In [1]:

```
import numpy as np
import pandas as pd
from matplotlib import pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.svm import SVR
from sklearn.metrics import mean_squared_error
```

In [2]:

```
data = pd.read_csv("heart.csv")
```

In [3]:

```
data.head()
```

Out[3]:

	age	sex	cp	trtbps	chol	fbs	restecg	thalachh	exng	oldpeak	slp	caa	thall	output
0	63	1	3	145	233	1	0	150	0	2.3	0	0	1	1
1	37	1	2	130	250	0	1	187	0	3.5	0	0	2	1
2	41	0	1	130	204	0	0	172	0	1.4	2	0	2	1
3	56	1	1	120	236	0	1	178	0	0.8	2	0	2	1
4	57	0	0	120	354	0	1	163	1	0.6	2	0	2	1

In [4]:

```
data.shape
```

Out[4]:

```
(303, 14)
```

In [5]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 303 entries, 0 to 302
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       303 non-null    int64  
 1   sex       303 non-null    int64  
 2   cp        303 non-null    int64  
 3   trtbps    303 non-null    int64  
 4   chol      303 non-null    int64  
 5   fbs       303 non-null    int64  
 6   restecg   303 non-null    int64  
 7   thalachh  303 non-null    int64  
 8   exng      303 non-null    int64  
 9   oldpeak   303 non-null    float64
 10  slp       303 non-null    int64  
 11  caa       303 non-null    int64  
 12  thall     303 non-null    int64  
 13  output    303 non-null    int64  
dtypes: float64(1), int64(13)
memory usage: 33.3 KB
```

In [6]:

```
data.describe()
```

Out[6]:

	age	sex	cp	trtbps	chol	fbs	restecg	thala
count	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.00
mean	54.366337	0.683168	0.966997	131.623762	246.264026	0.148515	0.528053	149.64
std	9.082101	0.466011	1.032052	17.538143	51.830751	0.356198	0.525860	22.90
min	29.000000	0.000000	0.000000	94.000000	126.000000	0.000000	0.000000	71.00
25%	47.500000	0.000000	0.000000	120.000000	211.000000	0.000000	0.000000	133.50
50%	55.000000	1.000000	1.000000	130.000000	240.000000	0.000000	1.000000	153.00
75%	61.000000	1.000000	2.000000	140.000000	274.500000	0.000000	1.000000	166.00
max	77.000000	1.000000	3.000000	200.000000	564.000000	1.000000	2.000000	202.00

In [7]:

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

Out[7]:

```
age          0
sex          0
cp           0
trtbps       0
chol         0
fbs          0
restecg      0
thalachh     0
exng         0
oldpeak      0
slp          0
caa          0
thall        0
output       0
dtype: int64
```

In [8]:

```
data.head()
```

Out[8]:

	age	sex	cp	trtbps	chol	fbs	restecg	thalachh	exng	oldpeak	slp	caa	thall	output
0	63	1	3	145	233	1	0	150	0	2.3	0	0	1	1
1	37	1	2	130	250	0	1	187	0	3.5	0	0	2	1
2	41	0	1	130	204	0	0	172	0	1.4	2	0	2	1
3	56	1	1	120	236	0	1	178	0	0.8	2	0	2	1
4	57	0	0	120	354	0	1	163	1	0.6	2	0	2	1

In [9]:

```
data = data.rename(columns = {"cp" : "Chest Pain" ,
                               "trtbps" : "BP" ,
                               "chol" : "cholesterol" ,
                               "fbs" : "Suger" ,
                               "restecg" : "Restoelectrogram" ,
                               "thalachh" : "Max heart rate",
                              "oldpeak" : "Dpression",
                              })
```

In [10]:

```
data
```

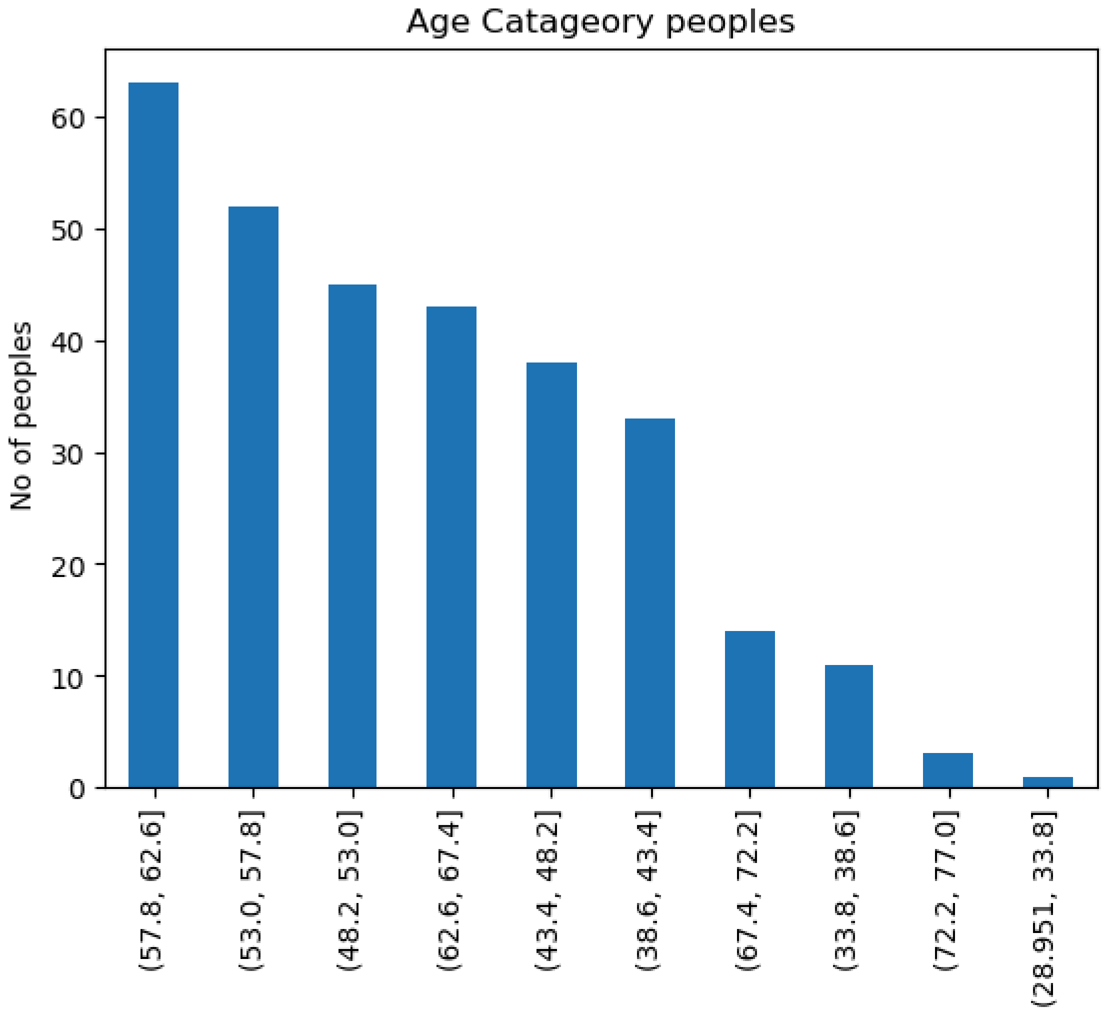
Out[10]:

	age	sex	Chest Pain	BP	cholesterol	Suger	Restoelectrogram	Max heart rate	exng	Dpression	slp	ca
0	63	1	3	145	233	1	0	150	0	2.3	0	
1	37	1	2	130	250	0	1	187	0	3.5	0	
2	41	0	1	130	204	0	0	172	0	1.4	2	
3	56	1	1	120	236	0	1	178	0	0.8	2	
4	57	0	0	120	354	0	1	163	1	0.6	2	
...	...	...	...	...	...	...	...	...	...	...	...	.
298	57	0	0	140	241	0	1	123	1	0.2	1	
299	45	1	3	110	264	0	1	132	0	1.2	1	
300	68	1	0	144	193	1	1	141	0	3.4	1	
301	57	1	0	130	131	0	1	115	1	1.2	1	
302	57	0	1	130	236	0	0	174	0	0.0	1	

303 rows × 14 columns

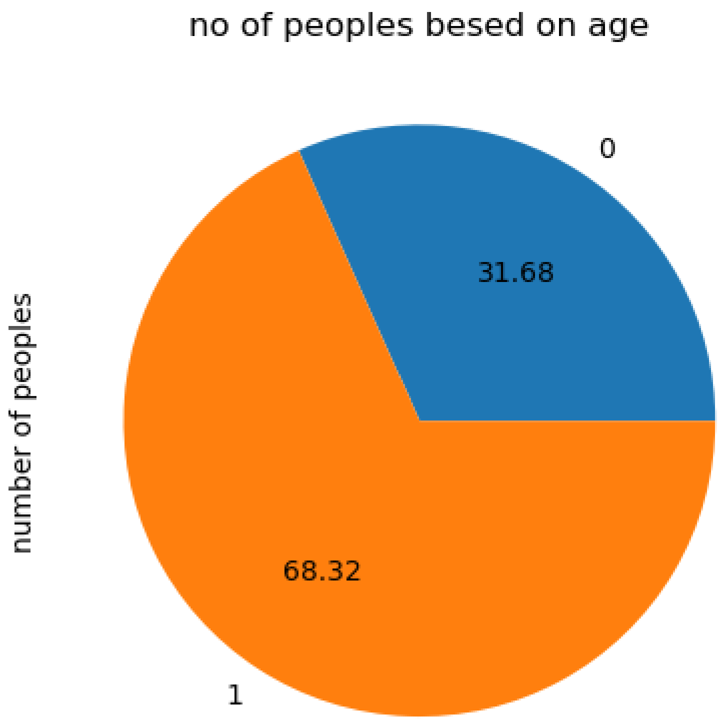
In [11]:

```
age = data["age"].value_counts(bins = 10).sort_values(ascending = False).plot(kind
```



In [12]:
```
data.groupby("sex")["age"].count().plot(kind = "pie" , autopct = "%.2f" , xlabel =
```

Out[12]:
```
<Axes: title={'center': 'no of peoples besed on age'}, ylabel='number of peoples'>
```



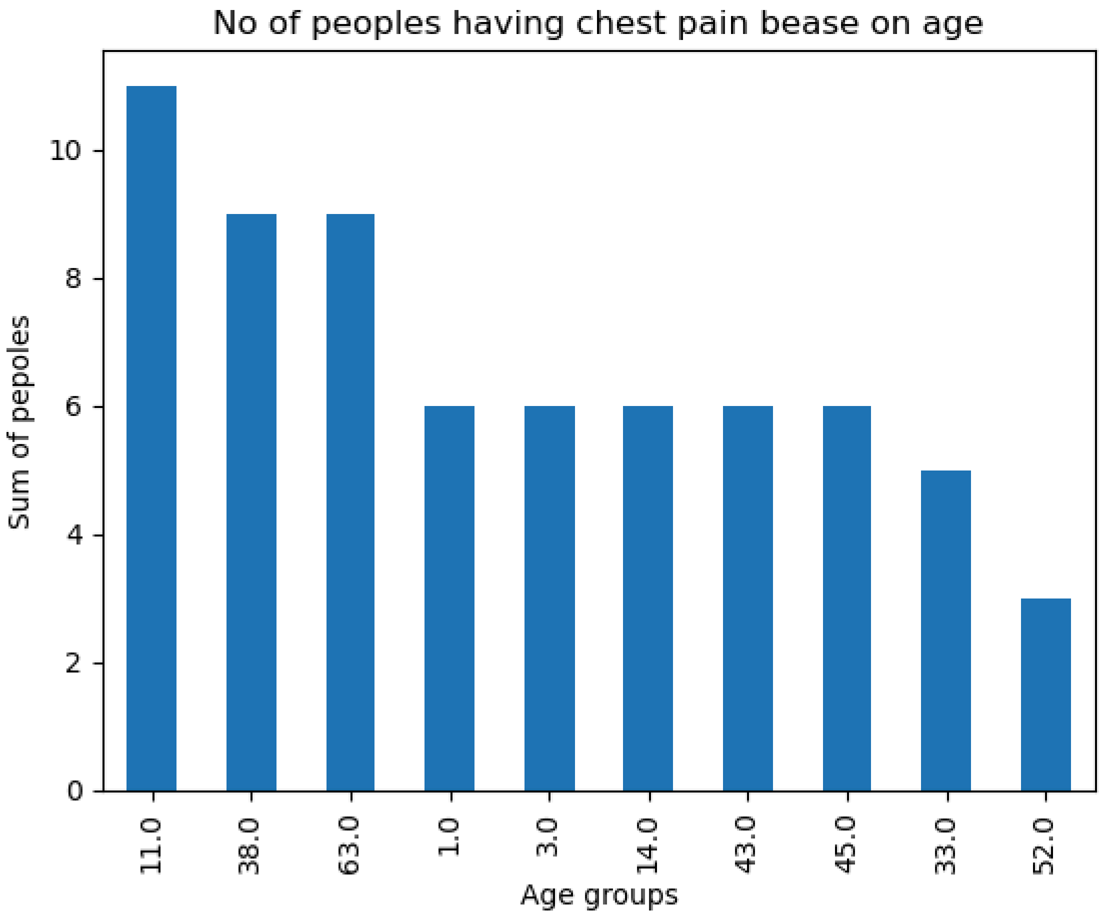
In [13]:
```
data.head()
```

Out[13]:

	age	sex	Chest Pain	BP	cholesterol	Suger	Restoelectrogram	Max heart rate	exng	Dpression	slp	caa
0	63	1	3	145	233	1	0	150	0	2.3	0	0
1	37	1	2	130	250	0	1	187	0	3.5	0	0
2	41	0	1	130	204	0	0	172	0	1.4	2	0
3	56	1	1	120	236	0	1	178	0	0.8	2	0
4	57	0	0	120	354	0	1	163	1	0.6	2	0

In [14]:
```
age_bins = data["age"].value_counts(bins = 10)
```

In [15]:
```
number_of_peoples_having_chest_pain = data.groupby(age_bins)["Chest Pain"].sum().sc
```

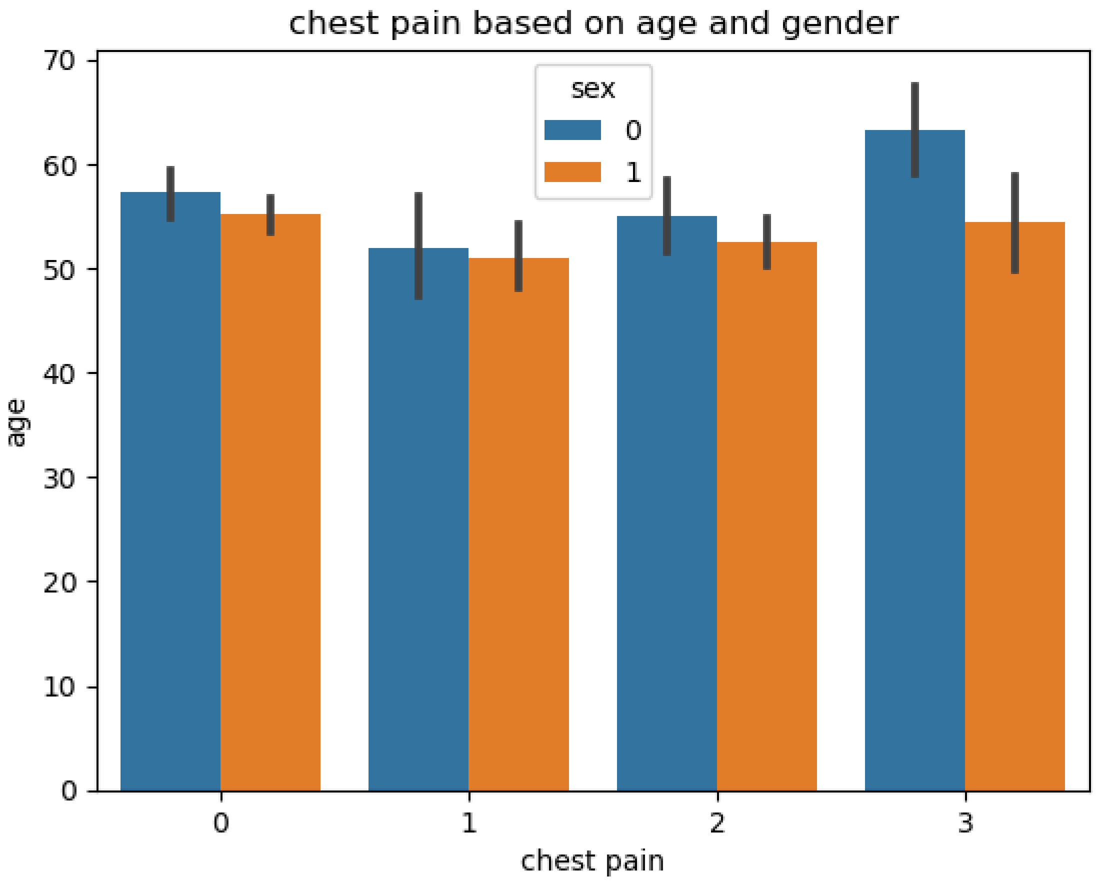


In [16]:

```
sns.barplot(data = data , x = "Chest Pain" , y = "age" , hue = "sex")
plt.xlabel("chest pain")
plt.ylabel("age")
plt.title("chest pain based on age and gender")
```

Out[16]:

```
Text(0.5, 1.0, 'chest pain based on age and gender')
```



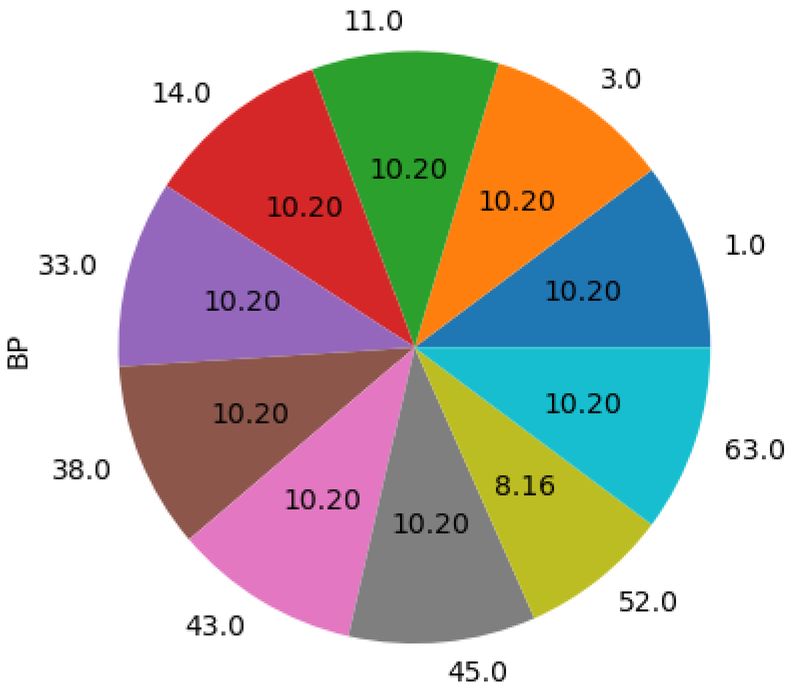
In [17]:
```
data.head()
```

Out[17]:

	age	sex	Chest Pain	BP	cholesterol	Suger	Restoelectrogram	Max heart rate	exng	Dpression	slp	caa
0	63	1	3	145	233	1	0	150	0	2.3	0	0
1	37	1	2	130	250	0	1	187	0	3.5	0	0
2	41	0	1	130	204	0	0	172	0	1.4	2	0
3	56	1	1	120	236	0	1	178	0	0.8	2	0
4	57	0	0	120	354	0	1	163	1	0.6	2	0

In [18]:
```
data.groupby(age_bins)["BP"].count().plot(kind = "pie" , autopct = "%.2f")
```

Out[18]:
```
<Axes: ylabel='BP'>
```



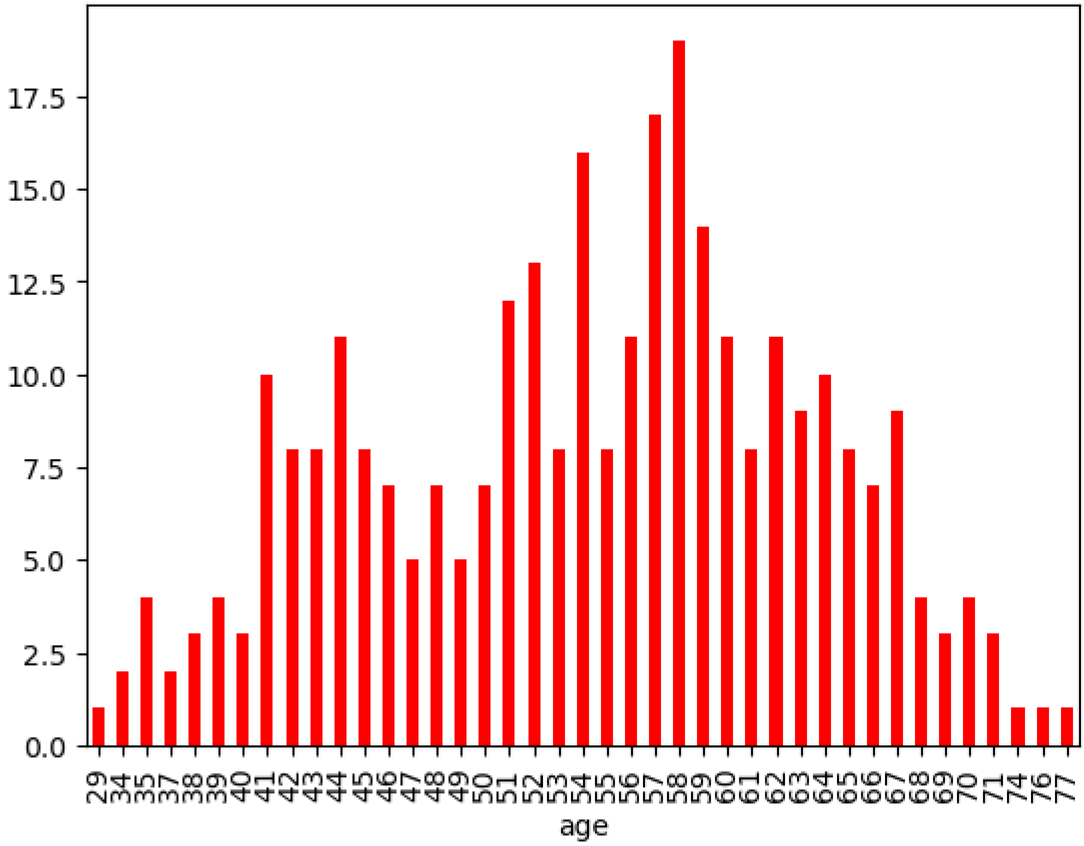
In [19]:
```
data.head()
```

Out[19]:

	age	sex	Chest Pain	BP	cholesterol	Suger	Restoelectrogram	Max heart rate	exng	Dpression	slp	caa
0	63	1	3	145	233	1	0	150	0	2.3	0	0
1	37	1	2	130	250	0	1	187	0	3.5	0	0
2	41	0	1	130	204	0	0	172	0	1.4	2	0
3	56	1	1	120	236	0	1	178	0	0.8	2	0
4	57	0	0	120	354	0	1	163	1	0.6	2	0

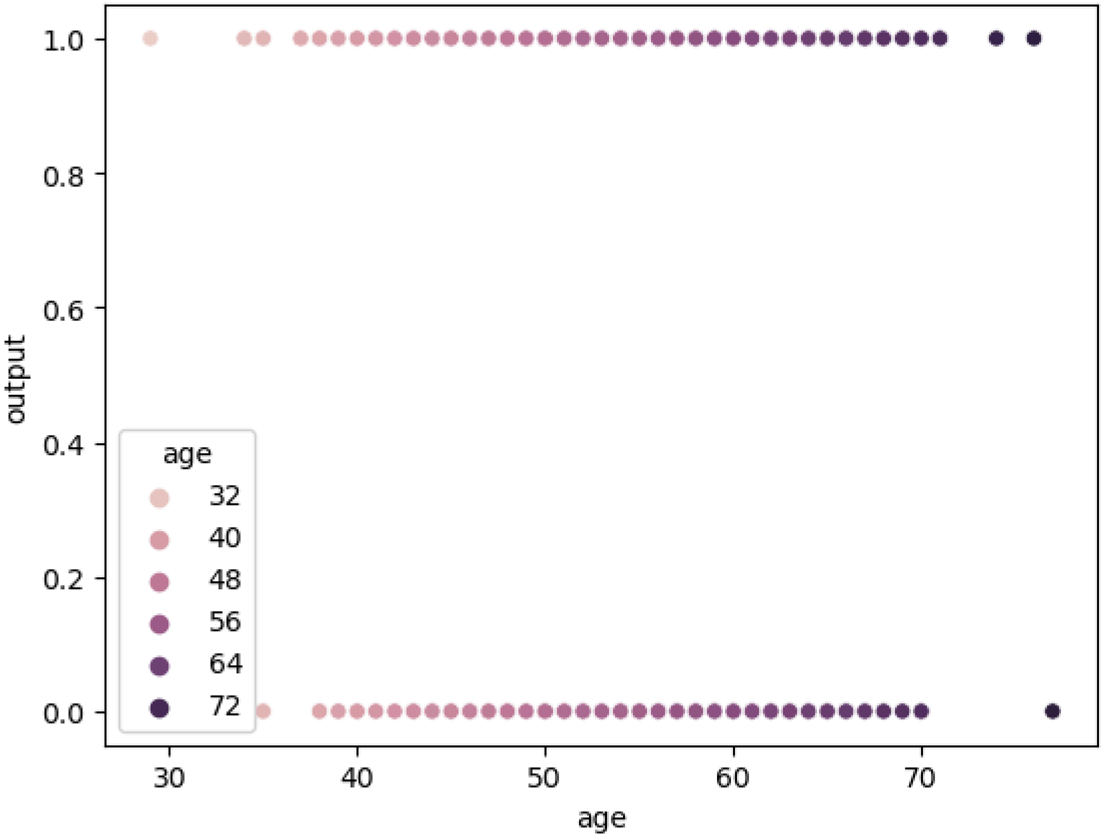
In [20]:
```
