EDA

In [ ]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import nltk
from nltk import word_tokenize
from nltk import tokenize
```

描述性统计

In [ ]:
```
data = pd.read_csv('train.csv')
data.describe()
```

Out[ ]:

	discourse_id	essay_id	discourse_text	discourse_type	discourse_effectiveness
count	36765	36765	36765	36765	36765
unique	36765	4191	36691	7	3
top	0013cc385424	91B1F82B2CF1	Summer projects should be student-designed	Evidence	Adequate
freq	1	23	14	12105	20977

In [ ]:
```
data.head(10)
```

Out[ ]:

	discourse_id	essay_id	discourse_text	discourse_type	discourse_effectiveness
0	0013cc385424	007ACE74B050	Hi, i'm Isaac, i'm going to be writing about h...	Lead	Adequate
1	9704a709b505	007ACE74B050	On my perspective, I think that the face is a ...	Position	Adequate
2	c22adee811b6	007ACE74B050	I think that the face is a natural landform be...	Claim	Adequate
3	a10d361e54e4	007ACE74B050	If life was on Mars, we would know by now. The...	Evidence	Adequate
4	db3e453ec4e2	007ACE74B050	People thought that the face was formed by ali...	Counterclaim	Adequate
5	36a565e45db7	007ACE74B050	though some say that life on Mars does exist, ...	Rebuttal	Ineffective
6	fb65fe816ba3	007ACE74B050	It says in paragraph 7, on April 5, 1998, Mars...	Evidence	Adequate
7	4e472e2584fa	007ACE74B050	Everyone who thought it was made by alieans ev...	Counterclaim	Adequate
8	28a94d3ee425	007ACE74B050	Though people were not satified about how the ...	Concluding Statement	Adequate
9	d226f06362f5	00944C693682	Limiting the usage of cars has personal and pr...	Lead	Effective

In [ ]:
```
data.essay_id.value_counts()
```

Out[ ]:
```
91B1F82B2CF1    23
4CA37D113612    23
900A879708F0    23
A7EC6F462F8B    22
DECAE402BB38    22
                ..
AB02689C1A9B     1
FFFF80B8CC2F     1
377548575048     1
5E85F1FB4E22     1
9706F8E7D534     1
Name: essay_id, Length: 4191, dtype: int64
```

可以看出，有的文章包含的议论元素有多种（总共7种），总数达到了23，而有些文章包含的议论元素的总数只有 1

In [ ]:
```
data.loc[data.essay_id == '91B1F82B2CF1']
```

Out[ ]:

	discourse_id	essay_id	discourse_text	discourse_type	discourse_effectiveness
25190	2d4def8e7c09	91B1F82B2CF1	Many people may think that attending school on...	Lead	Adequate
25191	0a6634792991	91B1F82B2CF1	I would say that I disagree with that statemen...	Position	Adequate
25192	e73c3a854460	91B1F82B2CF1	Yes, online school would be better for student...	Counterclaim	Adequate
25193	57d92e1dddb3	91B1F82B2CF1	but what about in the future when they lack ba...	Rebuttal	Adequate
25194	4e57f20c26e0	91B1F82B2CF1	yes, the online courses could be more personal...	Counterclaim	Adequate
25195	2e8d1ead6a99	91B1F82B2CF1	not all. Even if online school is more persona...	Rebuttal	Adequate
25196	cef7e3667fca	91B1F82B2CF1	People with the idea that online school is the...	Counterclaim	Adequate
25197	764225413a40	91B1F82B2CF1	however, I would argue that practicing to wake...	Rebuttal	Adequate
25198	093a12dbd472	91B1F82B2CF1	In the real world, employers are not going to ...	Evidence	Effective
25199	00ec98773bda	91B1F82B2CF1	Compromise is a skill that is required in the ...	Evidence	Adequate
25200	cb48bea2f550	91B1F82B2CF1	This is another skill that is very frequently ...	Claim	Adequate
25201	b4d1026aaf79	91B1F82B2CF1	Often times, people who are homeschooled lack ...	Claim	Adequate
25202	d17d9c6e0abf	91B1F82B2CF1	Many public schools offer organizations and cl...	Evidence	Adequate
25203	989400cf7054	91B1F82B2CF1	It is true that online students most likely wo...	Counterclaim	Adequate
25204	038cfbf972a9	91B1F82B2CF1	but it would be more difficult for them as the...	Rebuttal	Adequate
25205	e46b3a1c078e	91B1F82B2CF1	People who attend online school may feel like ...	Evidence	Effective
25206	65665fa1cb3c	91B1F82B2CF1	Branching off of social skills, online school ...	Claim	Effective
25207	b5fc91b0e049	91B1F82B2CF1	Public school students encounter people of man...	Evidence	Effective
25208	6d4addff5c19	91B1F82B2CF1	One of the apparent reasons that students atte...	Counterclaim	Adequate
25209	9f826949f0c5	91B1F82B2CF1	Statistically, bullying has reduced significan...	Evidence	Ineffective
25210	f6b45f782663	91B1F82B2CF1	Consequently, the new technology that made onl...	Rebuttal	Effective
25211	c94b9ae6c2ee	91B1F82B2CF1	In public schools students can learn how to de...	Evidence	Effective
25212	e023de8ac51b	91B1F82B2CF1	Ultimately, there are benefits and disadvantag...	Concluding Statement	Effective

In [ ]:
```
data.loc[data.essay_id=='9706F8E7D534']
```

Out[ ]:

	discourse_id	essay_id	discourse_text	discourse_type	discourse_effectiveness
8358	11057d62414d	9706F8E7D534	Luke Bomberger was just an ordanery small town...	Evidence	Ineffective

In [ ]:
```
data.discourse_type.value_counts()
```

Out[ ]:
```
Evidence                12105
Claim                   11977
Position                 4024
Concluding Statement     3351
Lead                     2291
Counterclaim             1773
Rebuttal                 1244
Name: discourse_type, dtype: int64
```

In [ ]:
```
data.discourse_effectiveness.value_counts()
```

Out[ ]:
```
Adequate       20977
Effective       9326
Ineffective     6462
Name: discourse_effectiveness, dtype: int64
```

数据分析

我们可以看到一共有 36765 个议论元素，但是议论元素的文本内容只有 36691，说明有的议论元素的文本内容在不同文章中重复出现

In [ ]:
```
def highlight_duplicate(val):
    if val.discourse_text == "Big States ":
        return ['background-color: green']*len(val)
    else:
        return ['background-color: white']*len(val)

duplicates = data[data.discourse_text.duplicated(keep=False)].sort_values(by="discourse_text")
duplicates.head(10).style.apply(highlight_duplicate, axis=1)
```

Out[ ]:

	discourse_id	essay_id	discourse_text	discourse_type	discourse_effectiveness
26691	7f9c3500259d	A602D45D22B2	"That's a lava dome that takes the form of an isolated mesa about the same height as the Face on Mars."	Evidence	Adequate
27350	d628a6adda3a	ADB68BCD2874	"That's a lava dome that takes the form of an isolated mesa about the same height as the Face on Mars."	Evidence	Adequate
25391	781452d9404c	942ECB176B3A	At the most basic level, the electoral college is unfair to voters.	Position	Adequate
28835	6fa171a95540	C2BAF4ADA2CA	At the most basic level, the electoral college is unfair to voters.	Claim	Adequate
28436	9e12ec699196	BB3A6C2D0B65	Big States	Claim	Adequate
20121	35bf70c4a673	4CA37D113612	Big States	Claim	Ineffective
3933	c5b2ecb3888e	44E2726DA1B3	I agree	Position	Adequate
11285	5e4022e93247	CB66B685DAF6	I agree	Position	Adequate
17087	99782ca26927	2714214F7D9E	I think students should be required to perform community service.	Position	Adequate
29590	33d6bbba823c	CE64FA08E4CF	I think students should be required to perform community service.	Position	Adequate

In [ ]:
```
duplicates.describe()
```

Out[ ]:

	discourse_id	essay_id	discourse_text	discourse_type	discourse_effectiveness
count	119	119	119	119	119
unique	119	108	45	6	3
top	7f9c3500259d	6F896BABB13C	Summer projects should be student-designed	Position	Adequate
freq	1	2	14	67	99

In [ ]:
```
true_duplicates = duplicates.groupby(["discourse_type", "discourse_text"]).discourse_effectiveness.
true_duplicates.columns = ["nunique_discourse_effectiveness"]
true_duplicates = true_duplicates[true_duplicates.nunique_discourse_effectiveness>1].reset_index(dr
true_duplicates
```

Out[ ]:

	discourse_type	discourse_text	nunique_discourse_effectiveness
0	Claim	Big States	2
1	Claim	Second, there could be a tie in the electoral ...	2
2	Claim	The Electoral College is unfair	2
3	Claim	be creative,	2
4	Claim	opinions,	2
5	Claim	you can help others.	2
6	Counterclaim	Opponents say that cell phones are good becaus...	2
7	Lead	When people ask for advice, they sometimes tal...	2
8	Position	I would want to keep the Electoral College	2
9	Position	Seeking multiple opinions can help someone mak...	2
10	Position	The author suggest that studying Venus is a wo...	2

In [ ]:
```
duplicates = duplicates[duplicates.discourse_text.isin(true_duplicates.discourse_text.unique())]
duplicates
```

Out[ ]:

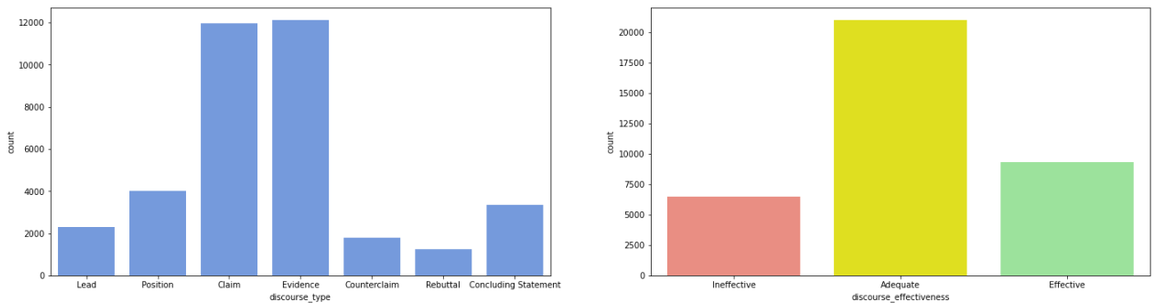
	discourse_id	essay_id	discourse_text	discourse_type	discourse_effectiveness
28436	9e12ec699196	BB3A6C2D0B65	Big States	Claim	Adequate
20121	35bf70c4a673	4CA37D113612	Big States	Claim	Ineffective
20842	34b98386dc46	5729D5AE055C	I would want to keep the Electoral College	Position	Effective
28406	98154af4855d	BACC53ECC1FB	I would want to keep the Electoral College	Position	Adequate
11970	cc0dad1234ec	D8013F49DE51	Opponents say that cell phones are good becaus...	Counterclaim	Adequate
6570	dee3f8aec4fc	7742D58270C9	Opponents say that cell phones are good becaus...	Counterclaim	Ineffective
31753	b318a4e3b80e	EE2FC4219F49	Second, there could be a tie in the electoral ...	Claim	Effective
31757	43848fd5dfb3	EE2FC4219F49	Second, there could be a tie in the electoral ...	Claim	Adequate
35299	608e1d81f4ed	9627B47C10DE	Seeking multiple opinions can help someone mak...	Position	Effective
34383	3312a23a5480	523EBD9ECA47	Seeking multiple opinions can help someone mak...	Position	Adequate
33016	699bebce624f	06936C8AA35D	Seeking multiple opinions can help someone mak...	Position	Adequate
35456	77fc6c349463	A814BD710140	Seeking multiple opinions can help someone mak...	Position	Adequate
18623	d258208bc946	38F0C2290179	The Electoral College is unfair	Claim	Effective
21785	ac4a6fb163a3	643B41BE89EE	The Electoral College is unfair	Claim	Adequate
5483	2ac5a02e11ee	648987861269	The author suggest that studying Venus is a wo...	Position	Adequate
2976	d95e0de29b68	3713AC622BFF	The author suggest that studying Venus is a wo...	Position	Ineffective
33794	5a8b56c597d3	331CA007D0AD	When people ask for advice, they sometimes tal...	Lead	Adequate
36587	391e3628a1f5	F52B9A0882BB	When people ask for advice, they sometimes tal...	Lead	Ineffective
4461	3c850f2249c7	4FAC3B29417F	be creative,	Claim	Effective
11100	bedb68b0c6ee	C7FA88E9DF3B	be creative,	Claim	Adequate
35973	9b72380e4fc2	C8FB2508978A	opinions,	Claim	Ineffective
35969	d9c17f7d8b7a	C8FB2508978A	opinions,	Claim	Adequate
34776	39fb3c694aeb	73D52BB6390A	opinions,	Claim	Adequate
35488	bcdb6e47ede3	AB8EFBD82820	you can help others.	Claim	Ineffective
35493	98510222f9b8	AB8EFBD82820	you can help others.	Claim	Adequate

可以看出，在不同文章中，一些相同内容的议论元素的有效性会出现不同的结果，这样的议论元素一共有 11

条

可视化

In [ ]:
```
fig, ax = plt.subplots(nrows=1, ncols=2, figsize=(24, 6))
sns.countplot(data = data, x = "discourse_type", ax = ax[0], color='cornflowerblue')
sns.countplot(data = data, x = "discourse_effectiveness", order = ['Ineffective', 'Adequate', 'Effe
plt.show()
```



In [ ]:
```
temp = data.groupby(["essay_id"]).discourse_type.value_counts().to_frame()
temp.columns = ['amount']
temp.reset_index(drop = False, inplace=True)
temp = temp.pivot(index="essay_id", columns = "discourse_type").amount
temp
```

Out[ ]:

essay_id	Claim	Concluding Statement	Counterclaim	Evidence	Lead	Position	Rebuttal
00066EA9880D	3.0	1.0	NaN	3.0	1.0	1.0	NaN
000E6DE9E817	5.0	1.0	1.0	3.0	NaN	1.0	1.0
0016926B079C	7.0	NaN	NaN	3.0	NaN	1.0	NaN
00203C45FC55	1.0	1.0	3.0	3.0	1.0	1.0	3.0
0029F4D19C3F	2.0	1.0	1.0	2.0	1.0	1.0	1.0
...	...	...	...	...	...	...	...
FFA381E58FC6	2.0	1.0	NaN	1.0	NaN	1.0	NaN
FFC43F453EF6	4.0	1.0	3.0	1.0	NaN	1.0	1.0
FFD97A99CEBA	NaN	NaN	NaN	1.0	NaN	NaN	NaN
FFF868E06176	3.0	1.0	NaN	3.0	1.0	1.0	NaN
FFFF80B8CC2F	NaN	NaN	NaN	1.0	NaN	NaN	NaN

4191 rows × 7 columns

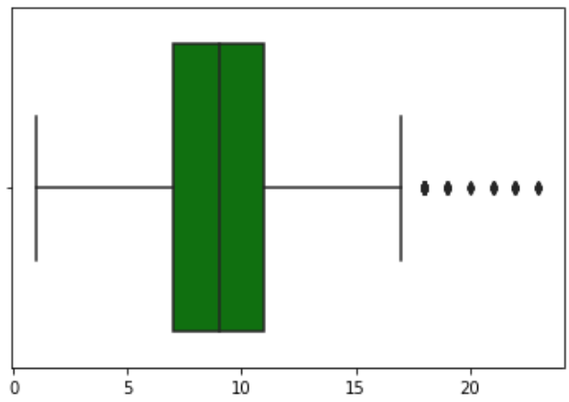
In [ ]:
```
temp.mean()
```

Out[ ]:
```
discourse_type
Claim                   3.172715
Concluding Statement    1.005702
Counterclaim            1.314307
Evidence                2.904968
Lead                    1.000874
Position                1.004744
Rebuttal                1.223206
dtype: float64
```

In [ ]:
```
sns.boxplot(temp.fillna(0).sum(axis=1), color='green')
```

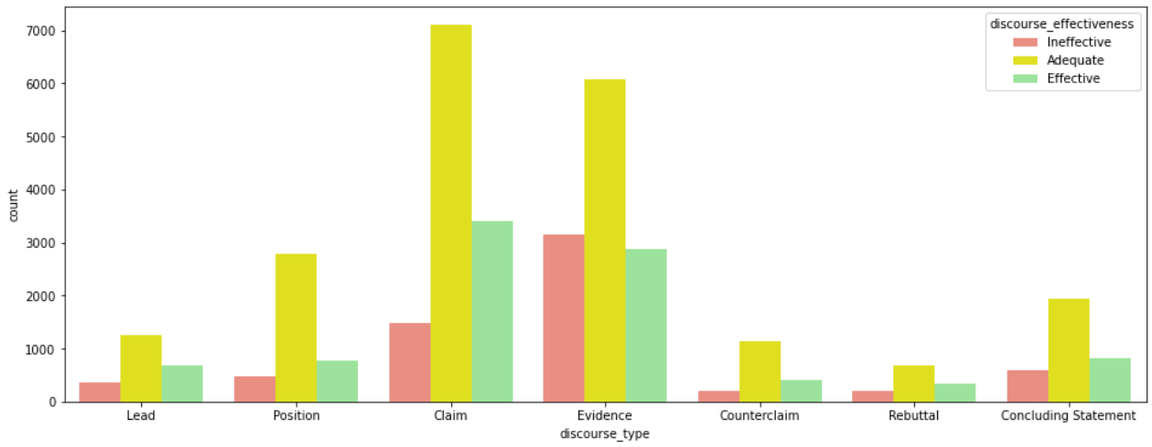
```
d:\Software\MiniConda\miniconda\lib\site-packages\seaborn\_decorators.py:43: FutureWarning: Pass th
e following variable as a keyword arg: x. From version 0.12, the only valid positional argument wil
l be `data`, and passing other arguments without an explicit keyword will result in an error or mis
interpretation.
  FutureWarning
```

Out[ ]:
```
<AxesSubplot:>
```



可以看出，平均每篇文章包含有 8 个议论元素

In [ ]:
```
fig, ax = plt.subplots(nrows=1, ncols=1, figsize=(16, 6))
sns.countplot(data = data, x = 'discourse_type', hue='discourse_effectiveness', hue_order = ['Inef
plt.show()
```



可以看到，在不同的议论元素中，有效性类别的比例差别不是很大

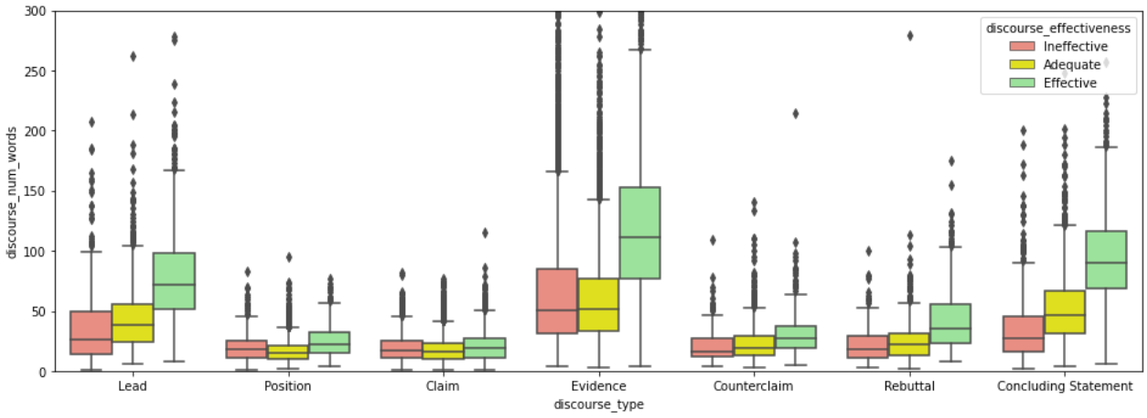
In [ ]:
```
data["discourse_num_words"] = data.discourse_text.apply(lambda x: len(x.split()))
data["discourse_num_sentences"] = data.discourse_text.apply(lambda x: len(tokenize.sent_tokenize(x
```

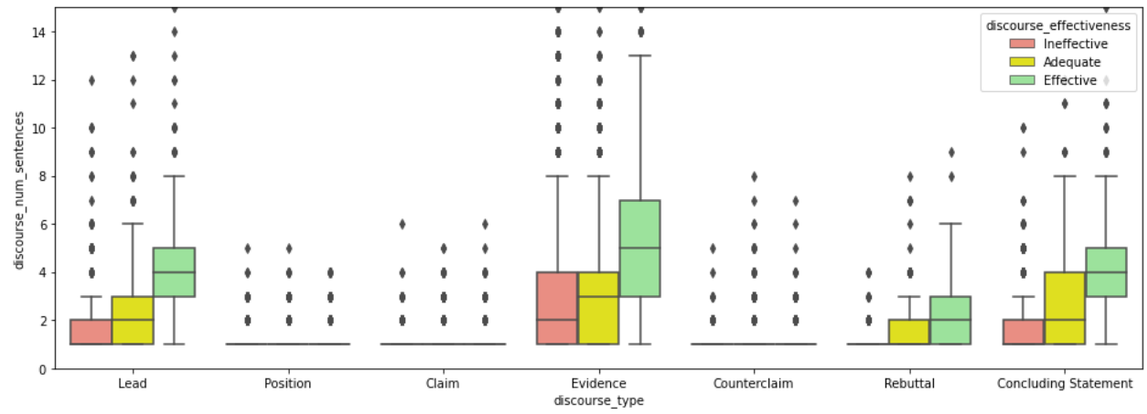
In [ ]:
```
fig, ax = plt.subplots(nrows=2,ncols=1, figsize=(16, 12))
sns.boxplot(data = data,
            y = 'discourse_num_words',
            x='discourse_type',
            hue='discourse_effectiveness',
            hue_order = ['Ineffective', 'Adequate', 'Effective'],
            palette = ['salmon', 'yellow', 'lightgreen'],
            ax=ax[0])

ax[0].set_ylim([0,300])


sns.boxplot(data = data, y = 'discourse_num_sentences',
            x='discourse_type',
            hue='discourse_effectiveness',
            hue_order = ['Ineffective', 'Adequate', 'Effective'],
            palette = ['salmon', 'yellow', 'lightgreen'],
            ax=ax[1])
ax[1].set_ylim([0,15])
```

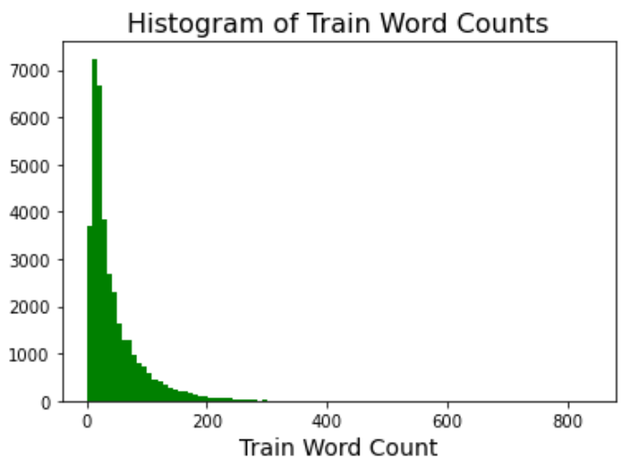
Out[ ]:
```
(0.0, 15.0)
```





可以看出，有效的议论元素一般比无效的议论元素具有更多的词汇

In [ ]:
```
plt.hist(data["discourse_num_words"], bins=100, color='green')
plt.title('Histogram of Train Word Counts',size=16)
plt.xlabel('Train Word Count',size=14)
plt.show()
```



可以看到，大部分议论元素的单词数都不超过250左右，这可以为以后选择模型参数提供一定的帮助