Information Retrieval System

CS6370-NLP Project

Team - 20

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In [1]:
```
from util import *
from sentencesegmentation import *
from tokenisation import *
from stopwordremoval import *
from inflectionReduction import *
from informationretrieval import *
from evaluation import *
```

```
[nltk_data] Downloading package omw-1.4 to /home/rishaab/nltk_data...
[nltk_data]   Package omw-1.4 is already up-to-date!
[nltk_data] Downloading package punkt to /home/rishaab/nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package stopwords to
[nltk_data]     /home/rishaab/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package wordnet to /home/rishaab/nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

In [2]:
```
pq=[]
ss=SentenceSegmentation()
tk=Tokenization()
sr=StopwordRemoval()
st=InflectionReduction()
ir=InformationRetrieval()
eva=Evaluation()
```

Read Queries

In [3]:
```
queries_json = json.load(open('./cranfield/'+ "cran_queries.json", 'r'))[:]
query_ids, queries = [item["query number"] for item in queries_json],[item["query"] f
```

Process queries

In [4]:
```
proc_queries=[]
for q in queries:
    ssq=ss.punkt(q)
    tkq=tk.pennTreeBank(ssq)
    srq=sr.fromList(tkq)
    stq=st.reduce(srq)
    proc_queries.append(stq)
```

Read documents

In [5]:
```
docs_json = json.load(open('./cranfield/' + "cran_docs.json", 'r'))[:]
```

```
doc_ids, docs = [item["id"] for item in docs_json],[item["body"] for item in docs_jso
```

Process Documents

```
In [6]: proc_docs=[]
        for d in docs:
            ssd=ss.punkt(d)
            tkd=tk.pennTreeBank(ssd)
            srd=sr.fromList(tkd)
            std=st.reduce(srd)
            proc_docs.append(std)
```

TF_IDF Matrix

```
In [7]: tfidf_docs_df=ir.buildIndex(proc_docs,doc_ids)
```

```
In [11]: tfidf_docs_df.shape
```

```
Out[11]: (1400, 6611)
```

```
In [8]: tfidf_queries_df=ir.tfidfq(proc_queries)
```

Latent Semantic analysis

```
In [28]: lsadocs,lsaw2v=ir.lsa_doc(tfidf_docs_df,500)
```

```
In [29]: lsaqueries,lsaq2v=ir.lsa_query(tfidf_queries_df)
```

Word2Vec Embedding on LSA

```
In [30]: doc_lsa_w2v=ir.w2v(lsaw2v)
```

```
In [31]: q_lsa_w2v=ir.w2v(lsaq2v)
```

Word2Vec embedding standalone

```
In [32]: doc_w2v=ir.w2v(tfidf_docs_df)
         q_w2v=ir.w2v(tfidf_queries_df)
```

Different Models Evaluated

```
In [35]: doc_ord_mod1=ir.rank(doc_ids,tfidf_docs_df,tfidf_queries_df)
```

```
In [34]: doc_ord_mod2=ir.rank(doc_ids,lsadocs,lsaqueries)
```

```
In [33]: doc_ord_mod3=ir.rank(doc_ids,doc_lsa_w2v,q_lsa_w2v)
```

```
In [36]: doc_ord_mod4=ir.rank(doc_ids,doc_w2v,q_w2v)
```

```
In [37]: ev=Evaluation()
```

```
In [38]: qrels = json.load(open('./cranfield/' + "cran_qrels.json", 'r'))[:]
```

Plain VSM TF_IDF Model

```
In [42]: ev.meanAveragePrecision(doc_ord_mod1,query_ids,qrels,10)
```

```
Out[42]: 0.32691764858923683
```

LSA Model

```
In [41]: ev.meanAveragePrecision(doc_ord_mod2,query_ids,qrels,10)
```

```
Out[41]: 0.3328471536867305
```

LSA + Word2Vec

```
In [40]: ev.meanAveragePrecision(doc_ord_mod3,query_ids,qrels,10)
```

```
Out[40]: 0.2512909672215898
```

Word2Vec

```
In [44]: ev.meanAveragePrecision(doc_ord_mod4,query_ids,qrels,10)
```

```
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lookups. To retain the old behavior, use `series.iloc[i:j]`. To get the future behavi
or, use `series.loc[i:j]`.
  for docID in query_doc_IDs_ordered[:k]:
```

