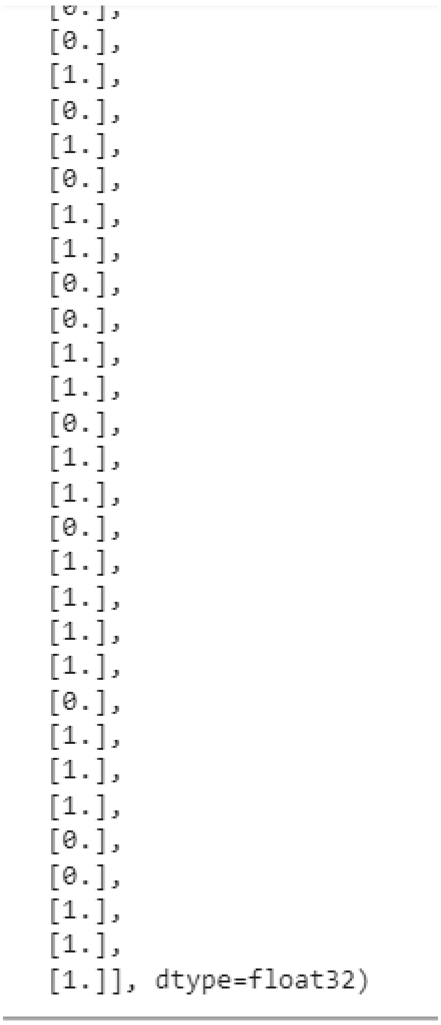
```
/usr/local/lib/python3.9/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but RandomForestClassifier was fitted with feature r
  warnings.warn(
array([2])
```



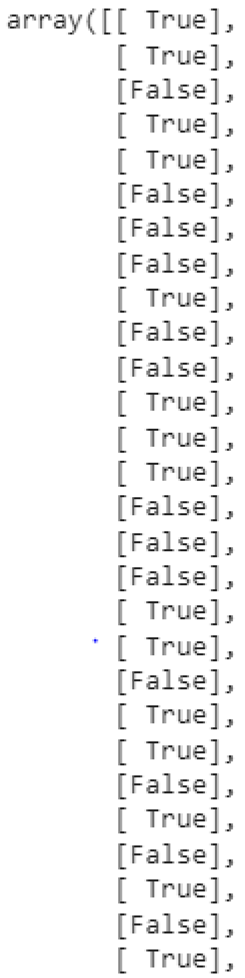
```
3/3 [==============================] - 0s 5ms/step
```



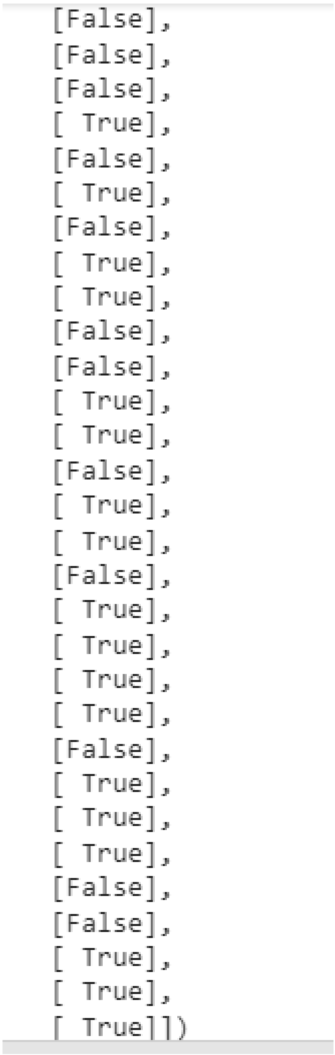
```
array([[1.],
       [1.],
       [0.],
       [1.],
       [1.],
       [0.],
       [0.],
       [0.],
       [1.],
       [0.],
       [0.],
       [1.],
       [1.],
       [1.],
       [0.],
       [0.],
       [0.],
       [1.],
       [1.],
       [0.],
       [1.],
       [1.],
       [0.],
       [1.],
       [0.],
```



