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Understanding the Career of Data Scientists, Analysis

This notebook contains the analytics for the ways to get started with as a data scientist. Stack Overflow is an online technology forum that has a large monthly active user base, using the survey results could find out the insights of the general software engineer community.

Import packages

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

Data Preparation

Load stack overflow survey data from 2011 to 2018, store them in a dictionary

In [2]:
```
path = "./data/"
all_files = glob.glob(os.path.join(path, "*.csv"))
survey_results = {}
year = '2011'

for file in all_files:
    # Getting the file name without extension
    file_name = os.path.splitext(os.path.basename(file))[0]
    year = file_name.split()[0]
    if year in ['2011', '2012']:
        survey_results[year] = pd.read_csv(path + file_name + '.csv', header =
[0,1],engine='python',
                                            encoding= 'latin1')
    elif year in ['2013', '2014']:
        survey_results[year] = pd.read_csv(path + file_name + '.csv', header =
[0,1],
                                    low_memory=False)

    elif year in ['2015']:
        survey_results[year] = pd.read_csv(path + file_name + '.csv',
                                            skiprows= 1, low_memory=False)
    else:
        survey_results[year] = pd.read_csv(path + file_name + '.csv',
                                            low_memory=False)
```

Data Scientists Community Growth

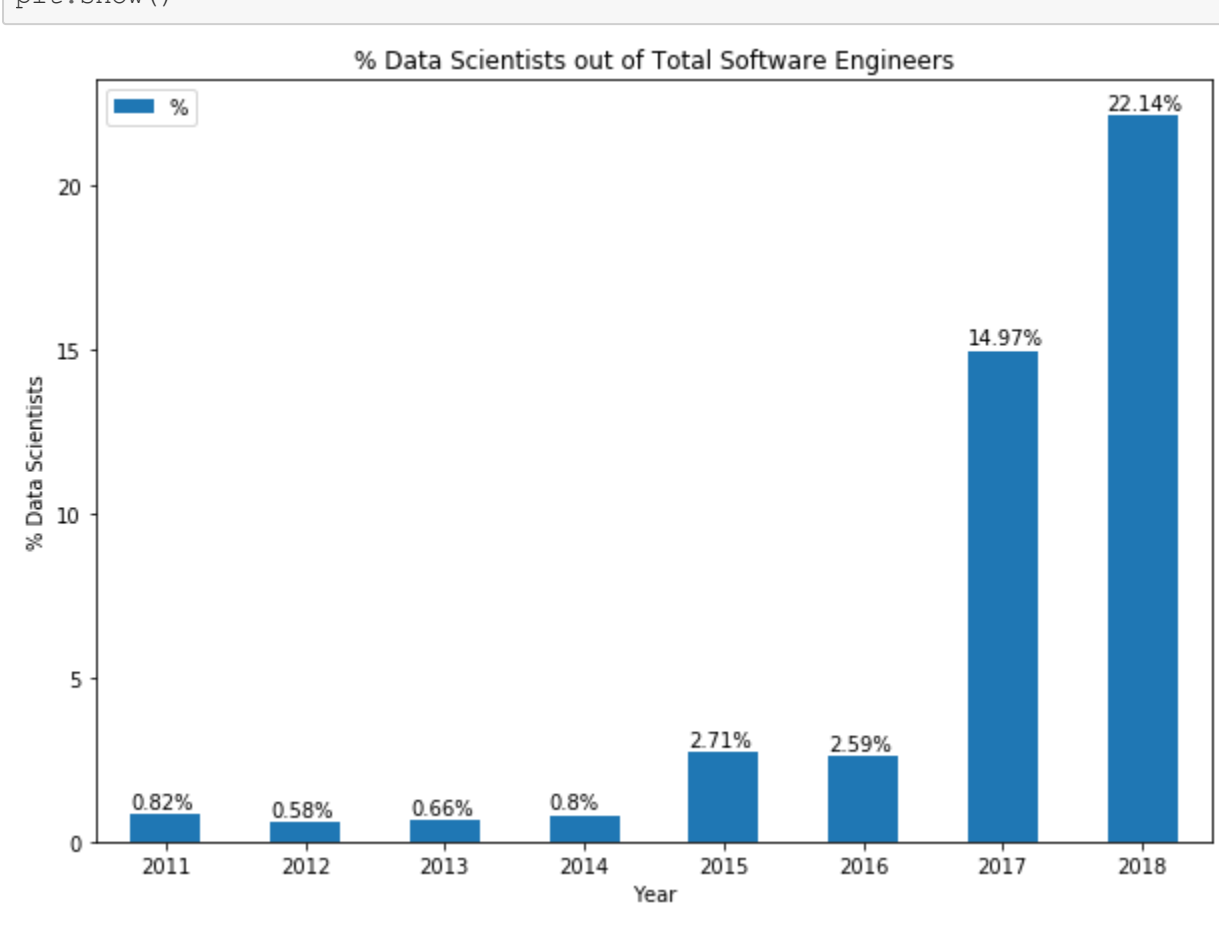
Corresponds to the visualization in the introduction

Filter for data scientists

In [3]:
```
data_scientists = {year: survey_results[year][survey_results[year].filter(rege
x = '.*ccupation').iloc[:,0]
                                                                        .str.co
ntains('.*ata|machine learning|algorithm',

na=False)]
                                                                        for yea
r in [str(i) for i in np.arange(2011, 2017, 1)]}
for year in [str(i) for i in np.arange(2017, 2019, 1)]:
    data_scientists[year] = (survey_results[year][survey_results[year]
                                                     .filter(regex = '.*ev').il
oc[:,0]
                                                     .str.contains('.*ata|achi
ne|earning|lgorithm',  na=False)])
```

Plot % of data scientists. Missing data here is counted as 1 individual of data scientist, even though some of his/her information is not complete.

