In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [98]:
```
#read the datasets
bank_df=pd.read_csv("bank.csv",sep=";")
bank_df
```

Out[98]:

	age	job	marital	education	default	balance	housing	loan	contact	da
0	30	unemployed	married	primary	no	1787	no	no	cellular	
1	33	services	married	secondary	no	4789	yes	yes	cellular	
2	35	management	single	tertiary	no	1350	yes	no	cellular	
3	30	management	married	tertiary	no	1476	yes	yes	unknown	
4	59	blue-collar	married	secondary	no	0	yes	no	unknown	
...	...	...	...	...	...	...	...	...	...	
4516	33	services	married	secondary	no	-333	yes	no	cellular	
4517	57	self-employed	married	tertiary	yes	-3313	yes	yes	unknown	
4518	57	technician	married	secondary	no	295	no	no	cellular	
4519	28	blue-collar	married	secondary	no	1137	no	no	cellular	
4520	44	entrepreneur	single	tertiary	no	1136	yes	yes	cellular	

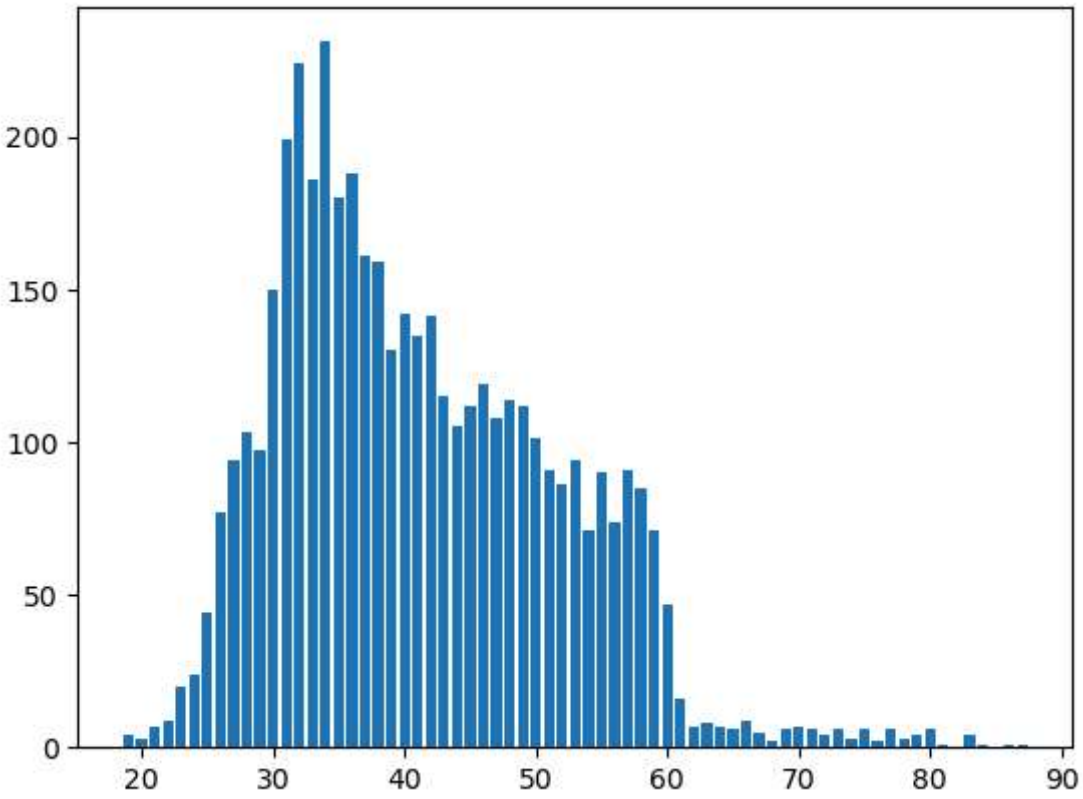
4521 rows × 17 columns

In [3]:
```
cat_col=bank_df.select_dtypes(include="object").columns
num_col=bank_df.select_dtypes(exclude="object").columns
```

In [4]:
```
num_col
```

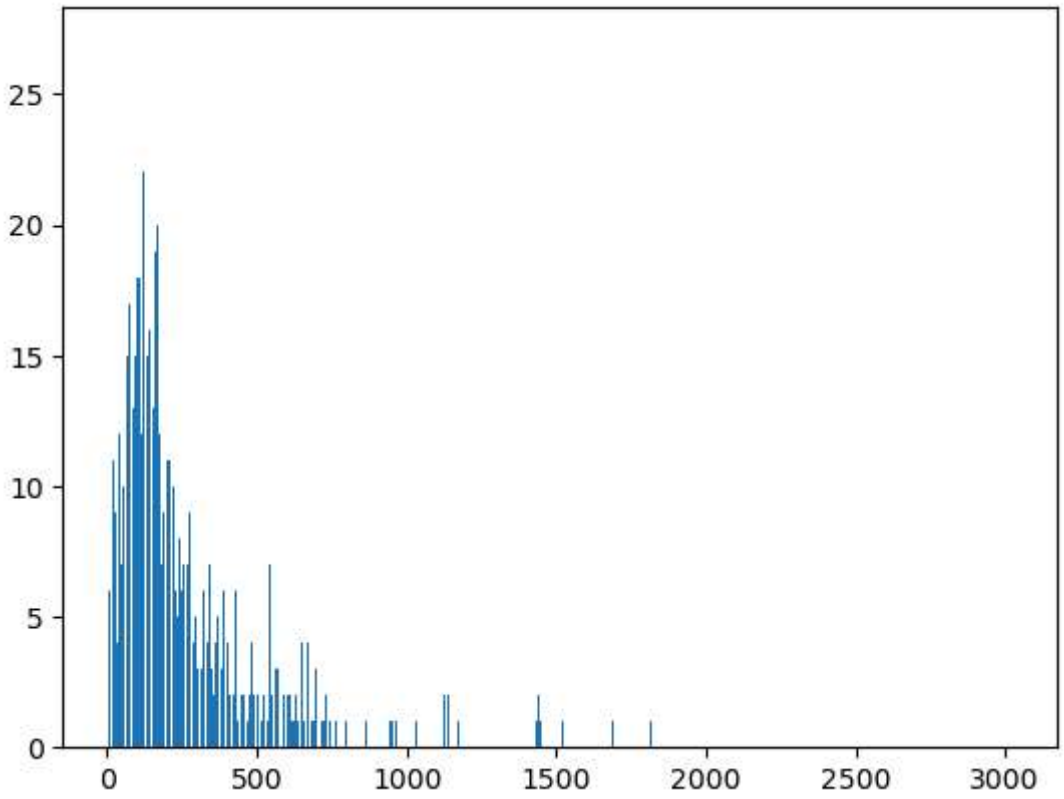
Out[4]:
```
Index(['age', 'balance', 'day', 'duration', 'campaign', 'pdays', 'previous'], dtyp
e='object')
```

In [100…
```
#uni-Variente Analysis
data=bank_df["age"].value_counts()
keys=data.keys()
values=data.values
df=pd.DataFrame(zip(keys,values),columns=["level","count"])
plt.bar("level","count",data=df)
plt.show()
```



In [102…

```
data=bank_df["duration"].value_counts()
keys=data.keys()
values=data.values
df=pd.DataFrame(zip(keys,values),columns=["level","count"])
plt.bar("level","count",data=df)
plt.show()
```



In [8]:
```
bank_df["age"].unique()
```

Out[8]:
```
array([30, 33, 35, 59, 36, 39, 41, 43, 20, 31, 40, 56, 37, 25, 38, 42, 44,
       26, 55, 67, 53, 68, 32, 49, 78, 23, 52, 34, 61, 45, 48, 57, 54, 63,
       51, 29, 50, 27, 60, 28, 21, 58, 22, 46, 24, 77, 75, 47, 70, 65, 64,
       62, 66, 19, 81, 83, 80, 71, 72, 69, 79, 73, 86, 74, 76, 87, 84],
      dtype=int64)
```

