Importing the Libraries:

In [23]:
```
import pandas as pd
import gensim
from gensim import corpora, models
from gensim.models import CoherenceModel
import ast
from tqdm import tqdm
import matplotlib.pyplot as plt
import seaborn as sns
from wordcloud import WordCloud, STOPWORDS
import matplotlib.colors as mcolors
from nltk.corpus import stopwords
import itertools
```

Loading the Pre-processed (Lemmatized) Data:

In [2]:
```
lemmatized_text_data = pd.read_csv(r"C:\Users\Utkarsh\Desktop\Amazon_comments_processe
lemmatized_text_data = lemmatized_text_data.iloc[:, 1:]
lemmatized_text_data
```

Out[2]:

	Title_Review	Stars	Company_name	Recommend	CEO_approval	Business_outlook	
0	['good', 'impression', 'first', 'month']	5.0	['amazon']	['positive']	['neutral']	['neutral']	['document 'amazon', ' 'impo
1	['intern']	5.0	['amazon']	['neutral']	['neutral']	['neutral']	['4', 'day', '
2	['good']	5.0	['amazon']	['positive']	['positive']	['positive']	['great', 'balance', ' 'en
3	['job', 'review']	5.0	['amazon']	['positive']	['positive']	['positive']	['good', 'be 'flexible',
4	['growth', 'opportunity']	4.0	['amazon']	['positive']	['negative']	['negative']	['fast', 'p 'sta 'culture', '
...	...	...	...	...	...	...	
9995	['great', 'pay', 'onboarding']	5.0	['amazon']	['positive']	['positive']	['positive']	['am 'wond 'search'
9996	['great', 'comp']	5.0	['amazon']	['neutral']	['neutral']	['neutral']	[' 'company', 'find', 'ar
9997	['far', 'good']	5.0	['amazon']	['positive']	['positive']	['positive']	[' 'team 'great', 'e
9998	['use', 'great', 'company']	2.0	['amazon']	['negative']	['negative']	['negative']	['be 'exc 'pro 'solv
9999	['poor', 'management']	1.0	['amazon']	['neutral']	['neutral']	['neutral']	['pro', 'com

10000 rows × 12 columns

In [3]:

```
df = lemmatized_text_data[['id', 'Employee_seniority', 'Pros', 'Cons']]
df['current_employee'] = df['Employee_seniority'].apply(lambda x: 'current' in x).asty
df = df[['id', 'current_employee', 'Pros', 'Cons']]
df['Pros'] = df['Pros'].apply(ast.literal_eval)
df['Cons'] = df['Cons'].apply(ast.literal_eval)
df
```

```
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\1187017345.py:2: SettingWithCopyWa
rning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/us
er_guide/indexing.html#returning-a-view-versus-a-copy
  df['current_employee'] = df['Employee_seniority'].apply(lambda x: 'current' in x).a
stype(int)
```

Out[3]:

	id	current_employee	Pros	Cons
0	empReview_73247758	1	[documentation, amazon, super, important, poin...	[need, understand, job, need, improve, good, d...
1	empReview_73187609	0	[4, day, shifts, nice]	[long, hour, shift, make, feel, tire]
2	empReview_73188818	0	[great, work, balance, great, environment, loc...	[workload, heavy, sometimes]
3	empReview_73190433	0	[good, benefit, flexible, time, shift, take, c...	[good, organization, work, well, car, parking,...
4	empReview_73197210	1	[fast, paced, start-up, culture, benefit]	[compensation, growth, prospect, development, ...
...	...	...	...	...
9995	empReview_71536795	1	[amazon, wonderful, search, site, find, anythi...	[interview, process, long, worth, end]
9996	empReview_71537065	1	[great, company, easy, find, area, like]	[get, unlucky, team]
9997	empReview_71539933	1	[great, teamwork, great, work, environment, pe...	[little, far, home]
9998	empReview_71882994	0	[become, excellent, problem, solver, use, data...	[cut-throat, management, toxic, culture, unnec...
9999	empReview_72354621	0	[pro, company]	[poor, pay, poor, management]

10000 rows × 4 columns

Performing Topic Modelling on the Pros and Cons From Each Review:

Pros:

In this section we will evaluate the degree to which the words in the 'Pros' column are semantically related and form a coherent meaning.