In [4]:
```
active_users = pd.DataFrame.from_dict({i: len(survey_results[i]) for i in surv
ey_results},
                        orient='index',
                        columns = ['User Count'])

active_data_scientists = pd.DataFrame.from_dict({i: len(data_scientists[i]) fo
r i in data_scientists},
                        orient='index',
                        columns = ['User Count'])


ax =(active_data_scientists/active_users * 100).plot.bar(figsize = (10, 7))

plt.xlabel('Year')
plt.ylabel('% Data Scientists')
plt.xticks(rotation = 0)
plt.legend("% data scientists")
plt.title("% Data Scientists out of Total Software Engineers")
for p in ax.patches:
    ax.annotate(str(round(p.get_height(), 2))+ '%', (p.get_x(), p.get_height()
+ 0.2))
plt.show()
```



Does a data science role return you a happy career?

Job satisfaction data over the years (Not used)

In [5]:
```
satisfication = {}
satisfication['2011'] = data_scientists['2011'].iloc[:, -21]
satisfication['2012'] = data_scientists['2012'].iloc[:, -37]
satisfication['2013'] = data_scientists['2013'].iloc[:, -29]
satisfication['2015'] = data_scientists['2015']['Job Satisfaction']
satisfication['2016'] = data_scientists['2016']['job_satisfaction']
satisfication['2017'] = data_scientists['2017']['JobSatisfaction']
satisfication['2018'] = data_scientists['2018']['JobSatisfaction']
```

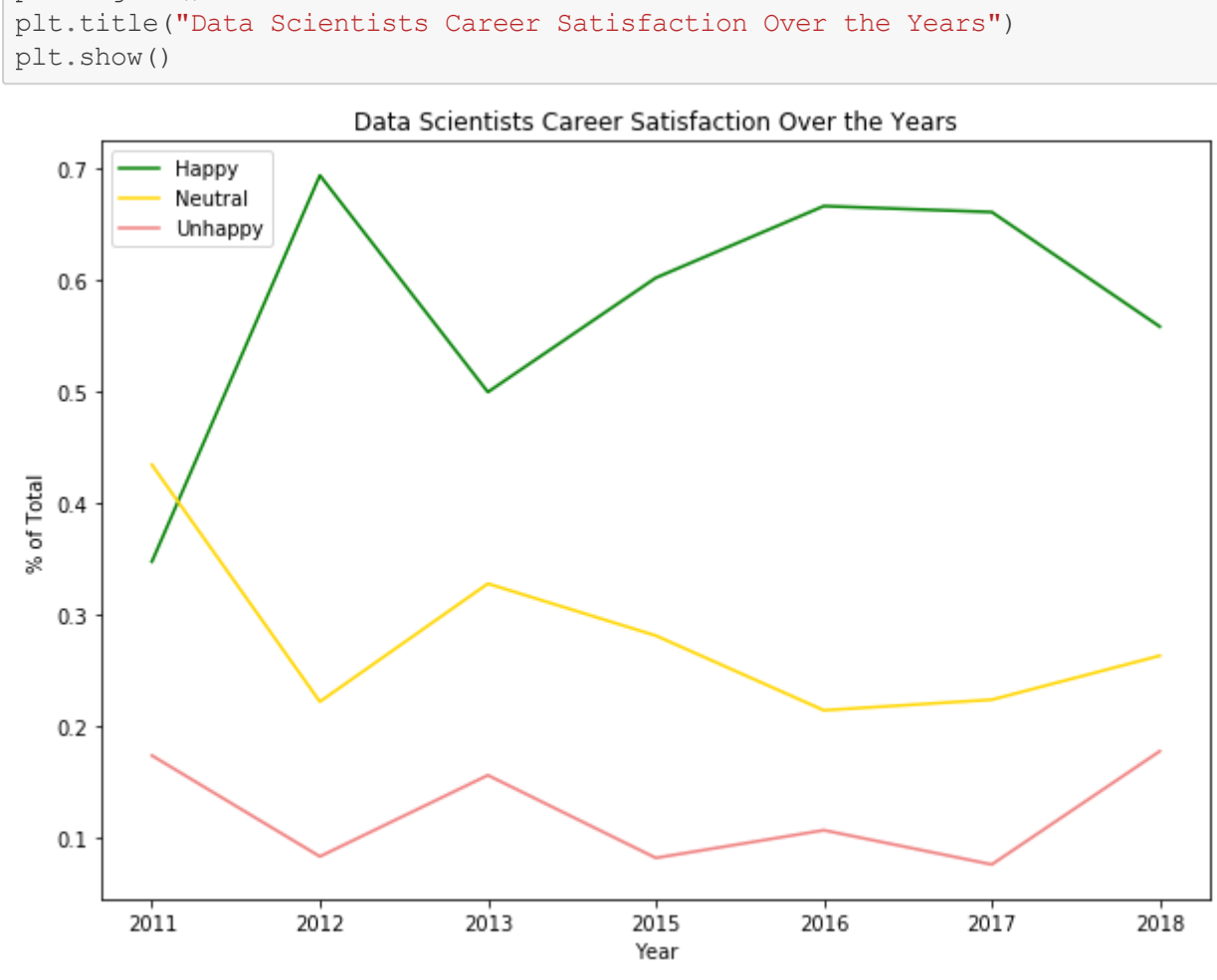
clear up messy formats. Missing data here are assumed to be individuals that are holds neutral outlooks on their career satisfactions, allowing more data points to be added to the total number of data scientists each year.