In [9]:
```
bank_df["campaign"].value_counts()
```

Out[9]:
```
campaign
1     1734
2     1264
3      558
4      325
5      167
6      155
7       75
8       56
9       30
10      27
11      22
12      21
13      17
14      10
15       9
16       8
17       7
18       7
25       4
19       3
20       3
28       3
24       3
32       2
21       2
23       2
22       2
31       1
29       1
50       1
30       1
44       1
Name: count, dtype: int64
```

In [10]:
```
bank_df["previous"].unique()
```

Out[10]:
```
array([ 0,  4,  1,  3,  2,  5, 20,  7,  6, 10,  9,  8, 18, 19, 12, 13, 11,
       14, 15, 24, 17, 22, 23, 25], dtype=int64)
```

In [11]:
```
cat_col=bank_df.select_dtypes(include="object").columns
cat_col
```

Out[11]:
```
Index(['job', 'marital', 'education', 'default', 'housing', 'loan', 'contact',
       'month', 'poutcome', 'y'],
      dtype='object')
```

In [12]:
```
#bi-variente Analysis(reletion between two columns)
indx=bank_df["job"].unique()
p1=[]
s1=[]
t1=[]
for i in bank_df["job"].unique():
    con1=bank_df["job"]==i
    con2=bank_df["education"]=="primary"
    con3=bank_df["education"]=="secondary"
```

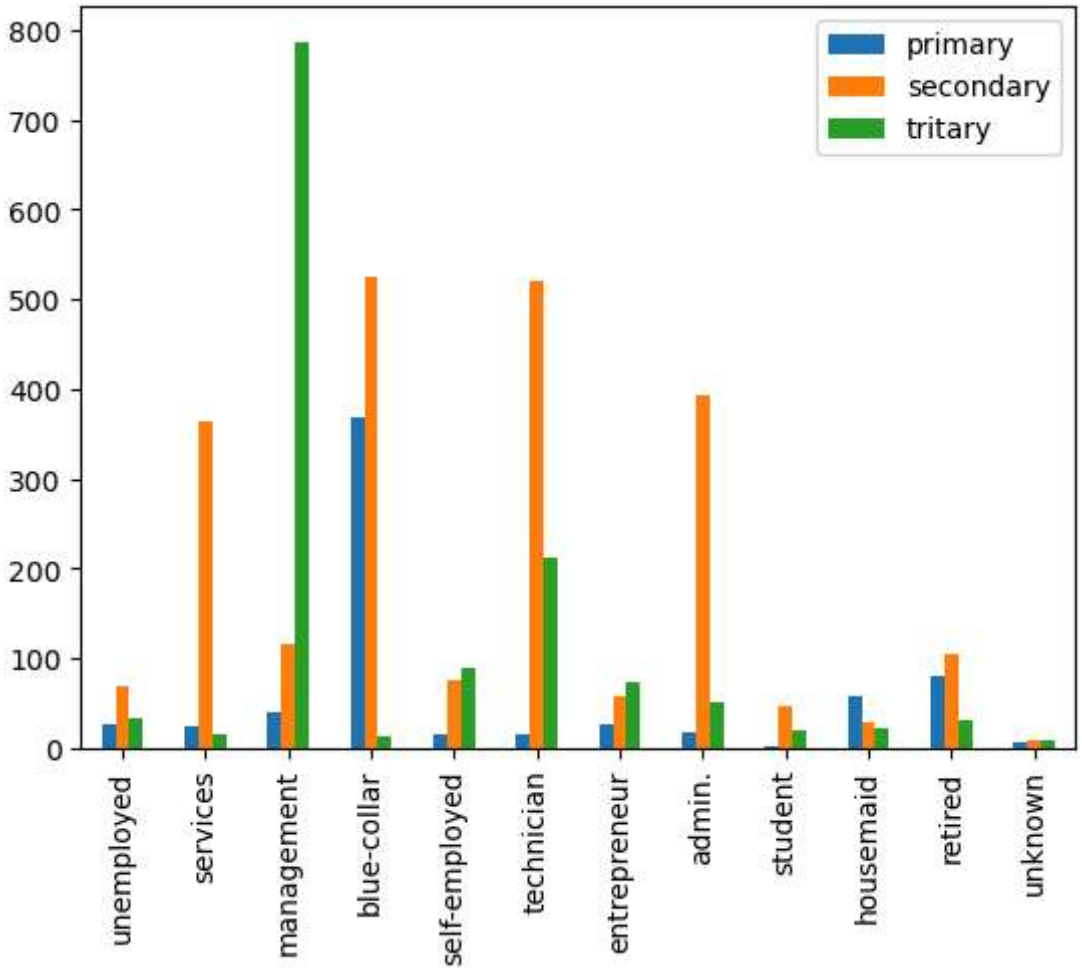
```
    con4=bank_df["education"]=="tertiary"
    c1=con1&con2
    c2=con1&con3
    c3=con1&con4
    n1=len(bank_df[c1])
    n2=len(bank_df[c2])
    n3=len(bank_df[c3])
    p1.append(n1)
    s1.append(n2)
    t1.append(n3)
dfs=pd.DataFrame(zip(p1,s1,t1),columns=["primary","secondary","tritary"],index=indx
dfs
```

Out[12]:

	primary	secondary	tritary
unemployed	26	68	32
services	25	363	16
management	39	116	787
blue-collar	369	524	12
self-employed	15	76	88
technician	15	520	211
entrepreneur	26	58	73
admin.	17	393	51
student	2	47	19
housemaid	57	28	22
retired	80	105	31
unknown	7	8	8

In [13]:
```
#plot
dfs.plot(kind="bar")
```

Out[13]: <Axes: >



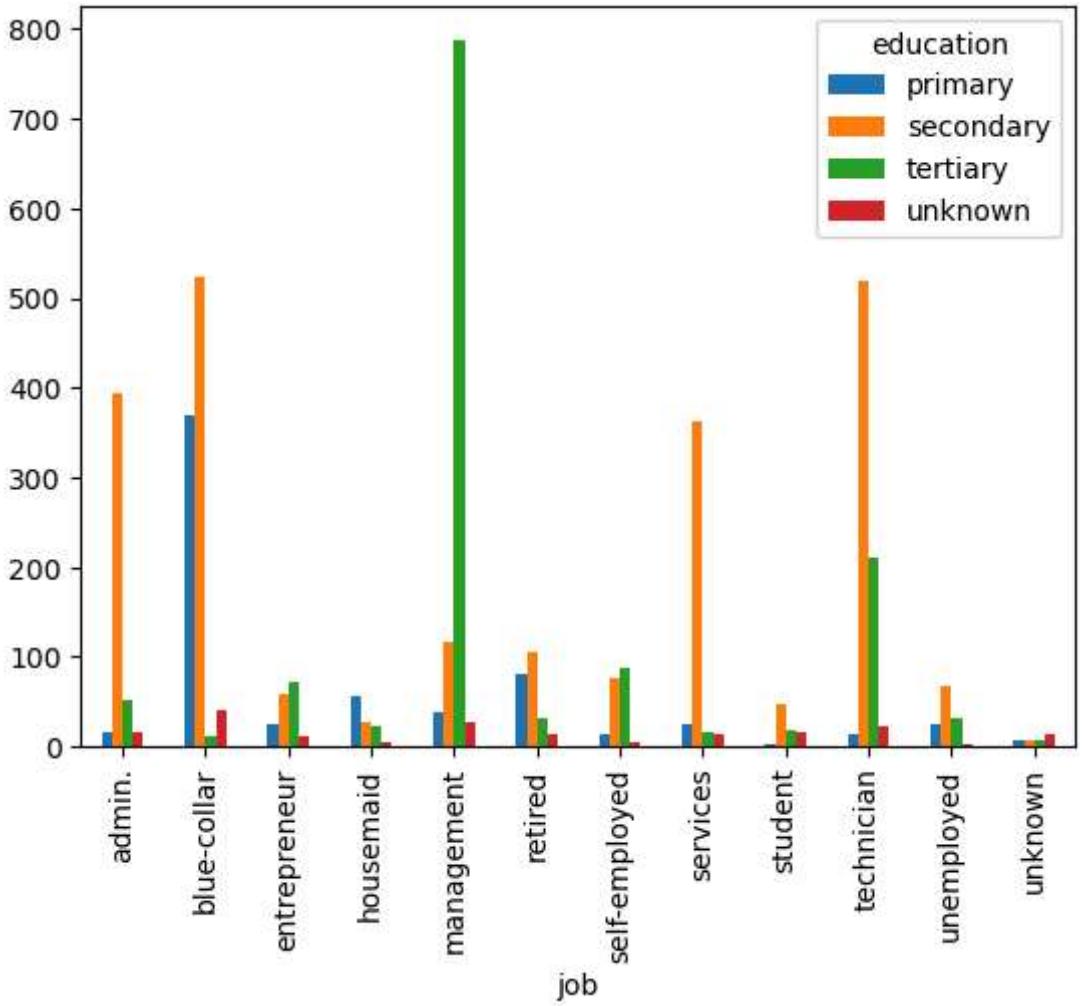
In [14]:
```
#reletion between two columns
indx=bank_df["job"]
col=bank_df["education"]
dfs2=pd.crosstab(indx,col)
dfs2
```