We will do this by calculating the topic coherence score for different numbers of topics and choosing the one results in the highest score.

In [4]:
```
# Prepare Dictionary
data_ready_pros = df['Pros'].tolist()
id2word = corpora.Dictionary(data_ready_pros)
corpus_pros = [id2word.doc2bow(text) for text in data_ready_pros]
```

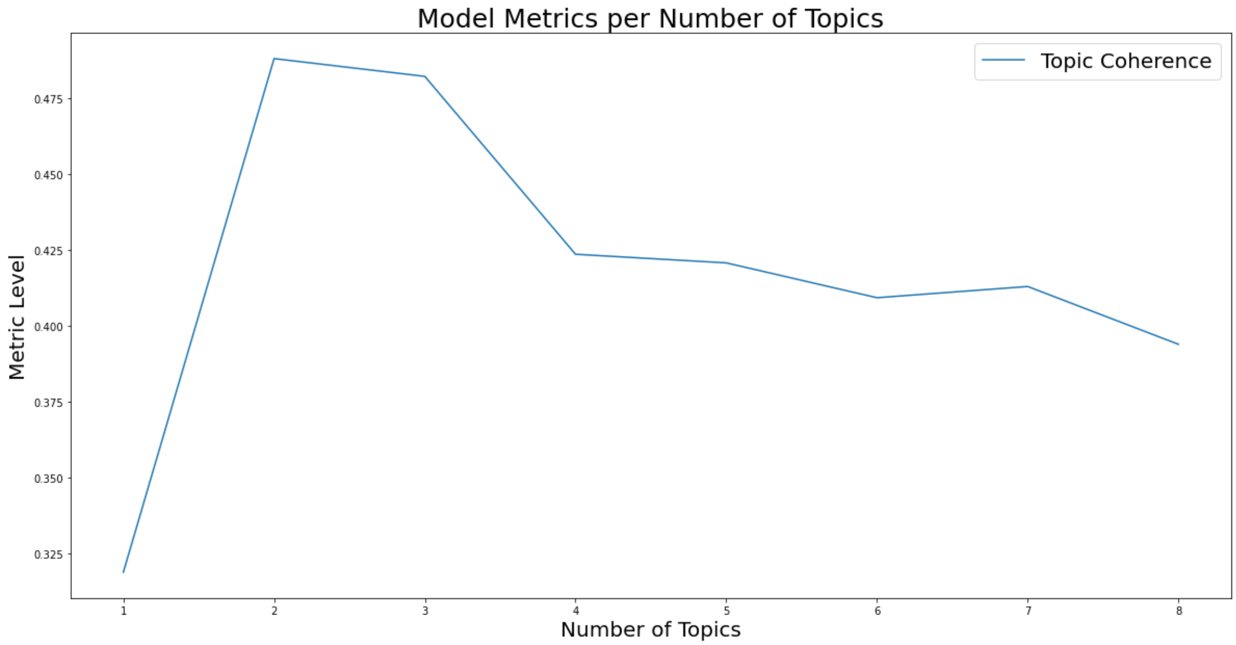
In [5]:
```
# Building model
num_topics = [i+1 for i in range(8)]
num_keywords = 20

LDA_models = {}
LDA_topics = {}
for i in tqdm(num_topics):
    LDA_models[i] = gensim.models.ldamodel.LdaModel(corpus=corpus_pros,
                                                    id2word=id2word,
                                                    num_topics=i,
                                                    update_every=1,
                                                    chunksize=10,
                                                    passes=20,
                                                    alpha='asymmetric',
                                                    random_state=100)

    shown_topics = LDA_models[i].show_topics(num_topics=i,
                                             num_words=num_keywords,
                                             formatted=False)
    LDA_topics[i] = [[word[0] for word in topic[1]] for topic in shown_topics]
```

```
100%|████████████████████████████████████████
████| 8/8 [12:03<00:00, 90.44s/it]
```

In [6]:
```
coherences = []
for i in tqdm(num_topics):
    coherences.append(gensim.models.CoherenceModel(model=LDA_models[i], texts=data_rea
```

```
100%|████████████████████████████████████████
████| 8/8 [01:12<00:00,  9.04s/it]
```

In [7]:
```
# Visualizing results
plt.figure(figsize=(20,10))
ax = sns.lineplot(x=num_topics, y=coherences, label='Topic Coherence')
ax.axes.set_title('Model Metrics per Number of Topics', fontsize=25)
ax.set_ylabel('Metric Level', fontsize=20)
ax.set_xlabel('Number of Topics', fontsize=20)
plt.legend(fontsize=20)
plt.show()
```



In [8]:
```
def format_topics_sentences(ldamodel, corpus, texts):
    sent_topics_df = pd.DataFrame()

    for i, row_list in enumerate(ldamodel[corpus]):
        row = row_list[0] if ldamodel.per_word_topics else row_list

        row = sorted(row, key=lambda x: (x[1]), reverse=True)
        # Get the Dominant topic, Perc Contribution and Keywords for each document
        for j, (topic_num, prop_topic) in enumerate(row):
            if j == 0:  # => dominant topic
                wp = ldamodel.show_topic(topic_num)
                topic_keywords = ", ".join([word for word, prop in wp])
                sent_topics_df = sent_topics_df.append(pd.Series([int(topic_num), rour
            else:
                break
    sent_topics_df.columns = ['Dominant_Topic', 'Perc_Contribution', 'Topic_Keywords']

    # Add original text to the end of the output
    contents = pd.Series(texts)
    sent_topics_df = pd.concat([sent_topics_df, contents], axis=1)
    return(sent_topics_df)
```

In [9]:
```
n_topics_pros = 2
lda_model_pros = LDA_models[n_topics_pros]
```

In [10]:
```
df_topic_pros_keywords = format_topics_sentences(ldamodel=lda_model_pros, corpus=corpu

# Format
df_dominant_topic = df_topic_pros_keywords.reset_index()
df_dominant_topic.columns = ['Review_ID', 'Dominant_Topic', 'Topic_Perc_Contrib', 'Key
```

```
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\2700792715.py:13: FutureWarning: T
he frame.append method is deprecated and will be removed from pandas in a future vers
ion. Use pandas.concat instead.
  sent_topics_df = sent_topics_df.append(pd.Series([int(topic_num), round(prop_topic,
4), topic_keywords]), ignore_index=True)
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\2700792715.py:13: FutureWarning: T
he frame.append method is deprecated and will be removed from pandas in a future vers
ion. Use pandas.concat instead.
  sent_topics_df = sent_topics_df.append(pd.Series([int(topic_num), round(prop_topic,
4), topic_keywords]), ignore_index=True)
```

In [11]:
```
df_dominant_topic['Review_ID'] = df['id']
df_dominant_topic.head(10)
```

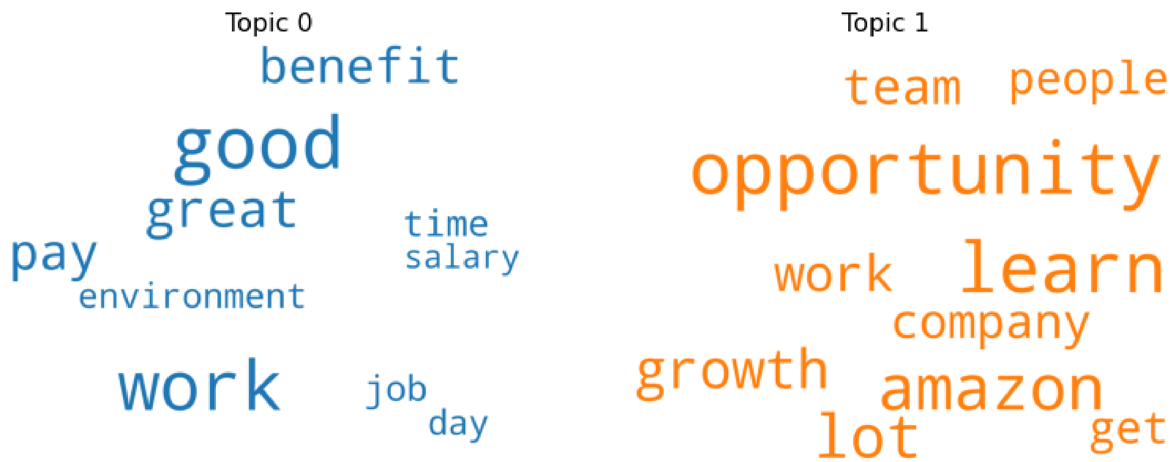
Out[11]:

	Review_ID	Dominant_Topic	Topic_Perc_Contrib	Keywords	Text
0	empReview_73247758	1	0.8816	opportunity, learn, amazon, lot, growth, work,...	[documentation, amazon, super, important, poin...
1	empReview_73187609	0	0.9250	good, work, great, pay, benefit, time, job, en...	[4, day, shifts, nice]
2	empReview_73188818	0	0.8313	good, work, great, pay, benefit, time, job, en...	[great, work, balance, great, environment, loc...
3	empReview_73190433	0	0.6971	good, work, great, pay, benefit, time, job, en...	[good, benefit, flexible, time, shift, take, c...
4	empReview_73197210	0	0.9292	good, work, great, pay, benefit, time, job, en...	[fast, paced, start-up, culture, benefit]
5	empReview_73208298	1	0.7689	opportunity, learn, amazon, lot, growth, work,...	[opportunity, grow, work, talented, people]
6	empReview_73149307	1	0.8495	opportunity, learn, amazon, lot, growth, work,...	[lot, challenge, speak, data, great, leadership]
7	empReview_73146117	0	0.7682	good, work, great, pay, benefit, time, job, en...	[good, pay, benefit, new, grad]
8	empReview_73105526	0	0.9354	good, work, great, pay, benefit, time, job, en...	[pay, rate, good, accord, work]
9	empReview_73108472	0	0.7679	good, work, great, pay, benefit, time, job, en...	[great, benefit, bonus, everything, available,...

In [13]:

```
stop_words = set(stopwords.words('english'))
cols = [color for name, color in mcolors.TABLEAU_COLORS.items()]  # more colors: 'mcol

cloud = WordCloud(stopwords=stop_words,
                  background_color='white',
                  width=2500,
                  height=1800,
                  max_words=20,
                  colormap='tab10',
                  color_func=lambda *args, **kwargs: cols[i],
```

```
                   prefer_horizontal=1.0)

topics = lda_model_pros.show_topics(formatted=False)

fig, axes = plt.subplots(1, 2, figsize=(11,11), sharex=True, sharey=True)

for i, ax in enumerate(axes.flatten()):
    fig.add_subplot(ax)
    topic_words = dict(topics[i][1])
    cloud.generate_from_frequencies(topic_words, max_font_size=300)
    plt.gca().imshow(cloud)
    plt.gca().set_title('Topic ' + str(i), fontdict=dict(size=16))
    plt.gca().axis('off')


plt.subplots_adjust(wspace=0, hspace=0)
plt.axis('off')
plt.margins(x=0, y=0)
plt.tight_layout()
plt.show()
```



Our process resulted in two being the optimal number of topics for the ‘Pros’ column. One of the topics highlighted the pay grade and benefits as the pros of working at Amazon (Topic 0). The other topic highlighted the opportunity to learn and grow as the pros of working at Amazon (Topic 1).

Cons:

In this section we will evaluate the degree to which the words in the 'Cons' column are semantically related and form a coherent meaning.

We will do this by once again calculating the topic coherence score for different numbers of topics and choosing the one results in the highest score.

In [14]:
```
# Prepare Dictionary
data_ready_cons = df['Cons'].tolist()
id2word = corpora.Dictionary(data_ready_cons)
corpus_cons = [id2word.doc2bow(text) for text in data_ready_cons]
```

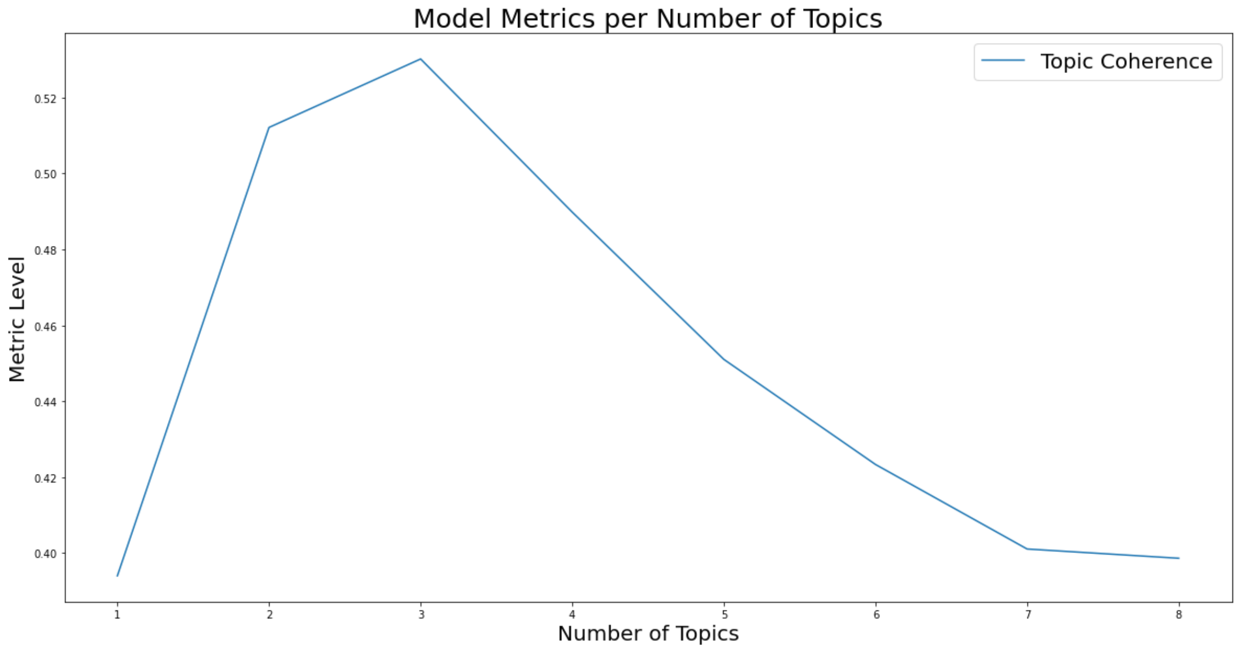
In [15]:
```
# Building model
num_topics = [i+1 for i in range(8)]
num_keywords = 20

LDA_models = {}
LDA_topics = {}
for i in tqdm(num_topics):
    LDA_models[i] = gensim.models.ldamodel.LdaModel(corpus=corpus_cons,
                                                    id2word=id2word,
                                                    num_topics=i,
                                                    update_every=1,
                                                    chunksize=10,
                                                    passes=20,
                                                    alpha='asymmetric',
                                                    random_state=100)

    shown_topics = LDA_models[i].show_topics(num_topics=i,
                                             num_words=num_keywords,
                                             formatted=False)
    LDA_topics[i] = [[word[0] for word in topic[1]] for topic in shown_topics]
```

```
100%|████████████████████████████████████████
██| 8/8 [14:31<00:00, 108.88s/it]
```

In [16]:
```
coherences = []
for i in tqdm(num_topics):
    coherences.append(gensim.models.CoherenceModel(model=LDA_models[i], texts=data_rea
```

```
100%|████████████████████████████████████████
██| 8/8 [01:06<00:00,  8.37s/it]
```

In [17]:
```
# Visualizing results
plt.figure(figsize=(20,10))
ax = sns.lineplot(x=num_topics, y=coherences, label='Topic Coherence')
ax.axes.set_title('Model Metrics per Number of Topics', fontsize=25)
ax.set_ylabel('Metric Level', fontsize=20)
ax.set_xlabel('Number of Topics', fontsize=20)
plt.legend(fontsize=20)
plt.show()
```



In [18]:
```
n_topics_cons = 3
lda_model_cons = LDA_models[n_topics_cons]
```

In [19]:
```
df_topic_cons_keywords = format_topics_sentences(ldamodel=lda_model_cons, corpus=corpu

# Format
df_dominant_topic_cons = df_topic_cons_keywords.reset_index()
df_dominant_topic_cons.columns = ['Review_ID', 'Dominant_Topic', 'Topic_Perc_Contrib',
```

```
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\2700792715.py:13: FutureWarning: T
he frame.append method is deprecated and will be removed from pandas in a future vers
ion. Use pandas.concat instead.
  sent_topics_df = sent_topics_df.append(pd.Series([int(topic_num), round(prop_topic,
4), topic_keywords]), ignore_index=True)
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\2700792715.py:13: FutureWarning: T
he frame.append method is deprecated and will be removed from pandas in a future vers
ion. Use pandas.concat instead.
  sent_topics_df = sent_topics_df.append(pd.Series([int(topic_num), round(prop_topic,
4), topic_keywords]), ignore_index=True)
```

In [20]:
```
df_dominant_topic_cons['Review_ID'] = df['id']
df_dominant_topic_cons.head(10)
```

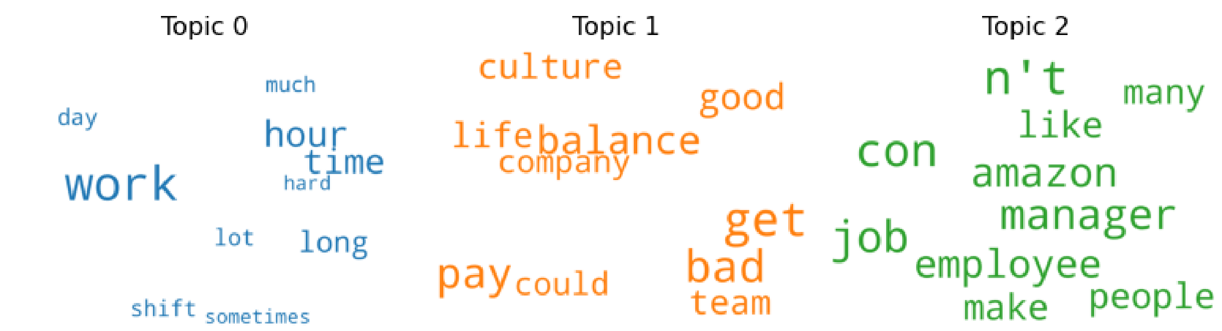
Out[20]:

	Review_ID	Dominant_Topic	Topic_Perc_Contrib	Keywords	Text
0	empReview_73247758	2	0.6520	n't, con, job, manager, amazon, employee, like...	[need, understand, job, need, improve, good, d...
1	empReview_73187609	0	0.6398	work, hour, time, long, lot, day, shift, much,...	[long, hour, shift, make, feel, tire]
2	empReview_73188818	0	0.8691	work, hour, time, long, lot, day, shift, much,...	[workload, heavy, sometimes]
3	empReview_73190433	1	0.4363	get, bad, pay, balance, good, culture, life, t...	[good, organization, work, well, car, parking,...
4	empReview_73197210	1	0.8770	get, bad, pay, balance, good, culture, life, t...	[compensation, growth, prospect, development, ...
5	empReview_73208298	0	0.5003	work, hour, time, long, lot, day, shift, much,...	[potential, layoff, fast, pace]
6	empReview_73149307	1	0.4016	get, bad, pay, balance, good, culture, life, t...	[none, best, company, ever, glad, worked]
7	empReview_73146117	0	0.8953	work, hour, time, long, lot, day, shift, much,...	[lot, work, high, stress]
8	empReview_73105526	0	0.4953	work, hour, time, long, lot, day, shift, much,...	[much, stress, give, employee]
9	empReview_73108472	0	0.5310	work, hour, time, long, lot, day, shift, much,...	[work, culture, negative, depend, location, li...

In [21]:

```
stop_words = set(stopwords.words('english'))
cols = [color for name, color in mcolors.TABLEAU_COLORS.items()]  # more colors: 'mcol

cloud = WordCloud(stopwords=stop_words,
                  background_color='white',
                  width=2500,
                  height=1800,
                  max_words=20,
                  colormap='tab10',
                  color_func=lambda *args, **kwargs: cols[i],
                  prefer_horizontal=1.0)

topics = lda_model_cons.show_topics(formatted=False)

fig, axes = plt.subplots(1, 3, figsize=(11,11), sharex=True, sharey=True)

for i, ax in enumerate(axes.flatten()):
    fig.add_subplot(ax)
```

```
    topic_words = dict(topics[i][1])
    cloud.generate_from_frequencies(topic_words, max_font_size=300)
    plt.gca().imshow(cloud)
    plt.gca().set_title('Topic ' + str(i), fontdict=dict(size=16))
    plt.gca().axis('off')


plt.subplots_adjust(wspace=0, hspace=0)
plt.axis('off')
plt.margins(x=0, y=0)
plt.tight_layout()
plt.show()
```



Our process resulted in three being the optimal number of topics for the 'Cons' column. One of the topics highlighted the long working times as the cons of working at Amazon (Topic 0). Another topic highlighted the bad culture and pay-grade as the cons of working at Amazon (Topic 1). The last topic highlighted managers and other fellow employees as the cons of working at Amazon (Topic 2).

Results:

In [22]:
```
df_pros_cons = df[["id", "current_employee"]]

df_pros_cons["Pros_Dominant_Topic"] = df_dominant_topic["Dominant_Topic"]
df_pros_cons["Pros_Topic_Perc_Contrib"] = df_dominant_topic["Topic_Perc_Contrib"]
df_pros_cons["Pros_Keywords"] = df_dominant_topic["Keywords"]

df_pros_cons["Cons_Dominant_Topic"] = df_dominant_topic_cons["Dominant_Topic"]
df_pros_cons["Cons_Topic_Perc_Contrib"] = df_dominant_topic_cons["Topic_Perc_Contrib"]
df_pros_cons["Cons_Keywords"] = df_dominant_topic_cons["Keywords"]

df_pros_cons
```

```
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\977120469.py:3: SettingWithCopyWar
ning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/us
er_guide/indexing.html#returning-a-view-versus-a-copy
  df_pros_cons["Pros_Dominant_Topic"] = df_dominant_topic["Dominant_Topic"]
```

Out[22]:

	id	current_employee	Pros_Dominant_Topic	Pros_Topic_Perc_Contrib	Pros_Key
0	empReview_73247758	1	1	0.8816	oppor learn, ar lot, g
1	empReview_73187609	0	0	0.9250	good grea benefi jo
2	empReview_73188818	0	0	0.8313	good grea benefi jo
3	empReview_73190433	0	0	0.6971	good grea benefi jo
4	empReview_73197210	1	0	0.9292	good grea benefi jo
...	...	...	...	...	
9995	empReview_71536795	1	1	0.6897	oppor learn, ar lot, g
9996	empReview_71537065	1	1	0.6064	oppor learn, ar lot, g
9997	empReview_71539933	1	0	0.9658	good grea benefi jo
9998	empReview_71882994	0	1	0.9774	oppor learn, ar lot, g
9999	empReview_72354621	0	1	0.7427	oppor learn, ar lot, g

