In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib as matplot
import seaborn as sns
%matplotlib inline

df = pd.DataFrame.from_csv('HR_comma_sep.csv', index_col=None)
df.isnull().any()
df.head()
```

```
/Users/thanakornpasangthien/anaconda3/lib/python3.6/site-packages/ip
ykernel_launcher.py:8: FutureWarning: from_csv is deprecated. Please
use read_csv(...) instead. Note that some of the default arguments a
re different, so please refer to the documentation for from_csv when
changing your function calls
```

Out[1]:

	satisfaction_level	last_evaluation	number_project	average_montly_hours	time_sp
0	0.38	0.53	2	157	3
1	0.80	0.86	5	262	6
2	0.11	0.88	7	272	4
3	0.72	0.87	5	223	5
4	0.37	0.52	2	159	3

In [2]:

```
df = df.rename(columns={'satisfaction_level': 'satisfaction',
'last_evaluation': 'evaluation',
'number_project': 'projectCount',
'average_montly_hours': 'averageMonthlyHours',
'time_spend_company': 'yearsAtCompany',
'Work_accident': 'workAccident',
'promotion_last_5years': 'promotion',
'sales' : 'department',
'left' : 'turnover'
})
```

In [3]:

```
front = df['turnover']
df.drop(labels=['turnover'], axis=1,inplace = True)
df.insert(0, 'turnover', front)
df.head()
```

Out[3]:

	turnover	satisfaction	evaluation	projectCount	averageMonthlyHours	yearsAtCom
0	1	0.38	0.53	2	157	3
1	1	0.80	0.86	5	262	6
2	1	0.11	0.88	7	272	4
3	1	0.72	0.87	5	223	5
4	1	0.37	0.52	2	159	3

In [4]:

```
df.shape
df.dtypes
df.describe()
```

Out[4]:

	turnover	satisfaction	evaluation	projectCount	averageMonthlyHou
count	14999.000000	14999.000000	14999.000000	14999.000000	14999.000000
mean	0.238083	0.612834	0.716102	3.803054	201.050337
std	0.425924	0.248631	0.171169	1.232592	49.943099
min	0.000000	0.090000	0.360000	2.000000	96.000000
25%	0.000000	0.440000	0.560000	3.000000	156.000000
50%	0.000000	0.640000	0.720000	4.000000	200.000000
75%	0.000000	0.820000	0.870000	5.000000	245.000000
max	1.000000	1.000000	1.000000	7.000000	310.000000

In [5]:

```
turnover_rate = df.turnover.value_counts() / len(df)
print(turnover_rate)
```

```
0    0.761917
1    0.238083
Name: turnover, dtype: float64
```

In [6]:

```
turnover_Summary = df.groupby('turnover')
turnover_Summary.mean()
```

Out[6]:

	satisfaction	evaluation	projectCount	averageMonthlyHours	yearsAtCompa
turnover					
0	0.666810	0.715473	3.786664	199.060203	3.380032
1	0.440098	0.718113	3.855503	207.419210	3.876505

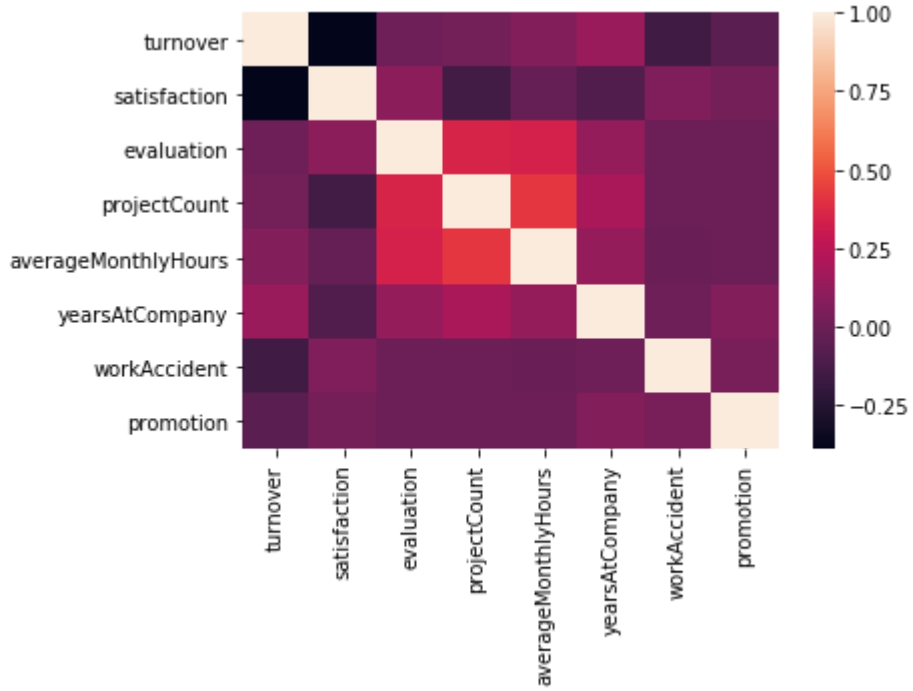
In [7]:

```
corr = df.corr()
corr = (corr)
sns.heatmap(corr,
xticklabels=corr.columns.values,
yticklabels=corr.columns.values)
print(corr)
```

	turnover	satisfaction	evaluation	projectCount
turnover	1.000000	-0.388375	0.006567	0.023787
satisfaction	-0.388375	1.000000	0.105021	-0.142970
evaluation	0.006567	0.105021	1.000000	0.349333
projectCount	0.023787	-0.142970	0.349333	1.000000
averageMonthlyHours	0.071287	-0.020048	0.339742	0.417211
yearsAtCompany	0.144822	-0.100866	0.131591	0.196786
workAccident	-0.154622	0.058697	-0.007104	-0.004741
promotion	-0.061788	0.025605	-0.008684	-0.006064

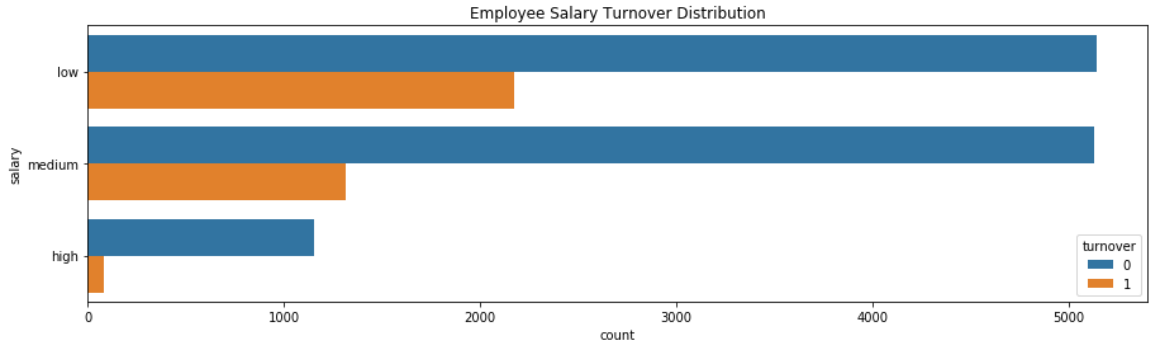
	averageMonthlyHours	yearsAtCompany	workAccident
turnover	0.071287	0.144822	-0.154622
satisfaction	-0.020048	-0.100866	0.058697
evaluation	0.339742	0.131591	-0.007104
projectCount	0.417211	0.196786	-0.004741
averageMonthlyHours	1.000000	0.127755	-0.010143
yearsAtCompany	0.127755	1.000000	0.002120
workAccident	-0.010143	0.002120	1.000000
promotion	-0.003544	0.067433	0.039245

	promotion
turnover	-0.061788
satisfaction	0.025605
evaluation	-0.008684
projectCount	-0.006064
averageMonthlyHours	-0.003544
yearsAtCompany	0.067433
workAccident	0.039245
promotion	1.000000



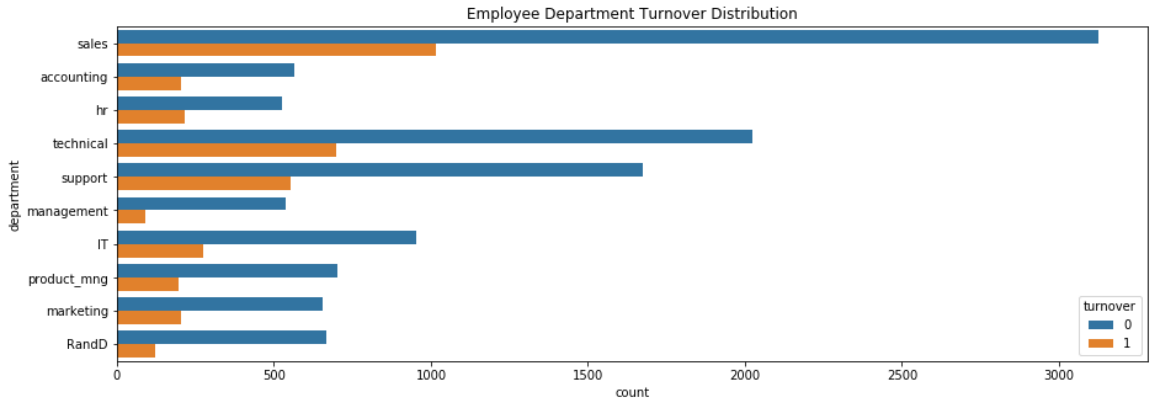
In [8]:

```
f, ax = plt.subplots(figsize=(15, 4))
sns.countplot(y="salary", hue='turnover', data=df).set_title('Employee Salary Tu
rnover Distribution');
```



In [9]:

```
f, ax = plt.subplots(figsize=(15, 5))
sns.countplot(y="department", hue='turnover', data=df).set_title('Employee Depar
tment Turnover Distribution');
```

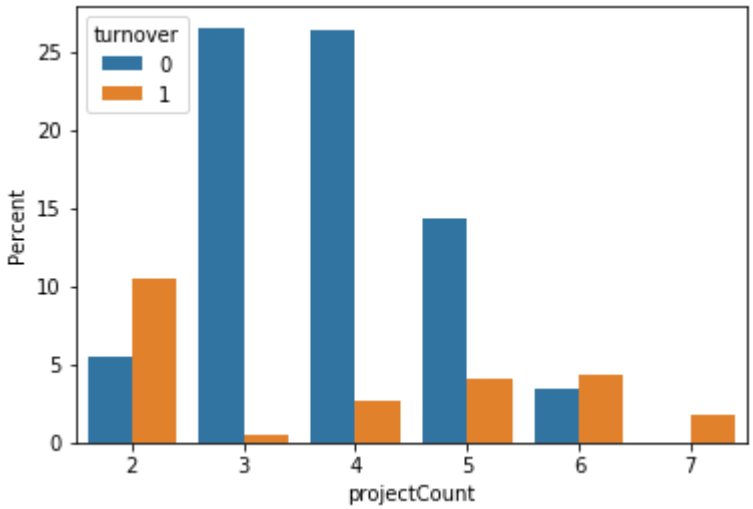


In [10]:

```
ax = sns.barplot(x="projectCount", y="projectCount", hue='turnover', data=df, es
timator=lambda x: len(x) / len(df) *
100)
ax.set(ylabel="Percent")
```

Out[10]:

```
[Text(0, 0.5, 'Percent')]
```

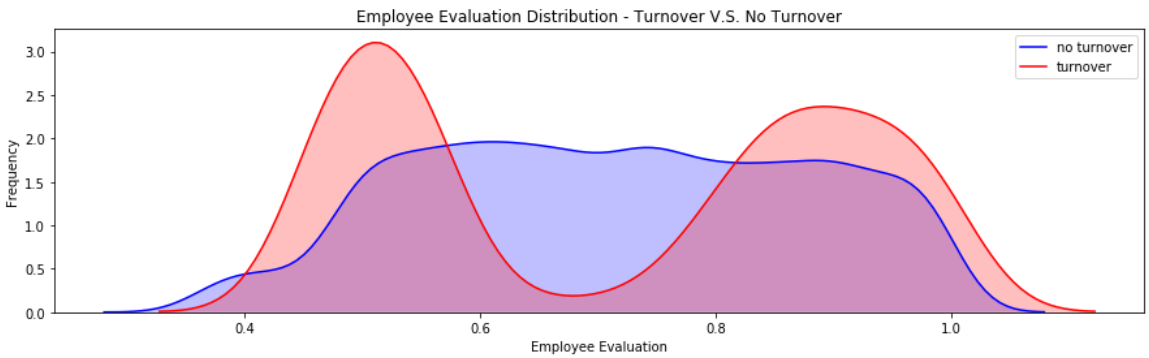


In [11]:

```
fig = plt.figure(figsize=(15,4),)
ax=sns.kdeplot(df.loc[(df['turnover'] == 0),'evaluation'] ,
color='b',shade=True,label='no turnover')
ax=sns.kdeplot(df.loc[(df['turnover'] == 1),'evaluation'] ,
color='r',shade=True, label='turnover')
ax.set(xlabel='Employee Evaluation', ylabel='Frequency')
plt.title('Employee Evaluation Distribution - Turnover V.S. No Turnover')
```

Out[11]:

```
Text(0.5, 1.0, 'Employee Evaluation Distribution - Turnover V.S. No
Turnover')
```

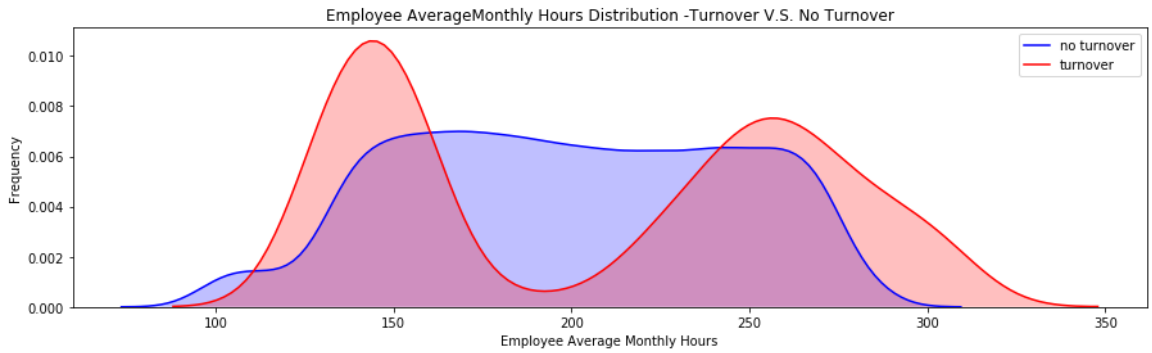


In [12]:

```
fig = plt.figure(figsize=(15,4))
ax=sns.kdeplot(df.loc[(df['turnover'] == 0),'averageMonthlyHours'] , color='b',s
hade=True, label='no turnover')
ax=sns.kdeplot(df.loc[(df['turnover'] == 1),'averageMonthlyHours'] , color='r',s
hade=True, label='turnover')
ax.set(xlabel='Employee Average Monthly Hours', ylabel='Frequency')
plt.title('Employee AverageMonthly Hours Distribution -Turnover V.S. No Turnove
r')
```

Out[12]:

```
Text(0.5, 1.0, 'Employee AverageMonthly Hours Distribution -Turnover
V.S. No Turnover')
```

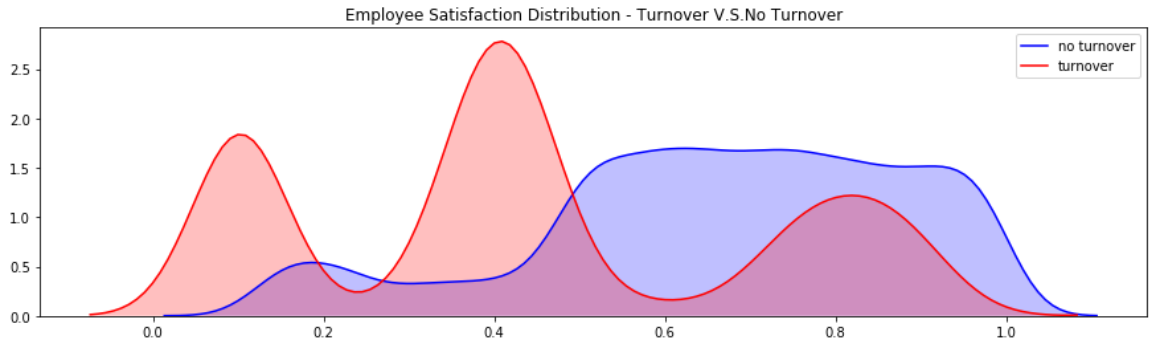


In [13]:

```
fig = plt.figure(figsize=(15,4))
ax=sns.kdeplot(df.loc[(df['turnover'] == 0),'satisfaction'] ,
color='b',shade=True, label='no turnover')
ax=sns.kdeplot(df.loc[(df['turnover'] == 1),'satisfaction'] ,
color='r',shade=True, label='turnover')
plt.title('Employee Satisfaction Distribution - Turnover V.S.No Turnover')
```

Out[13]:

```
Text(0.5, 1.0, 'Employee Satisfaction Distribution - Turnover V.S.No
Turnover')
```

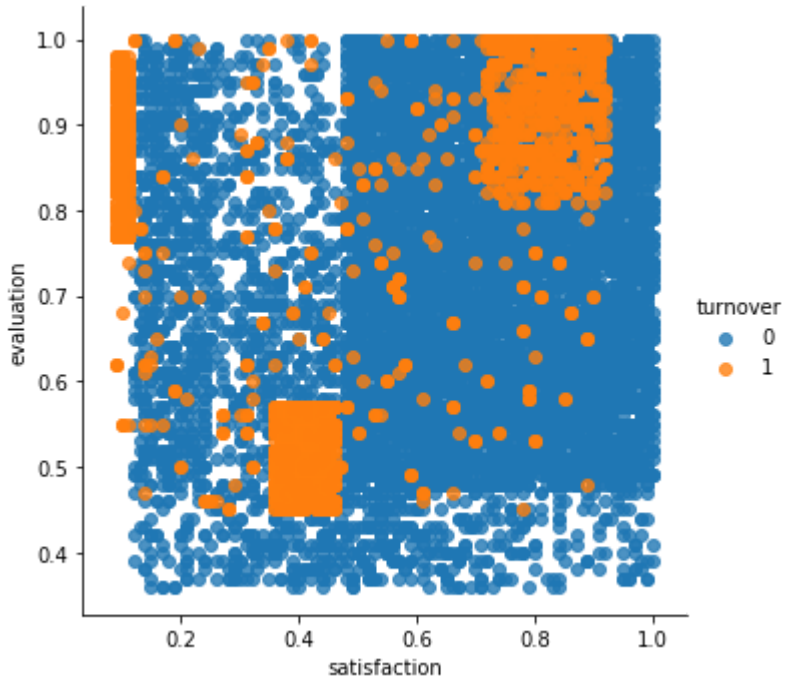


In [14]:

```
sns.lmplot(x='satisfaction', y='evaluation', data=df, fit_reg=
False, hue='turnover')
```

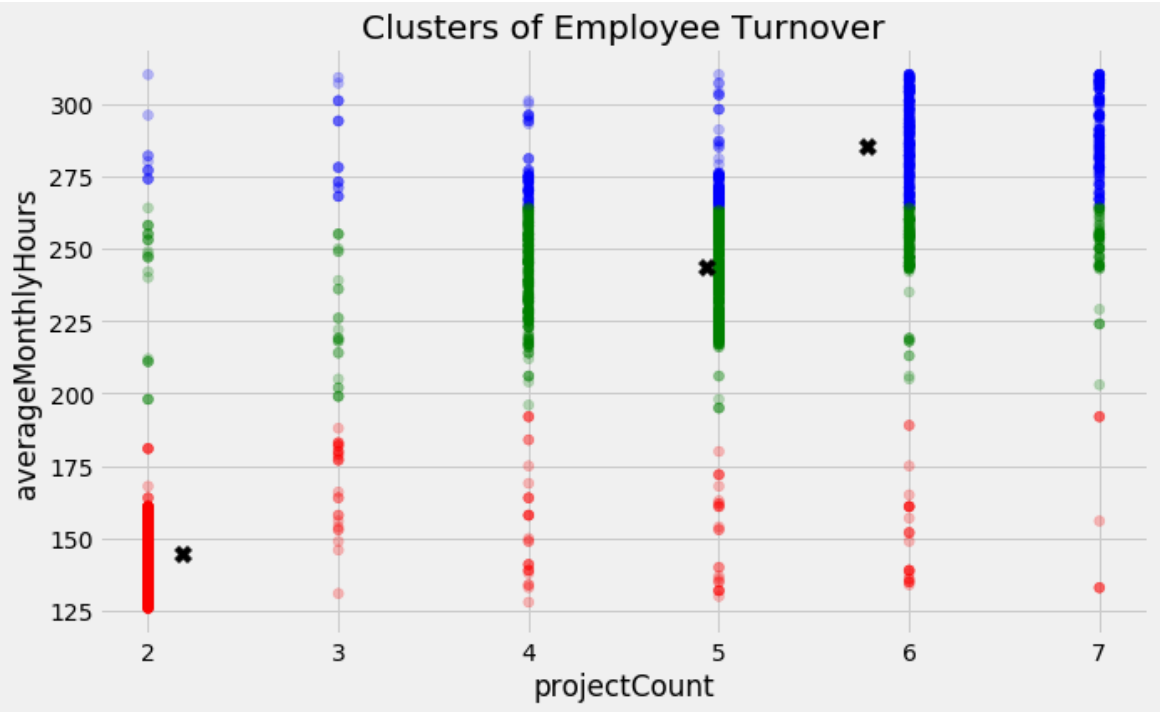
Out[14]:

```
<seaborn.axisgrid.FacetGrid at 0x11799e208>
```



In [38]:

```
from sklearn.cluster import KMeans
kmeans = KMeans(n_clusters=3,random_state=2)
kmeans.fit(df[df.turnover==1][["projectCount","averageMonthlyHours"]])
kmeans_colors = ['green' if c == 0 else 'blue' if c == 2 else 'red' for c in kme
ans.labels_]
fig = plt.figure(figsize=(10, 6))
plt.scatter(x="projectCount",y="averageMonthlyHours", data=df[df.
turnover==1], alpha=0.25,color = kmeans_colors)
2
plt.xlabel("projectCount")
plt.ylabel("averageMonthlyHours")
plt.scatter(x=kmeans.cluster_centers_[:,0],y=kmeans.
cluster_centers_[:,1],color="black",marker="X",s=100)
plt.title("Clusters of Employee Turnover")
plt.show()
```



In [59]:

```
from sklearn import tree
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
plt.style.use('fivethirtyeight')
plt.rcParams['figure.figsize'] = (12,6)
# you can skip this part, if you already changed the column
df = df.rename(columns={'satisfaction_level': 'satisfaction', 'last_evaluation':
 'evaluation', 'number_project': 'projectCount', 'average_montly_hours': 'averag
eMonthlyHours'
, 'time_spend_company': 'yearsAtCompany', 'Work_accident': 'workAccident', 'prom
otion_last_5years': 'promotion', 'sales'
: 'department', 'left' : 'turnover'
})
# Convert these variables into categorical variables
df["department"] = df["department"].astype('category').cat.codes
df["salary"] = df["salary"].astype('category').cat.codes
# Create train and test splits
target_name = 'turnover'
X = df.drop('turnover', axis=1)
y=df[target_name]
X_train, X_test, y_train, y_test = train_test_split(X,y,
test_size=0.15, random_state=123, stratify=y)
dtree = tree.DecisionTreeClassifier(max_depth=3, class_weight="balanced", min_we
ight_fraction_leaf=0.01)
dtree = dtree.fit(X_train,y_train)
```

In [60]:

```
from sklearn.externals.six import StringIO
from IPython.display import Image
from sklearn.tree import export_graphviz
import graphviz
import pydotplus
dot_data = StringIO()
export_graphviz(dtree,out_file=dot_data,filled=True, rounded=True,special_charac
ters=True)
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
dotfile = open("dtree2.dot",'w')
tree.export_graphviz(dtree, out_file = dotfile, feature_names = X.columns)
dotfile.close()
```

In [61]:

```
dtree = tree.DecisionTreeClassifier(max_depth=3, class_weight="balanced", min_we
ight_fraction_leaf=0.01)
```