In [6]:
```
# Save Encoding Dictionary
cleanup_satisfaction = {}
cleanup_satisfaction['2011'] = {"I enjoy going to work": "Happy",
                               "It pays the bills": "Neutral",
                                "So happy it hurts": "Unhappy",
                                np.nan:"Neutral",
                                "I'm not happy in my job": "Unhappy"
                                }

cleanup_satisfaction['2012'] = {"I enjoy going to work": "Happy",
                                "I love my job": "Happy",
                               "Love my job":"Happy",
                               "Its a paycheck": "Neutral",
                                "Hate my job": "Unhappy",
                                np.nan:"Neutral",
                                "I'm not happy in my job": "Unhappy"
                                }

cleanup_satisfaction['2013'] = {"I enjoy going to work": "Happy",
                                "Love my job": "Happy",
                               "It's a paycheck": "Neutral",
                                "Hate my job": "Unhappy",
                                 np.nan:"Neutral",
                                "I'm not happy in my job": "Unhappy"
                                }

cleanup_satisfaction['2015'] = {"I'm somewhat satisfied with my job": "Happy",
                                 "I love my job": "Happy",
                                 "I'm neither satisfied nor dissatisfied with my
 job": "Neutral",
                                 "Hate my job": "Unhappy",
                                 np.nan:"Neutral",
                                 "I'm somewhat dissatisfied with my job": "Unhapp
y"
                                }

cleanup_satisfaction['2016'] = {"I'm somewhat satisfied with my job": "Happy",
                                 "I love my job": "Happy",
                                 "I'm neither satisfied nor dissatisfied": "Neutr
al",
                                 "I hate my job": "Unhappy",
                                  np.nan:"Neutral",
                                 "I'm somewhat dissatisfied with my job": "Unhapp
y"
                                }

cleanup_satisfaction['2018'] = {"Moderately satisfied": "Happy",
                                 "Extremely satisfied": "Happy",
                                  "Slightly satisfied": "Happy",
                                  "Neither satisfied nor dissatisfied": "Neutral"
,
                                  "Slightly dissatisfied": "Unhappy",
                                   "Moderately dissatisfied": "Unhappy",
                                   "Extremely dissatisfied": "Unhappy",
                                   np.nan:"Neutral",
                                }
```

In [7]:
```
for i in cleanup_satisfaction:
    satisfication[i] = satisfication[i].map(cleanup_satisfaction[i])
satisfication['2017'] = pd.cut(data_scientists['2017']['JobSatisfaction'],
                                bins= 3, labels = ['Unhappy', 'Neutral', 'Happ
y'], include_lowest=True)
```

Perform a unique value count at each year exluding 2014 (Since 2014's survey does not have the career satisfaction question).

In [8]:
```
satisfication_counts = pd.DataFrame.from_dict({i: satisfication[i].value_count
s()/len(satisfication[i])
                                                    for i in satisfication})
colors = ['green', 'gold', 'lightcoral']
plt.figure(figsize = (10, 7))
j = 0
for i in list(satisfication_counts.T.columns):
    plt.plot(satisfication_counts.T.loc[:, i], label = i, color = colors[j])
    j += 1
plt.xlabel('Year')
plt.ylabel('% of Total')
plt.legend()
plt.title("Data Scientists Career Satisfaction Over the Years")
plt.show()
```



Does a data science role return you a happy career?

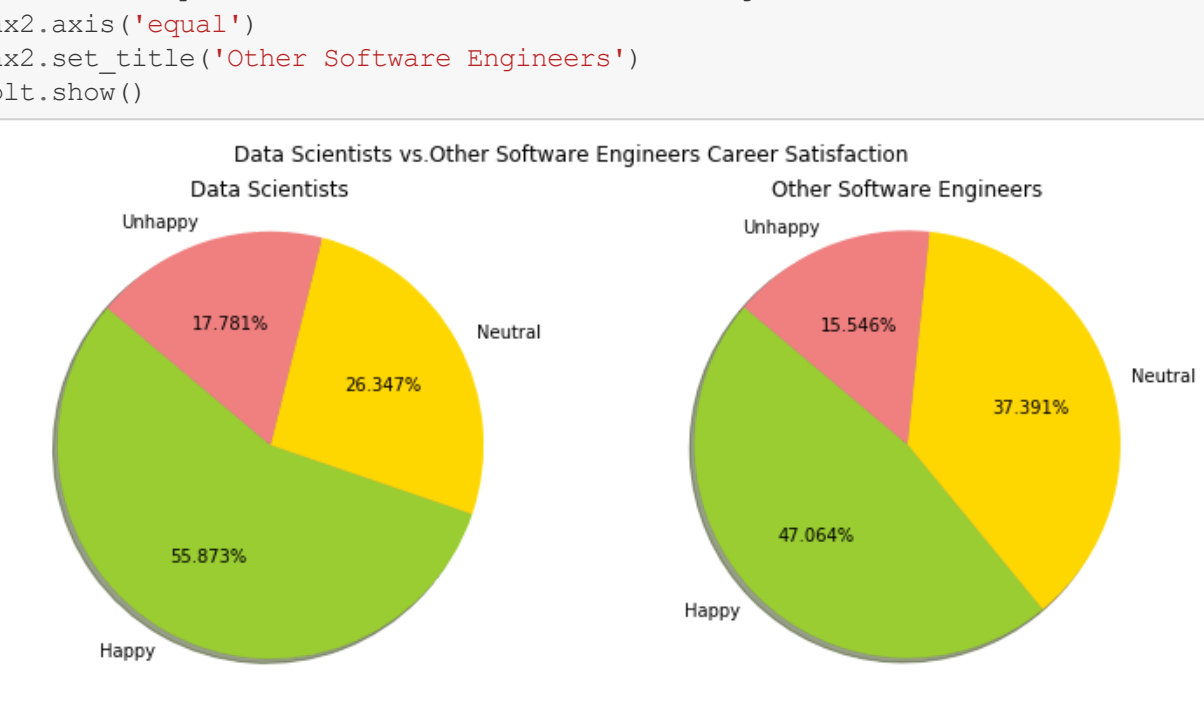
Data Scientist Career Satisfaction vs. Other Software Engineers