Out[14]:

education job	primary	secondary	tertiary	unknown
admin.	17	393	51	17
blue-collar	369	524	12	41
entrepreneur	26	58	73	11
housemaid	57	28	22	5
management	39	116	787	27
retired	80	105	31	14
self-employed	15	76	88	4
services	25	363	16	13
student	2	47	19	16
technician	15	520	211	22
unemployed	26	68	32	2
unknown	7	8	8	15

In [15]:
```
#plot
dfs2.plot(kind="bar")
```

Out[15]:
```
<Axes: xlabel='job'>
```



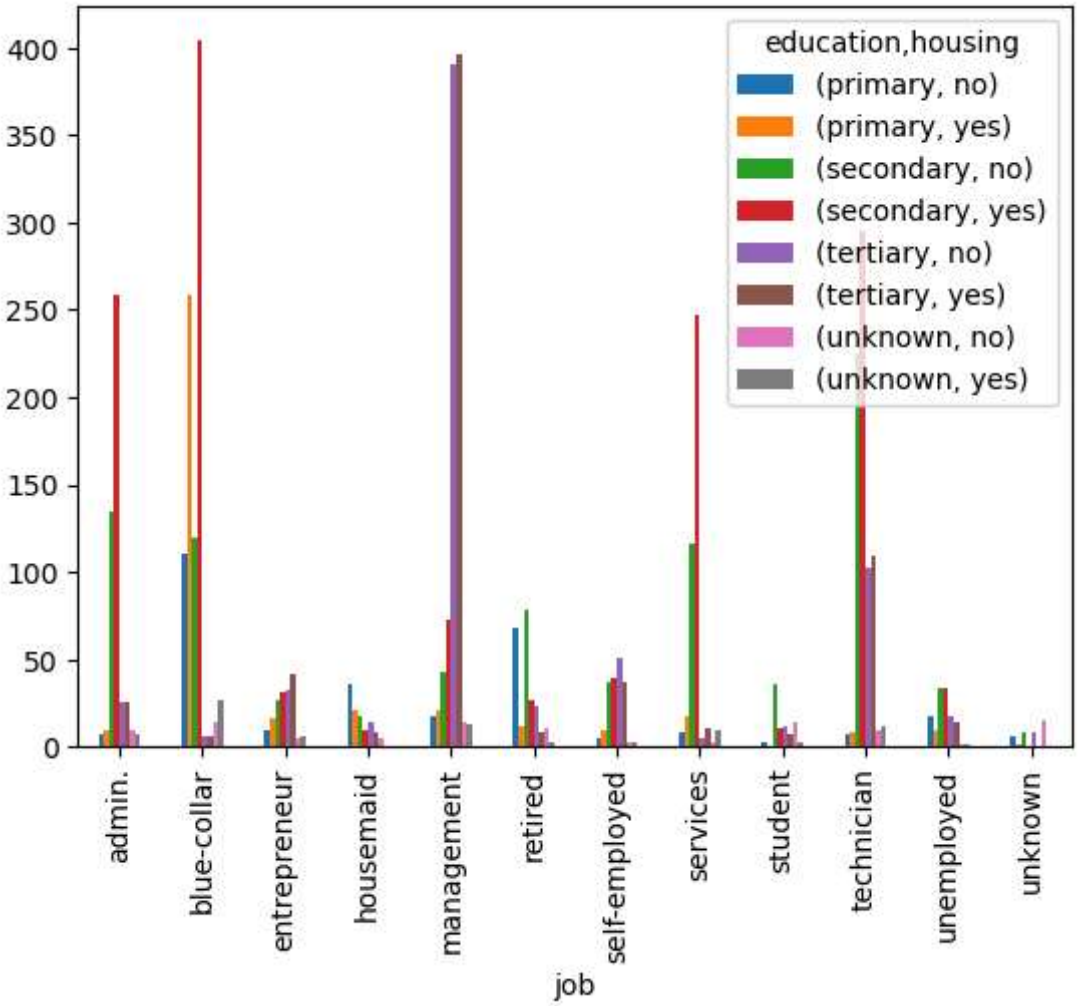
In [16]:
```
#Multi-variente Analysis(reletion between more than two columns)
indx=bank_df["job"]
colm=[bank_df["education"],bank_df["housing"]]
dfs3=pd.crosstab(indx,colm)
dfs3
```

Out[16]:

education	primary		secondary		tertiary		unknown	
housing	no	yes	no	yes	no	yes	no	yes
job								
admin.	7	10	134	259	25	26	10	7
blue-collar	111	258	120	404	6	6	14	27
entrepreneur	10	16	27	31	32	41	5	6
housemaid	36	21	18	10	14	8	5	0
management	18	21	43	73	391	396	14	13
retired	68	12	78	27	23	8	11	3
self-employed	5	10	37	39	51	37	2	2
services	8	17	116	247	5	11	3	10
student	2	0	36	11	12	7	14	2
technician	7	8	225	295	102	109	10	12
unemployed	17	9	34	34	18	14	1	1
unknown	6	1	8	0	8	0	15	0

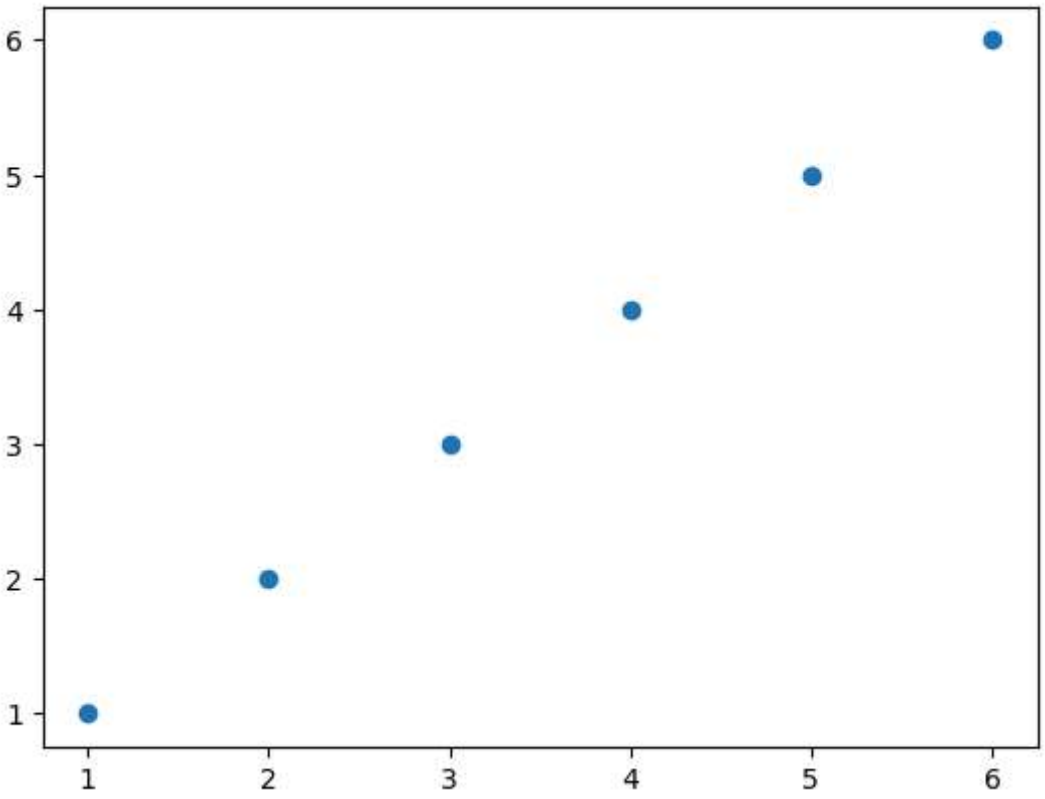
In [17]:
```
#plot
plt.figure(figsize=(20,10))
dfs3.plot(kind="bar")
plt.show()
```

```
<Figure size 2000x1000 with 0 Axes>
```