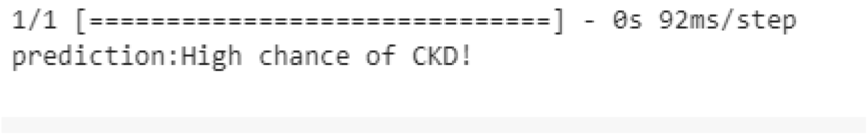
```
       [0.],
       [0.],
       [1.],
       [0.],
       [1.],
       [0.],
       [1.],
       [1.],
       [0.],
       [0.],
       [1.],
       [1.],
       [0.],
       [1.],
       [1.],
       [0.],
       [1.],
       [1.],
       [1.],
       [1.],
       [0.],
       [1.],
       [1.],
       [1.],
       [0.],
       [0.],
       [1.],
       [1.],
       [1.]], dtype=float32)
```



```
array([[ True],
       [ True],
       [False],
       [ True],
       [ True],
       [False],
       [False],
       [False],
       [ True],
       [False],
       [False],
       [ True],
       [ True],
       [ True],
       [False],
       [False],
       [False],
       [ True],
       [ True],
       [False],
       [ True],
       [ True],
       [False],
       [ True],
       [False],
       [ True],
       [False],
       [ True],
```

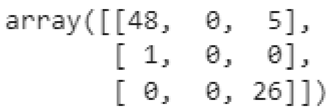


```
       [False],
       [False],
       [False],
       [ True],
       [False],
       [ True],
       [False],
       [ True],
       [ True],
       [False],
       [False],
       [ True],
       [ True],
       [False],
       [ True],
       [ True],
       [False],
       [ True],
       [ True],
       [ True],
       [ True],
       [False],
       [ True],
       [ True],
       [ True],
       [False],
       [False],
       [ True],
       [ True],
       [ True]])
```

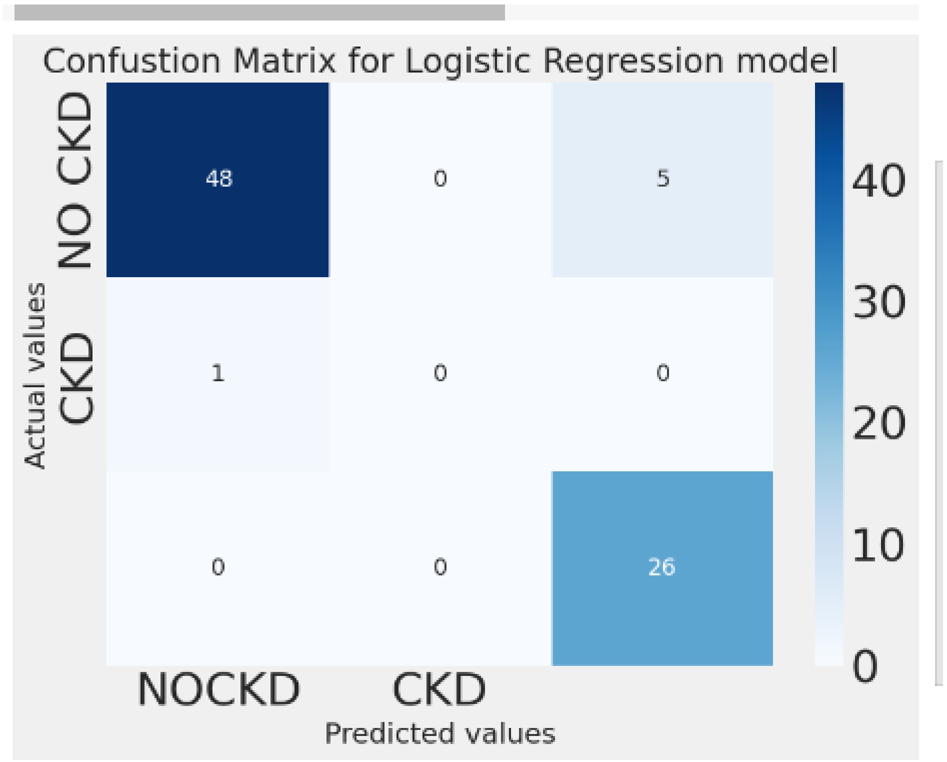


```
1/1 [==============================] - 0s 92ms/step
prediction:High chance of CKD!
```