Again, missing data in career satisfaction column is treated as "No Opinion"

In [9]:
```
not_ds_2018 = (survey_results['2018'][~survey_results['2018']
                           .filter(regex = '.*ev').iloc[:,0].str.contains('.*ata',
na=False)])
```

Plot career satisfaction pie charts

In [10]:
```
f, (ax1, ax2) = plt.subplots(1, 2, figsize=(12,5))
f.suptitle('Data Scientists vs.Other Software Engineers Career Satisfaction')
labels = 'Happy', 'Neutral', 'Unhappy'
sizes_ax1 = list(satisfication['2018'].value_counts())
sizes_ax2 = list(not_ds_2018['JobSatisfaction'].map(cleanup_satisfaction['201
8']).value_counts())
colors = ['yellowgreen', 'gold', 'lightcoral']
ax1.pie(sizes_ax1, labels=labels, colors=colors,
        autopct='%1.3f%%', shadow=True, startangle=140)
ax1.axis('equal')
ax1.set_title('Data Scientists')

ax2.pie(sizes_ax2, labels=labels, colors=colors,
        autopct='%1.3f%%', shadow=True, startangle=140)
ax2.axis('equal')
ax2.set_title('Other Software Engineers')
plt.show()
```



Does a data science role lead to a healthier lifestyle?

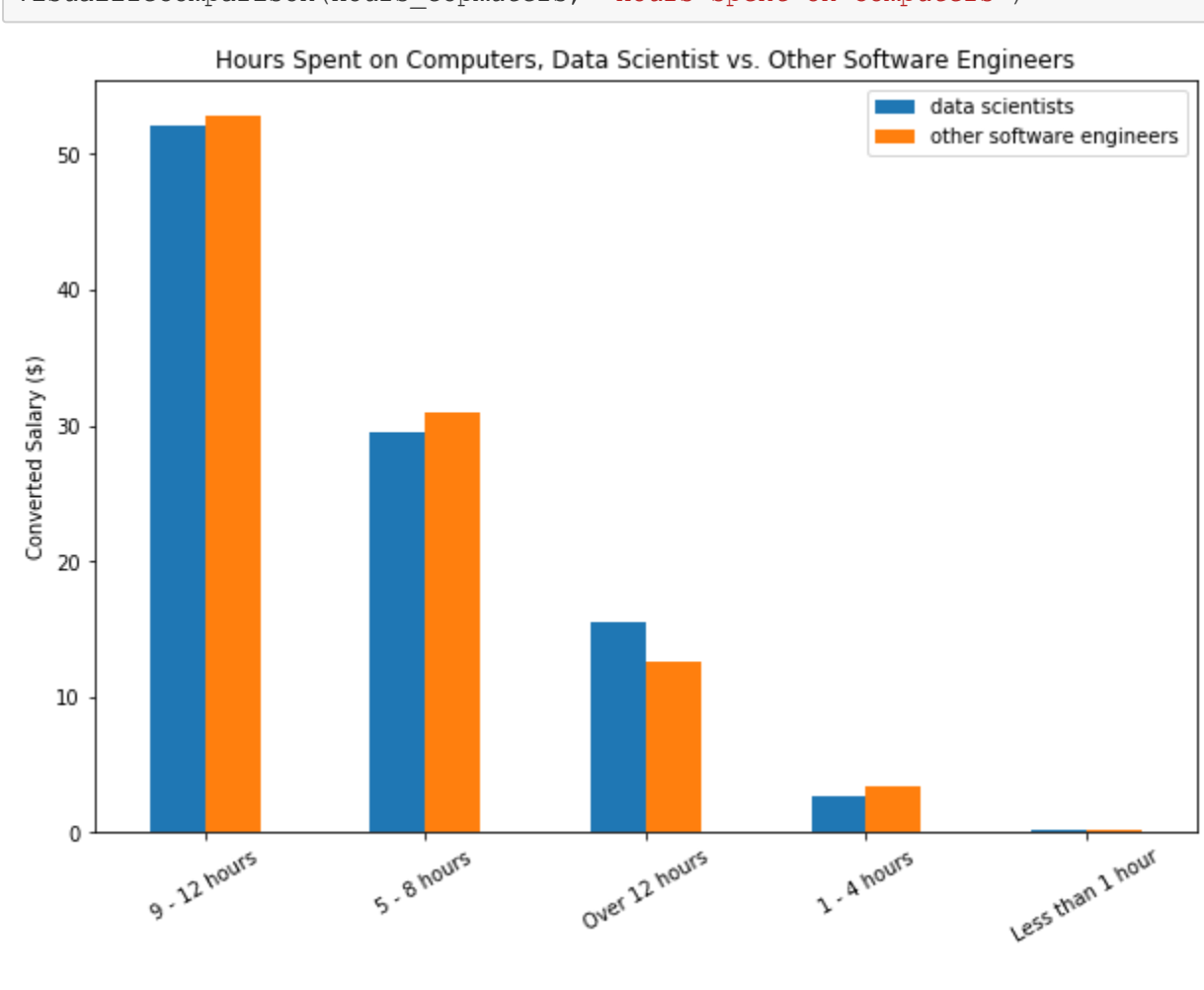
Data Scientists Hours Spent on Computer

In [11]:
```
def visualizeComparison(comparison, name):
    """This function visualizes the comparison for data scientists and softwar
e engineers

        Input: dataframe contains different categories
        Output: returns None, but plots visualizations of comparison
    """
    comparison.plot(kind = 'bar', figsize = (10, 7),
                         title = name + ', Data Scientist vs. Other Software
 Engineers' )
    plt.xticks(rotation = 30)
    plt.ylabel('Converted Salary ($)')
    plt.show()
```