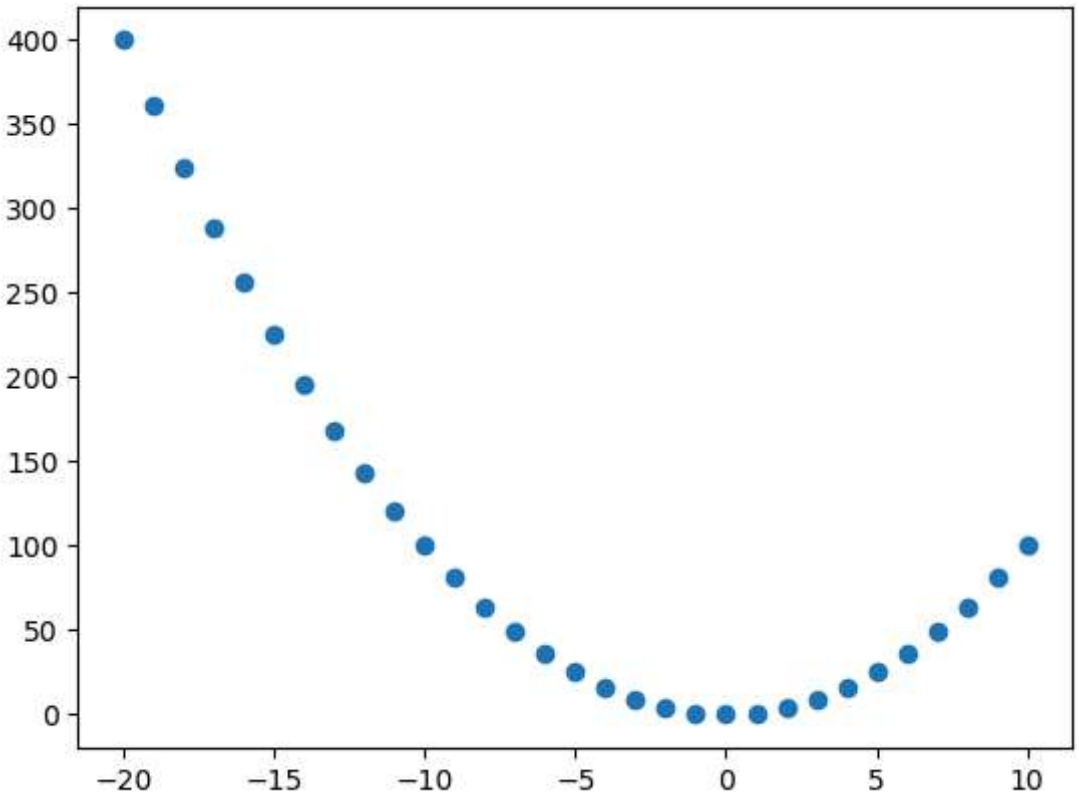


Numerical column to Numerical column Analysis

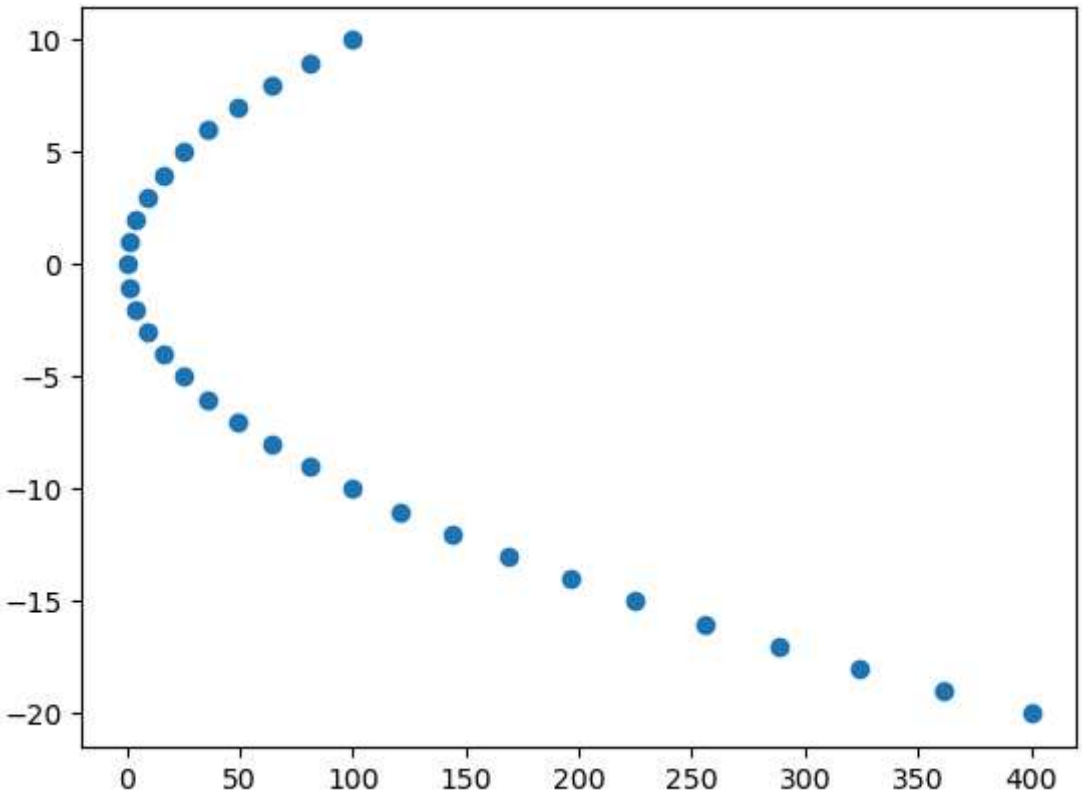
In [19]:
```
x=[1,2,3,4,5,6]
y=[1,2,3,4,5,6]
plt.scatter(x,y)
plt.show()
```



