In [ ]:
```
!pip install plotly
!pip install cufflinks
!pip install textblob
!pip install -U pip setuptools wheel
!pip install -U spacy
!pip install nltk
!python -m spacy download en_core_web_sm
!pip install wordcloud
```

In [106]:
```
import pandas as pd
import numpy as np
import re
import xlrd # to read excel
import nltk # NLP toolkit
import matplotlib.pyplot as plt # for visualization
import string # for handling string
import seaborn as sns
import spacy
```

In [107]:
```
import plotly as py
import cufflinks as cf
```

In [108]:
```
from plotly.offline import iplot
```

In [109]:
```
py.offline.init_notebook_mode(connected=True)
cf.go_offline()
```

In [110]:
```
summary = pd.read_excel('dataset.xlsx')
summary.head()
```

Out[110]:

	Title	Authors	Date	UID	Summary	PDF URL	Cyber_Risk	Not_Cyber
0	Cyber security and the Leviathan	['Joseph Da Silva']	2022-03-10	2203.05256v1	Dedicated cyber-security functions are common ...	http://arxiv.org/pdf/2203.05256v1.pdf	1.0	0.0
1	Evaluation of Machine Learning Algorithms in N...	['Tuan-Hong Chua', 'Iftekhar Salam']	2022-03-10	2203.05232v1	Cybersecurity has become one of the focuses of...	http://arxiv.org/pdf/2203.05232v1.pdf	1.0	0.0
2	Getting Critical: Making Sense of the EU Cyber...	['Ian Walden', 'Johan David Michels']	2022-03-09	2203.04887v1	In this chapter, we review how the EU cybersec...	http://arxiv.org/pdf/2203.04887v1.pdf	1.0	0.0
3	Adaptative Perturbation Patterns: Realistic Ad...	['João Vitorino', 'Nuno Oliveira', 'Isabel Pra...	2022-03-08	2203.04234v1	Adversarial attacks pose a major threat to mac...	http://arxiv.org/pdf/2203.04234v1.pdf	NaN	NaN
4	Guidelines for cyber risk management in shipbo...	['Priyanga Rajaram', 'Mark Goh', 'Jianying Zhou']	2022-03-08	2203.04072v2	Over the past few years, we have seen several ...	http://arxiv.org/pdf/2203.04072v2.pdf	NaN	NaN

In [111]:
```
print(summary.isnull().sum())
```

```
Title           0
Authors         0
Date            0
UID             0
Summary         0
PDF URL         0
Cyber_Risk    1709
Not_Cyber     1709
dtype: int64
```

In [112]:
```
new = summary.drop(['Date', 'UID', 'PDF URL', 'Cyber_Risk', 'Not_Cyber'], axis=1)
new.head()
```

Out[112]:

	Title	Authors	Summary
0	Cyber security and the Leviathan	['Joseph Da Silva']	Dedicated cyber-security functions are common ...
1	Evaluation of Machine Learning Algorithms in N...	['Tuan-Hong Chua', 'Iftekhar Salam']	Cybersecurity has become one of the focuses of...
2	Getting Critical: Making Sense of the EU Cyber...	['Ian Walden', 'Johan David Michels']	In this chapter, we review how the EU cybersec...
3	Adaptative Perturbation Patterns: Realistic Ad...	['João Vitorino', 'Nuno Oliveira', 'Isabel Pra...	Adversarial attacks pose a major threat to mac...
4	Guidelines for cyber risk management in shipbo...	['Priyanga Rajaram', 'Mark Goh', 'Jianying Zhou']	Over the past few years, we have seen several ...