In [12]:
```
ds_computer = data_scientists['2018']['HoursComputer'].value_counts().rename(
'data scientists')
no_ds_computer = not_ds_2018['HoursComputer'].value_counts().rename('other sof
tware engineers')
```

Plot data scientists hours spent on Computer

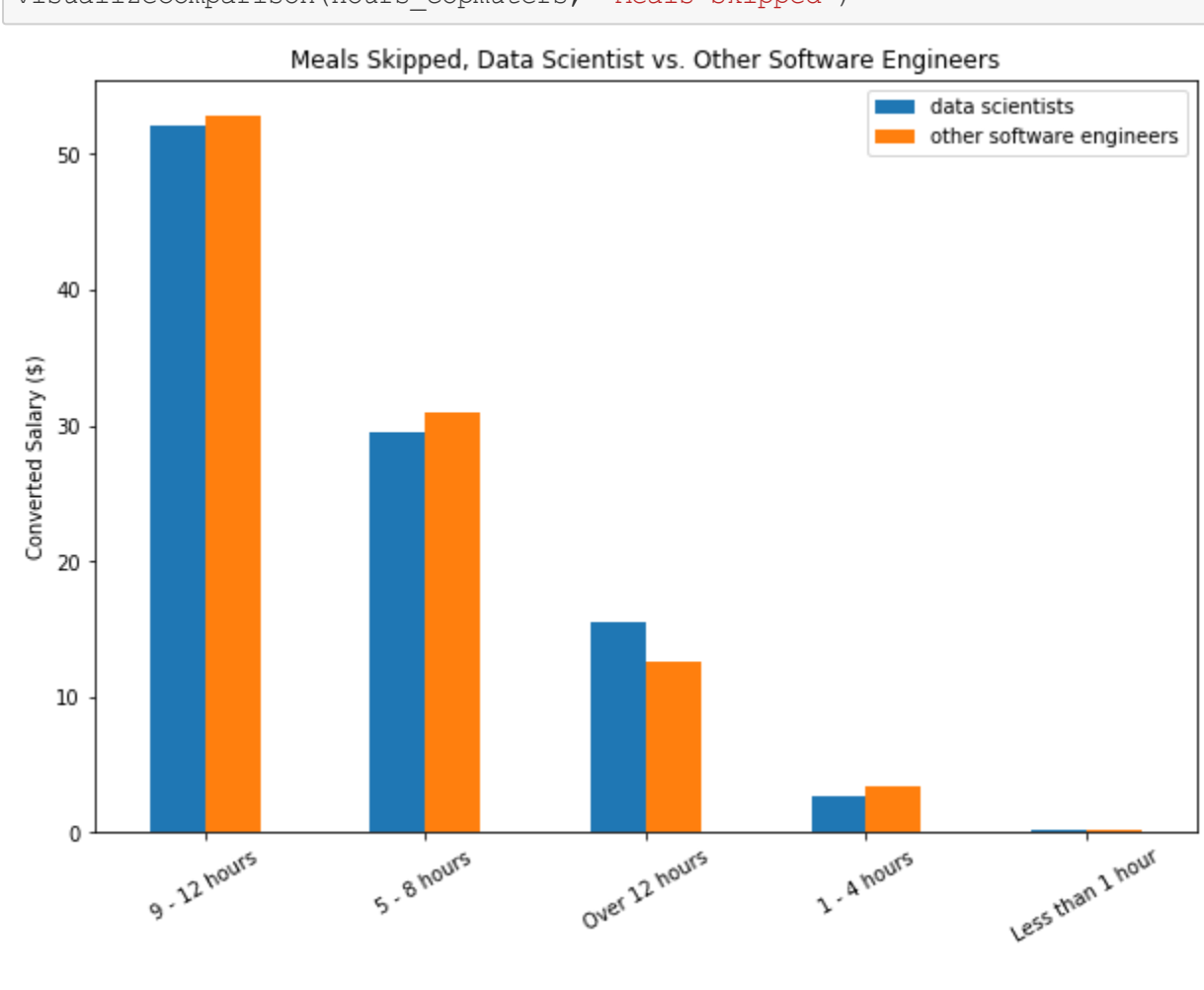
In [13]:
```
Hours_copmuters = pd.DataFrame(ds_computer/sum(ds_computer)*100).join(pd.DataF
rame(no_ds_computer/sum(no_ds_computer)*100))
visualizeComparison(Hours_copmuters, "Hours Spent on Computers")
```



Data Scientists Meals Skipped

In [14]:
```
ds_meals = data_scientists['2018']['SkipMeals'].value_counts().rename('data sc
ientists')
no_ds_meals = not_ds_2018['SkipMeals'].value_counts().rename('other software e
ngineers')
```

In [15]:
```
meals_skipped  = pd.DataFrame(ds_meals/sum(ds_meals)*100).join(pd.DataFrame(no
_ds_meals/sum(no_ds_meals)*100))
visualizeComparison(Hours_copmuters, "Meals Skipped")
```



What skills do you need as a data scientist?

Trends in Programming Languages

Get programming language counts from 2013 to 2018, using the following function. Missing data in programming languages are removed due to the fact that we are only interested in a select few most popular languages (sorted by number of users hoping to use beyond 2018) in the dataset. Removing those datapoints will not affect the result too much.

Meanwhile, since one person may know multiple languages at the same time, the long string format of the categorical variable is splitted based on delimiter "," to perform unique counts.