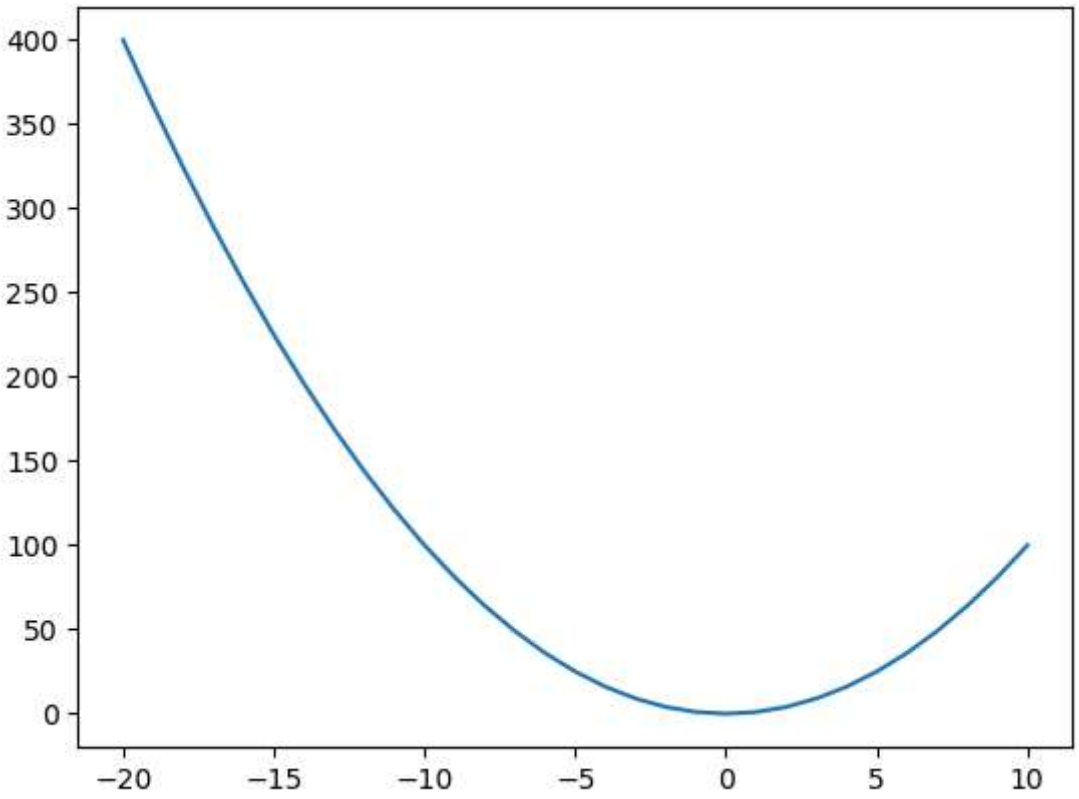
In [20]:
```
l1=[i for i in range(-20,11)]
l2=[i*i for i in l1]
plt.scatter(l1,l2)
plt.show()
```



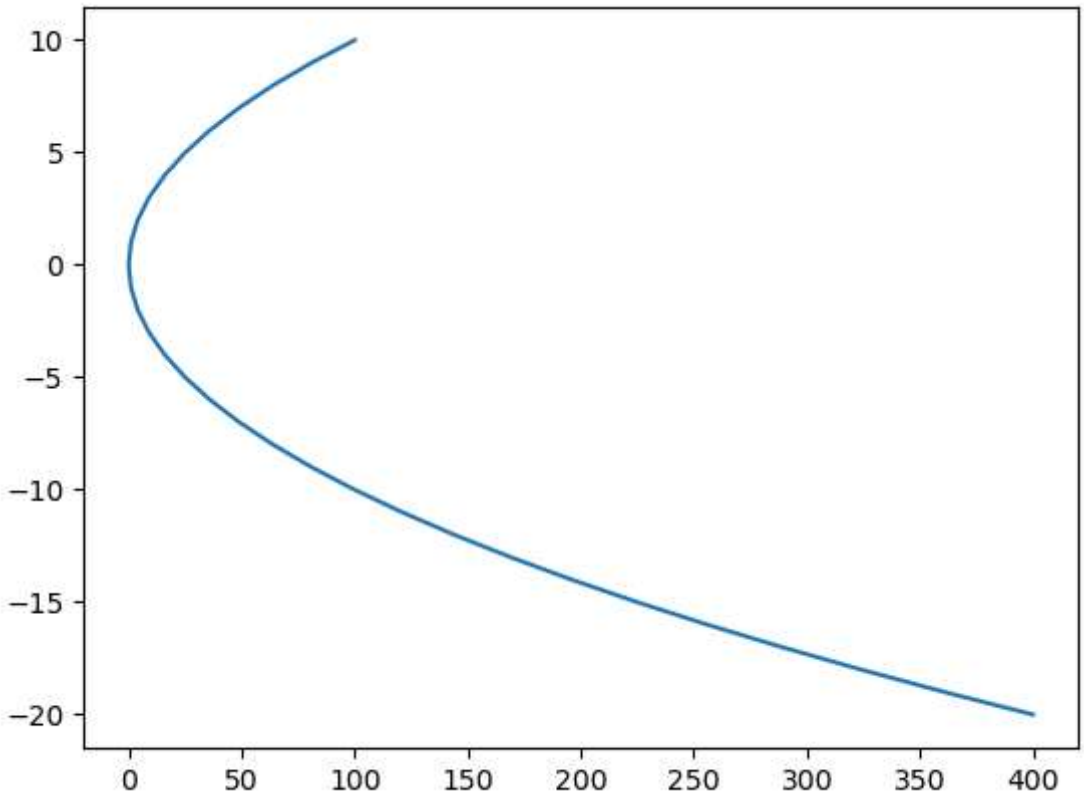
In [21]:
```
l1=[i for i in range(-20,11)]
l2=[i*i for i in l1]
plt.scatter(l2,l1)
plt.show()
```



In [22]:
```
l1=[i for i in range(-20,11)]
l2=[i*i for i in l1]
plt.plot(l1,l2)
plt.show()
```



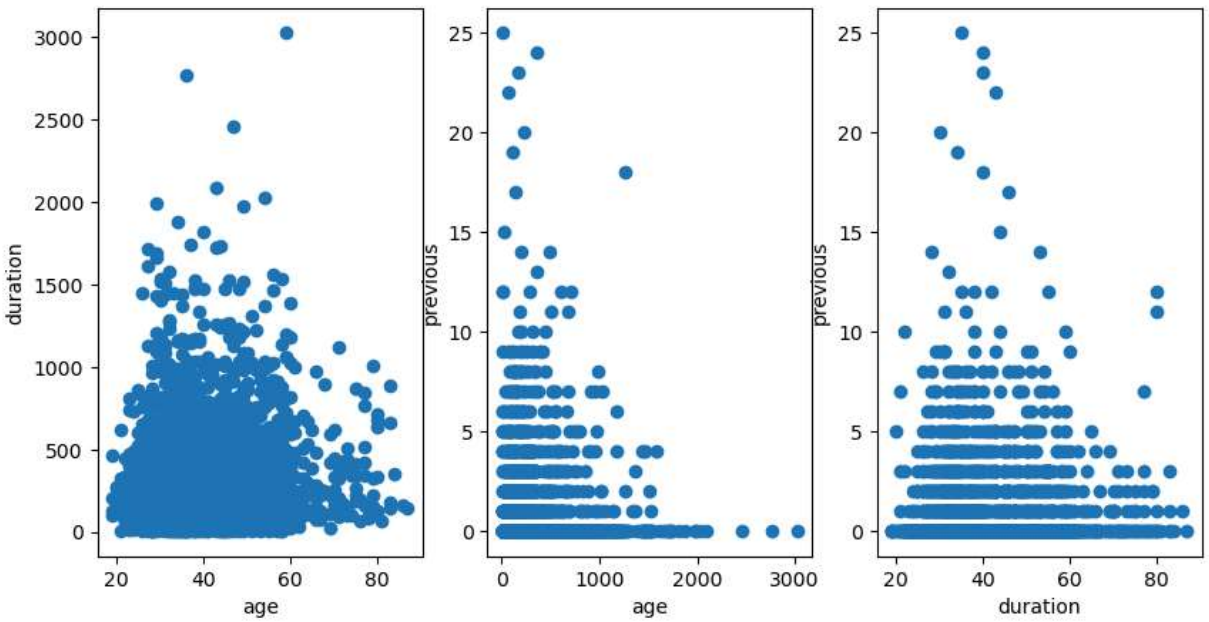
In [23]:
```
l1=[i for i in range(-20,11)]
l2=[i*i for i in l1]
plt.plot(l2,l1)
plt.show()
```



In [24]:
```
num_col
```

Out[24]:
```
Index(['age', 'balance', 'day', 'duration', 'campaign', 'pdays', 'previous'], dtype='object')
```