10000 rows × 8 columns

In [27]:

```
# Count the number of occurrences of each unique value
pros_counts = df_pros_cons['Pros_Dominant_Topic'].value_counts()
cons_counts = df_pros_cons['Cons_Dominant_Topic'].value_counts()

# Print the result
print("Occurrence of Pro Topics:")
```

```
print(pros_counts)

print("Occurrence of Con Topics:")
print(cons_counts)
```

```
Occurrence of Pro Topics:
0    6220
1    3780
Name: Pros_Dominant_Topic, dtype: int64
Occurrence of Con Topics:
0    4652
1    2906
2    2442
Name: Cons_Dominant_Topic, dtype: int64
```

In [28]:

```
# Get all possible combinations of Pros_Dominant_Topic and Cons_Dominant_Topic
combinations = list(itertools.product([0, 1], [0, 1, 2]))

# Create a DataFrame to store the results
result_df = pd.DataFrame({'Pros_Dominant_Topic': [], 'Cons_Dominant_Topic': [], 'count

# Loop through the combinations and count the occurrences in the original DataFrame
for combination in combinations:
    count = ((df_pros_cons['Pros_Dominant_Topic'] == combination[0]) & (df_pros_cons['
    result_df = result_df.append({'Pros_Dominant_Topic': combination[0], 'Cons_Dominar

# Print the result
print(result_df)
```

```
   Pros_Dominant_Topic  Cons_Dominant_Topic   count
0                  0.0                  0.0  3375.0
1                  0.0                  1.0  1544.0
2                  0.0                  2.0  1301.0
3                  1.0                  0.0  1277.0
4                  1.0                  1.0  1362.0
5                  1.0                  2.0  1141.0
```

```
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\1291327798.py:10: FutureWarning: T
he frame.append method is deprecated and will be removed from pandas in a future vers
ion. Use pandas.concat instead.
  result_df = result_df.append({'Pros_Dominant_Topic': combination[0], 'Cons_Dominant
_Topic': combination[1], 'count': count}, ignore_index=True)
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\1291327798.py:10: FutureWarning: T
he frame.append method is deprecated and will be removed from pandas in a future vers
ion. Use pandas.concat instead.
  result_df = result_df.append({'Pros_Dominant_Topic': combination[0], 'Cons_Dominant
_Topic': combination[1], 'count': count}, ignore_index=True)
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\1291327798.py:10: FutureWarning: T
he frame.append method is deprecated and will be removed from pandas in a future vers
ion. Use pandas.concat instead.
  result_df = result_df.append({'Pros_Dominant_Topic': combination[0], 'Cons_Dominant
_Topic': combination[1], 'count': count}, ignore_index=True)
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\1291327798.py:10: FutureWarning: T
he frame.append method is deprecated and will be removed from pandas in a future vers
ion. Use pandas.concat instead.
  result_df = result_df.append({'Pros_Dominant_Topic': combination[0], 'Cons_Dominant
_Topic': combination[1], 'count': count}, ignore_index=True)
C:\Users\Utkarsh\AppData\Local\Temp\ipykernel_5604\1291327798.py:10: FutureWarning: T
he frame.append method is deprecated and will be removed from pandas in a future vers
ion. Use pandas.concat instead.
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_Topic': combination[1], 'count': count}, ignore_index=True)
```

From the results above, we can see that most employee reviews mention the pay grade and other benefits as the pros of working at Amazon. As for the cons of working at Amazon, most employee reviews mention the long working hours. In fact, approximately a third of the employee reviews point toward this combination of pros and cons. Reviews that focused on the opportunity to learn and grow as the pros of working at Amazon had a more even distribution of the cons topics, though the topic associated with the pay-grade and company culture was the most frequent.

Exporting the Data:

In [ ]:

```
df_pros_cons.to_csv('employee_pros_cons_topic_modelling.csv', index=False)
```