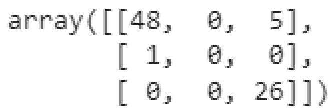
Logistic Regressign Model



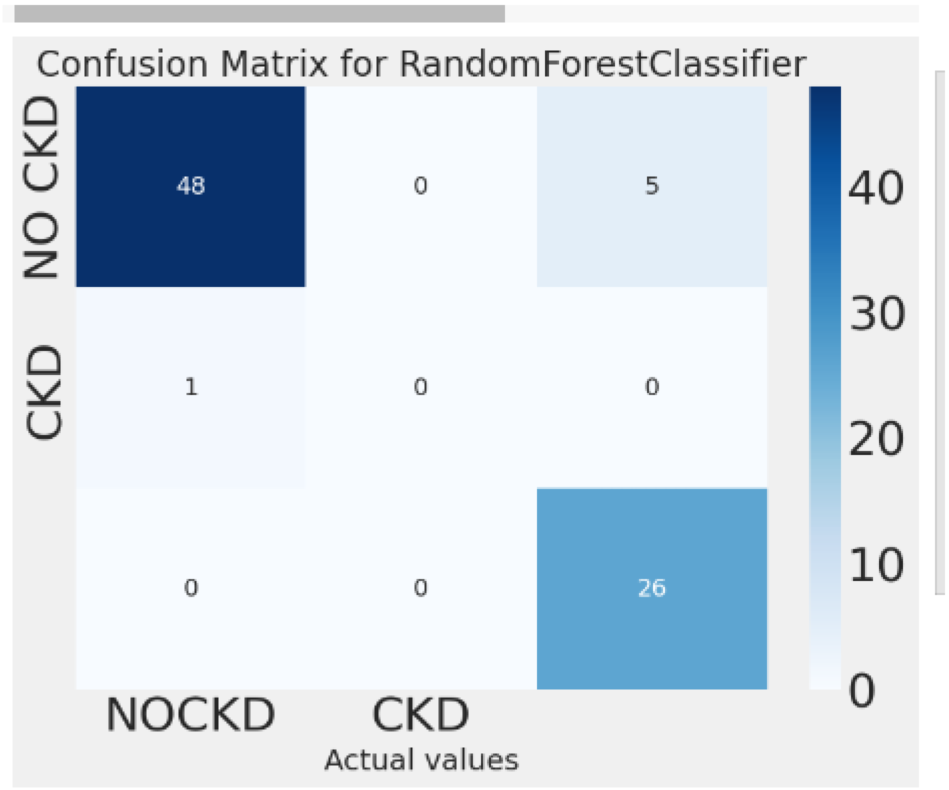
```
array([[48,  0,  5],
       [ 1,  0,  0],
       [ 0,  0, 26]])
```



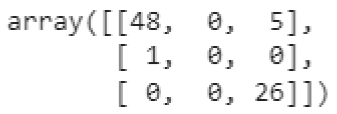
RandomForestCassifier



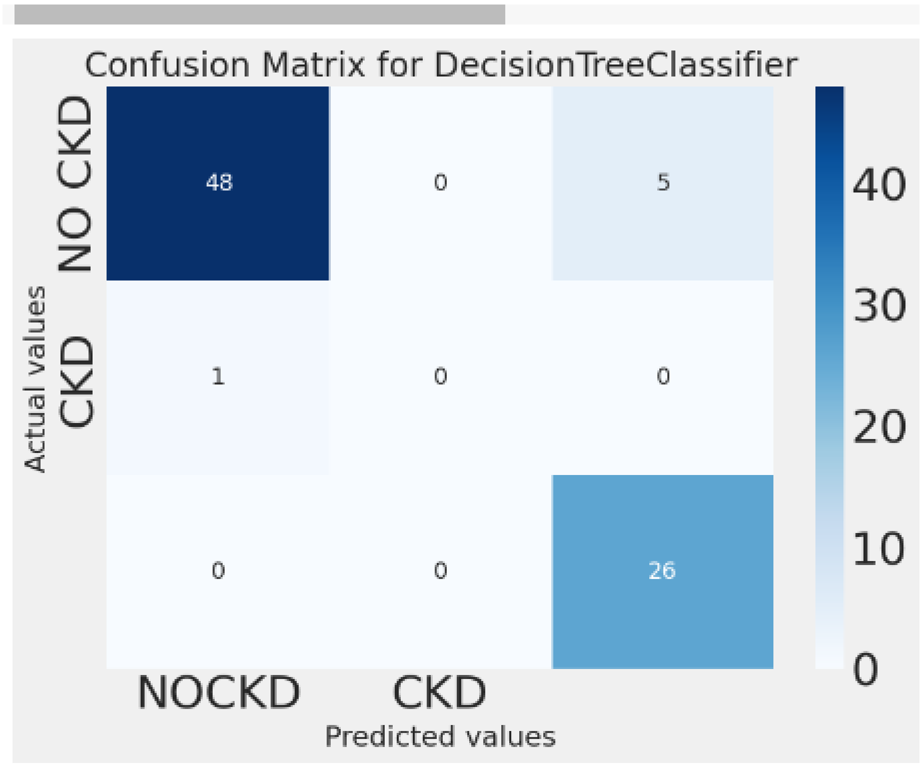
```
array([[48,  0,  5],
       [ 1,  0,  0],
       [ 0,  0, 26]])
```