In [25]:
```
#plot scatter (showing the relation between two columns)

emp=bank_df['age']
yr=bank_df['duration']
pw=bank_df['previous']
plt.figure(figsize=(10,5))

################################
plt.subplot(1,3,1)
plt.scatter(emp,yr)
plt.xlabel("age")
plt.ylabel("duration")

##############################
plt.subplot(1,3,2)
plt.scatter(yr,pw)
plt.xlabel("age")
plt.ylabel("previous")

################################
plt.subplot(1,3,3)
plt.scatter(emp,pw)
plt.xlabel("duration")
plt.ylabel("previous")
plt.show()
```



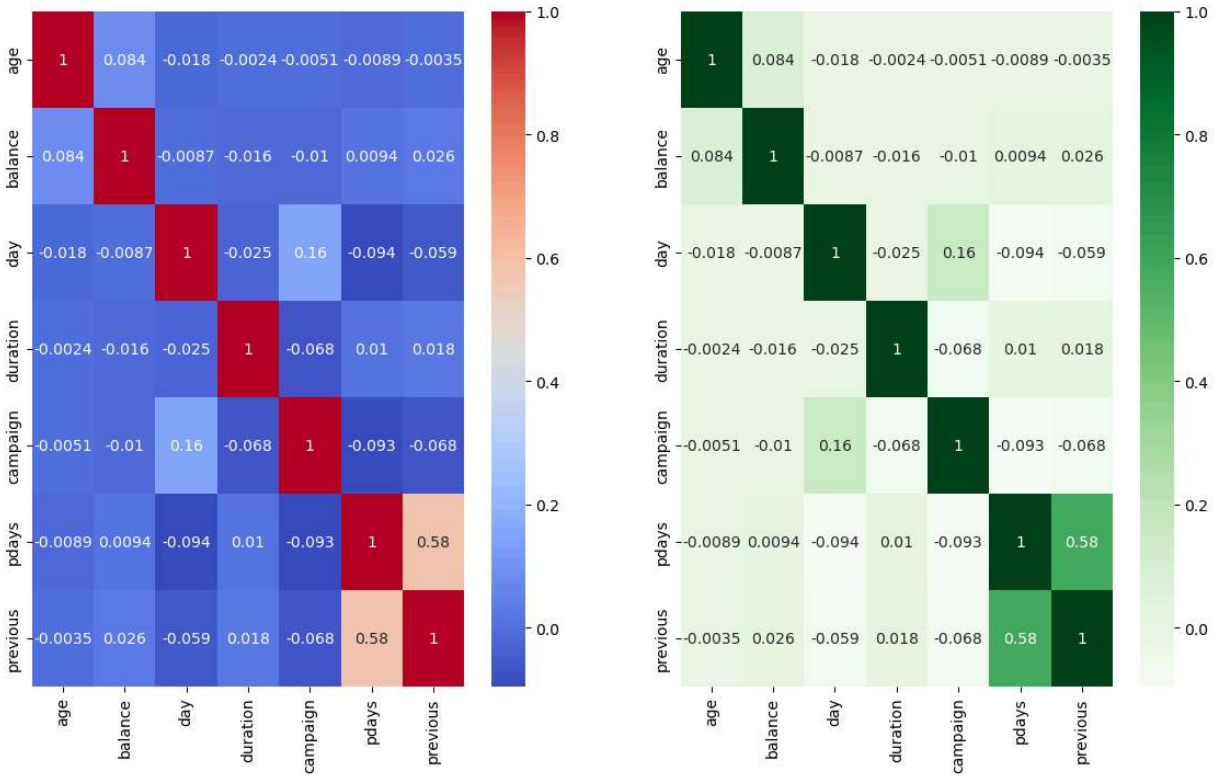
In [26]:
```
#correleation:corr
dfn=bank_df.corr(numeric_only=True)
dfn
```

Out[26]:

	age	balance	day	duration	campaign	pdays	previous
age	1.000000	0.083820	-0.017853	-0.002367	-0.005148	-0.008894	-0.003511
balance	0.083820	1.000000	-0.008677	-0.015950	-0.009976	0.009437	0.026196
day	-0.017853	-0.008677	1.000000	-0.024629	0.160706	-0.094352	-0.059114
duration	-0.002367	-0.015950	-0.024629	1.000000	-0.068382	0.010380	0.018080
campaign	-0.005148	-0.009976	0.160706	-0.068382	1.000000	-0.093137	-0.067833
pdays	-0.008894	0.009437	-0.094352	0.010380	-0.093137	1.000000	0.577562
previous	-0.003511	0.026196	-0.059114	0.018080	-0.067833	0.577562	1.000000

In [27]:
```
#ploting heatmap to showing correletion between columns
#using package seborn
plt.figure(figsize=(14,8))
plt.subplot(1,2,1)
sns.heatmap(dfn,annot=True,cmap="coolwarm")

plt.subplot(1,2,2)
sns.heatmap(dfn,annot=True,cmap="Greens")
```

Out[27]: <Axes: >



Categorical columns to Categorical columms Analysis

In [29]:
```
cat_col
```

Out[29]:
```
Index(['job', 'marital', 'education', 'default', 'housing', 'loan', 'contact',
       'month', 'poutcome', 'y'],
      dtype='object')
```

In [30]:
```
bank_df["job"].value_counts
```

Out[30]:
```
<bound method IndexOpsMixin.value_counts of 0          unemployed
1            services
2          management
3          management
4         blue-collar
             ...
4516         services
4517    self-employed
4518       technician
4519      blue-collar
4520     entrepreneur
Name: job, Length: 4521, dtype: object>
```

In [31]:
```
bank_df["education"].value_counts()
```

Out[31]:
```
education
secondary    2306
tertiary     1350
primary       678
unknown       187
Name: count, dtype: int64
```

In [108…
```
l=[]
for i in bank_df["job"].unique():
        for j in bank_df["education"].unique():
            con1=bank_df["job"]==i
            con2=bank_df["education"]==j
            con=con1 &con2
            l.append(bank_df[con][["job","education"]])
```

