Data Project Pt. 2: Exploratory Data Analysis & Creating Visualizations

In this notebook, I'll be conducting an exploratory data analysis and creating visualizations for purposes of analysis and to showcase important features of the dataset. Visualizations and images used are in the project src folder.

In [1]:
```
import pandas as pd
import numpy as np
import plotly
import plotly.express as px
import plotly.graph_objects as go
from plotly.subplots import make_subplots
import matplotlib.pyplot as plt
from PIL import Image
from wordcloud import WordCloud, ImageColorGenerator
from stop_words import get_stop_words
import scipy.stats as stats
```

In [2]:
```
# importing datasets from saved JSON files
entire_series = pd.read_json('src/NGE_entire_series.json')
by_episode = pd.read_json('src/NGE_by_episode.json')
```

by_episode is currently filled with None values where there is no line data (episodes where the character doesn't appear). replacing None values with the proper empty/zero values will avoid future type errors.

In [3]:
```
by_episode = by_episode.where(~by_episode.isnull(), {'Lines': [], 'Line Count': 0, 'Word
by_episode.head(3)
```

Out[3]:

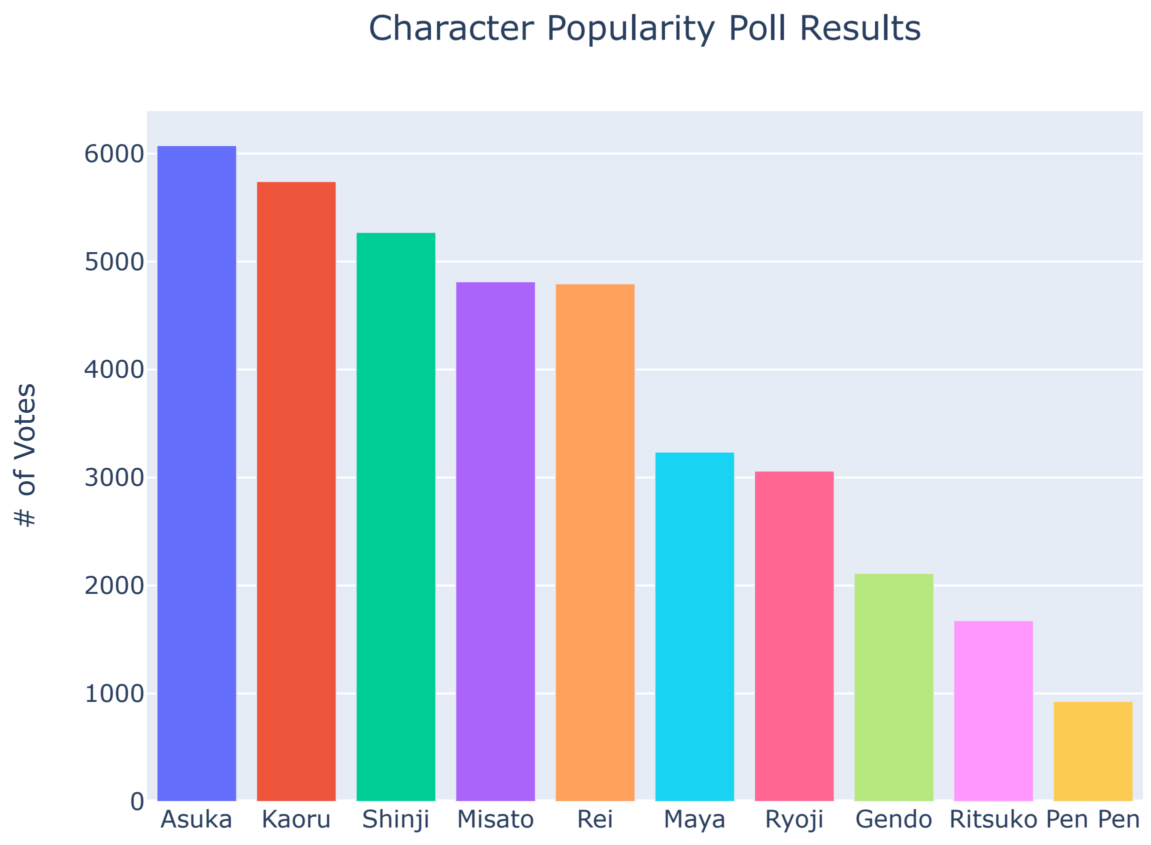
	1	2	3	4	5	6	7	8	9	
	{'Lines': ['#The Traffic panel shows "Tokyo-3:...	{'Lines': ['#The cover of the report says: ...	{'Lines': ['#JAPANESE GREETING LESSON: We alwa...	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Li [], ' Co 'V Co
Aircraft	{'Lines': ['Aircraft: Ah! '], 'Line Count': 1...	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Li [], ' Co 'V Co
Announce	{'Lines': ['Announce: The gate is closing. Att...	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': ['Announce:Enemy's particle accelera...	{'Lines': ['Announce: Unit One has cleared the...	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Lines': [], 'Line Count': 0, 'Word Count': 0}	{'Li [], ' Co 'V Co

3 rows × 26 columns

Adding in character popularity ranking data

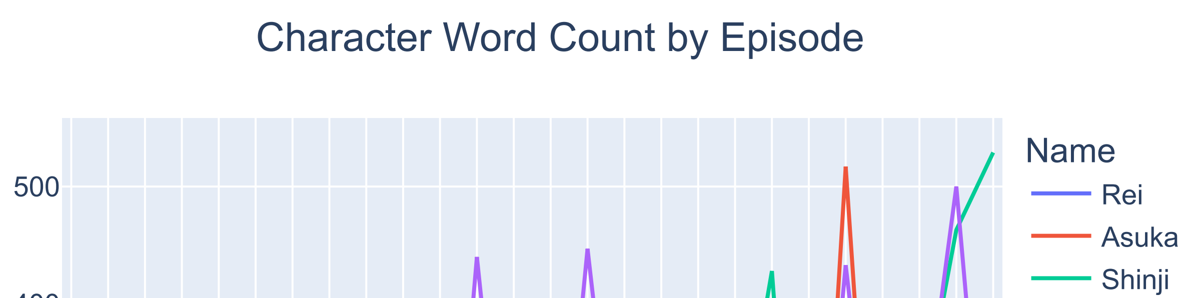
For some additional analysis, I found a character popularity poll with data from 1997. There are many more recent and easily accessible popularity polls, but due to new media coming out between then and now, and this dataset only pulling from the original TV series, it seemed more accurate to look for historical data.

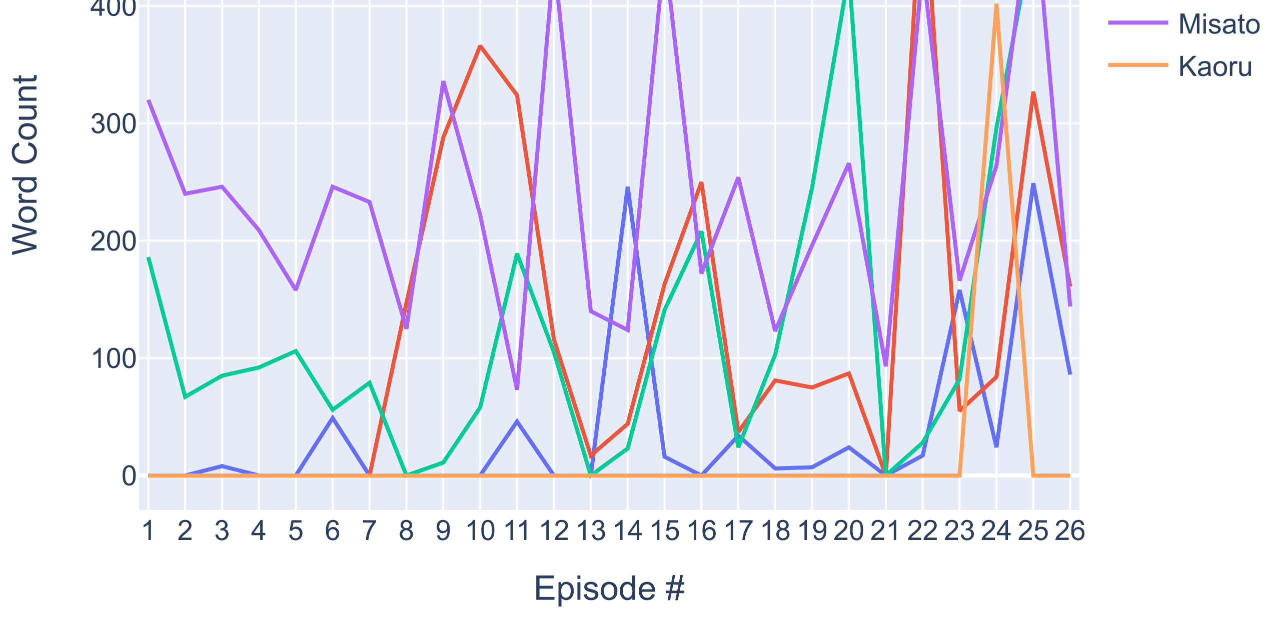
```
In [4]: data = {'Name': ['Asuka','Kaoru','Shinji','Misato','Rei','Maya','Ryoji','Gendo','Ritsuko
                'Ranking': [1,2,3,4,5,6,7,8,9,10],
                'Votes': [6074,5741,5270,4813,4794,3236,3060,2112,1675,927]}

        character_popularity = pd.DataFrame(data)
        # character_popularity.set_index('Name',inplace=True)

        character_popularity

        fig = px.bar(character_popularity, x='Name', y='Votes',color='Name',title='Character Ran

        fig.update_layout(
            title={
                'text': "Character Popularity Poll Results",
                'y':0.9,
                'x':0.5,
                'xanchor': 'center',
                'yanchor': 'top'},
            xaxis_title='',
            yaxis_title='# of Votes',
            template='plotly',
            showlegend=False)
        # fig.write_image("src/plots/character_rankings.png")
```



In [5]:
```python
# defining functions to help with plotting line and wordcount data

def char_lines(name):
    """Returns a list with the number of lines for a given character for every episode""
    result = []
    for i in range(1,27):
        result.append(by_episode.loc[name][i]['Line Count'])
    return result

def char_words(name):
    """Returns a list with the number of words for a given character for every episode""
    result = []
    for i in range(1,27):
        result.append(by_episode.loc[name][i]['Word Count'])
    return result
```

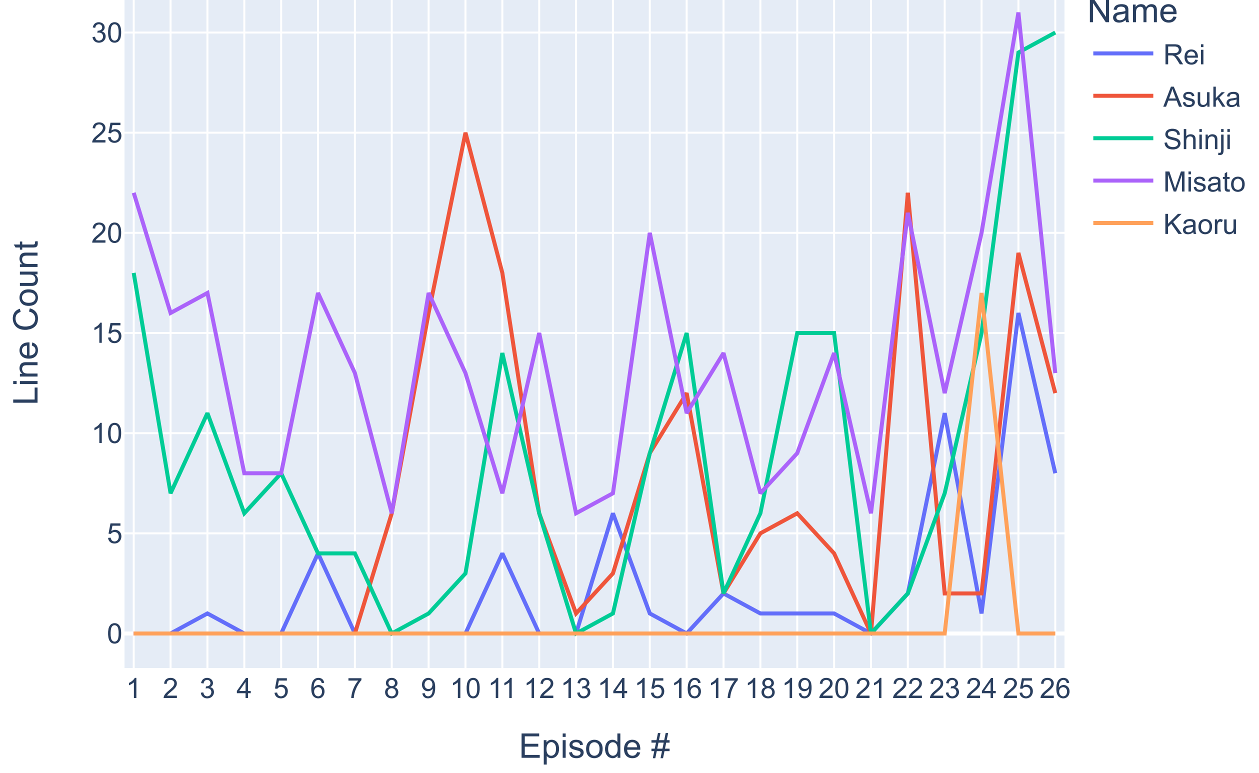
In [6]:
```python
# building word count plot
fig = go.Figure()

# list of characters to plot
character_list = ['Rei','Asuka','Shinji','Misato','Kaoru']

# function takes a list of character names and adds a trace to a plotly graph object to
def add_traces(namelist):
    for name in namelist:
        fig.add_trace(
            go.Scatter(x=list(by_episode.columns), y=char_words(name), name=name, mode='
        )

# adding character data to graph
add_traces(character_list)

fig.update_layout(
    template='plotly',
    title={
        'text': "Character Word Count by Episode",
        'y':0.9,
        'x':0.5,
        'xanchor': 'center',
        'yanchor': 'top'},
    xaxis_title="Episode #",
    yaxis_title="Word Count",
    xaxis = dict(
    tickmode = 'linear',
    range=[.75, 26.25]),
    legend_title="Name",
    font=dict(
        family="Arial, monospace",
        size=14,
        )
)
# fig.write_image("src/plots/character_wordcount_by_episode.png")
```





In [7]:

```
# building the line count plot

fig = go.Figure()

# list of characters to plot
character_list = ['Rei','Asuka','Shinji','Misato','Kaoru']

# this function takes a list of character names and adds a trace to a plotly graph objec
def add_traces(namelist):
    for name in namelist:
        fig.add_trace(
            go.Scatter(x=list(by_episode.columns), y=char_lines(name), name=name, mode='
        )

# adding character data to graph
add_traces(character_list)

fig.update_layout(
    template='plotly',
    title={
        'text': "Character Line Count by Episode",
        'y':0.9,
        'x':0.5,
        'xanchor': 'center',
        'yanchor': 'top'},
    xaxis_title="Episode #",
    yaxis_title="Line Count",
    xaxis = dict(
    tickmode = 'linear',
    range=[.75, 26.25]),
    legend_title="Name",
    font=dict(
        family="Arial, monospace",
        size=14)
)
# fig.write_image("src/plots/character_linecount_by_episode.png")
```



Entire Series dataset - feature engineering

Now I'm going to add a couple new variables out of current ones for some basic feature engineering to look for any potential relationships.

In [8]:
```
# Average Line Length: entire series wordcount divided by linecount by character
entire_series['Avg Line Length'] = round(entire_series['Wordcount'] / entire_series['Lin

data1 = pd.DataFrame(data)
data1.set_index('Name',inplace=True)

# merging the webscrape dataframe and popularity data, where popularity data is availabl
entire_series = entire_series.merge(data1, left_index=True, right_index=True, how='left'

# # adding in the 10th most popular character (who has no lines)
entire_series.loc['Pen Pen'] = {'Lines': ['n/a'], 'Linecount': 0, 'Wordcount': 0, 'Avg L
entire_series.sort_values(by='Wordcount',ascending=False, inplace=True)
entire_series.sort_values(by='Ranking', inplace=True)
```

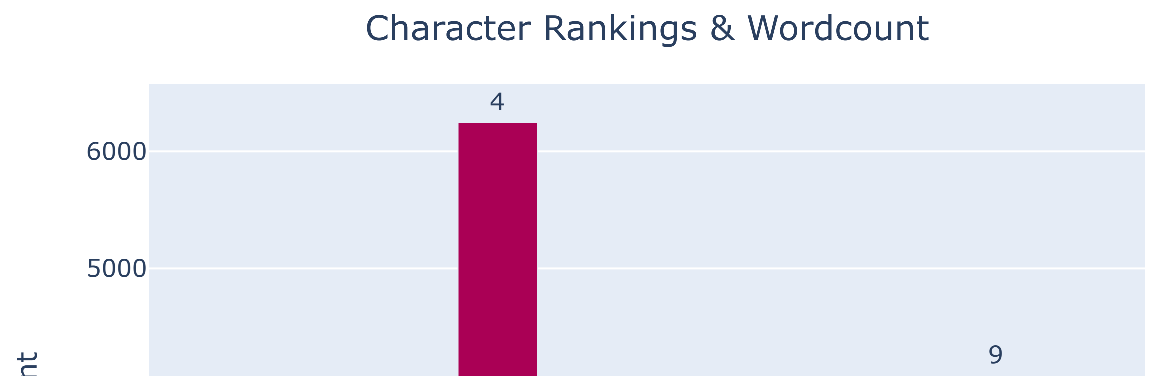
In [9]:
```
# Speaking Episodes: # of episodes where the character speaks at least 1 line

# dataframe where no lines equals 1, and and any other value equals 0, for summing up th
nones = by_episode.where(by_episode.values == {'Lines': [], 'Line Count': 0, 'Word Count
nones = nones.where(nones.values != {'Lines': [], 'Line Count': 0, 'Word Count': 0}, 0)

list_ = []
for index in entire_series.index:
    # Pen Pen as a key throws an error because he has no speaking lines
    if index != 'Pen Pen':
        list_.append(sum(nones.loc[index]))
    else:
        list_.append(0)

entire_series['Speaking Episodes'] = list_
entire_series.head(12)
```

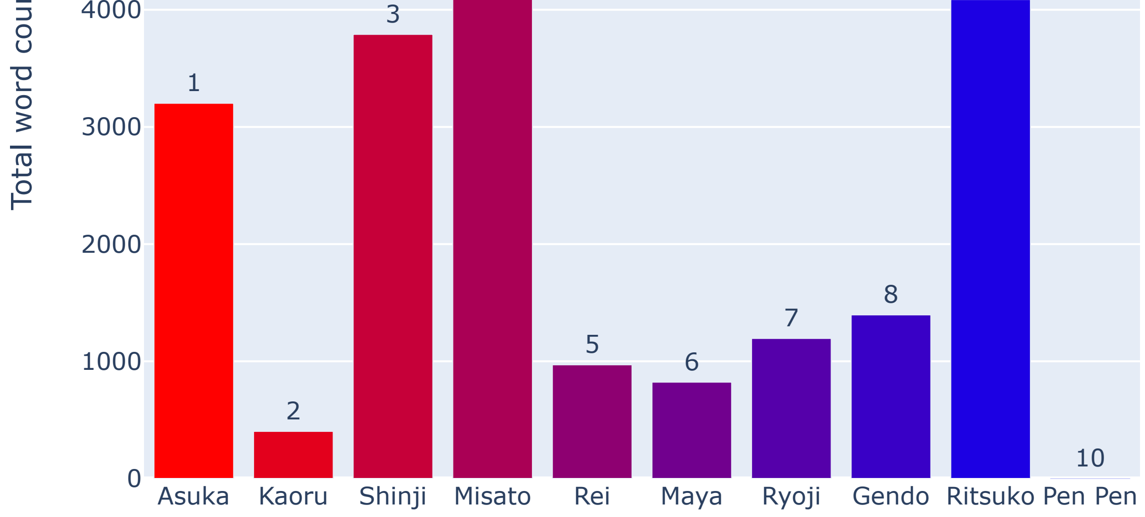
Out[9]:

	Lines	Linecount	Wordcount	Avg Line Length	Ranking	Votes	Speaking Episodes
Asuka	[Asuka: So, which is the much-discussed Third...	173	3202	18.51	1.0	6074.0	18
Kaoru	[Kaoru: You are, the First Children? ...	17	402	23.65	2.0	5741.0	1
Shinji	[Shinji: Out of order ... I shouldn't have com...	235	3790	16.13	3.0	5270.0	23
Misato	[Misato: Why, of all times, have I missed him ...	355	6249	17.60	4.0	4813.0	26
Rei	[Rei: An emergency call ...... I'll go first	59	970	16.44	5.0	4794.0	14
Maya	[Maya: All values of the harmonics are normal....	57	822	14.42	6.0	3236.0	19
Ryoji	[Ryoji: Hey! Just a moment! , Ryoji: Akagi go...	64	1195	18.67	7.0	3060.0	2
Gendo	[Gendo: Normal weapons have no effect on Angel...	85	1396	16.42	8.0	2112.0	6
Ritsuko	[Ritsuko: I'm dumbfound. She must have got los...	214	4087	19.10	9.0	1675.0	24
Pen Pen	[n/a]	0	0	0.00	10.0	927.0	0
Fuyutsuki	[Fuyutsuki: The next invasion is a matter of t...	70	1209	17.27	NaN	NaN	8
Kensuke	[Kensuke: What, Class Rep? , Kensuke: That ca...	53	1078	20.34	NaN	NaN	14

In [10]:

```python
fig = px.bar(entire_series.head(10), x=entire_series.head(10).index, text='Ranking',
             y='Wordcount',color='Ranking', color_continuous_scale=px.colors.sequential.

fig.update_layout(
    title={
        'text': "Character Rankings & Wordcount",
        'y':.95,
        'x':0.5,
        'xanchor': 'center',
        'yanchor': 'top'},
    xaxis_title='',
    yaxis_title='Total word count',
    template='plotly')

fig.update(layout_coloraxis_showscale=False)
fig.update_traces(textfont_size=12, textposition="outside")
# fig.write_image("src/plots/character_rankings_wordcount.png")
```





In [11]:
```
entire_series.corr(numeric_only=True)
```

Out[11]:

	Linecount	Wordcount	Avg Line Length	Ranking	Votes	Speaking Episodes
Linecount	1.000000	0.996197	-0.003312	-0.290405	0.295782	0.882391
Wordcount	0.996197	1.000000	0.026436	-0.275631	0.279370	0.872921
Avg Line Length	-0.003312	0.026436	1.000000	-0.582052	0.599820	-0.008173
Ranking	-0.290405	-0.275631	-0.582052	1.000000	-0.985591	-0.275574
Votes	0.295782	0.279370	0.599820	-0.985591	1.000000	0.286171
Speaking Episodes	0.882391	0.872921	-0.008173	-0.275574	0.286171	1.000000

No real correlation between word count, average line length and popularity ranking. The only real correlations seen are in the obvious relationships such as linecount and wordcount, and votes with ranking. Not even the number of episodes the character speaks/appears in really correlates with their popularity.

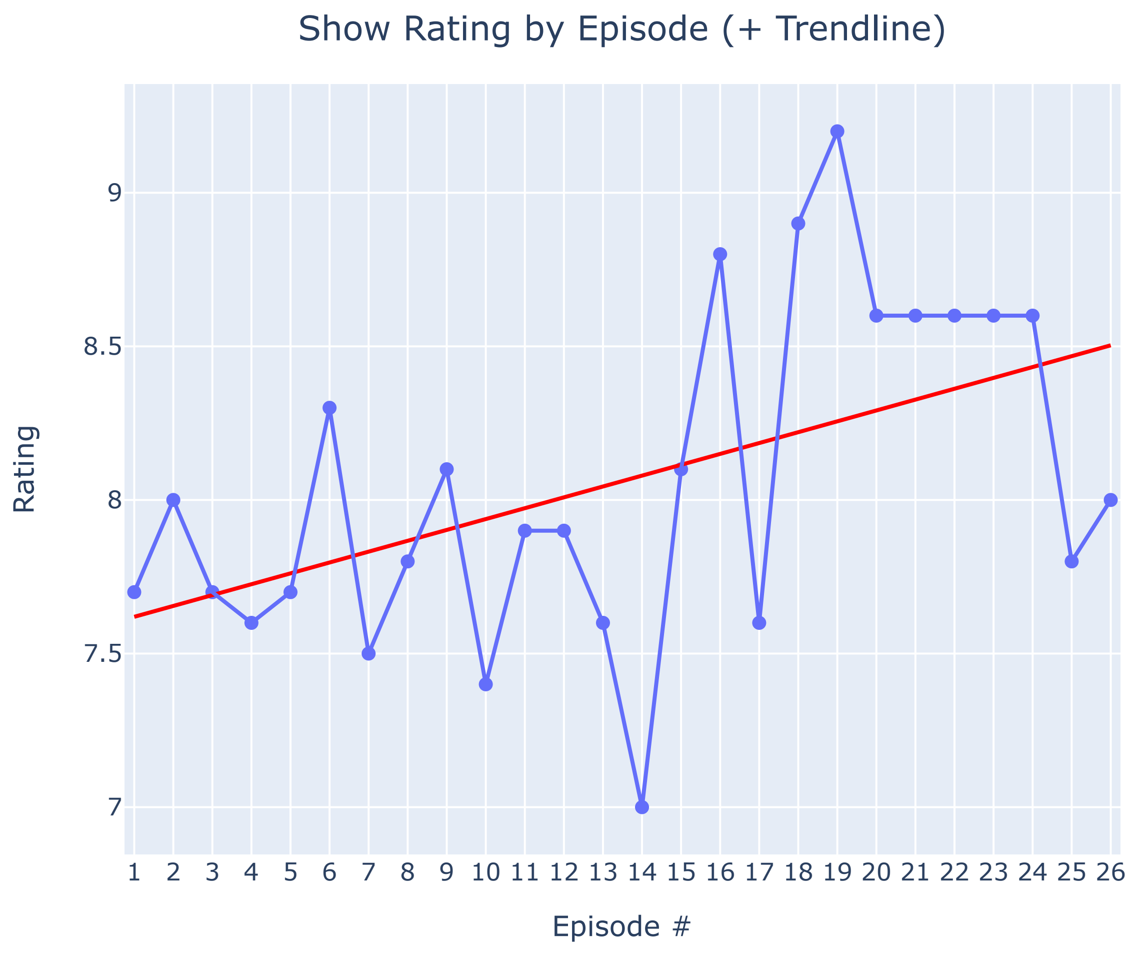
This is because so many other factors go into a character's popularity, such as their design, personality, role in the story, how outgoing they are - some of these are likely correlated with how many lines/words they speak in the series but can't be analyzed just from these variables. Characters like Kaoru and Pen Pen affect the data because Kaoru appears in only 1 episode but has a significant impact on Shinji and so has few total lines, and Pen Pen is a pet penguin.

By Episode dataset - Adding in episode ratings and wordcounts

In [12]:
```
# adding in a word count value for each episode
ep_total_word_counts = {}

for i in range(1,27):
    total_word_counts = []
    for key in by_episode[i]:
        total_word_counts.append(key['Word Count'])
    ep_total_word_counts[i] = sum(total_word_counts)

by_episode.loc['Total Word Counts'] = ep_total_word_counts
```

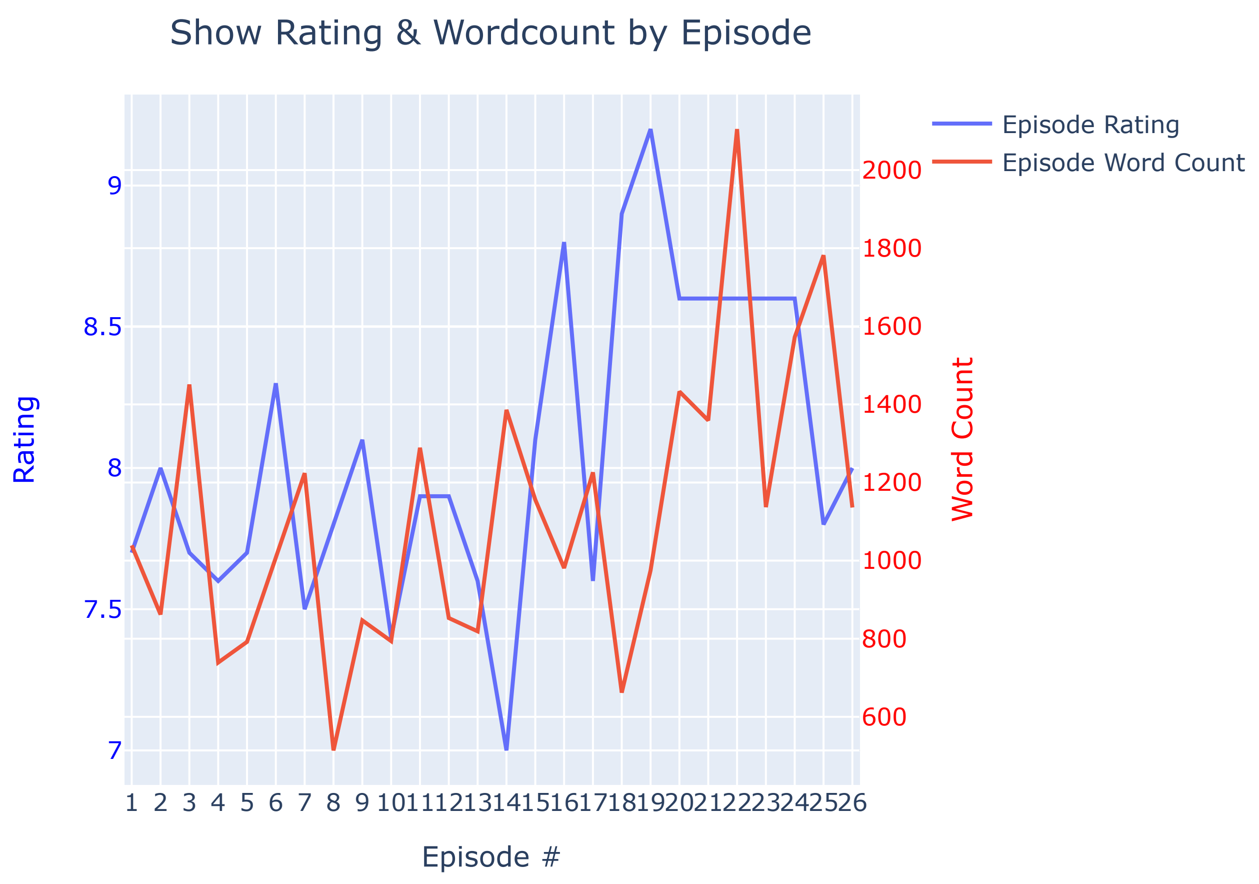
```
# adding in episode rankings from IMDB
episode_ratings = [7.7, 8.0, 7.7, 7.6, 7.7, 8.3, 7.5, 7.8, 8.1, 7.4, 7.9, 7.9, 7.6, 7.0,
by_episode.loc['Rating'] = episode_ratings
```

In [13]:
```
fig = px.scatter(x=list(by_episode.columns),y=by_episode.loc['Rating'],trendline ='ols',

fig.update_traces(marker=dict(size=7))

fig.add_trace(go.Scatter(x=list(by_episode.columns),y=by_episode.loc['Rating'],
                    mode='lines',
                    showlegend=False,
                         line_color='#636EFA'))

fig.update_layout(
    title={
        'text': "Show Rating by Episode (+ Trendline)",
        'y':.95,
        'x':0.5,
        'xanchor': 'center',
        'yanchor': 'top'},
    xaxis_title='Episode #',
    yaxis_title='Rating',
    xaxis = dict(
        tickmode = 'linear',
        range=[.75, 26.25]),
    template='plotly')
# fig.write_image("src/plots/show_rating_by_episode.png")
```



In [14]:
```
# Create figure with secondary y-axis
fig = make_subplots(specs=[[{"secondary_y": True}]])
```

```
# Add traces
fig.add_trace(
    go.Scatter(x=list(by_episode.columns),y=by_episode.loc['Rating'], name="Episode Rati
    secondary_y=False,
)

fig.add_trace(
    go.Scatter(x=list(by_episode.columns),y=by_episode.loc['Total Word Counts'], name="E
    secondary_y=True,
)


# Set y-axes titles
fig.update_yaxes(title_text="Word Count", secondary_y=False,color='blue')
fig.update_yaxes(title_text="Word Count", secondary_y=True,color='red')

fig.update_layout(
    title={
        'text': "Show Rating & Wordcount by Episode",
        'y':.88,
        'x':0.4,
        'xanchor': 'center',
        'yanchor': 'top'},
    xaxis_title='Episode #',
    yaxis_title='Rating',
    xaxis = dict(
        tickmode = 'linear',
        range=[.75, 26.25]),
    template='plotly')
fig.update_xaxes(tickangle=0)
# fig.write_image("src/plots/show_rating_wordcount.png")
```



In [15]:
```
corr, pval=stats.pearsonr(by_episode.T['Rating'],by_episode.T['Total Word Counts'])
corr, pval
```
Out[15]:
```
(0.118832136256235, 0.5631411529484844)
```

There doesn't appear to be a strong or statistically significant correlation between the word count of an episode and its IMDB rating. I thought that it was possible that a higher wordcount implies an episode with more dialogue and exposition and a lower wordcount would be correlated with more action, which may be correlated with episode rating. However, this relationship is not shown in the data.

Finding most popular words spoken by each character

More of a fun visualization - I wanted to show each character's most frequent words, as done in The Office data viz, but then I thought learning how to create the data and plot it in a wordcloud would be a good challenge and way to visually represent each character.

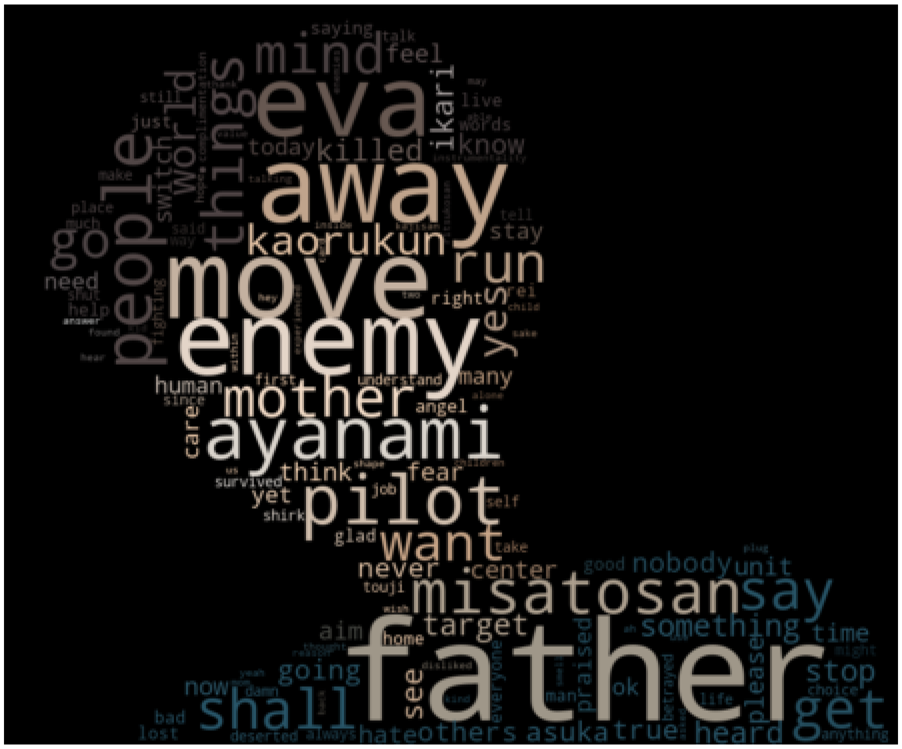
In [16]:
```
stop = get_stop_words('english')

def char_word_frequency(name, numwords):
    """Given a character name and number of words to return, returns a named series of t
    word_dict = {}
    for line in entire_series.loc[name]['Lines']:
        # standardizing words by removing trailing or leading punctuation, and standardi
        for word in line.translate({ord(i): None for i in '!()-[]{};:"\,<>./?@#$%^&*_~'}
            if word in word_dict:
                word_dict[word] += 1
            else:
                word_dict[word] = 1
    # filtering out addiional stop words
    filtered_words = [[word,key] for word,key in word_dict.items() if word not in stop]
    # converting to dictionary then series
    dictionary = {}
    for item in filtered_words:
        dictionary[item[0]] = item[1]
    df = pd.Series(dictionary, name = name)
    return df.sort_values(ascending=False).head(numwords+1)[1:numwords+1]
```

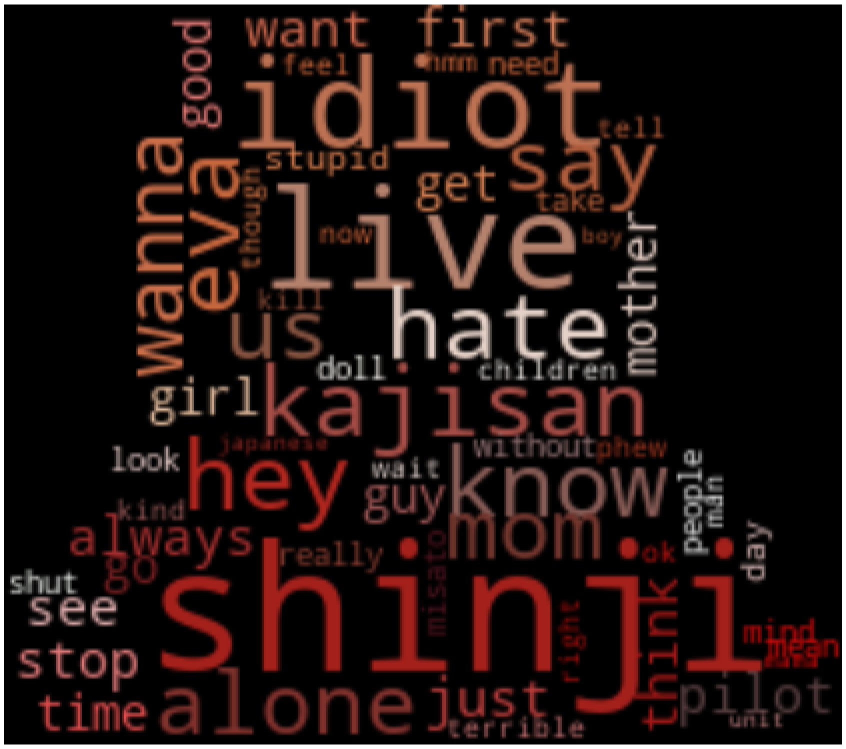
In [17]:
```
# Character most frequent words in series format
print(char_word_frequency('Shinji', 10))
print()
print(char_word_frequency('Asuka', 10))
print()
print(char_word_frequency('Misato', 10))
```
```
father      32
nothing     23
move        22
away        20
like        19
enemy       19
eva         18
ayanami     17
pilot       15
people      14
Name: Shinji, dtype: int64

shinji      21
oh          17
must        17
nothing     14
```

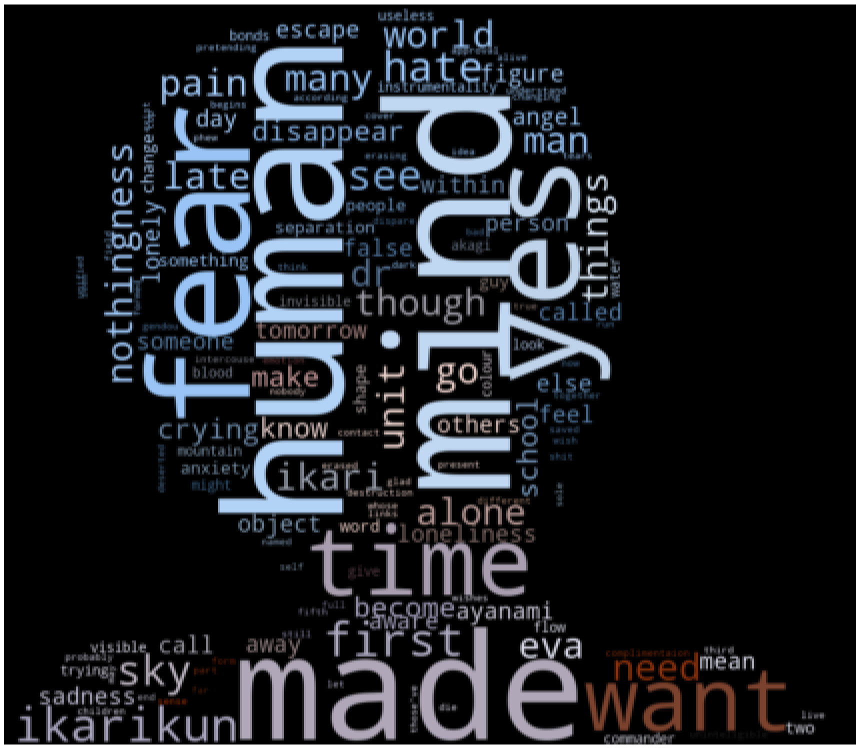
```
come        14
one         14
like        13
live        12
will        12
idiot       10
Name: Asuka, dtype: int64

will            37
shinjikun       31
unit            28
one             23
eva             22
yes             22
time            22
must            21
know            20
father          18
Name: Misato, dtype: int64
```

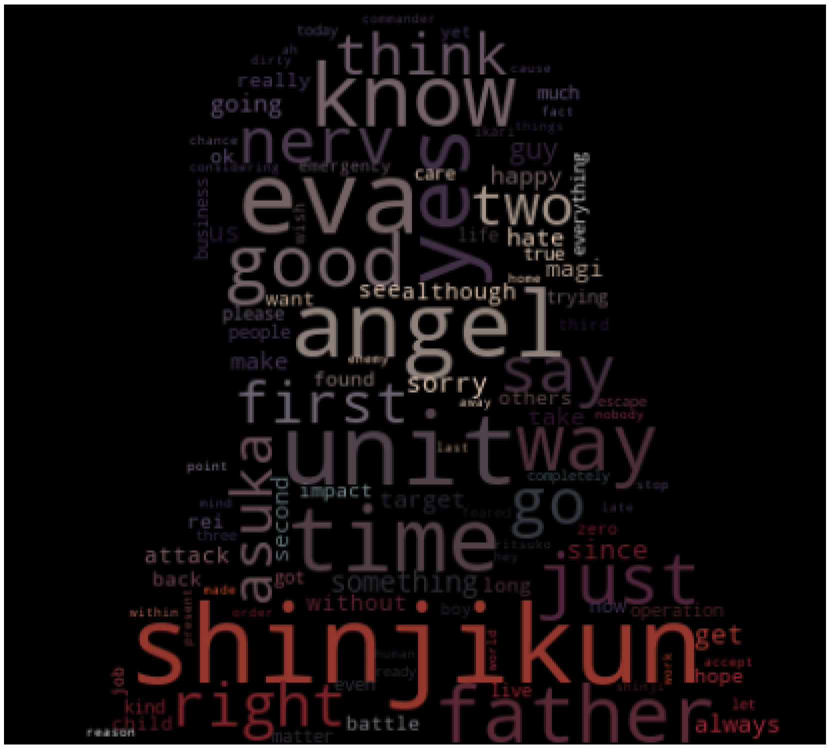
In [18]:
```
def to_string(series):
    """converts series data to string parsable by wordcloud. Example: if a character say
    throughout the series, this function takes that series item and expands it to the st
    list_ = [(f'{a} ')*b for a,b in zip(list(series.index),list(series.values*10))]
    result = ''
    for item in list_:
        result += item
    return result

# additional stopwords for wordclouds
stopwords = set()
stopwords.update(['oh','must','thing','can','well','will','come','nothing','ryoji','one'

def plot_char_word_cloud(name, wordcount, image):
    """takes a character to convert to a word cloud and an image to use as a mask,
       returns a word cloud with the shape and colors of the mask"""
    mask = np.array(Image.open(image))
    image_colors = ImageColorGenerator(mask)

    # creating wordcloud object
    wcloud = WordCloud(
                        stopwords=stopwords,
                        background_color="black",
                        mode="RGBA",
                        mask=mask,
                        margin=0,
                        collocations = False,
                        min_font_size = 6
                        )

    text = to_string(char_word_frequency(name,wordcount))
    wcloud.generate(text)
    wcloud.recolor(color_func = image_colors)

    # smoothing image result and saving to file. also removing white border
    plt.imshow(wcloud,interpolation='bilinear')
    plt.axis("off")
    plt.show()

    # saves to image file - commented out
    # plt.savefig(f'src/character_word_clouds/{name}_cloud', bbox_inches='tight', pad_in
```

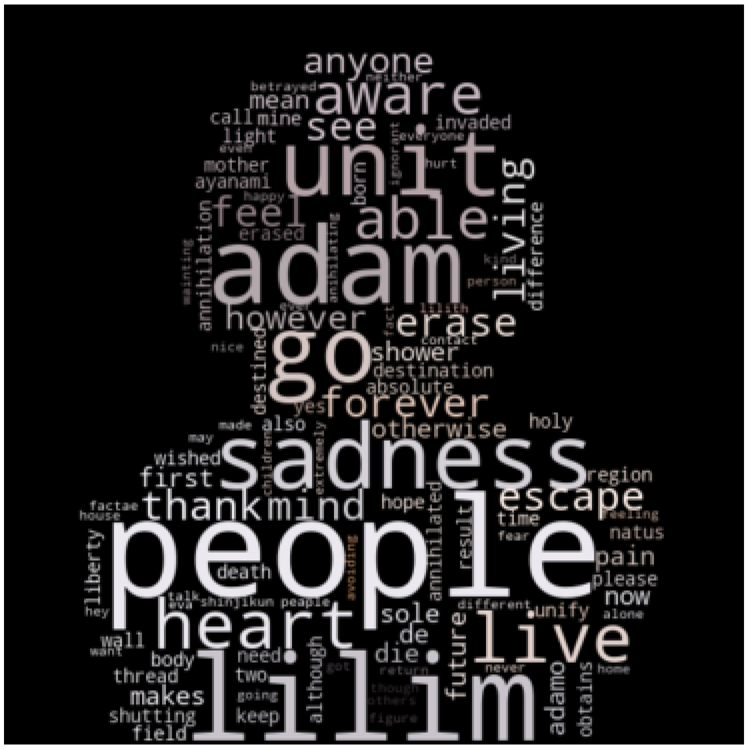
In [19]:
```
# plotting character word clouds for the top 5 most popular characters

plot_char_word_cloud('Shinji', 150, 'src/character_masks/shinjimask.png')
plot_char_word_cloud('Asuka', 150, 'src/character_masks/asukamask.jpg')
plot_char_word_cloud('Rei', 150, 'src/character_masks/reimask.png')
plot_char_word_cloud('Misato', 150, 'src/character_masks/misatomask.png')
plot_char_word_cloud('Kaoru', 150, 'src/character_masks/kaworumask.png')
```






made
human
mind
fear
yes
time
want
ikarikun
first
sky
eva
alone
ikari
unit
nothingness
hate
world
many
pain
late
see
though


shinjikun
unit
angel
eva
know
time
yes
good
father
just
way
first
say
right
think
asuka
two
nerv
go



The final visualizations! Of course these will make more sense to someone who's seen the show before, but overall I think these visualizations do a good job of capturing each characters motivations and interests at a glance.