data.groupby("age").count()["cholesterol"].plot(kind = "bar" , color = "red")
```

Out[20]:
```
<Axes: xlabel='age'>
```



In [21]:
```
sns.scatterplot(data = data , x = "age" , y = "output" , hue = "age")
```

Out[21]:
```
<Axes: xlabel='age', ylabel='output'>
```



In [ ]:

In [ ]:

In [22]:
```
data
```

Out[22]:

	age	sex	Chest Pain	BP	cholesterol	Suger	Restoelectrogram	Max heart rate	exng	Dpression	slp	ca
0	63	1	3	145	233	1	0	150	0	2.3	0	
1	37	1	2	130	250	0	1	187	0	3.5	0	
2	41	0	1	130	204	0	0	172	0	1.4	2	
3	56	1	1	120	236	0	1	178	0	0.8	2	
4	57	0	0	120	354	0	1	163	1	0.6	2	
...	...	...	...	...	...	...	...	...	...	...	...	
298	57	0	0	140	241	0	1	123	1	0.2	1	
299	45	1	3	110	264	0	1	132	0	1.2	1	
300	68	1	0	144	193	1	1	141	0	3.4	1	
301	57	1	0	130	131	0	1	115	1	1.2	1	
302	57	0	1	130	236	0	0	174	0	0.0	1	

303 rows × 14 columns

In [23]:
```
x = data.drop("output" , axis = 1)
```

In [24]:
```
y = data[["output"]]
```

In [25]:
```
x
```

Out[25]:

	age	sex	Chest Pain	BP	cholesterol	Suger	Restoelectrogram	Max heart rate	exng	Dpression	slp	ca
0	63	1	3	145	233	1	0	150	0	2.3	0	
1	37	1	2	130	250	0	1	187	0	3.5	0	
2	41	0	1	130	204	0	0	172	0	1.4	2	
3	56	1	1	120	236	0	1	178	0	0.8	2	