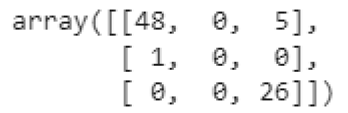


DecisionTreeClassifier

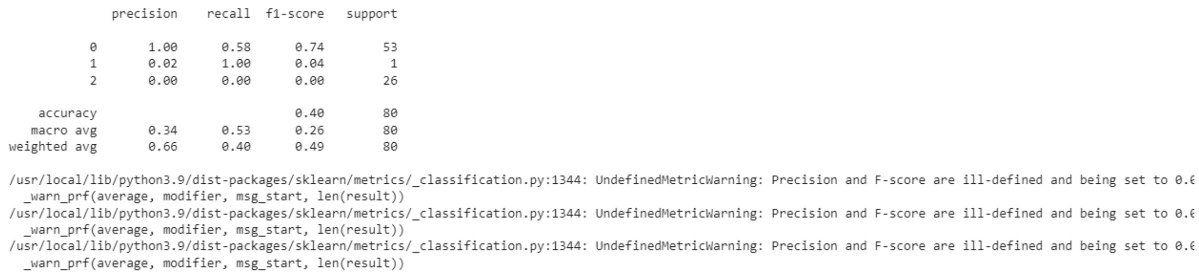


```
array([[48,  0,  5],
       [ 1,  0,  0],
       [ 0,  0, 26]])
```



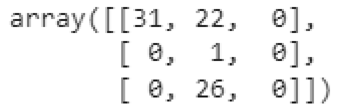


```
array([[48,  0,  5],
       [ 1,  0,  0],
       [ 0,  0, 26]])
```

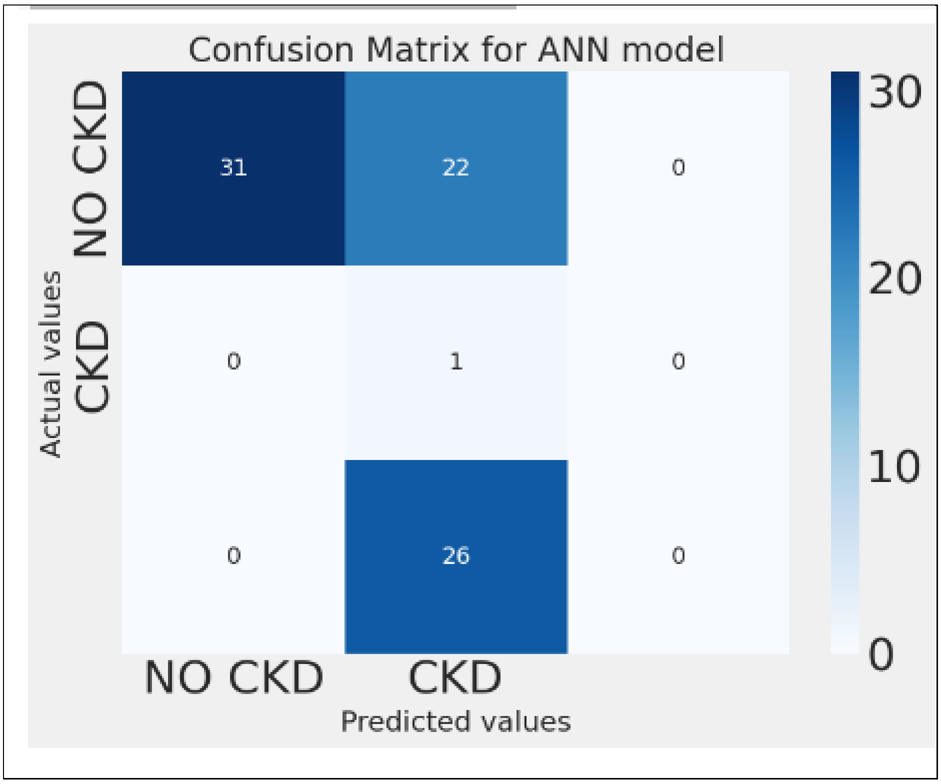


```
              precision    recall  f1-score   support

           0       1.00      0.58      0.74        53
           1       0.02      1.00      0.04         1
           2       0.00      0.00      0.00        26

    accuracy                           0.40        80
   macro avg       0.34      0.53      0.26        80
weighted avg       0.66      0.40      0.49        80

/usr/local/lib/python3.9/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.6
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.9/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.6
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.9/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.6
  _warn_prf(average, modifier, msg_start, len(result))
```

ANN Model



```
array([[31, 22,  0],
       [ 0,  1,  0],
       [ 0, 26,  0]])
```


Confusion Matrix for ANN model
Actual values
NO CKD
CKD
NO CKD
CKD
Predicted values