In [33]:
```
bank_df["marital"].unique()
```

Out[33]:
```
array(['married', 'single', 'divorced'], dtype=object)
```

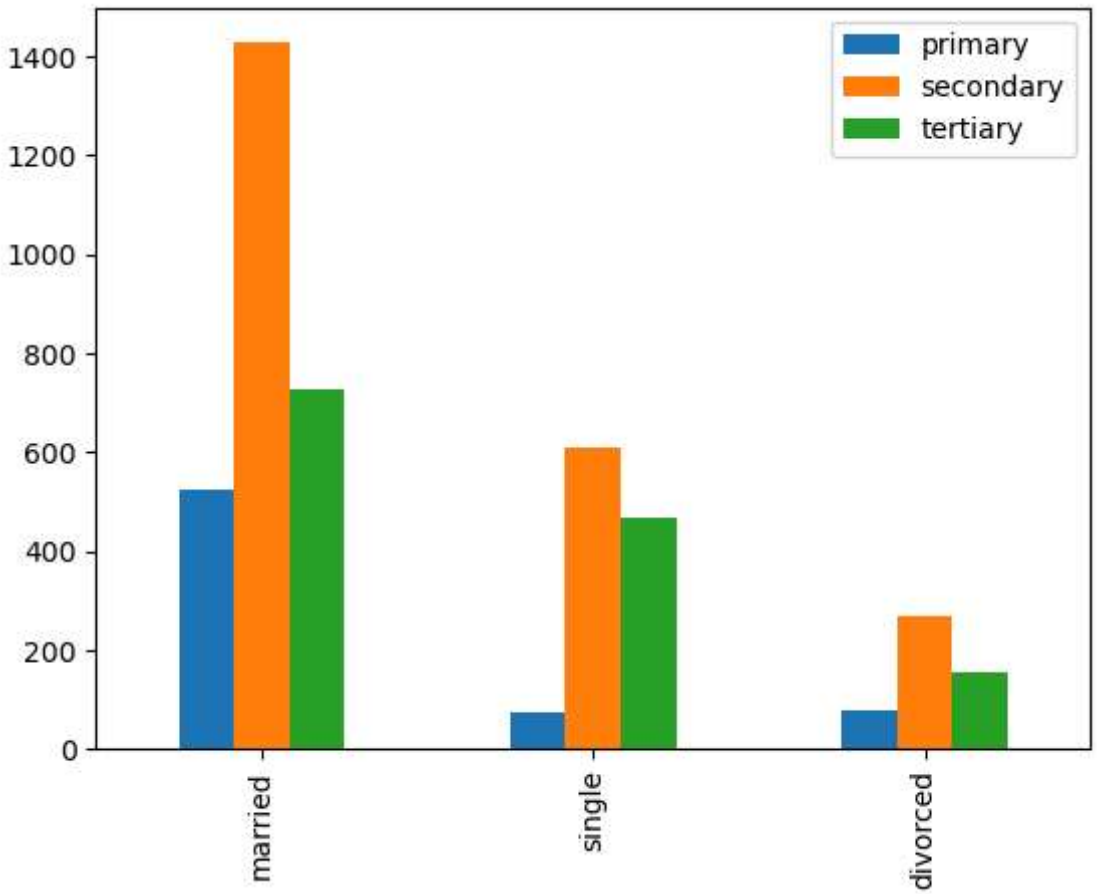
In [34]:
```
l1=[]
l2=[]
l3=[]
for i in bank_df["marital"].unique():
    con1= bank_df["marital"]==i
    con2=bank_df["education"]=="primary"
    con3=bank_df["education"]=="secondary"
    con4=bank_df["education"]=="tertiary"
    p1=con1 & con2
    p2=con1 & con3
    p3=con1 & con4

    n_p1=len(bank_df[p1])
    n_p2=len(bank_df[p2])
    n_p3=len(bank_df[p3])
```

```
    l1.append(n_p1)
    l2.append(n_p2)
    l3.append(n_p3)
dfs1=pd.DataFrame(zip(l1,l2,l3),columns=["primary","secondary","tertiary"],index=ba
dfs1
```

Out[34]:

	primary	secondary	tertiary
married	526	1427	727
single	73	609	468
divorced	79	270	155

In [35]:
```
dfs1.plot(kind="bar")
plt.show()
```



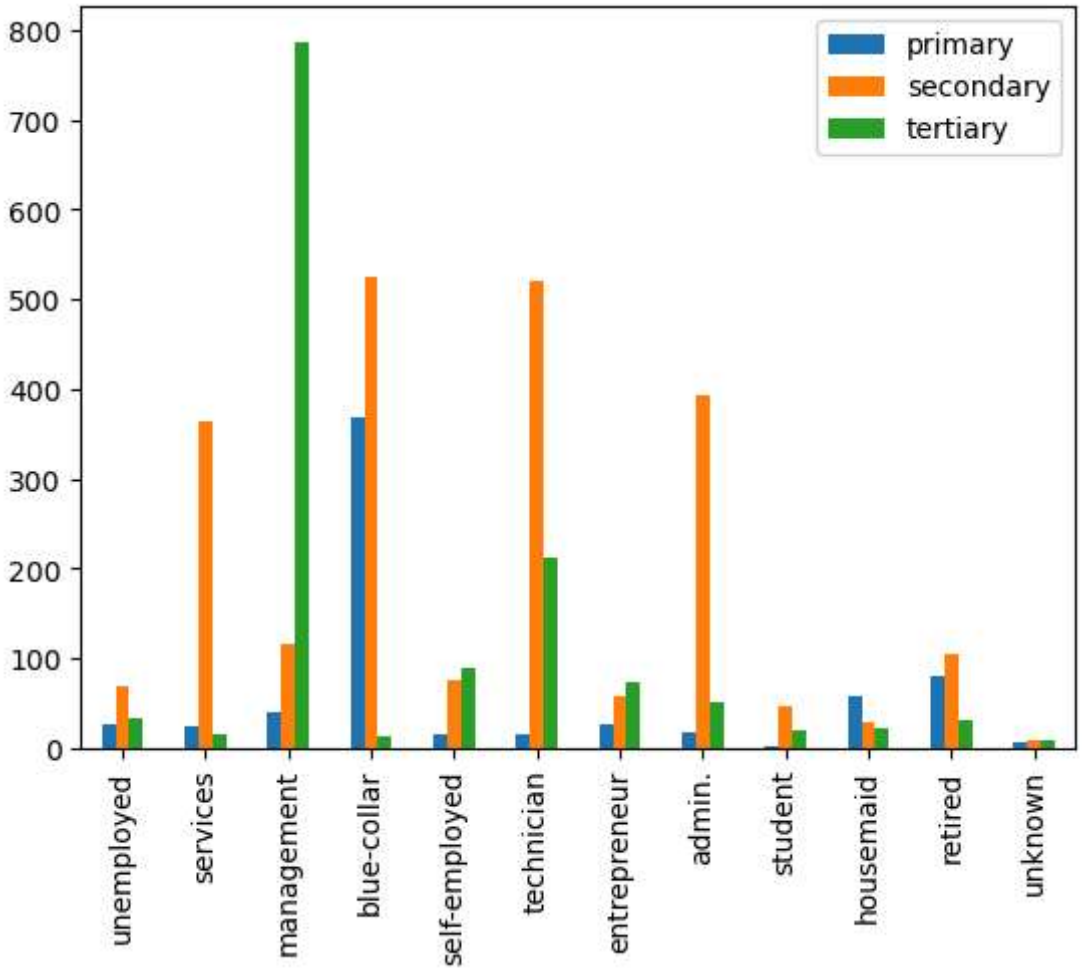
In [36]:
```
l1=[]
l2=[]
l3=[]
for i in bank_df["job"].unique():
    con1= bank_df["job"]==i
    con2=bank_df["education"]=="primary"
    con3=bank_df["education"]=="secondary"
    con4=bank_df["education"]=="tertiary"
    p1=con1 & con2
    p2=con1 & con3
    p3=con1 & con4
```

```
    n_p1=len(bank_df[p1])
    n_p2=len(bank_df[p2])
    n_p3=len(bank_df[p3])
    l1.append(n_p1)
    l2.append(n_p2)
    l3.append(n_p3)
dfs2=pd.DataFrame(zip(l1,l2,l3),columns=["primary","secondary","tertiary"],index=ba
dfs2
```

Out[36]:

	primary	secondary	tertiary
unemployed	26	68	32
services	25	363	16
management	39	116	787
blue-collar	369	524	12
self-employed	15	76	88
technician	15	520	211
entrepreneur	26	58	73
admin.	17	393	51
student	2	47	19
housemaid	57	28	22
retired	80	105	31
unknown	7	8	8

In [37]:
```
dfs2.plot(kind="bar")
plt.show()
```

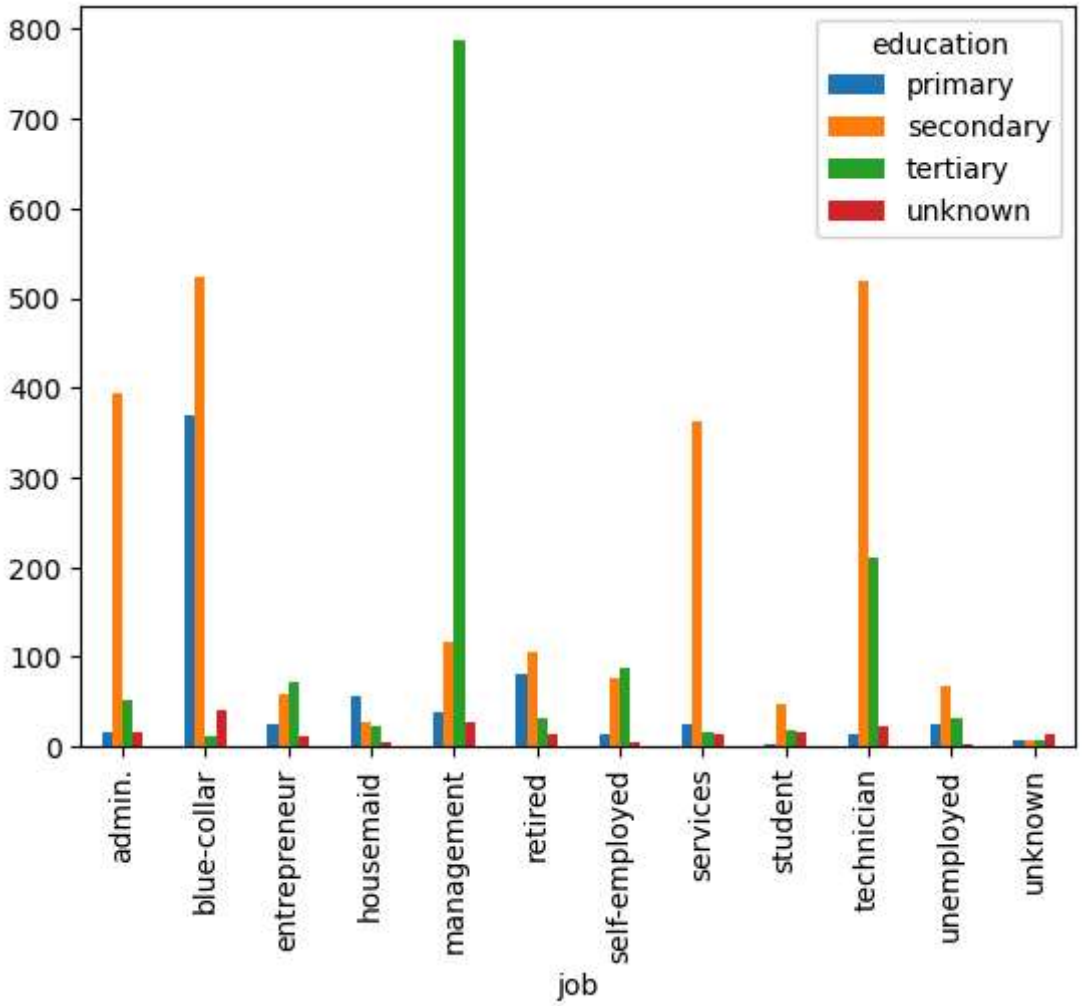


In [38]:
```
#<pandas package><crosstab>
#deal categorical- categorical

index=bank_df["job"]
column=bank_df["education"]
dfs3=pd.crosstab(index,column)
dfs3
```

Out[38]:

education job	primary	secondary	tertiary	unknown
admin.	17	393	51	17
blue-collar	369	524	12	41
entrepreneur	26	58	73	11
housemaid	57	28	22	5
management	39	116	787	27
retired	80	105	31	14
self-employed	15	76	88	4
services	25	363	16	13
student	2	47	19	16
technician	15	520	211	22
unemployed	26	68	32	2
unknown	7	8	8	15

In [39]:
```
dfs3.plot(kind="bar")
plt.show()
```



Categorical columns to Numerical Columns Analysis

In [41]:
```
#categorical
cat_col
```

Out[41]:
```
Index(['job', 'marital', 'education', 'default', 'housing', 'loan', 'contact',
       'month', 'poutcome', 'y'],
      dtype='object')
```

In [42]:
```
#Numerical
num_col
```

Out[42]:
```
Index(['age', 'balance', 'day', 'duration', 'campaign', 'pdays', 'previous'], dtyp
e='object')
```

In [43]:
```
num=bank_df["day"].unique()
num
```

Out[43]:
```
array([19, 11, 16,  3,  5, 23, 14,  6, 17, 20, 13, 30, 29, 27,  7, 18, 12,
       21, 26, 22,  2,  4, 15,  8, 28,  9,  1, 10, 31, 25, 24],
      dtype=int64)
```

In [44]:
```
cal=bank_df["job"].unique()
cal
```

Out[44]:
```
array(['unemployed', 'services', 'management', 'blue-collar',
       'self-employed', 'technician', 'entrepreneur', 'admin.', 'student',
       'housemaid', 'retired', 'unknown'], dtype=object)
```

In [45]:
```
#changing numerical to cotegorical

unique_labels=bank_df["job"].unique()
list1=[i for i in range(len(unique_labels))]

dict1= dict(zip(unique_labels,list1))
bank_df["job_numeric"]=bank_df["job"].map(dict1)

bank_df[["job","job_numeric"]]
```

Out[45]:

	job	job_numeric
0	unemployed	0
1	services	1
2	management	2
3	management	2
4	blue-collar	3
...	...	...
4516	services	1
4517	self-employed	4
4518	technician	5
4519	blue-collar	3
4520	entrepreneur	6

4521 rows × 2 columns

In [46]:
```
#changing numerical to cotegorical

unique_labels=bank_df["education"].unique()
list1=[i for i in range(len(unique_labels))]

dict1={key:values for key,values in zip(unique_labels,list1)}
bank_df["education_numeric"]=bank_df["education"].map(dict1)

bank_df[["education","education_numeric"]]
```

Out[46]:

	education	education_numeric
0	primary	0
1	secondary	1
2	tertiary	2
3	tertiary	2
4	secondary	1
...	...	...
4516	secondary	1
4517	tertiary	2
4518	secondary	1
4519	secondary	1
4520	tertiary	2

4521 rows × 2 columns

In [47]:
```
bank_df=pd.read_csv("bank.csv",sep=";")   #changing all the categorical columns int
for i in cat_col:
    unique_labels=bank_df[i].unique()
    list1=[i for i in range(len(unique_labels))]

    dict1= dict(zip(unique_labels,list1))
    bank_df[f"{i}_numeric"]=bank_df[i].map(dict1)

bank_df
```

Out[47]:

	age	job	marital	education	default	balance	housing	loan	contact	da
0	30	unemployed	married	primary	no	1787	no	no	cellular	
1	33	services	married	secondary	no	4789	yes	yes	cellular	
2	35	management	single	tertiary	no	1350	yes	no	cellular	
3	30	management	married	tertiary	no	1476	yes	yes	unknown	
4	59	blue-collar	married	secondary	no	0	yes	no	unknown	
...	...	...	...	...	...	...	...	...	...	
4516	33	services	married	secondary	no	-333	yes	no	cellular	
4517	57	self-employed	married	tertiary	yes	-3313	yes	yes	unknown	
4518	57	technician	married	secondary	no	295	no	no	cellular	
4519	28	blue-collar	married	secondary	no	1137	no	no	cellular	
4520	44	entrepreneur	single	tertiary	no	1136	yes	yes	cellular	

4521 rows × 27 columns

In [48]:

```
bank_df=pd.read_csv("bank.csv",sep=";")   #changing all the categorical columns int
for i in cat_col:
    unique_labels=bank_df[i].unique()
    list1=[i for i in range(len(unique_labels))]

    dict1= dict(zip(unique_labels,list1))
    bank_df[i]=bank_df[i].map(dict1)

bank_df
```

Out[48]:

	age	job	marital	education	default	balance	housing	loan	contact	day	month
0	30	0	0	0	0	1787	0	0	0	19	0
1	33	1	0	1	0	4789	1	1	0	11	1
2	35	2	1	2	0	1350	1	0	0	16	2
3	30	2	0	2	0	1476	1	1	1	3	3
4	59	3	0	1	0	0	1	0	1	5	1
...	...	...	...	...	...	...	...	...	...	...	...
4516	33	1	0	1	0	-333	1	0	0	30	7
4517	57	4	0	2	1	-3313	1	1	1	9	1
4518	57	5	0	1	0	295	0	0	0	19	5
4519	28	3	0	1	0	1137	0	0	0	6	4
4520	44	6	1	2	0	1136	1	1	0	3	2

4521 rows × 17 columns

In [49]:
```
###################Numerical use for train machaine learing model##################
```

In [50]:
```
# Thank you !
```