4	57	0	0	120	354	0	1	163	1	0.6	2	
...	...	...	...	...	...	...	...	...	...	...	...	
298	57	0	0	140	241	0	1	123	1	0.2	1	
299	45	1	3	110	264	0	1	132	0	1.2	1	
300	68	1	0	144	193	1	1	141	0	3.4	1	
301	57	1	0	130	131	0	1	115	1	1.2	1	
302	57	0	1	130	236	0	0	174	0	0.0	1	

303 rows × 13 columns

In [26]:
```
y
```

Out[26]:

	output
0	1
1	1
2	1
3	1
4	1
...	...
298	0
299	0
300	0
301	0
302	0

303 rows × 1 columns

In [27]:
```
x_train , x_test ,y_train ,y_test = train_test_split(x,y,test_size = 0.2 , random_s
```

In [28]:
```
x_train
```

Out[28]:

	age	sex	Chest Pain	BP	cholesterol	Suger	Restoelectrogram	Max heart rate	exng	Dpression	slp	ca
254	59	1	3	160	273	0	0	125	0	0.0	2	
99	53	1	2	130	246	1	0	173	0	0.0	2	
189	41	1	0	110	172	0	0	158	0	0.0	2	
186	60	1	0	130	253	0	1	144	1	1.4	2	
20	59	1	0	135	234	0	1	161	0	0.5	1	
...	...	...	...	...	...	...	...	...	...	...	...	
199	65	1	0	110	248	0	0	158	0	0.6	2	
155	58	0	0	130	197	0	1	131	0	0.6	1	
156	47	1	2	130	253	0	1	179	0	0.0	2	
133	41	1	1	110	235	0	1	153	0	0.0	2	
245	48	1	0	124	274	0	0	166	0	0.5	1	

242 rows × 13 columns

In [29]:
```
x_train.shape
```

Out[29]:
```
(242, 13)
```

In [30]:

```
y_train
```

Out[30]:

	output
254	0
99	1
189	0
186	0
20	1
...	...
199	0
155	1
156	1
133	1
245	0

242 rows × 1 columns

In [31]:

```
y_train.shape
```

Out[31]:

```
(242, 1)
```

In [32]:

```
x_test
```

Out[32]:

	age	sex	Chest Pain	BP	cholesterol	Suger	Restoelectrogram	Max heart rate	exng	Dpression	slp	ca
201	60	1	0	125	258	0	0	141	1	2.8	1	
197	67	1	0	125	254	1	1	163	0	0.2	1	
64	58	1	2	140	211	1	0	165	0	0.0	2	
134	41	0	1	126	306	0	1	163	0	0.0	2	
145	70	1	1	156	245	0	0	143	0	0.0	2	
...	...	...	...	...	...	...	...	...	...	...	...	
50	51	0	2	130	256	0	0	149	0	0.5	2	
92	52	1	2	138	223	0	1	169	0	0.0	2	
275	52	1	0	125	212	0	1	168	0	1.0	2	
86	68	1	2	118	277	0	1	151	0	1.0	2	
191	58	1	0	128	216	0	0	131	1	2.2	1	

61 rows × 13 columns

In [33]:

```
x_test.shape
```

Out[33]:
```
(61, 13)
```

In [34]:
```
y_test
```

Out[34]:

	output
201	0
197	0
64	1
134	1
145	1
...	...
50	1
92	1
275	0
86	1
191	0

61 rows × 1 columns

In [35]:
```
y_test.shape
```

Out[35]:
```
(61, 1)
```

In [36]:
```
from sklearn.preprocessing import StandardScaler
scalar = StandardScaler()
```

In [37]:
```
x_train_scalar = scalar.fit_transform(x_train)
x_test_scalar = scalar.transform(x_test)
```

In [38]:
```
x_train_scalar
```

Out[38]:
```
array([[ 0.52433249,  0.70929937,  1.94537163, ...,  1.00497103,
        -0.69140238, -0.4917684 ],
       [-0.13597174,  0.70929937,  0.97867772, ...,  1.00497103,
         2.46556698, -0.4917684 ],
       [-1.45658021,  0.70929937, -0.9547101 , ...,  1.00497103,
        -0.69140238,  1.16111984],
       ...,
       [-0.79627597,  0.70929937,  0.97867772, ...,  1.00497103,
        -0.69140238, -0.4917684 ],
       [-1.45658021,  0.70929937,  0.01198381, ...,  1.00497103,
        -0.69140238, -0.4917684 ],
       [-0.68622527,  0.70929937, -0.9547101 , ..., -0.59504864,
        -0.69140238,  1.16111984]])
```

In [39]:
```
x_test_scalar
```