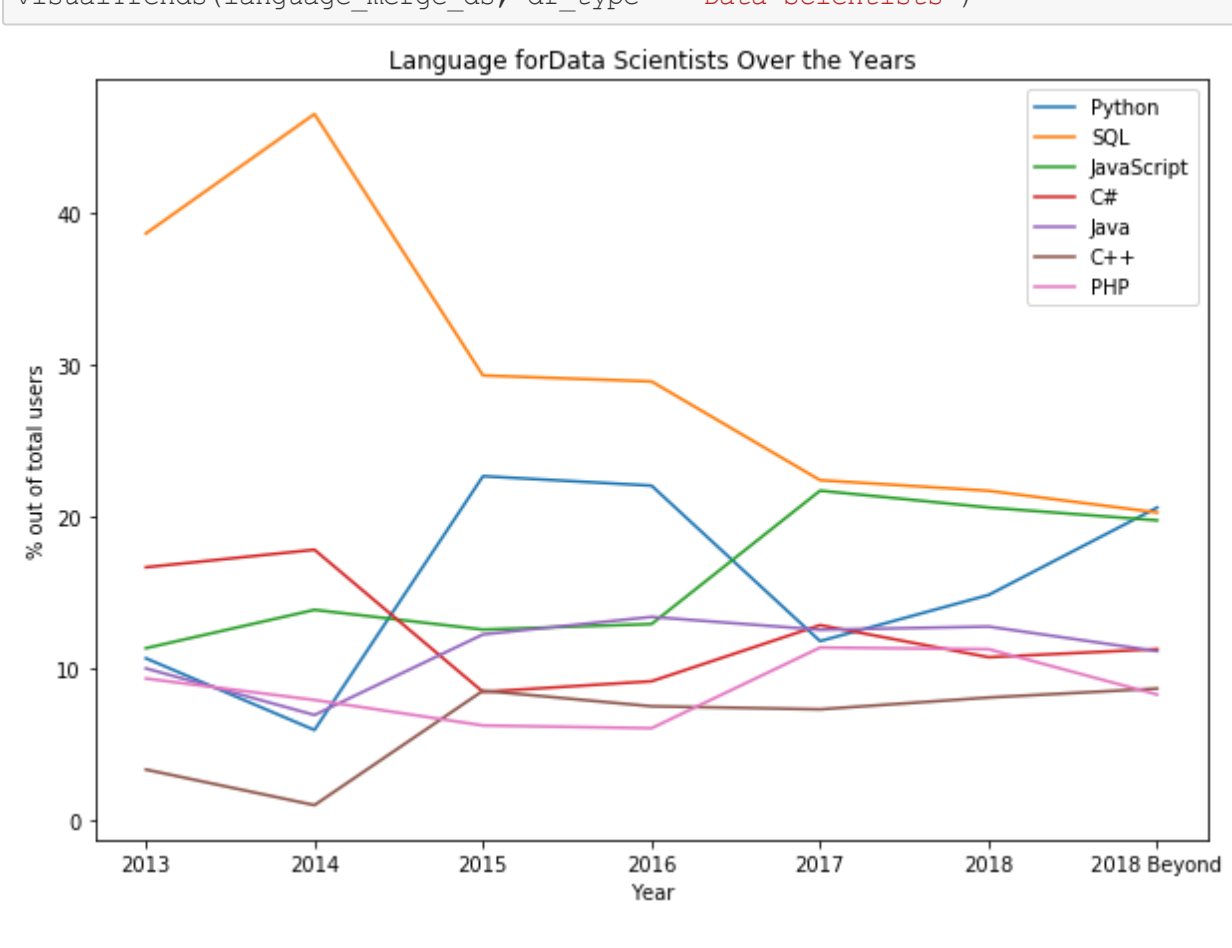
In [16]:
```
def getLanguage(df):

    """ Gets all the programming language counts for a certain dictionary of d
ataframes
        Input: dict
        Output: language merged dataframe
    """
    language = {}
    language['2013'] = pd.DataFrame(df['2013'].iloc[:, -72:-47]
                                .apply(lambda x: x.count()).rename('2013'
))
    language['2013'].index = language['2013'].reset_index()['level_1']
    language['2013'].index.name = None

    language['2014'] = pd.DataFrame(df['2014'].iloc[:, -78:-53]
                                .apply(lambda x: x.count()).rename('2014'
))
    language['2014'].index = language['2014'].reset_index()['level_1']
    language['2014'].index.name = None

    language['2015'] = pd.DataFrame(df['2015'].iloc[:, -214:-171]
                                .apply(lambda x: x.count()).rename('2015'
))
    language['2015'].index = (language['2015'].reset_index()['index']
                                 .apply(lambda x: x.replace(" ", "").split
(':')[1]))

    language['2016'] = pd.DataFrame(df['2016']['tech_do'].str.replace(" ", "")
.str
                                .split(";", expand=True)
                                .stack().reset_index(drop=True, level=1)
                                .value_counts().rename('2016'))

    language['2017'] = pd.DataFrame(df['2017']['HaveWorkedLanguage'].str.repla
ce(" ", "").str
                                .split(";", expand=True)
                                .stack().reset_index(drop=True, level=1)
                                .value_counts().rename('2017'))

    language['2018'] = pd.DataFrame(df['2018']['LanguageWorkedWith'].str.repla
ce(" ", "").str
                                .split(";", expand=True)
                                .stack().reset_index(drop=True, level=1)
                                .value_counts().rename('2018'))

    language['2018 Beyond'] = pd.DataFrame(df['2018']['LanguageDesireNextYear'
].str.replace(" ", "")
                                    .str.split(";", expand=True)
                                    .stack().reset_index(drop=True, lev
el=1)
                                    .value_counts().rename('2018 Beyon
d'))

    # Join all the value counts into 1 dataframe, keeping all the entries
    language_merge = pd.DataFrame()
    for i in language:
        try:
            language_merge = pd.merge(language_merge.reset_index(), language[i
].reset_index(), how = 'outer')
        except:
            language_merge = pd.merge(language_merge, language[i].reset_index
(), how = 'outer')
    language_merge.drop('level_0', inplace = True, axis = 1)
    language_merge.set_index('index', inplace=True)

    return language_merge
```