In [ ]:
```
' '.join(new['Summary'].tolist())
```

In [114]:
```
new['summary_in_lowercase']=new['Summary'].apply(lambda x: x.lower())
new.head()
```

Out[114]:

	Title	Authors	Summary	summary_in_lowercase
0	Cyber security and the Leviathan	['Joseph Da Silva']	Dedicated cyber-security functions are common ...	dedicated cyber-security functions are common ...
1	Evaluation of Machine Learning Algorithms in N...	['Tuan-Hong Chua', 'Iftekhar Salam']	Cybersecurity has become one of the focuses of...	cybersecurity has become one of the focuses of...
2	Getting Critical: Making Sense of the EU Cyber...	['Ian Walden', 'Johan David Michels']	In this chapter, we review how the EU cybersec...	in this chapter, we review how the eu cybersec...
3	Adaptative Perturbation Patterns: Realistic Ad...	['João Vitorino', 'Nuno Oliveira', 'Isabel Pra...	Adversarial attacks pose a major threat to mac...	adversarial attacks pose a major threat to mac...
4	Guidelines for cyber risk management in shipbo...	['Priyanga Rajaram', 'Mark Goh', 'Jianying Zhou']	Over the past few years, we have seen several ...	over the past few years, we have seen several ...

In [115]:
```
new['summary_without_punkt']=new['summary_in_lowercase'].apply(lambda x: re.sub('[%s]' % re.escape(string.punctuation), '', x))
new.head()
```

Out[115]:

	Title	Authors	Summary	summary_in_lowercase	summary_without_punkt
0	Cyber security and the Leviathan	['Joseph Da Silva']	Dedicated cyber-security functions are common ...	dedicated cyber-security functions are common ...	dedicated cybersecurity functions are common i...
1	Evaluation of Machine Learning Algorithms in N...	['Tuan-Hong Chua', 'Iftekhar Salam']	Cybersecurity has become one of the focuses of...	cybersecurity has become one of the focuses of...	cybersecurity has become one of the focuses of...
2	Getting Critical: Making Sense of the EU Cyber...	['Ian Walden', 'Johan David Michels']	In this chapter, we review how the EU cybersec...	in this chapter, we review how the eu cybersec...	in this chapter we review how the eu cybersecu...
3	Adaptative Perturbation Patterns: Realistic Ad...	['João Vitorino', 'Nuno Oliveira', 'Isabel Pra...	Adversarial attacks pose a major threat to mac...	adversarial attacks pose a major threat to mac...	adversarial attacks pose a major threat to mac...
4	Guidelines for cyber risk management in shipbo...	['Priyanga Rajaram', 'Mark Goh', 'Jianying Zhou']	Over the past few years, we have seen several ...	over the past few years, we have seen several ...	over the past few years we have seen several c...

In [ ]:
```
from nltk.corpus import stopwords
nltk.download('punkt')
nltk.download('stopwords')
stoplist = set(stopwords.words("english"))
```

In [117]:
```
from nltk.tokenize import word_tokenize

# tokenization
def preprocess(text):
  formatted_text = text.lower()
  tokens = []
  for token in nltk.word_tokenize(formatted_text):
    tokens.append(token)
  tokens = [word for word in tokens if word not in stoplist and word not in string.punctuation]
  formatted_text1 = ' '.join(element for element in tokens)
  formatted_text2 = ''.join([i for i in formatted_text1 if not i.isdigit()])
  return formatted_text2

# remove stop words
new['summary_without_stopw']=new['summary_without_punkt'].apply(lambda x: preprocess(x))

# remove numbers

new['summary_without_num']=new['summary_without_stopw'].apply(lambda x: x.replace(r'\d+',''))

# Loading model
nlp = spacy.load('en_core_web_sm',disable=['parser', 'ner'])

# Lemmatization with stopwords removal
new['lemmatized']=new['summary_without_num'].apply(lambda x: ' '.join([token.lemma_ for token in list(nlp(x)) if (token.is_stop==False)]))
new_text = ' '.join(new['lemmatized'].tolist())
```

In [118]:
```
word_frequency = nltk.FreqDist(nltk.word_tokenize(new_text))
word_frequency
```

