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Title of Experiment :

Exploratory data analysis.

Objective of Experiment :

To perform exploratory analysis on the datasets.

Outcome of Experiment :

Illustrate Exploratory Data Analysis.

Problem Statement :

Write a program in python to do exploratory analysis on the data set.

Description / Theory :

Mean

The most basic estimate of location is the mean, or average value. The mean is the sum of all values divided by the number of values.

Trimmed Mean

A variation of the mean is a trimmed mean, which you calculate by dropping a fixed number of sorted values at each end and then taking an average of the remaining values.

A trimmed mean eliminates the influence of extreme values.

Weighted Mean

Calculate by multiplying each data value xi by a user-specified weight wi and dividing their sum by the sum of the weights.

Median

The median is the middle number on a sorted list of the data. If there is an even number of data values, the middle value is one that is not actually in the data set, but rather the average of the two values that divide the sorted data into upper and lower halves.

Compared to the mean, which uses all observations, the median depends only on the values in the center of the sorted data.

Deviations

The difference between the observed values and the estimate of location.

Synonyms : errors, residuals

Variance

The sum of squared deviations from the mean divided by n – 1 where n is the number of data values.

Synonym : mean-squared-error

Standard deviation

The square root of the variance.

Mean absolute deviation

The mean of the absolute values of the deviations from the mean.

Synonym : l1-norm, Manhattan norm

Median absolute deviation

The median of the absolute value of the deviations from the median.

Percentile

The value such that *P* percent of the value take on this value and (100-P) percent take on this value or more

Synonym : quantile

Interquartile range

The difference between the 75th percentile and 25th percentile.

Synonym : IQR

Box Plots

Based on percentiles and give a quick way to visualize the distribution of data.

Frequency Table

A frequency table of a variable divides up the variable range into equally spaced segments and tells us how many values fall within each segment.

Histogram

A histogram is a way to visualize a frequency table, with bins on the x-axis and the data count on the y-axis.

Density Plot

It shows the distribution of data values as a continuous line. A density plot can be thought of as a smoothed histogram, although it is typically computed directly from the data through a kernel density estimate.

In [1]:
```python
import pandas as pd
import numpy as np
from scipy.stats import trim_mean
from statsmodels import robust
import wquantiles

import seaborn as sns
import matplotlib.pylab as plt
```

In [2]:
```python
df = pd.read_csv('./IT Salary Survey EU 2018.csv')
```

In [3]:
```python
df.columns
```

Out[3]:
```
Index(['Timestamp', 'Age', 'Gender', 'City', 'Position', 'Years of experience',
       'Your level', 'Current Salary', 'Salary one year ago',
       'Salary two years ago', 'Are you getting any Stock Options?',
       'Main language at work', 'Company size', 'Company type'],
      dtype='object')
```

In [4]:
```python
df.drop(['Timestamp', 'Salary one year ago', 'Salary two years ago', 'Are you getti
```

Out[4]:

	Age	Gender	City	Position	Years of experience	Your level	Current Salary	Main language at work
0	43.0	M	München	QA Ingenieur	11.0	Senior	77000.0	Deutsch
1	33.0	F	München	Senior PHP Magento developer	8.0	Senior	65000.0	Deutsch
2	32.0	M	München	Software Engineer	10.0	Senior	88000.0	Deutsch
3	25.0	M	München	Senior Frontend Developer	6.0	Senior	78000.0	English
4	39.0	M	München	UX Designer	10.0	Senior	69000.0	English
...	...	...	...	...	...	...	...	...
760	40.0	M	Köln	Java Developer junior	1.0	Junior	44000.0	Deutsch
761	NaN	M	Köln	E.g. C# Developer	1.0	Junior	45000.0	Deutsch
762	NaN	M	Köln	E.g. C# Developer	1.0	Junior	45000.0	Deutsch
763	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
764	31.0	F	München	Pm	10.0	Senior	110000.0	English

765 rows × 8 columns

In [5]:
```python
df.rename(columns = {'Current Salary':'salary', 'Years of experience':'experience',
```

In [6]:
```
df.fillna(df.median(), inplace=True)
```

```
C:\Users\dyota\AppData\Local\Temp\ipykernel_7888\3604797450.py:1: FutureWarning: Dr
opping of nuisance columns in DataFrame reductions (with 'numeric_only=None') is de
precated; in a future version this will raise TypeError.  Select only valid columns
before calling the reduction.
  df.fillna(df.median(), inplace=True)
```

In [7]:
```
df = df.dropna()
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 686 entries, 0 to 764
Data columns (total 14 columns):
 #   Column                             Non-Null Count  Dtype  
---  ------                             --------------  -----  
 0   Timestamp                          686 non-null    object 
 1   Age                                686 non-null    float64
 2   Gender                             686 non-null    object 
 3   City                               686 non-null    object 
 4   Position                           686 non-null    object 
 5   experience                         686 non-null    float64
 6   level                              686 non-null    object 
 7   salary                             686 non-null    float64
 8   Salary one year ago                686 non-null    float64
 9   Salary two years ago               686 non-null    float64
 10  Are you getting any Stock Options? 686 non-null    object 
 11  lang                               686 non-null    object 
 12  Company size                       686 non-null    object 
 13  Company type                       686 non-null    object 
dtypes: float64(5), object(9)
memory usage: 80.4+ KB
```

Estimate of Location

Location estimate of price and number of reviews

Mean

In [8]:
```
mean_salary = df['salary'].mean()
trimmed_mean_salary = trim_mean(df['salary'], 0.1)
weighted_mean_salary = np.average(df['salary'], weights=df['experience'])

print(f'Mean price = ${mean_salary}')
print(f'Trimmed mean price = ${trimmed_mean_salary}')
print(f'Weighted mean price = ${weighted_mean_salary}')
```

```
Mean price = $67907.03206997084
Trimmed mean price = $66543.78181818181
Weighted mean price = $71915.2170343766
```

Median

In [9]:
```
median_salary = df['salary'].median()
weighted_median_salary = wquantiles.median(df['salary'], weights=df['experience'])

print(f'Median price = ${median_salary}')
print(f'Weighted median price = ${weighted_median_salary}')
```

```
Median price = $65000.0
Weighted median price = $70000.0
```

Estimates of Variablity

In [10]:
```
print(f'Standard Deviation = {df["salary"].std()}')
print(f'Median Absolute Deviation = {robust.scale.mad(df["salary"])}')
```

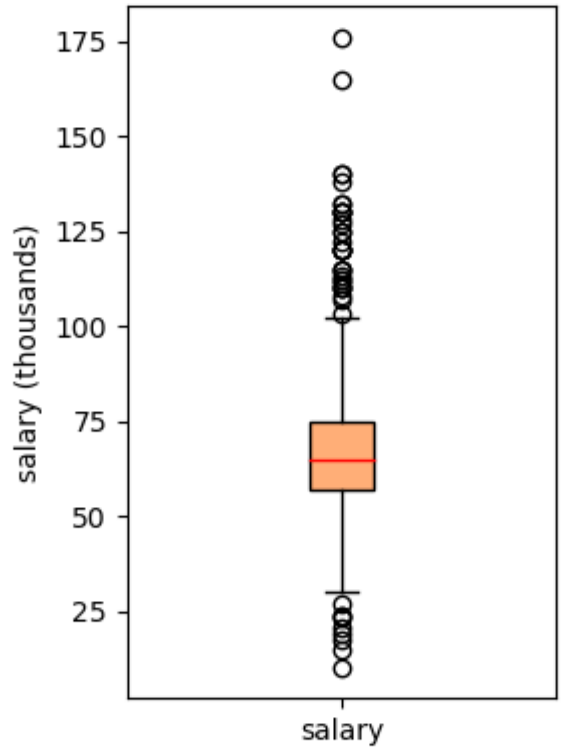
```
Standard Deviation = 19485.25344692599
Median Absolute Deviation = 14826.02218505602
```

Percentile and Boxplot

In [11]:
```
print(df['salary'].quantile([0.05, 0.25, 0.5, 0.75, 0.95]))
```

```
0.05     40200.0
0.25     57000.0
0.50     65000.0
0.75     75000.0
0.95    101500.0
Name: salary, dtype: float64
```

In [12]:
```
ax = (df['salary']/1000).plot.box(figsize=(3, 4), color='black',  patch_artist = Tr
ax.set_ylabel('salary (thousands)')

plt.tight_layout()
plt.show()
```

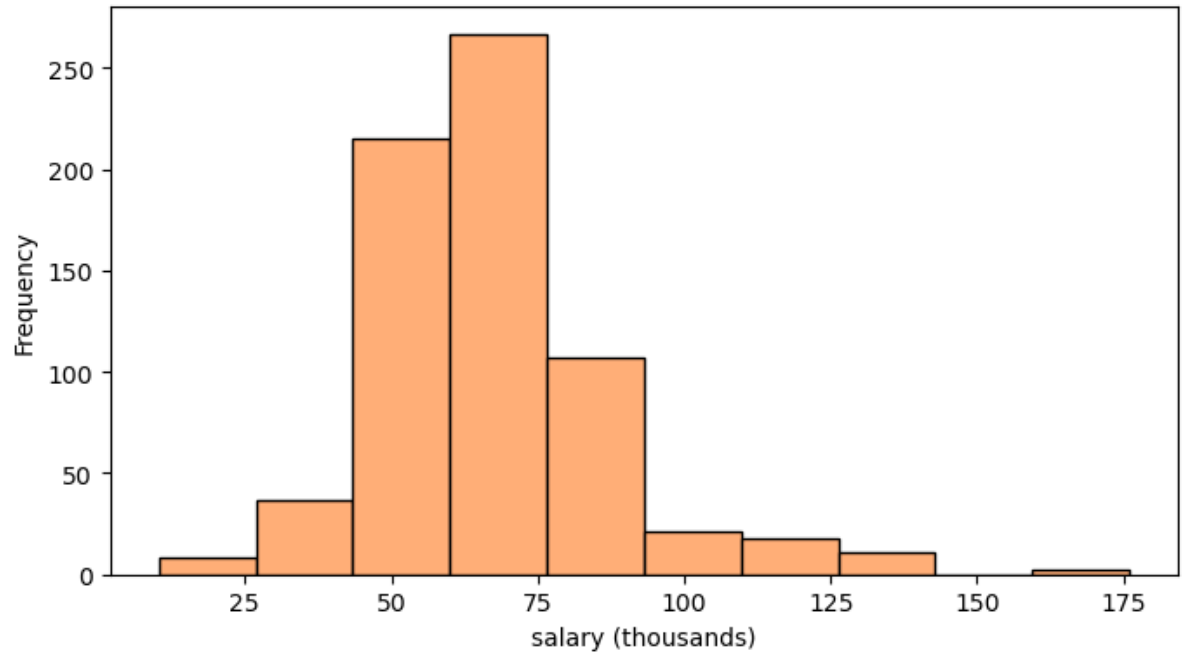


Frequency table and Histogram

In [13]:
```
binnedPopulation = pd.cut(df['salary'], 10)
print(binnedPopulation.value_counts())
```

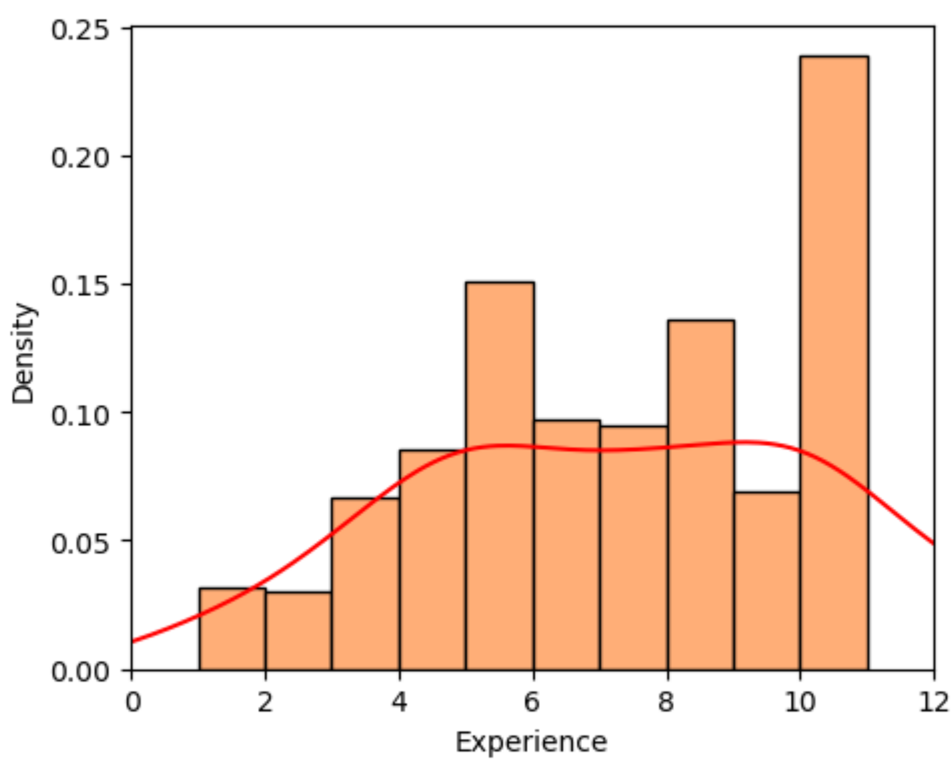
```
(60010.0, 76580.0]      267
(43440.0, 60010.0]      215
(76580.0, 93150.0]      107
(26870.0, 43440.0]       37
(93150.0, 109720.0]      21
(109720.0, 126290.0]     18
(126290.0, 142860.0]     11
(10134.3, 26870.0]        8
(159430.0, 176000.0]      2
(142860.0, 159430.0]      0
Name: salary, dtype: int64
```

In [14]:
```
ax = (df["salary"]/1000).plot.hist(figsize=(7, 4), color='#ffae77', edgecolor='blac
ax.set_xlabel('salary (thousands)')

plt.tight_layout()
plt.show()
```



Density Estimate

In [15]:
```
ax = df['experience'].plot.hist(density=True, xlim=[0, 12], bins=range(1,12), figsi
df['experience'].plot.density(ax=ax, color='red')
ax.set_xlabel('Experience')

plt.tight_layout()
plt.show()
```



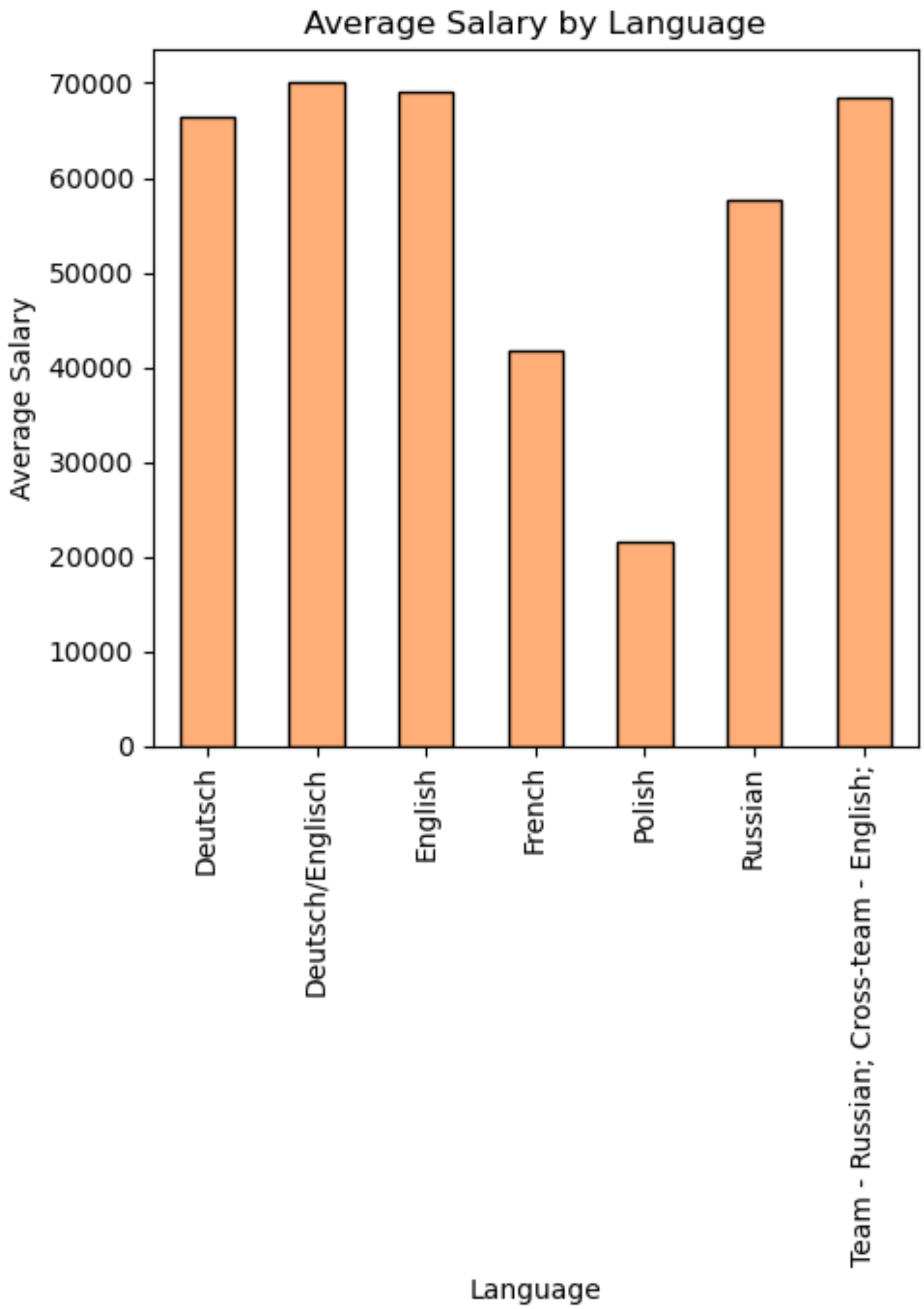
Exploring Binary and Categorical Data

In [16]:
```
print(df["Gender"].unique())
print(df["lang"].unique())
```

```
['M' 'F']
['Deutsch' 'English' 'Russian' 'French'
 'Team - Russian; Cross-team - English;' 'Polish' 'Deutsch/Englisch']
```

In [17]:
```
ax = df.boxplot(column='salary', by='Gender', figsize=(5, 4), color='black',  patch
ax.set_xlabel('Gender')
ax.set_ylabel('Salary')
plt.title('Salary Distribution by Gender')

plt.suptitle('')
plt.tight_layout()
plt.show()
```

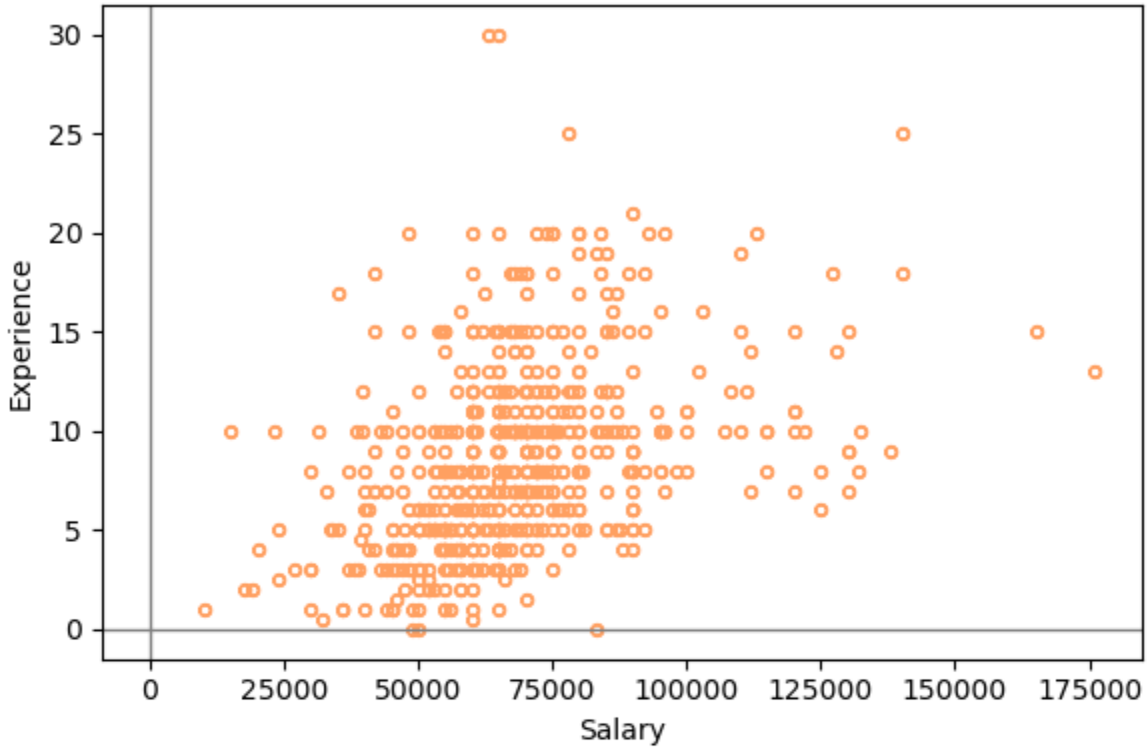
In [18]:
```
language_salary_mean = df.groupby('lang')['salary'].mean()

ax = language_salary_mean.plot(kind='bar', figsize=(5, 7), color='#ffae77', edgecol

ax.set_xlabel('Language')
ax.set_ylabel('Average Salary')
plt.title('Average Salary by Language')

plt.tight_layout()
plt.show()
```



Scatterplots

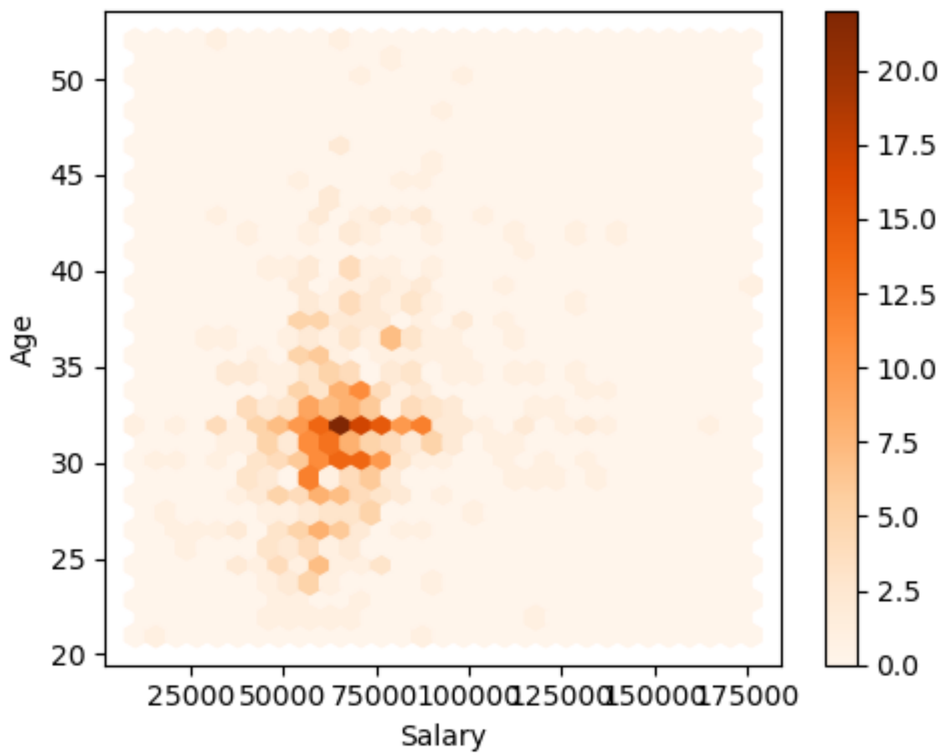
In [19]:
```
ax = df.plot.scatter(x='salary', y='experience', figsize=(6, 4), marker='$\u25EF$',
ax.set_xlabel('Salary')
ax.set_ylabel('Experience')
ax.axhline(0, color='grey', lw=1)
ax.axvline(0, color='grey', lw=1)

plt.tight_layout()
plt.show()
```

```
C:\Users\dyota\anaconda3\lib\site-packages\pandas\plotting\_matplotlib\core.py:111
4: UserWarning: No data for colormapping provided via 'c'. Parameters 'cmap' will b
e ignored
  scatter = ax.scatter(
```

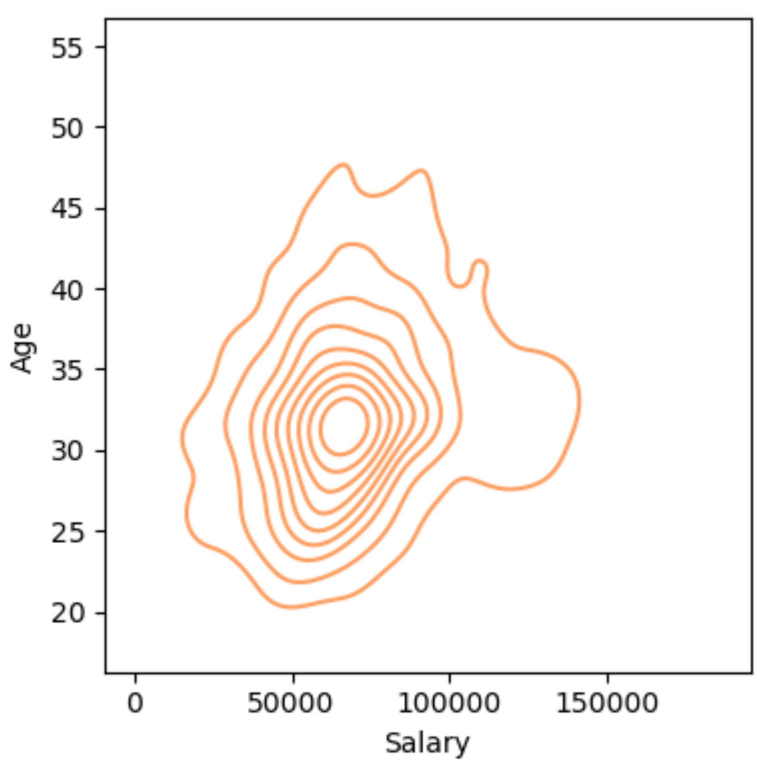


Hexagonal binning and Contour

In [20]:
```python
ax = df.plot.hexbin(x='salary', y='Age', gridsize=30, sharex=False, figsize=(5, 4),
ax.set_xlabel('Salary')
ax.set_ylabel('Age')

plt.tight_layout()
plt.show()
```



In [21]:
```
fig, ax = plt.subplots(figsize=(4, 4))
sns.kdeplot(data=df, x='salary', y='Age', ax=ax, color='#ffa061')
ax.set_xlabel('Salary')
ax.set_ylabel('Age')

plt.tight_layout()
plt.show()
```



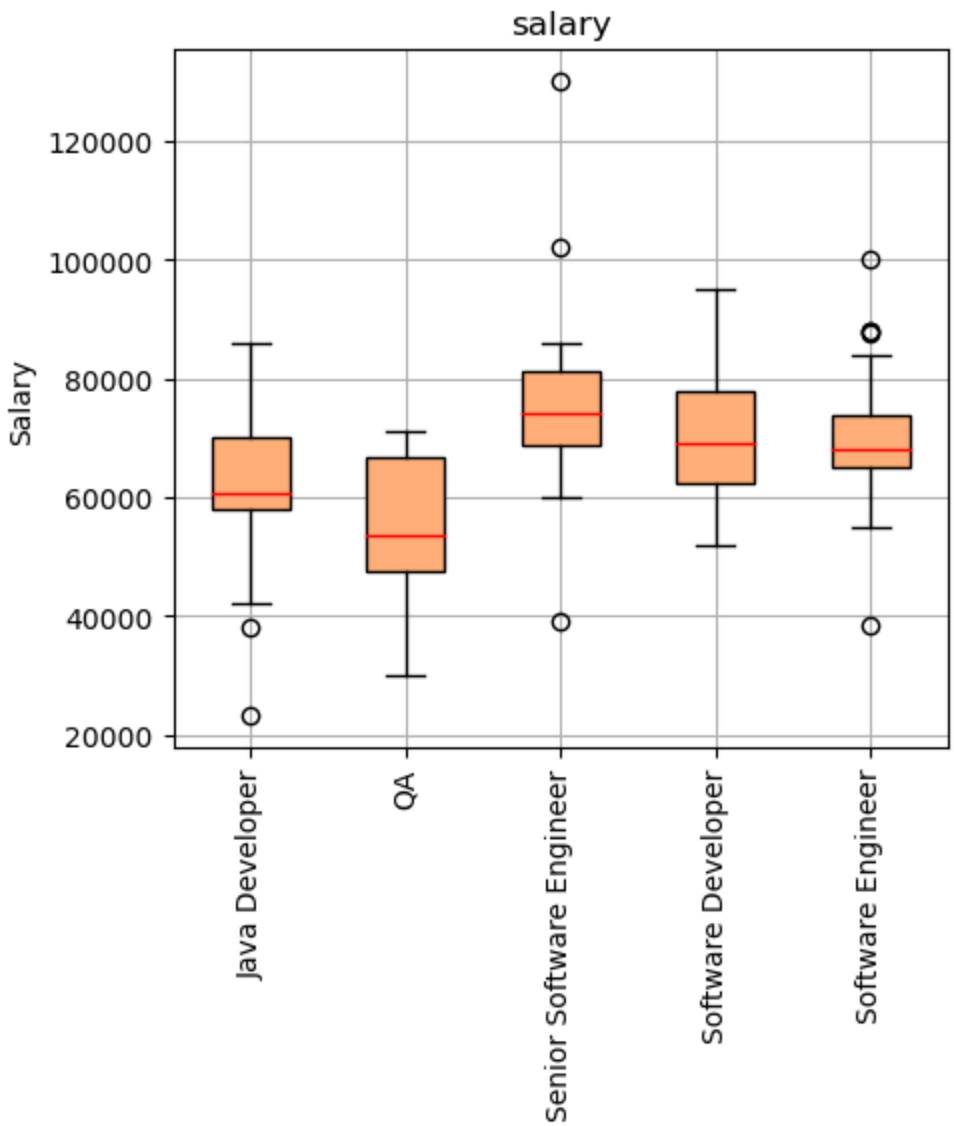
Two Categorical Variables

In [22]:
```
df0 = df[['lang', 'level']].copy()
pivot_table_position_lvl = df0.pivot_table(index='lang', columns='level', aggfunc=l

print(pivot_table_position_lvl)
```

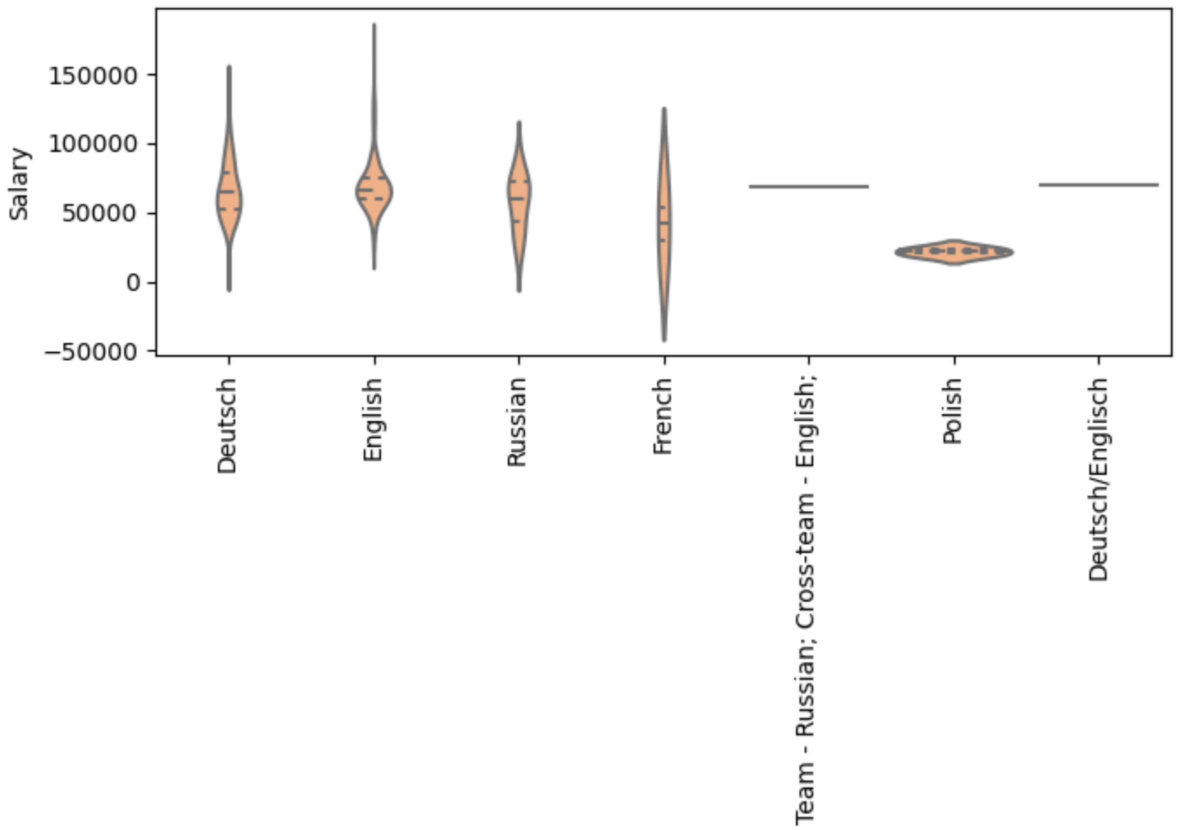
```
level                                 Junior  Middle  Senior  All
lang
Deutsch                                   13      37      66  116
Deutsch/Englisch                           0       0       1    1
English                                   18     144     377  539
French                                     1       1       0    2
Polish                                     0       2       0    2
Russian                                    1       6      18   25
Team - Russian; Cross-team - English;      0       0       1    1
All                                       33     190     463  686
```

Categorical and Numeric Data

In [23]:
```
position_counts = df['Position'].value_counts()
top_5_positions = position_counts.head(5).index
df_top_5_positions = df[df['Position'].isin(top_5_positions)]

ax = df_top_5_positions.boxplot(by='Position', column='salary', figsize=(5, 6), col
ax.set_xlabel('')
ax.set_ylabel('Salary')
plt.suptitle('')
plt.xticks(rotation=90)
plt.tight_layout()
plt.show()
```



In [24]:
```
fig, ax = plt.subplots(figsize=(7, 5))
sns.violinplot(data=df, x='lang', y='salary',ax=ax, inner='quartile', color='#ffae7
ax.set_xlabel('')
ax.set_ylabel('Salary')
plt.xticks(rotation=90)
plt.tight_layout()
plt.show()
```



Salary
150000
100000
50000
0
−50000
Deutsch
English
Russian
French
Team - Russian; Cross-team - English;
Polish
Deutsch/Englisch