In [17]:
```
language_merge_ds = getLanguage(data_scientists)
```

Visualize trends of each language over the years

In [18]:
```
def visualTrends(language_merge, df_type = 'Data Scientists'):
    """ This function visualized trends of programming languages given a datas
et
        Input: dataframe that contains trends of languages indexed by year
        Output: Returns None, but plots language trends
    """
    language_merge = language_merge.dropna().loc[language_merge.dropna().sort_
values(ascending = False,

by = '2018 Beyond').head(7).index]
    plt.figure(figsize = (10, 7))
    for i in list(language_merge.dropna().T.columns):
        plt.plot((language_merge/language_merge.sum() *100).T.loc[:, i], label
= i)
    plt.xlabel('Year')
    plt.ylabel('% out of total users')
    plt.legend(bbox_to_anchor=(1, 1))
    plt.title("Language for" + df_type +" Over the Years")
    plt.show()
```

In [19]:
```
visualTrends(language_merge_ds, df_type = 'Data Scientists')
```



Do data scientists get paid higher salaries for skipping more meals?

Salary , Data Scientists vs. Software Engineers By Country

By Country, missing data are again removed since they will not be evaluated in the graph below

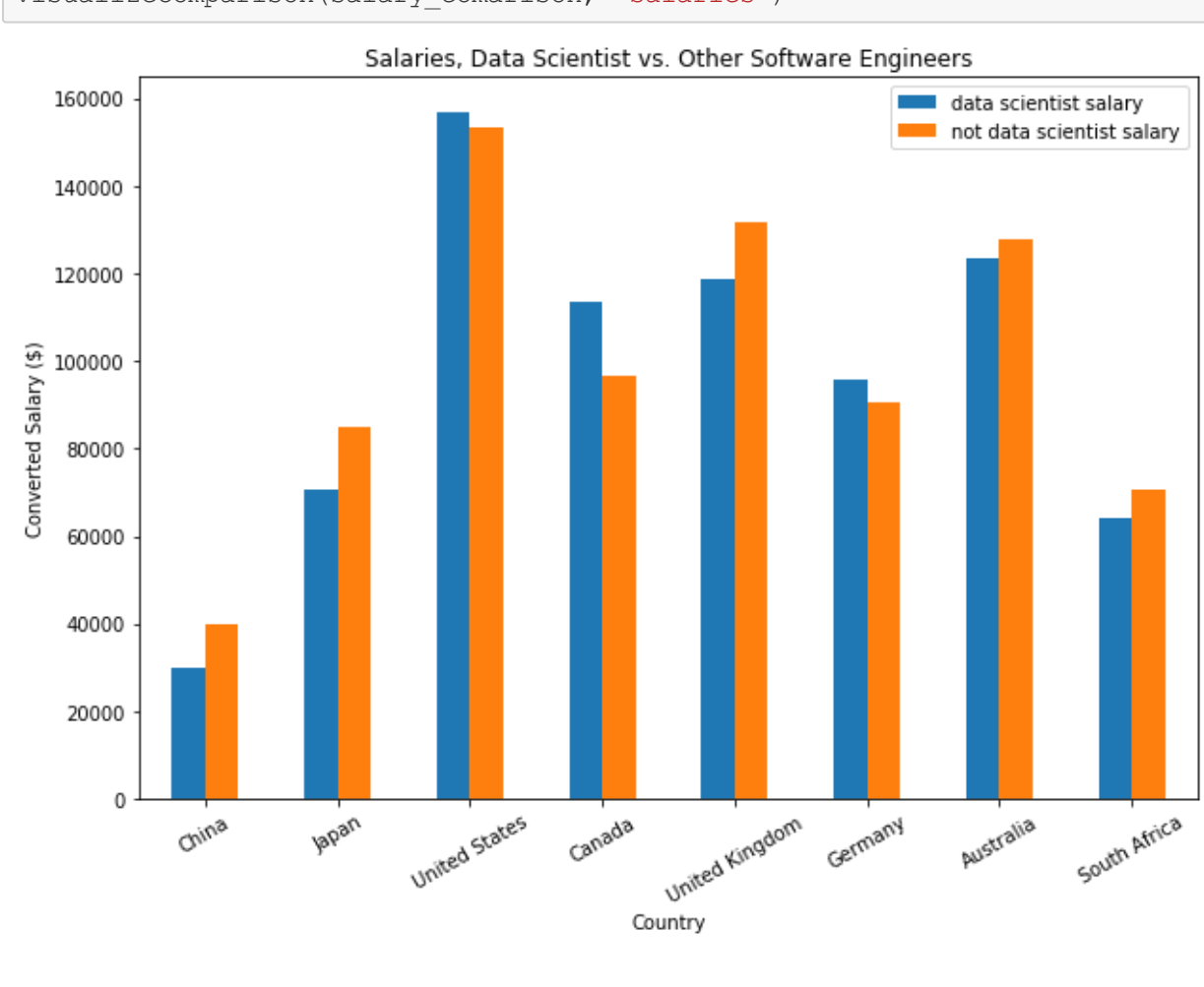
In [20]:
```
ds_salary = data_scientists['2018'].groupby('Country').mean()['ConvertedSalar
y'].rename('data scientist salary')
not_ds_salary = not_ds_2018.groupby('Country').mean()['ConvertedSalary'].renam
e('not data scientist salary')
```

Now select 7 countries to compare

In [21]:
```
countries = ['China', 'Japan', 'United States', 'Canada',
             'United Kingdom', 'Germany',  'Australia', 'South Africa']
salary_comarison = pd.DataFrame(ds_salary[countries]).join(pd.DataFrame(not_ds
_salary[countries]))
```

Plot salary comparisons

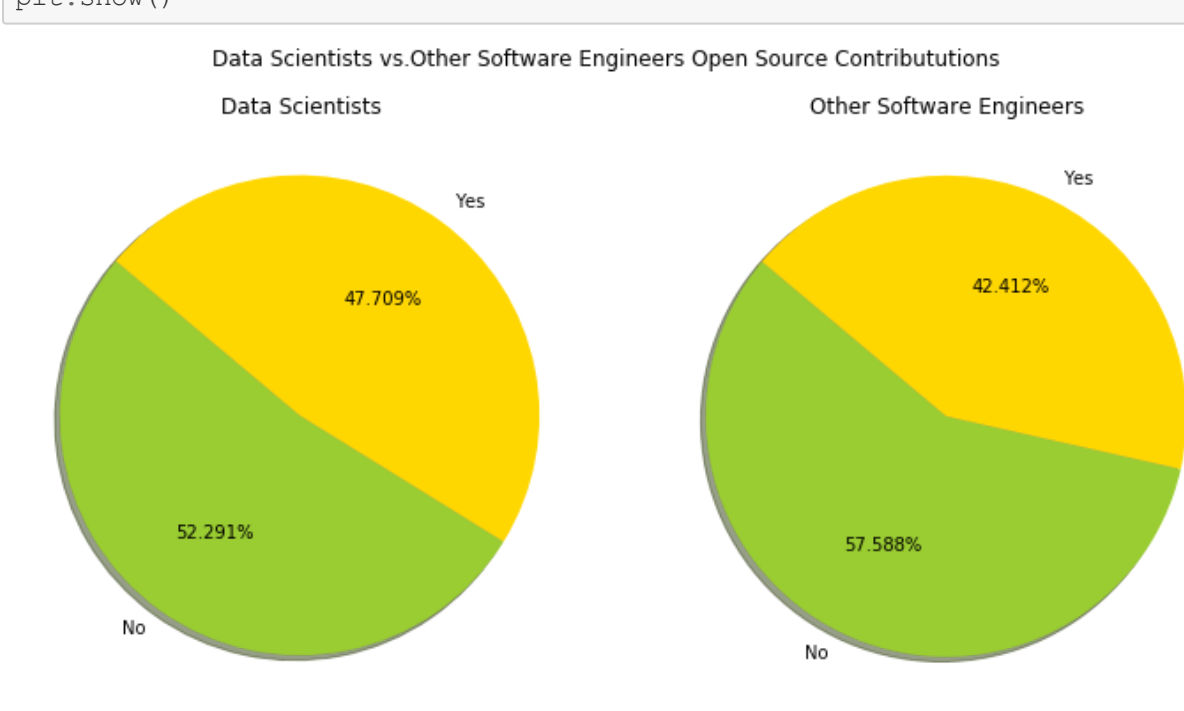
In [22]:
```
visualizeComparison(salary_comarison, "Salaries")
```



Open Source Contributions

In [23]:
```
ds_contributions = (data_scientists['2018']['OpenSource'].value_counts()
                    /data_scientists['2018']['OpenSource'].value_counts().sum
())
nds_contributions = (not_ds_2018['OpenSource'].value_counts()/not_ds_2018['Ope
nSource'].value_counts().sum())
```

In [24]:
```
f, (ax1, ax2) = plt.subplots(1, 2, figsize=(12,6))
f.suptitle('Data Scientists vs.Other Software Engineers Open Source Contributu
tions')
labels = 'No', 'Yes'
sizes_ax1 = list(ds_contributions)
sizes_ax2 = list(nds_contributions)
ax1.pie(sizes_ax1, labels=labels, colors=colors,
        autopct='%1.3f%%', shadow=True, startangle=140)
ax1.axis('equal')
ax1.set_title('Data Scientists')

ax2.pie(sizes_ax2, labels=labels, colors=colors,
        autopct='%1.3f%%', shadow=True, startangle=140)
ax2.axis('equal')
ax2.set_title('Other Software Engineers')
plt.show()
```



Artificial Intelligence Sentiment

Used in "What you should know if you have made it this far"

Find the AI sentiments for both data scientists and other software engineers

In [25]:
```
AI_sentiments_ds = (data_scientists['2018'].filter(regex = 'AI')
                    .join(data_scientists['2018'][['Age', 'FormalEducation','Unde
rgradMajor', 'DevType']])).sort_values('Age')
AI_sentiments_nds = (not_ds_2018.filter(regex = 'AI')
                    .join(not_ds_2018[['Age', 'FormalEducation','UndergradMajor',
'DevType']])).sort_values('Age')
```

Sentiment About AI by different Age Group

In [26]:
```
pd.options.mode.chained_assignment = None
sentiment_map = {"I'm worried about the dangers more than I'm excited about th
e possibilities.": 'Worried',
                 "I'm excited about the possibilities more than worrie
d about the dangers.": "Excited",
                 "I don't care about it, or I haven't thought about i
t.": "No Opinion"
                }
AI_sentiments_Future_ds = AI_sentiments_ds.dropna(subset=['AIFuture'])
AI_sentiments_Future_ds.loc[:, 'AIFuture'] = (AI_sentiments_Future_ds['AIFutur
e']
                        .map(sentiment_map))
AI_sentiments_Future_nds = AI_sentiments_nds.dropna(subset=['AIFuture'])
AI_sentiments_Future_nds.loc[:, 'AIFuture'] = (AI_sentiments_Future_nds['AIFut
ure']
                        .map(sentiment_map))
```

In [27]:
```
f, (ax1, ax2) = plt.subplots(1, 2, figsize=(18,7))
f.suptitle('Data Scientists vs.Other Software Engineers AI Sentiment')
sns.countplot(x = 'Age', hue="AIFuture", data = AI_sentiments_Future_ds, ax =
ax1)
ax1.set_title('Data Scientists')
sns.countplot(x = 'Age', hue="AIFuture", data = AI_sentiments_Future_nds, ax =
ax2)
ax2.set_title('Other Software Engineers')
```