Out[118]:
```
FreqDist({'datum': 2349, 'security': 2263, 'system': 1949, 'attack': 1637, 'model': 1374, 'network': 1315, 'cyber': 1236, 'cybersecurity': 116
8, 'paper': 1074, 'propose': 1040, ...})
```

In [119]:
```
output = pd.DataFrame(list(word_frequency.items()), columns = ["Word", "Frequency"])
```

In [120]:
```
output.to_excel("output.xlsx")
```

In [121]:
```
new['summary_len'] = new['Summary'].apply(lambda x: len(x))
```

In [122]:
```
new['word_count'] = new['Summary'].apply(lambda x: len(x.split()))
```

In [123]:
```
def get_avg_len(x):
    words = x.split()
    word_len = 0
    for word in words:
        word_len=word_len+len(word)
    return word_len/len(words)
```

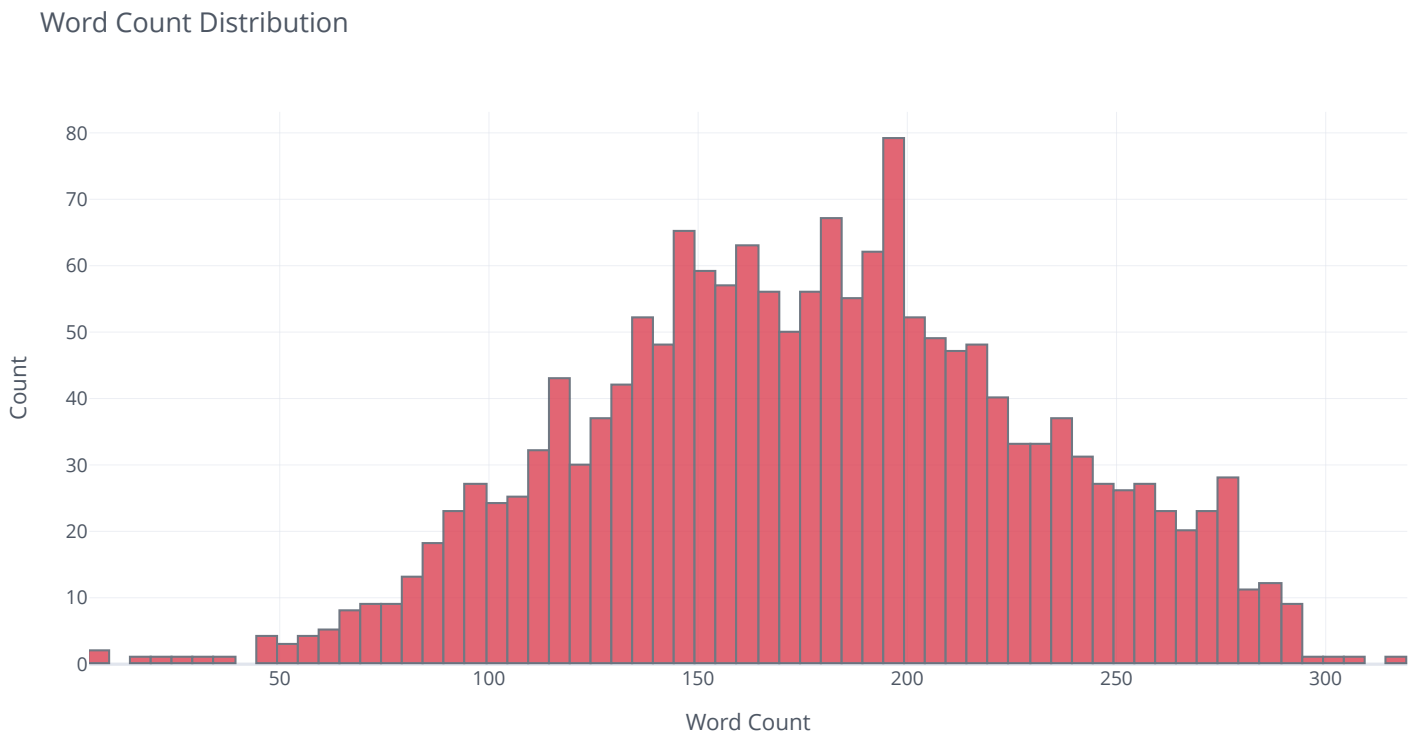
In [124]:
```
new['avg_word_len']=new['lemmatized'].apply(lambda x: get_avg_len(x))
```

In [125]:
```
new.head()
```

Out[125]:

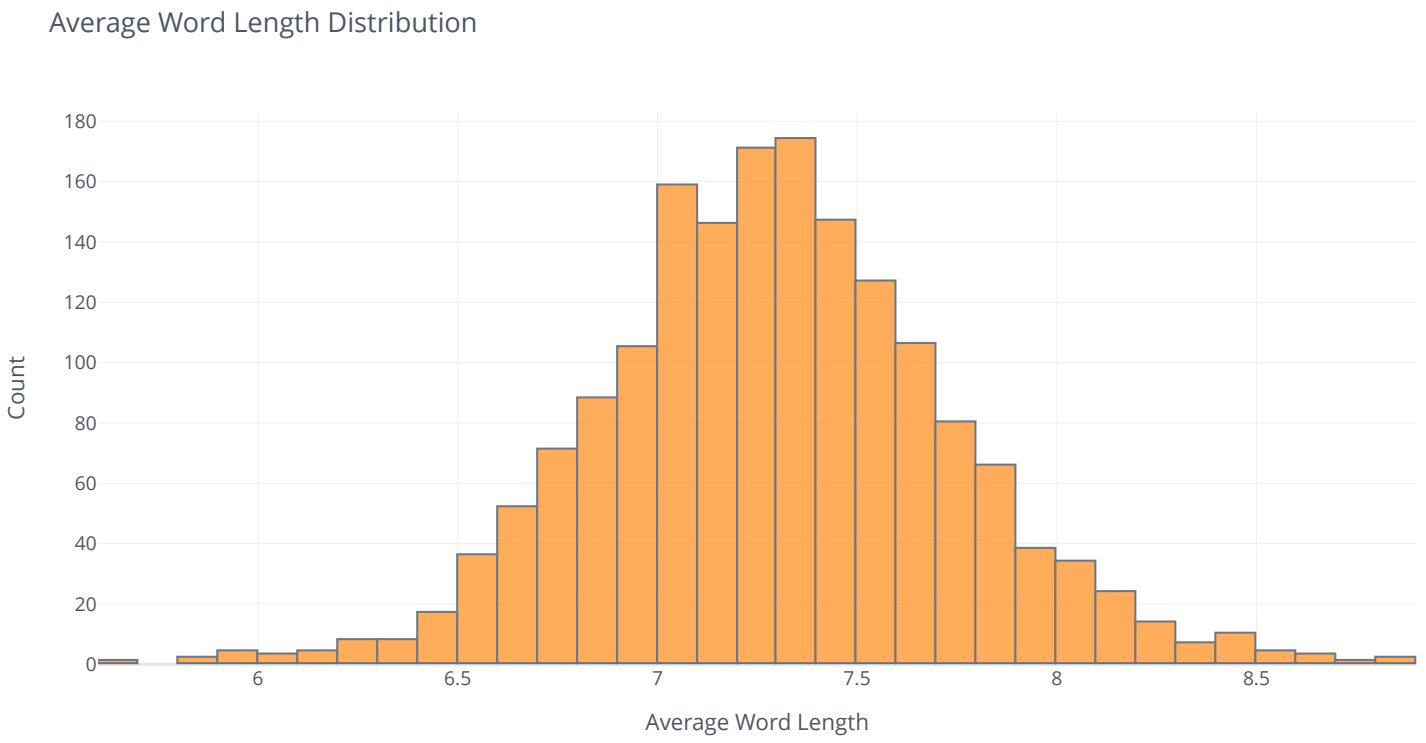
	Title	Authors	Summary	summary_in_lowercase	summary_without_punkt	summary_without_stopw	summary_without_num	lemmatized	summary_len	word_count
0	Cyber security and the Leviathan	['Joseph Da Silva']	Dedicated cyber-security functions are common ...	dedicated cyber-security functions are common ...	dedicated cybersecurity functions are common i...	dedicated cybersecurity functions common comme...	dedicated cybersecurity functions common comme...	dedicated cybersecurity function common commer...	1124	156
1	Evaluation of Machine Learning Algorithms in N...	['Tuan-Hong Chua', 'Iftekhar Salam']	Cybersecurity has become one of the focuses of...	cybersecurity has become one of the focuses of...	cybersecurity has become one of the focuses of...	cybersecurity become one focuses organisations...	cybersecurity become one focuses organisations...	cybersecurity focus organisation number cybera...	1871	301
2	Getting Critical: Making Sense of the EU Cyber...	['Ian Walden', 'Johan David Michels']	In this chapter, we review how the EU cybersec...	in this chapter, we review how the eu cybersec...	in this chapter we review how the eu cybersecu...	chapter review eu cybersecurity regulatory fra...	chapter review eu cybersecurity regulatory fra...	chapter review eu cybersecurity regulatory fra...	953	139
3	Adaptative Perturbation Patterns: Realistic Ad...	['João Vitorino', 'Nuno Oliveira', 'Isabel Pra...	Adversarial attacks pose a major threat to mac...	adversarial attacks pose a major threat to mac...	adversarial attacks pose a major threat to mac...	adversarial attacks pose major threat machine ...	adversarial attacks pose major threat machine ...	adversarial attack pose major threat machine l...	1234	175
4	Guidelines for cyber risk management in shipbo...	['Priyanga Rajaram', 'Mark Goh', 'Jianying Zhou']	Over the past few years, we have seen several ...	over the past few years, we have seen several ...	over the past few years we have seen several c...	past years seen several cyber incidents report...	past years seen several cyber incidents report...	past year see cyber incident report primary ca...	1202	187

In [126]:
```
new['word_count'].iplot(kind = 'hist', colors = 'red', bins=100, xTitle='Word Count', yTitle='Count', title='Word Count Distribution')
```



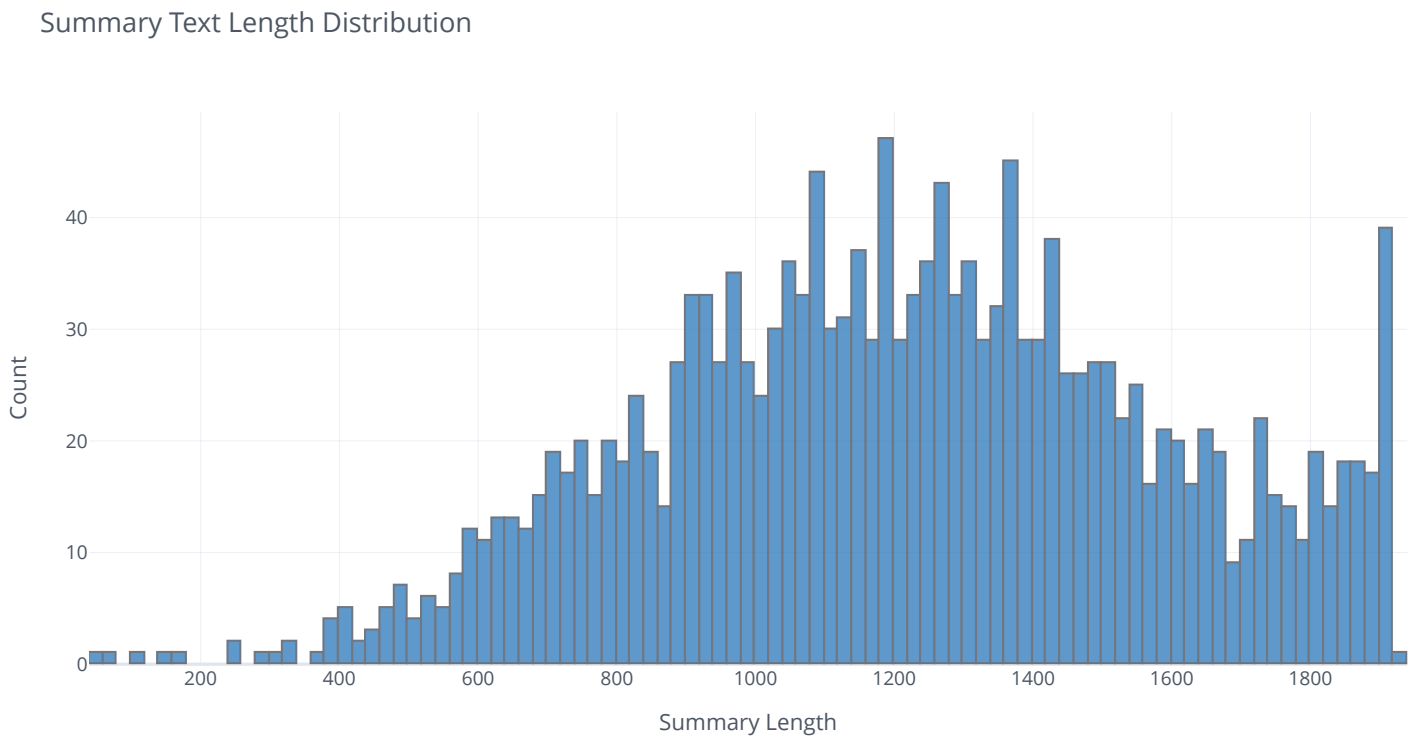
Export to plot.ly »

In [127]:
```
_len'].iplot(kind = 'hist', colors = 'orange', bins=50, xTitle='Average Word Length', yTitle='Count', title='Average Word Length Distribution')
```



Export to plot.ly »

In [128]:
```
ew['summary_len'].iplot(kind='hist', color='blue', bins=100, xTitle='Summary Length', yTitle='Count', title='Summary Text Length Distribution')
```



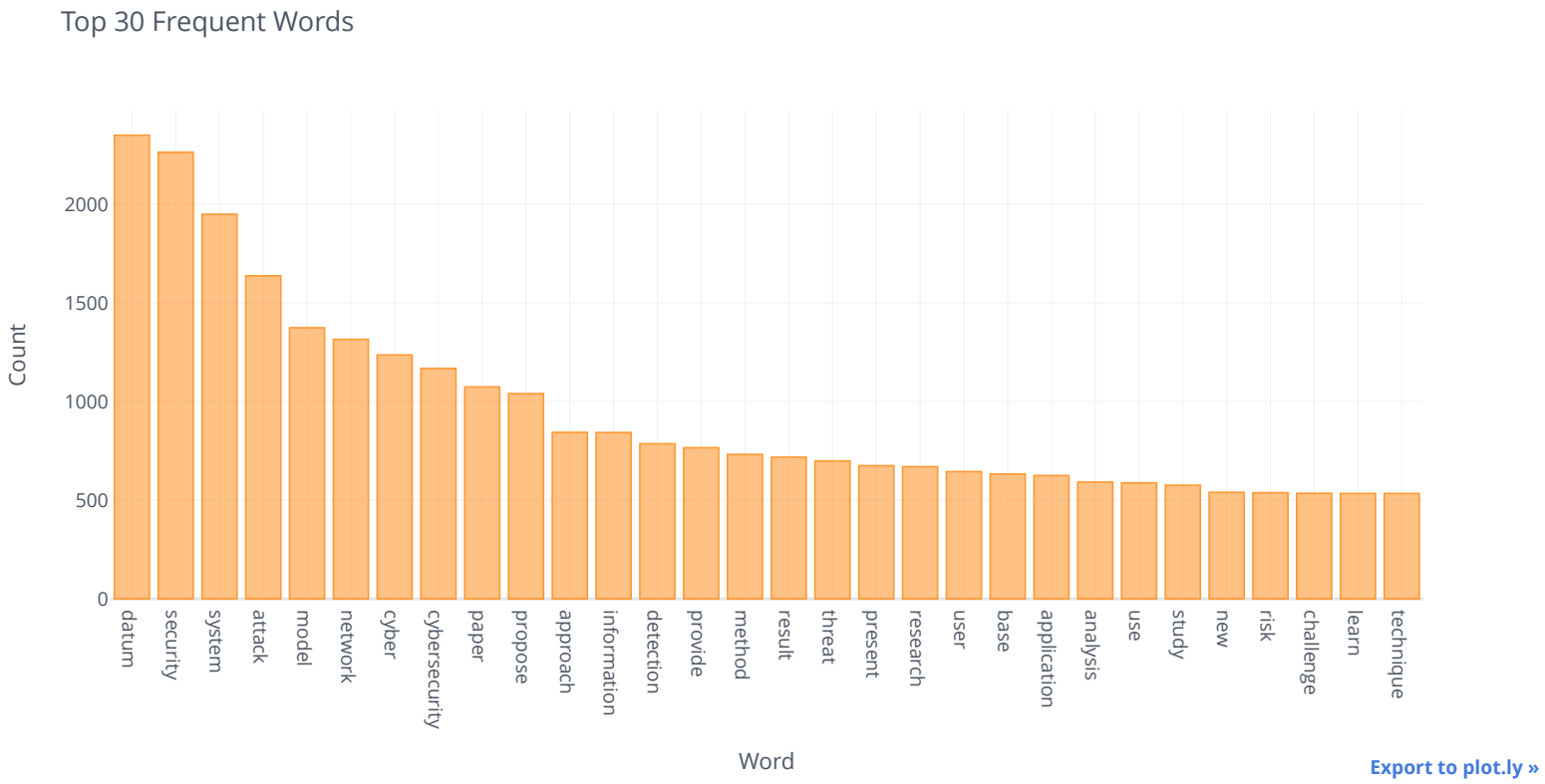
Export to plot.ly »

In [129]:
```
from sklearn.feature_extraction.text import CountVectorizer
```

In [130]:
```
x = new['lemmatized']
vec = CountVectorizer().fit(x)
def get_top_n_words(x, n):
    vec = CountVectorizer().fit(x)
bow=vec.transform(x)
sum_words = bow.sum(axis=0)
words_freq=[(word, sum_words[0, idx]) for word, idx in vec.vocabulary_.items()]
words_freq=sorted(words_freq, key=lambda x: x[1], reverse=True)
words_freq[:30]
```

Out[130]:
```
[('datum', 2349),
 ('security', 2263),
 ('system', 1949),
 ('attack', 1637),
 ('model', 1374),
 ('network', 1315),
 ('cyber', 1236),
 ('cybersecurity', 1168),
 ('paper', 1074),
 ('propose', 1040),
 ('approach', 844),
 ('information', 843),
 ('detection', 786),
 ('provide', 766),
 ('method', 732),
 ('result', 718),
 ('threat', 699),
 ('present', 675),
 ('research', 670),
 ('user', 645),
 ('base', 633),
 ('application', 625),
 ('analysis', 592),
 ('use', 588),
 ('study', 576),
 ('new', 540),
 ('risk', 538),
 ('challenge', 535),
 ('learn', 534),
 ('technique', 534)]
```

In [131]:
```
top_output=pd.DataFrame(words_freq[:30], columns = ['Word', 'Frequency'])
top_output=top_output.set_index('Word')
top_output.iplot(kind='bar', xTitle='Word', yTitle='Count', title='Top 30 Frequent Words')
```



In [132]:
```
sns.pairplot(new)
```

Out[132]: <seaborn.axisgrid.PairGrid at 0x270519f2c70>