```
Out[39]: array([[ 0.6343832 ,  0.70929937, -0.9547101 , -0.37531416,  0.20140385,
                 -0.40430377, -0.97132985, -0.39884669,  1.47790748,  1.51384339,
                 -0.59504864,  0.36092074,  1.16111984],
                [ 1.40473814,  0.70929937, -0.9547101 , -0.37531416,  0.12667832,
                  2.47338777,  0.90916474,  0.56112608, -0.67663234, -0.7347644 ,
                 -0.59504864,  1.41324386,  1.16111984],
                [ 0.41428179,  0.70929937,  0.97867772,  0.48315491, -0.67662123,
                  2.47338777, -0.97132985,  0.64839634, -0.67663234, -0.90773423,
                  1.00497103, -0.69140238, -0.4917684 ],
                [-1.45658021, -1.40984195,  0.01198381, -0.31808289,  1.09811032,
                 -0.40430377,  0.90916474,  0.56112608, -0.67663234, -0.90773423,
                  1.00497103, -0.69140238, -0.4917684 ],
                [ 1.73489025,  0.70929937,  0.01198381,  1.39885525, -0.04145415,
                 -0.40430377, -0.97132985, -0.31157644, -0.67663234, -0.90773423,
                  1.00497103, -0.69140238, -0.4917684 ],
                [-0.24602244,  0.70929937, -0.9547101 , -1.34824578, -0.26563076,
                  2.47338777,  0.90916474, -0.13703593, -0.67663234, -0.82124932,
                  1.00497103,  2.46556698,  1.16111984],
                [ 0.85448461,  0.70929937,  0.97867772, -0.08915781, -0.30299353,
                 -0.40430377,  0.90916474, -0.18067106, -0.67663234,  0.64899424,
                 -0.59504864,  2.46556698,  1.16111984],
                [ 1.07458602, -1.40984195, -0.9547101 ,  2.77240576,  1.45305663,
                 -0.40430377,  0.90916474,  0.16840995,  1.47790748, -0.90773423,
                  1.00497103, -0.69140238, -0.4917684 ],
                [ 0.30423108,  0.70929937, -0.9547101 ,  0.02530474, -0.75134677,
                 -0.40430377,  0.90916474,  0.77930171,  1.47790748, -0.90773423,
                  1.00497103, -0.69140238,  1.16111984],
                [ 0.85448461,  0.70929937,  0.01198381, -0.20362035, -0.73266538,
                  2.47338777, -0.97132985, -0.44248182, -0.67663234, -0.90773423,
                  1.00497103, -0.69140238, -0.4917684 ],
                [-1.12642809,  0.70929937,  0.97867772, -0.66147052, -0.39640046,
                 -0.40430377,  0.90916474,  0.82293684, -0.67663234, -0.90773423,
                  1.00497103, -0.69140238, -0.4917684 ],
                [-1.67668162, -1.40984195,  0.97867772, -2.14948358, -0.90079785,
                 -0.40430377,  0.90916474,  1.2592881 , -0.67663234, -0.90773423,
                  1.00497103, -0.69140238, -0.4917684 ],
                [-1.67668162,  0.70929937,  0.97867772,  0.48315491,  1.37833109,
                 -0.40430377, -0.97132985,  1.39019348, -0.67663234, -0.90773423,
                  1.00497103, -0.69140238, -0.4917684 ],
                [ 1.18463673, -1.40984195, -0.9547101 ,  1.05546762, -0.41508184,
                 -0.40430377, -0.97132985, -1.57699509, -0.67663234, -0.04288508,
                 -0.59504864,  2.46556698,  1.16111984],
                [ 0.96453532,  0.70929937, -0.9547101 , -0.08915781,  1.54646356,
                  2.47338777, -0.97132985, -0.79156282,  1.47790748,  0.64899424,
                  1.00497103,  2.46556698,  1.16111984],
                [-0.35607315,  0.70929937,  0.97867772, -2.14948358, -0.37771907,
                 -0.40430377,  0.90916474,  0.16840995,  1.47790748, -0.90773423,
                  1.00497103,  0.36092074,  1.16111984],
                [ 1.29468743,  0.70929937, -0.9547101 ,  1.62778034, -0.35903769,
                 -0.40430377, -0.97132985, -0.52975207, -0.67663234,  1.08141882,
                  1.00497103, -0.69140238, -2.14465665],
                [-1.3465295 ,  0.70929937, -0.9547101 ,  0.25422982,  1.26624279,
                 -0.40430377,  0.90916474, -1.09700871,  1.47790748,  0.64899424,
                 -0.59504864, -0.69140238, -2.14465665],
                [-0.35607315, -1.40984195,  0.97867772, -0.66147052,  0.89261509,
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                 -0.59504864,  2.46556698,  1.16111984]])
```

In [ ]:

```

```

In [44]:

```
model = SVR(kernel = "rbf")
```

In [45]:

```
model.fit(x_train_scalar , y_train)
```

```
C:\Users\godde\anaconda3\Lib\site-packages\sklearn\utils\validation.py:1184: DataC
onversionWarning: A column-vector y was passed when a 1d array was expected. Pleas
e change the shape of y to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```

Out[45]:

```
▾ SVR
SVR()
```

In [46]:

```
y_prediction = model.predict(x_test_scalar)
```

In [47]:

```
model
```

Out[47]:

```
▾ SVR
SVR()
```

In [48]:

```
model.fit(x_train,y_train)
```

```
C:\Users\godde\anaconda3\Lib\site-packages\sklearn\utils\validation.py:1184: DataC
onversionWarning: A column-vector y was passed when a 1d array was expected. Pleas
e change the shape of y to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```

Out[48]:

```
▾ SVR
SVR()
```

In [49]:

```
y_prediction[:10]
```

Out[49]:

```
array([-0.10968341,  0.38198476,  1.04143739,  1.08039946,  0.30343952,
        0.37341665,  0.12303239,  0.30586577,  0.42026224,  0.81318492])
```

In [ ]:

In [50]:

```
y_predictions = model.predict(x_test)
```

In [ ]:

In [ ]:

In [51]:

```
y_predictions[:10]
```

Out[51]:

```
array([0.51558008, 0.74601425, 0.77313558, 0.70378048, 0.41690722,
       0.70125808, 0.586247  , 0.32430583, 0.83668284, 0.57230711])
```

In [52]:

```
y_test[:10]
```

Out[52]:

```
     output
201       0
197       0
 64       1
134       1
145       1
 97       1
 52       1
110       1
 91       1
137       1
```

In [53]:

```
error = mean_squared_error(y_test , y_predictions)
```

In [55]:

```
error
```

Out[55]:

```
0.17922969756439228
```

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]: