In [58]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import LabelEncoder
import warnings
warnings.filterwarnings('ignore')
```

In [59]:
```python
df = pd.read_csv('employee_promotion.csv')
df.head()
```

Out[59]:

	employee_id	department	region	education	gender	recruitment_channel	no_of_trainings
0	65438	Sales & Marketing	region_7	Master's & above	f	sourcing	1
1	65141	Operations	region_22	Bachelor's	m	other	1
2	7513	Sales & Marketing	region_19	Bachelor's	m	sourcing	1
3	2542	Sales & Marketing	region_23	Bachelor's	m	other	2
4	48945	Technology	region_26	Bachelor's	m	other	1

In [60]:
```python
df.shape
```

Out[60]:
```
(54808, 13)
```

In [61]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 54808 entries, 0 to 54807
Data columns (total 13 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   employee_id           54808 non-null  int64  
 1   department            54808 non-null  object 
 2   region                54808 non-null  object 
 3   education             52399 non-null  object 
 4   gender                54808 non-null  object 
 5   recruitment_channel   54808 non-null  object 
 6   no_of_trainings       54808 non-null  int64  
 7   age                   54808 non-null  int64  
 8   previous_year_rating  50684 non-null  float64
 9   length_of_service     54808 non-null  int64  
 10  awards_won            54808 non-null  int64  
 11  avg_training_score    52248 non-null  float64
 12  is_promoted           54808 non-null  int64  
dtypes: float64(2), int64(6), object(5)
memory usage: 5.4+ MB
```

In [62]:
```
df.isnull().sum()
```

Out[62]:
```
employee_id                0
department                 0
region                     0
education               2409
gender                     0
recruitment_channel        0
no_of_trainings            0
age                        0
previous_year_rating    4124
length_of_service          0
awards_won                 0
avg_training_score      2560
is_promoted                0
dtype: int64
```

In [63]:
```
df['education'].value_counts()
```

Out[63]:
```
Bachelor's          36669
Master's & above    14925
Below Secondary       805
Name: education, dtype: int64
```

In [64]:
```
df['previous_year_rating'].value_counts()
```

Out[64]:
```
3.0    18618
5.0    11741
4.0     9877
1.0     6223
2.0     4225
Name: previous_year_rating, dtype: int64
```

In [65]:
```
df['avg_training_score'].value_counts()
```

Out[65]:
```
50.0    2716
49.0    2681
48.0    2437
51.0    2347
60.0    2155
59.0    2064
58.0    1898
52.0    1856
47.0    1746
62.0    1450
82.0    1447
57.0    1437
81.0    1357
53.0    1324
80.0    1206
83.0    1198
84.0    1168
79.0    1160
46.0    1136
85.0    1072
56.0    1070
70.0    1055
63.0    1021
69.0    1018
54.0     997
68.0     935
78.0     933
86.0     912
71.0     898
55.0     872
67.0     728
72.0     725
64.0     708
77.0     697
87.0     655
65.0     599
66.0     580
73.0     523
76.0     516
88.0     444
74.0     433
75.0     403
44.0     335
89.0     301
90.0     185
43.0     176
91.0     117
92.0      99
93.0      84
94.0      65
42.0      62
97.0      49
96.0      48
95.0      45
```

```
98.0      37
99.0      35
41.0      26
40.0       5
39.0       2
Name: avg_training_score, dtype: int64
```

In [66]:
```
df.describe()
```

Out[66]:

	employee_id	no_of_trainings	age	previous_year_rating	length_of_service	award
count	54808.000000	54808.000000	54808.000000	50684.000000	54808.000000	54808.(
mean	39195.830627	1.253011	34.803915	3.329256	5.865512	0.(
std	22586.581449	0.609264	7.660169	1.259993	4.265094	0.
min	1.000000	1.000000	20.000000	1.000000	1.000000	0.(
25%	19669.750000	1.000000	29.000000	3.000000	3.000000	0.(
50%	39225.500000	1.000000	33.000000	3.000000	5.000000	0.(
75%	58730.500000	1.000000	39.000000	4.000000	7.000000	0.(
max	78298.000000	10.000000	60.000000	5.000000	37.000000	1.(

In [67]:
```
df['previous_year_rating'].fillna(df['previous_year_rating'].mean(),inplace=
```

In [68]:
```
df['avg_training_score'].fillna(df['avg_training_score'].mean(),inplace=True
```

In [69]:
```
print(df['education'].mode())
```

```
0    Bachelor's
dtype: object
```

In [70]:
```
print(df['education'].mode()[0])
```

```
Bachelor's
```

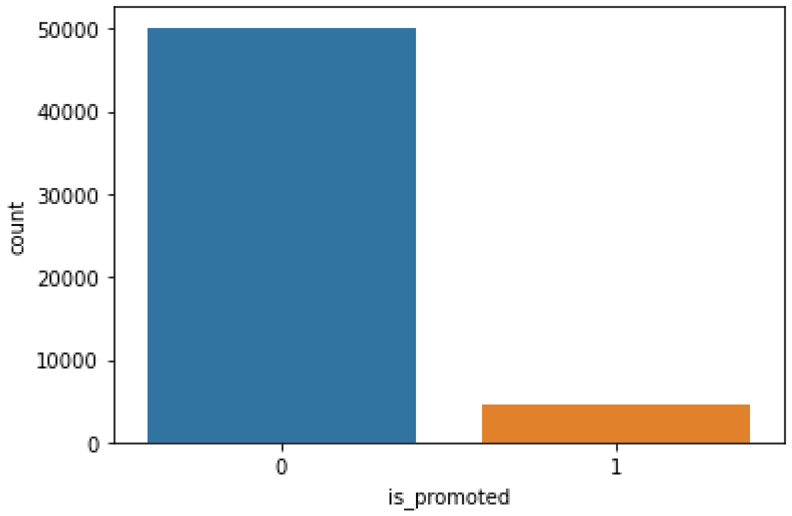
In [71]:
```
df['education'].fillna(df['education'].mode()[0],inplace=True)
```

In [72]:
```
df.isnull().sum()
```

Out[72]:
```
employee_id             0
department              0
region                  0
education               0
gender                  0
recruitment_channel     0
no_of_trainings         0
age                     0
previous_year_rating    0
length_of_service       0
awards_won              0
avg_training_score      0
is_promoted             0
dtype: int64
```

In [73]:
```
sns.countplot('is_promoted',data = df)
```

Out[73]:
```
<AxesSubplot:xlabel='is_promoted', ylabel='count'>
```



In [74]:
```
df['is_promoted'].value_counts()
```

Out[74]:
```
0    50140
1     4668
Name: is_promoted, dtype: int64
```

In [75]:
```
df = df.drop(columns='employee_id',axis = 1)
```

In [76]:
```
df.head()
```

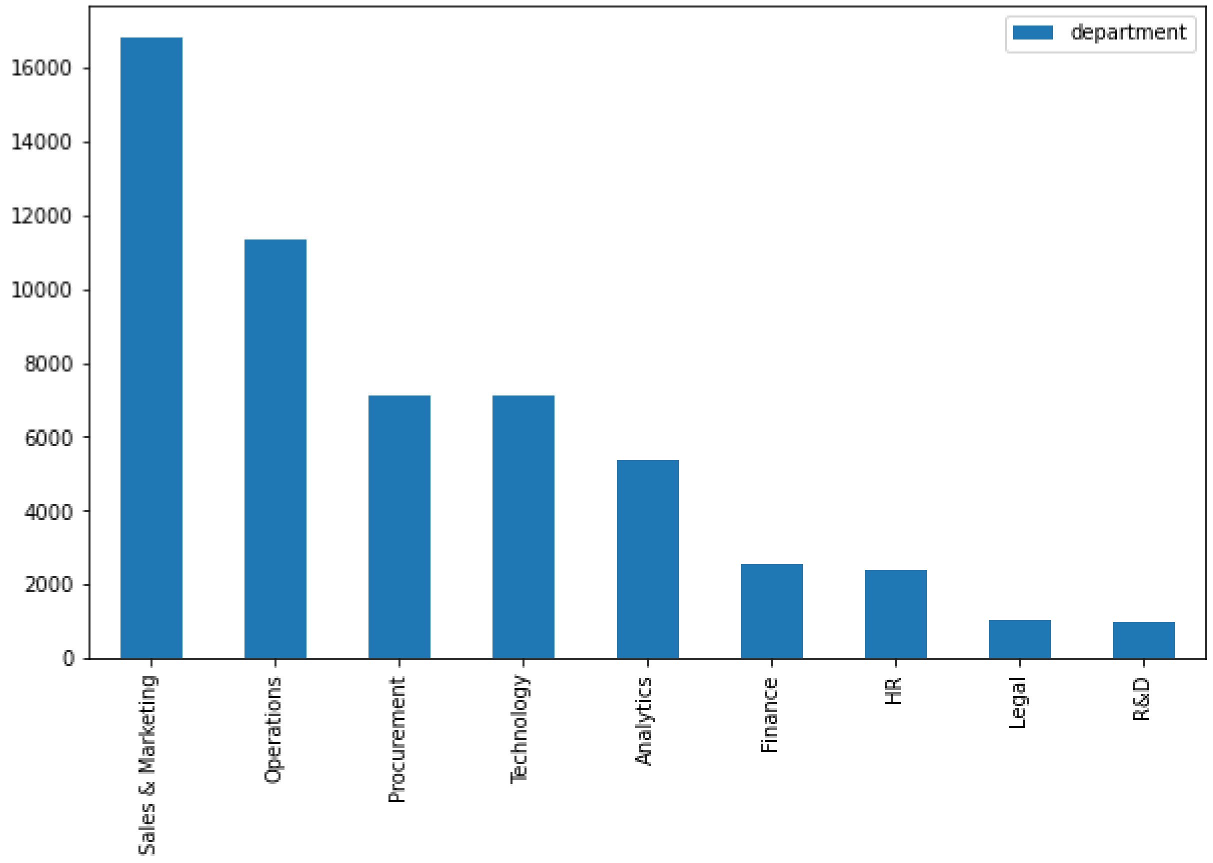
Out[76]:

	department	region	education	gender	recruitment_channel	no_of_trainings	age	previous_y
0	Sales & Marketing	region_7	Master's & above	f	sourcing	1	35	
1	Operations	region_22	Bachelor's	m	other	1	30	
2	Sales & Marketing	region_19	Bachelor's	m	sourcing	1	34	
3	Sales & Marketing	region_23	Bachelor's	m	other	2	39	
4	Technology	region_26	Bachelor's	m	other	1	45	

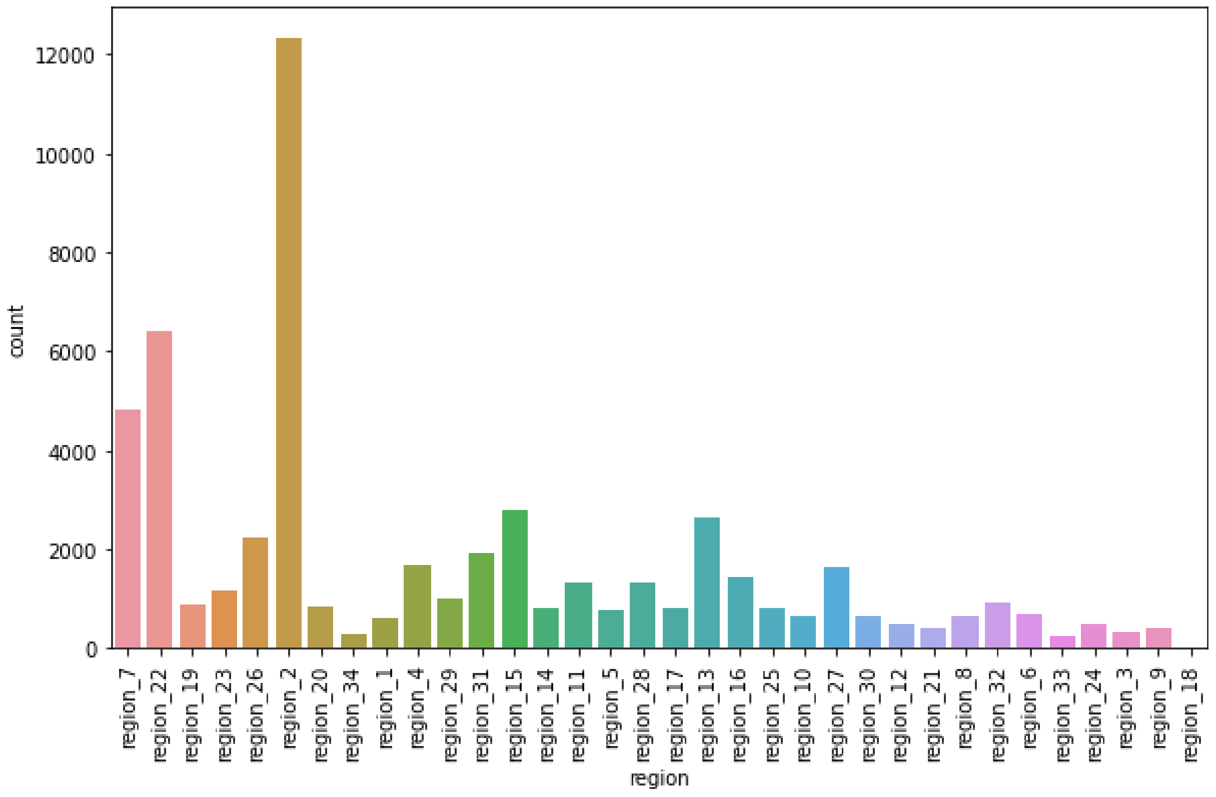
In [77]:
```
df['department'].value_counts()
```

Out[77]:
```
Sales & Marketing    16840
Operations           11348
Procurement           7138
Technology            7138
Analytics             5352
Finance               2536
HR                    2418
Legal                 1039
R&D                    999
Name: department, dtype: int64
```

In [78]:
```
plt.figure(figsize=(10,6))
df['department'].value_counts().plot(kind='bar').legend()
plt.show()
```

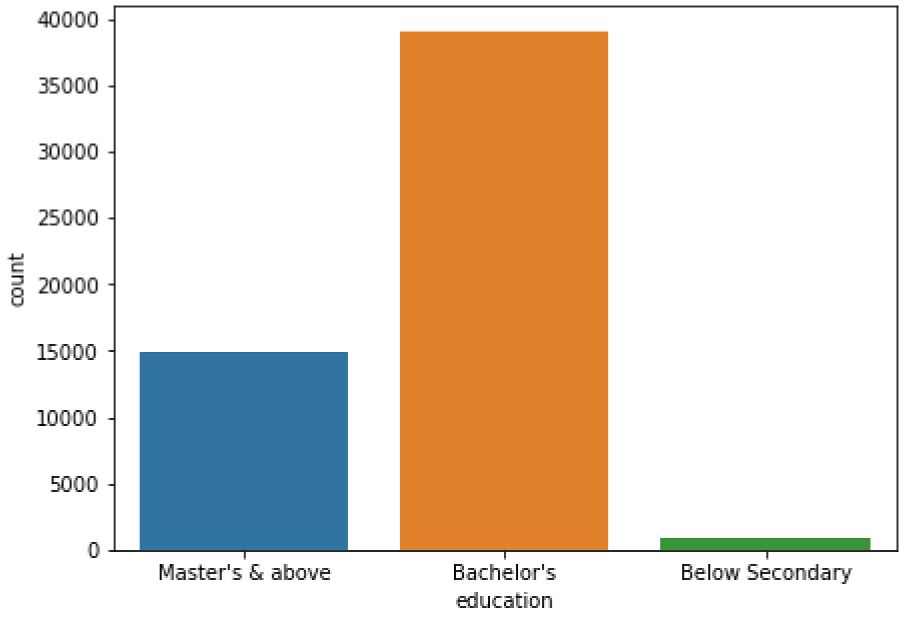


In [79]:
```
plt.figure(figsize=(10,6))
sns.countplot(data=df,x='region')
plt.xticks(rotation=90)
plt.show()
```



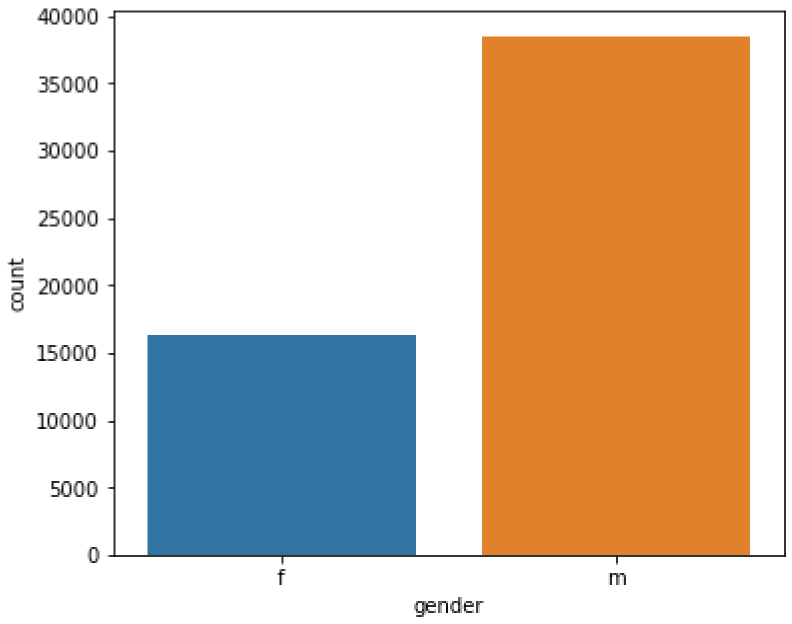
In [80]:
```
plt.figure(figsize=(7,5))
sns.countplot('education', data=df)
```

Out[80]:
```
<AxesSubplot:xlabel='education', ylabel='count'>
```



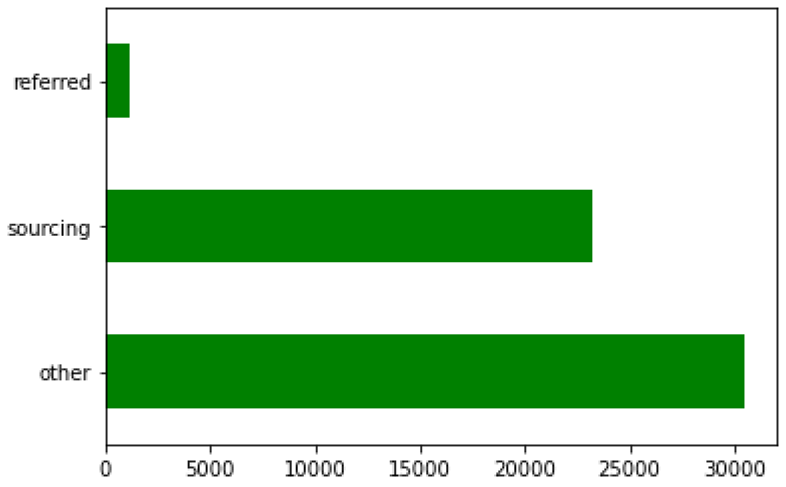
In [81]:
```
plt.figure(figsize=(6,5))
sns.countplot('gender', data=df)
```

Out[81]:
```
<AxesSubplot:xlabel='gender', ylabel='count'>
```

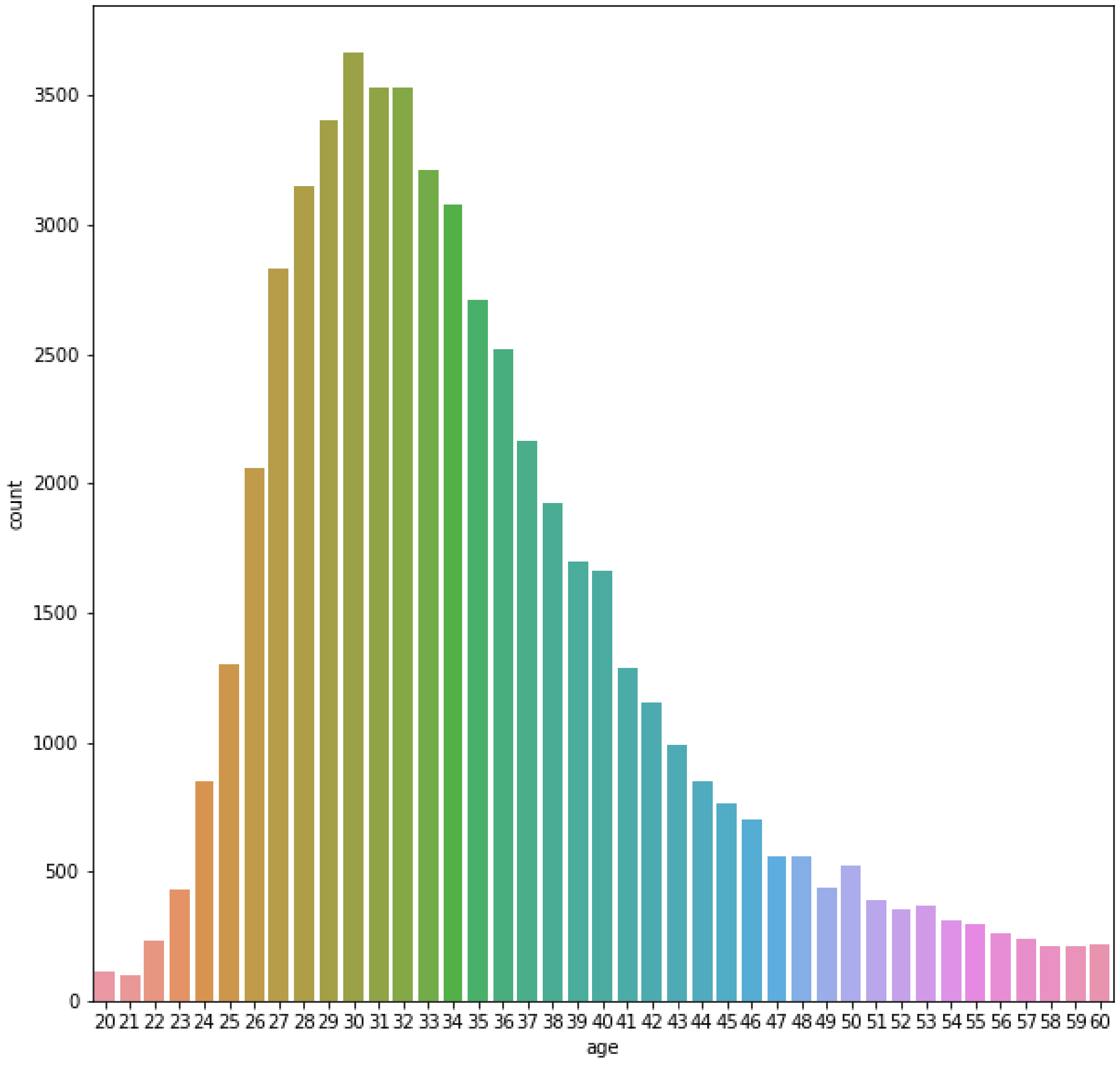


In [82]:
```
df['recruitment_channel'].value_counts().plot(kind='barh',color='green')
```

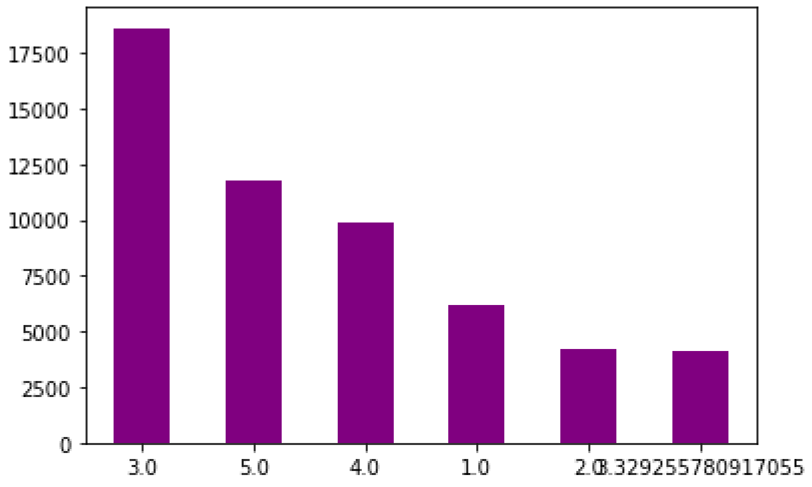
Out[82]:
```
<AxesSubplot:>
```



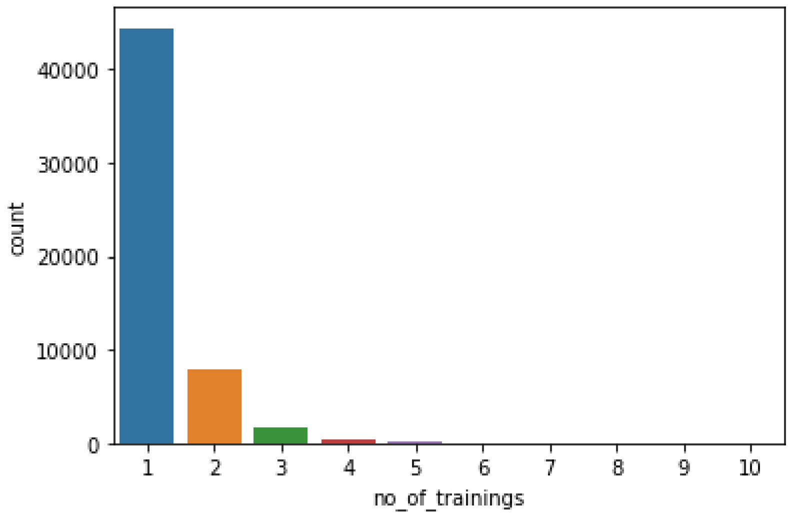
In [83]:
```
plt.figure(figsize=(10,10))
sns.countplot(df.age)
plt.show()
```



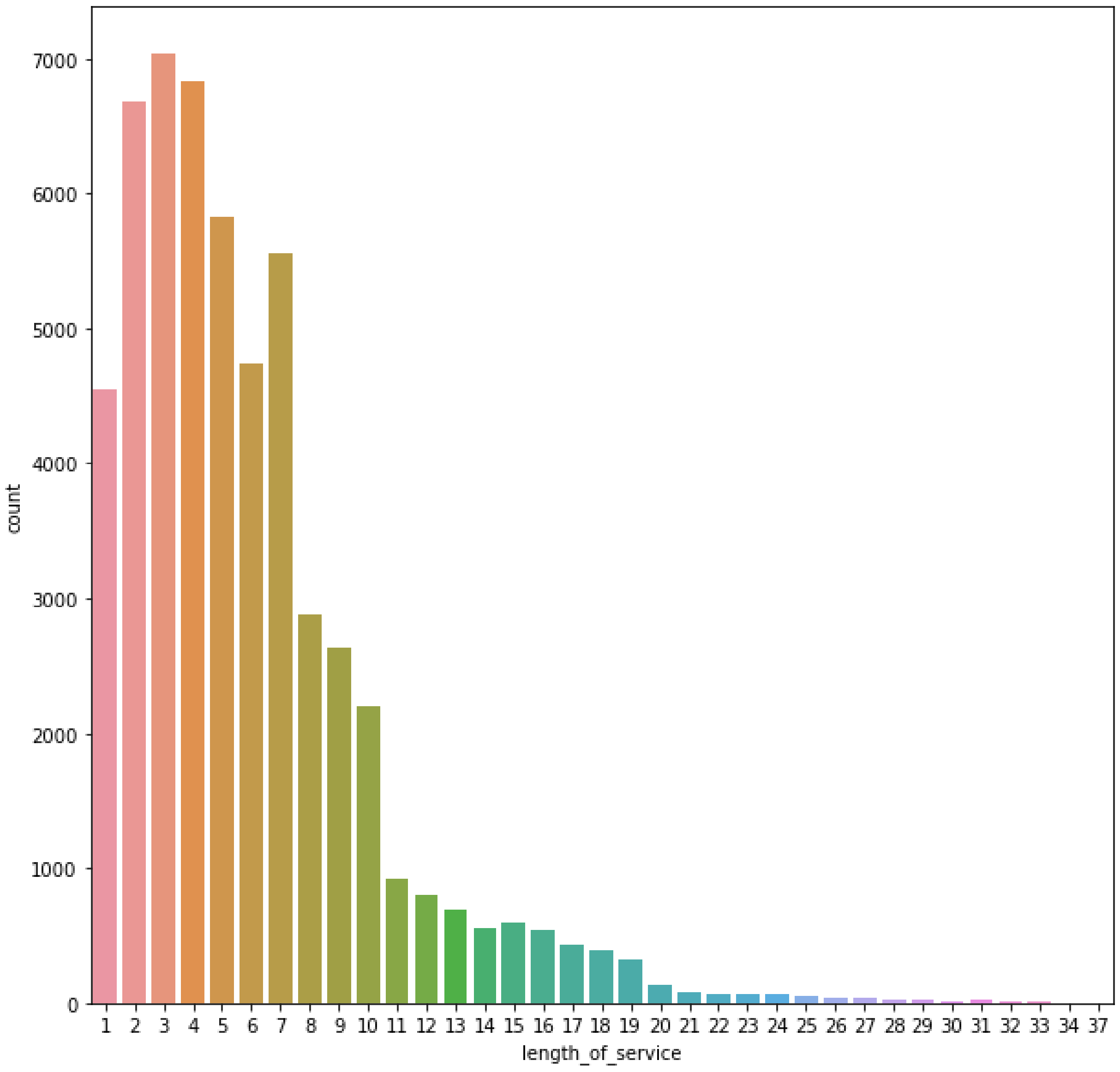
In [84]:
```
df['previous_year_rating'].value_counts().plot(kind='bar',color='purple')
plt.xticks(rotation=0)
plt.show()
```



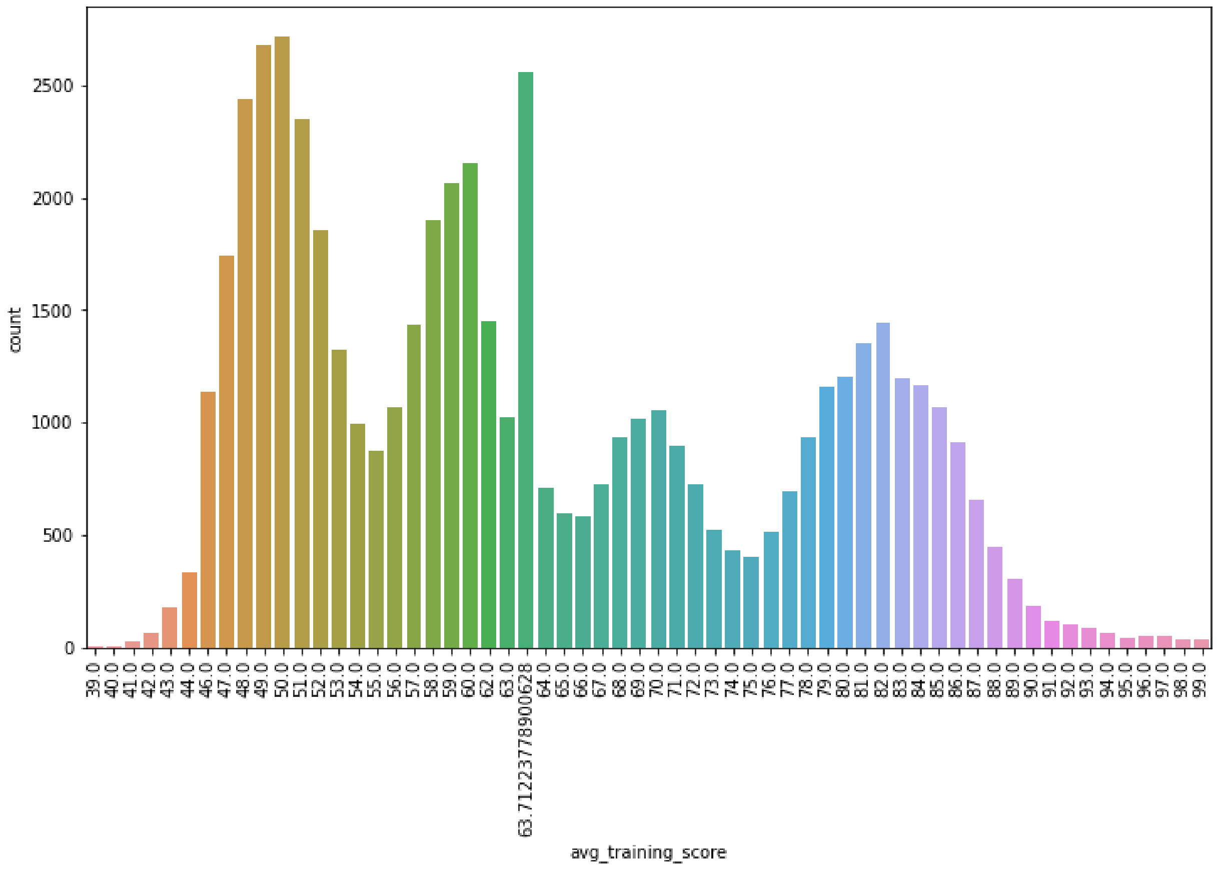
In [85]:
```
sns.countplot(df.no_of_trainings)
plt.show()
```



In [86]:
```python
plt.figure(figsize=(10,10))
sns.countplot(df.length_of_service)
plt.show()
```

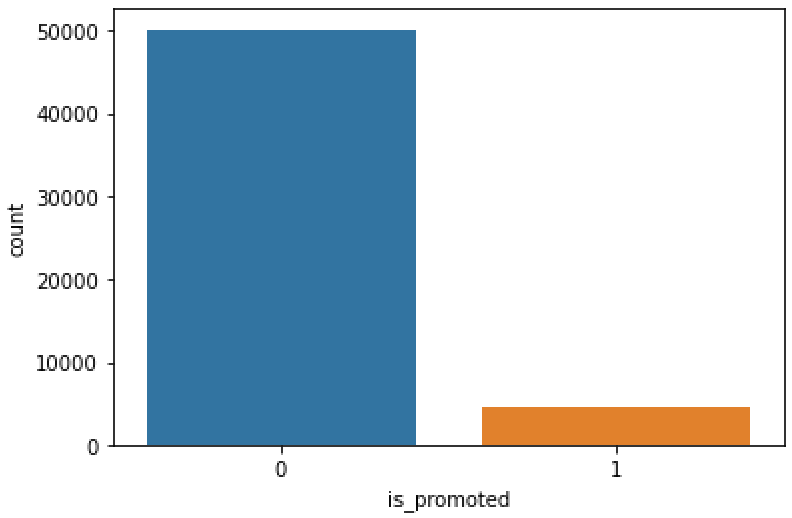


In [87]:
```python
plt.figure(figsize=(12,7))
sns.countplot(df.avg_training_score)
plt.xticks(rotation=90)
plt.show()
```



In [88]:
```
sns.countplot('is_promoted',data = df)
```

Out[88]:
```
<AxesSubplot:xlabel='is_promoted', ylabel='count'>
```



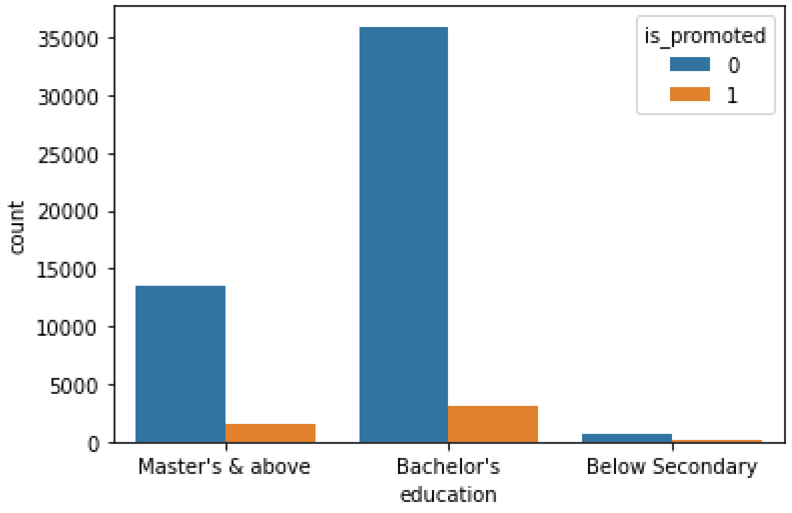
In [89]:
```
df.head()
```

Out[89]:

	department	region	education	gender	recruitment_channel	no_of_trainings	age	previous_y
0	Sales & Marketing	region_7	Master's & above	f	sourcing	1	35	
1	Operations	region_22	Bachelor's	m	other	1	30	
2	Sales & Marketing	region_19	Bachelor's	m	sourcing	1	34	
3	Sales & Marketing	region_23	Bachelor's	m	other	2	39	
4	Technology	region_26	Bachelor's	m	other	1	45	

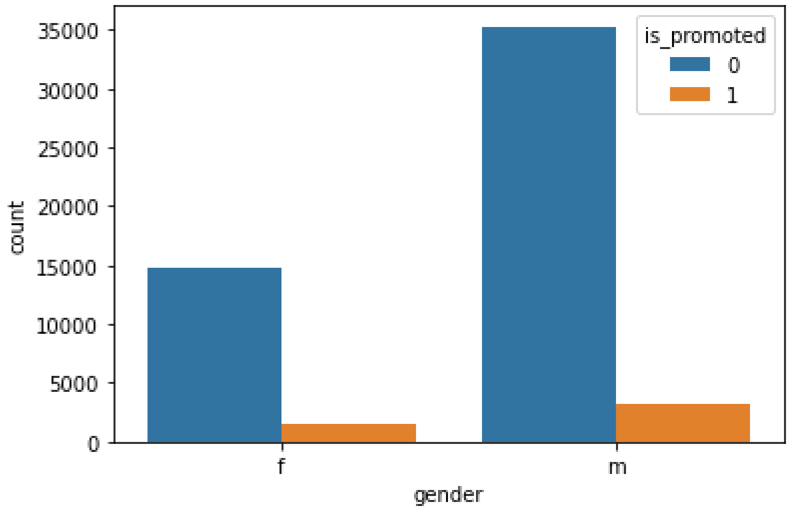
In [90]:
```
sns.countplot('education',hue='is_promoted',data=df)
```

Out[90]:
```
<AxesSubplot:xlabel='education', ylabel='count'>
```



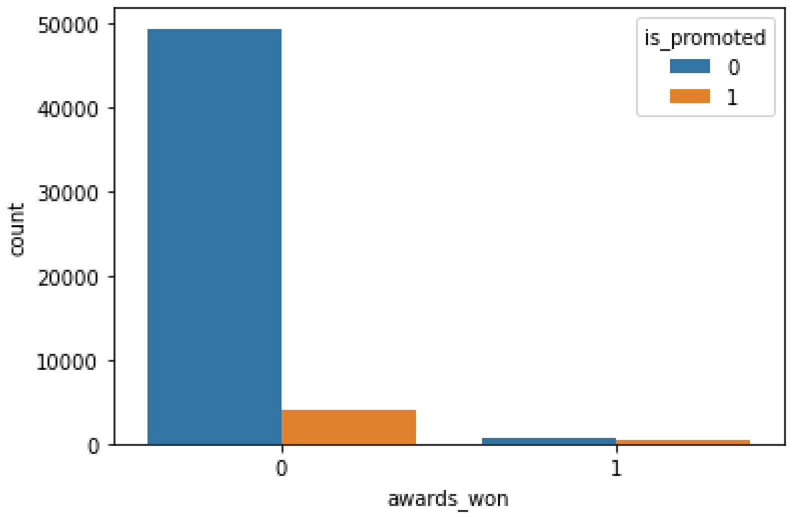
In [91]:
```
sns.countplot('gender',hue='is_promoted',data=df)
```

Out[91]:
```
<AxesSubplot:xlabel='gender', ylabel='count'>
```



In [92]:
```
sns.countplot('awards_won',hue='is_promoted',data=df)
```

Out[92]:
```
<AxesSubplot:xlabel='awards_won', ylabel='count'>
```



In [93]:
```
le = LabelEncoder()
```

In [94]:
```
df['department'] = le.fit_transform(df['department'])
df['gender'] = le.fit_transform(df['gender'])
df['education'] = le.fit_transform(df['education'].astype(str))
df['recruitment_channel'] = le.fit_transform(df['recruitment_channel'])
df['region']=le.fit_transform(df['region'])
```

In [95]:
```
df.head()
```

Out[95]:

	department	region	education	gender	recruitment_channel	no_of_trainings	age	previous_yea
0	7	31	2	0	2	1	35	
1	4	14	0	1	0	1	30	
2	7	10	0	1	2	1	34	
3	7	15	0	1	0	2	39	
4	8	18	0	1	0	1	45	

In [96]:
```python
cols = [ 'previous_year_rating', 'avg_training_score']
for col in cols:
   df[col] = df[col].apply(lambda x: int(x) if x == x else 0)
```

In [97]:
```python
dc = df.corr()
dc
```

Out[97]:

	department	region	education	gender	recruitment_channel	no_of_traini
department	1.000000	-0.020592	0.043441	-0.030108	0.004732	0.014
region	-0.020592	1.000000	-0.003815	0.019730	-0.000920	-0.004
education	0.043441	-0.003815	1.000000	-0.032368	-0.003564	-0.033
gender	-0.030108	0.019730	-0.032368	1.000000	0.006567	0.084
recruitment_channel	0.004732	-0.000920	-0.003564	0.006567	1.000000	-0.010
no_of_trainings	0.014152	-0.004590	-0.033469	0.084501	-0.010405	1.000
age	0.079162	-0.088918	0.339966	-0.016293	-0.011400	-0.081
previous_year_rating	-0.135561	-0.005977	0.027393	-0.024024	0.005731	-0.061
length_of_service	0.059060	-0.058939	0.233666	-0.019675	-0.002887	-0.057
awards_won	-0.002151	0.000307	-0.001409	0.002381	-0.005510	-0.007
avg_training_score	-0.248411	0.023830	0.031798	-0.022761	-0.002650	0.043
is_promoted	0.000130	0.008841	0.029257	-0.011109	0.002229	-0.024

In [98]:
```python
df.columns
```

Out[98]:
```
Index(['department', 'region', 'education', 'gender', 'recruitment_channel',
       'no_of_trainings', 'age', 'previous_year_rating', 'length_of_service',
       'awards_won', 'avg_training_score', 'is_promoted'],
      dtype='object')
```

In [99]:
```python
X = df[['department', 'region', 'education', 'gender', 'recruitment_channel'
       'no_of_trainings', 'age', 'previous_year_rating', 'length_of_service'
       'awards_won', 'avg_training_score']]
Y = df[['is_promoted']]
```

In [100]:
```
print(X)
```

```
       department  region  education  gender  recruitment_channel  \
0               7      31          2       0                    2   
1               4      14          0       1                    0   
2               7      10          0       1                    2   
3               7      15          0       1                    0   
4               8      18          0       1                    0   
...           ...     ...        ...     ...                  ...   
54803           8       5          0       1                    2   
54804           4      19          2       0                    0   
54805           0       0          0       1                    0   
54806           7      33          0       1                    2   
54807           2      14          0       1                    0   

       no_of_trainings  age  previous_year_rating  length_of_service  \
0                    1   35                     5                  8   
1                    1   30                     5                  4   
2                    1   34                     3                  7   
3                    2   39                     1                 10   
4                    1   45                     3                  2   
...                ...  ...                   ...                ...   
54803                1   48                     3                 17   
54804                1   37                     2                  6   
54805                1   27                     5                  3   
54806                1   29                     1                  2   
54807                1   27                     1                  5   

       awards_won  avg_training_score  
0               0                  49  
1               0                  60  
2               0                  50  
3               0                  50  
4               0                  73  
...           ...                 ...  
54803           0                  78  
54804           0                  56  
54805           0                  79  
54806           0                  63  
54807           0                  49  

[54808 rows x 11 columns]
```

In [101]:
```
print(Y)
```

```
       is_promoted
0                0
1                0
2                0
3                0
4                0
...            ...
54803            0
54804            0
54805            0
54806            0
54807            0

[54808 rows x 1 columns]
```

In [102]:
```
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size=0.3)
```

In [103]:
```
print(X_train.shape)
print(Y_train.shape)
print(X_test.shape)
print(Y_test.shape)
```

```
(38365, 11)
(38365, 1)
(16443, 11)
(16443, 1)
```

In [104]:
```
model = LogisticRegression(solver='liblinear')
```

In [105]:
```
model.fit(X_train,Y_train)
```

Out[105]:
```
LogisticRegression(solver='liblinear')
```

In [106]:
```
pred = model.predict(X_train)
```

In [107]:
```
training_data_accuracy=accuracy_score(pred,Y_train)
```

In [108]:
```
print('Accuracy Score od Training Data: ',training_data_accuracy)
```

```
Accuracy Score od Training Data:  0.9186498110256744
```

In [109]:
```
pred1 = model.predict(X_test)
```

In [110]:
```
test_data_accuracy=accuracy_score(pred1,Y_test)
```

In [111]:

```
print('Accuracy Score on Test Data: ',test_data_accuracy)
```

```
Accuracy Score on Test Data:  0.9189320683573557
```

In [112]:

```
print('Accuracy Score on Training Data: ',training_data_accuracy*100,'%')
print('Accuracy Score on Test Data: ',test_data_accuracy*100,'%')
```

```
Accuracy Score on Training Data:  91.86498110256744 %
Accuracy Score on Test Data:  91.89320683573557 %
```