```
Out[44]: 0.20479112536927754
```

Finding optimal number of components for LSA and LSA+Word2Vec based on MAP

```
In [45]: def lsa_model(k):
             lsadocs=ir.lsa_doc(tfidf_docs_df,k)[0]
             lsaqueries=ir.lsa_query(tfidf_queries_df)[0]
             doc_ord=ir.rank(doc_ids,lsadocs,lsaqueries)
             return doc_ord,ev.meanAveragePrecision(doc_ord,query_ids,qrels,1)
```

```
In [46]: def lsa_model2(k):
             lsadocs=ir.lsa_doc(tfidf_docs_df,k)[1]
             lsaqueries=ir.lsa_query(tfidf_queries_df)[1]
             lsa_w2v=ir.w2v(lsadocs)
             q_w2v=ir.w2v(lsaqueries)
             doc_ord=ir.rank(doc_ids,lsa_w2v,q_w2v)
             return doc_ord,ev.meanAveragePrecision(doc_ord,query_ids,qrels,1)
```

```
In [47]: order=[]
         MAP=[]
         for i in range(100,3100,100):
             o,m = lsa_model(i)
             order.append(o)
             MAP.append(m)
```

```
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lookups. To retain the old behavior, use `series.iloc[i:j]`. To get the future behavi
or, use `series.loc[i:j]`.
  for docID in query_doc_IDs_ordered[:k]:
```
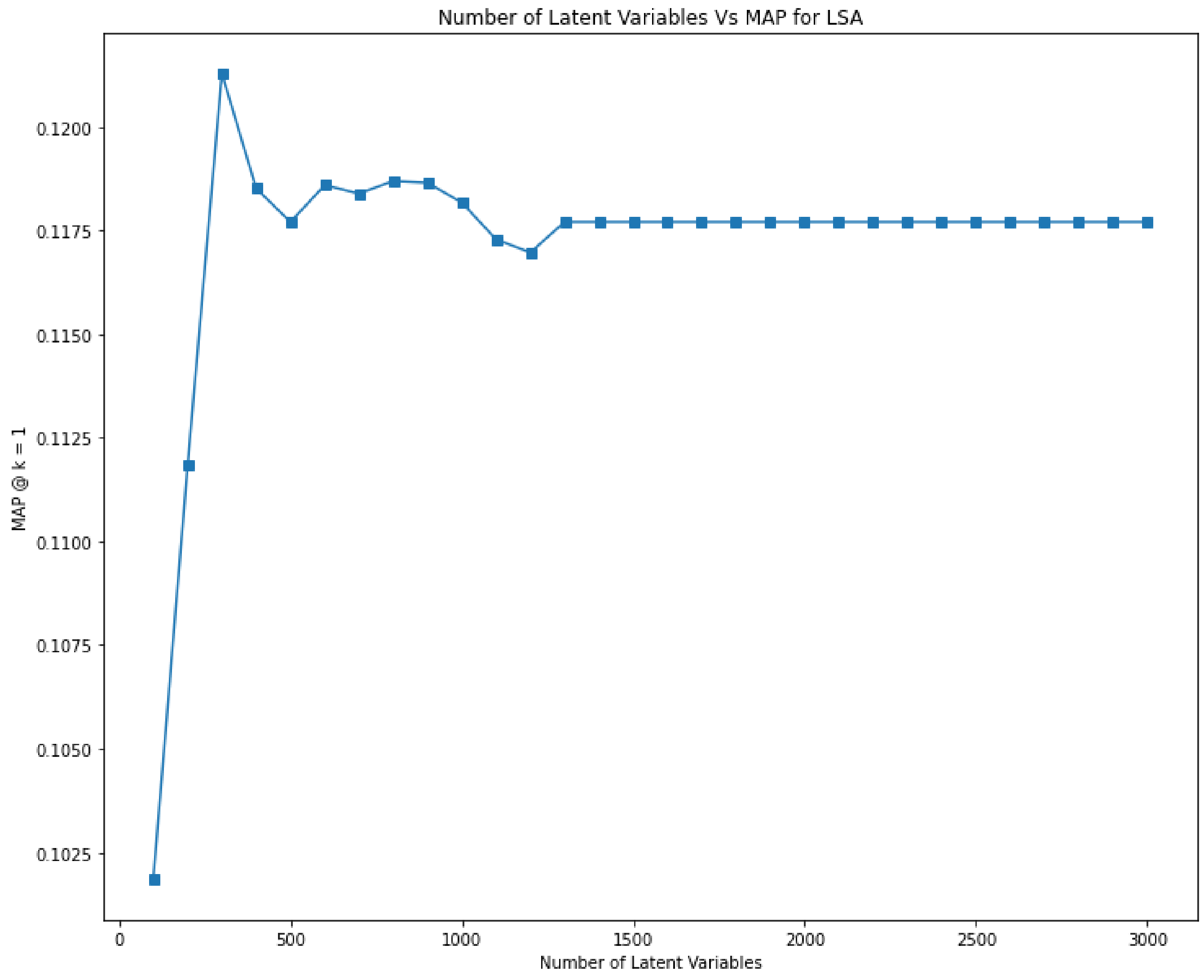

In [55]:

```
plt.figure(figsize=[12,10])
plt.plot(range(100,3100,100),MAP,'-s')
plt.title('Number of Latent Variables Vs MAP for LSA')
plt.xlabel('Number of Latent Variables')
plt.ylabel('MAP @ k = 1')
plt.show()
```



```
In [49]: order2=[]
         MAP2=[]
         for i in range(100,3100,100):
             o,m = lsa_model2(i)
             order2.append(o)
             MAP2.append(m)
```

```
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lookups. To retain the old behavior, use `series.iloc[i:j]`. To get the future behavi
or, use `series.loc[i:j]`.
  for docID in query_doc_IDs_ordered[:k]:
```
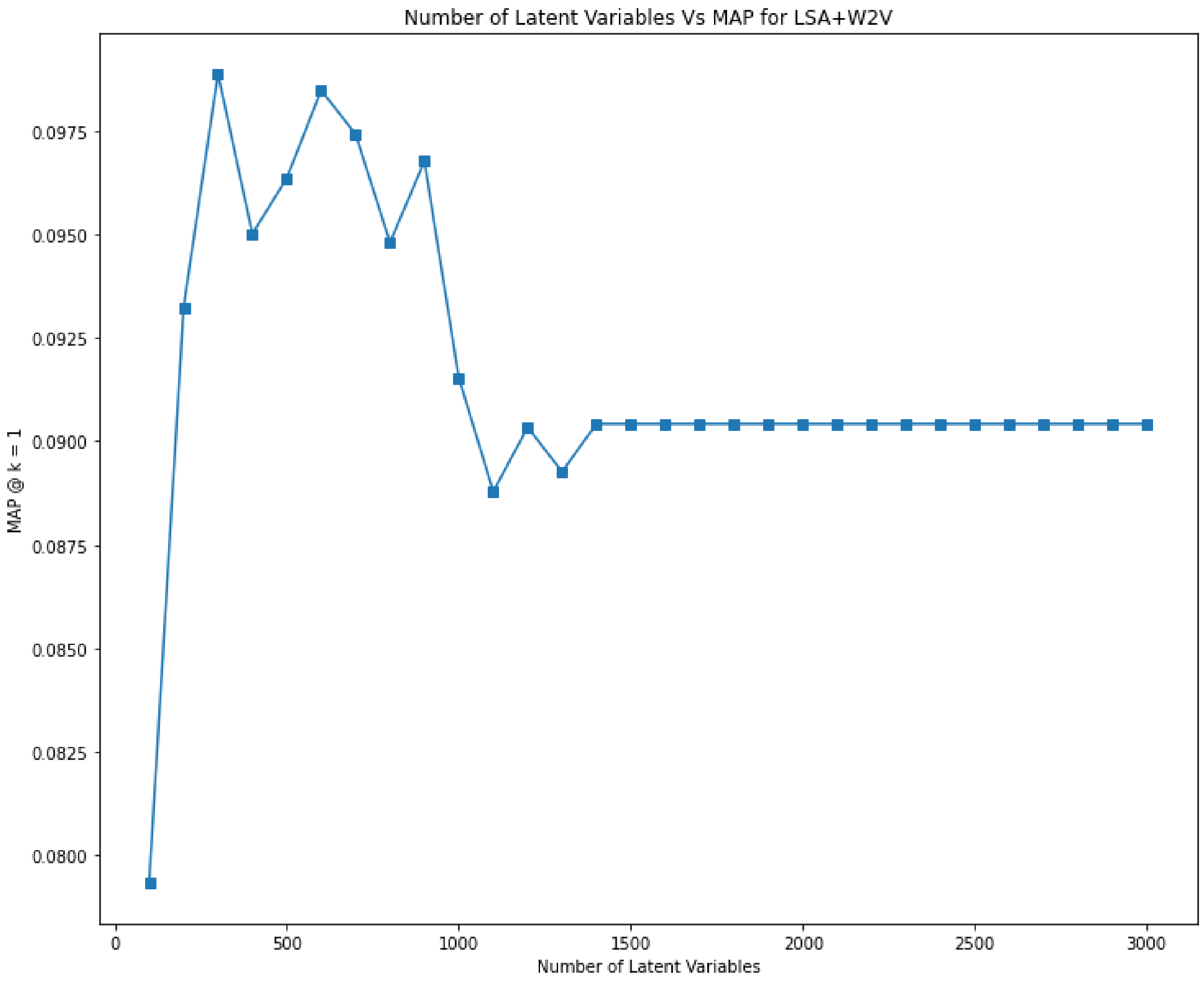

In [54]:

```
plt.figure(figsize=[12,10])
plt.plot(range(100,3100,100),MAP2,'-s')
plt.title('Number of Latent Variables Vs MAP for LSA+W2V')
plt.xlabel('Number of Latent Variables')
plt.ylabel('MAP @ k = 1')
plt.show()
```



Functions to plot different Evaluation metrics

```
In [51]: def eval_met(doc_ord_mod1):
             prec=[]
             meanap=[]
             meanFscore=[]
             meanrecall=[]
             nDCG=[]
             for i in range(1,20):
                 prec.append(ev.meanPrecision(doc_ord_mod1,query_ids,qrels,i))
                 meanap.append(ev.meanAveragePrecision(doc_ord_mod1,query_ids,qrels,i))
                 meanFscore.append(ev.meanFscore(doc_ord_mod1,query_ids,qrels,i))
                 meanrecall.append(ev.meanRecall(doc_ord_mod1,query_ids,qrels,i))
                 nDCG.append(ev.meanNDCG(doc_ord_mod1,query_ids,qrels,i))
             model1=pd.DataFrame({'Precision':prec,'MaP':meanap,"meanFscore":meanFscore,'meanr
             return model1
```

```
In [59]: def plot_model(df,title):
             plt.figure(figsize=[12,10])
             for i in df.columns:
                 plt.plot(range(1,20),df[i],label=i)
                 plt.legend()
                 plt.xlabel("k")
                 plt.title(title)
```

VSM-TF_IDF

```
In [56]: model1=eval_met(doc_ord_mod1)
```

```
/home/rishaab/Desktop/SEM8/CS6370/project/Code/evaluation.py:32: FutureWarning: The b
ehavior of `series[i:j]` with an integer-dtype index is deprecated. In a future versi
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lookups. To retain the old behavior, use `series.iloc[i:j]`. To get the future behavi
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  for docID in query_doc_IDs_ordered[:k]:
/home/rishaab/Desktop/SEM8/CS6370/project/Code/evaluation.py:118: FutureWarning: The
behavior of `series[i:j]` with an integer-dtype index is deprecated. In a future vers
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lookups. To retain the old behavior, use `series.iloc[i:j]`. To get the future behavi
or, use `series.loc[i:j]`.
  for docID in query_doc_IDs_ordered[:k]:
```
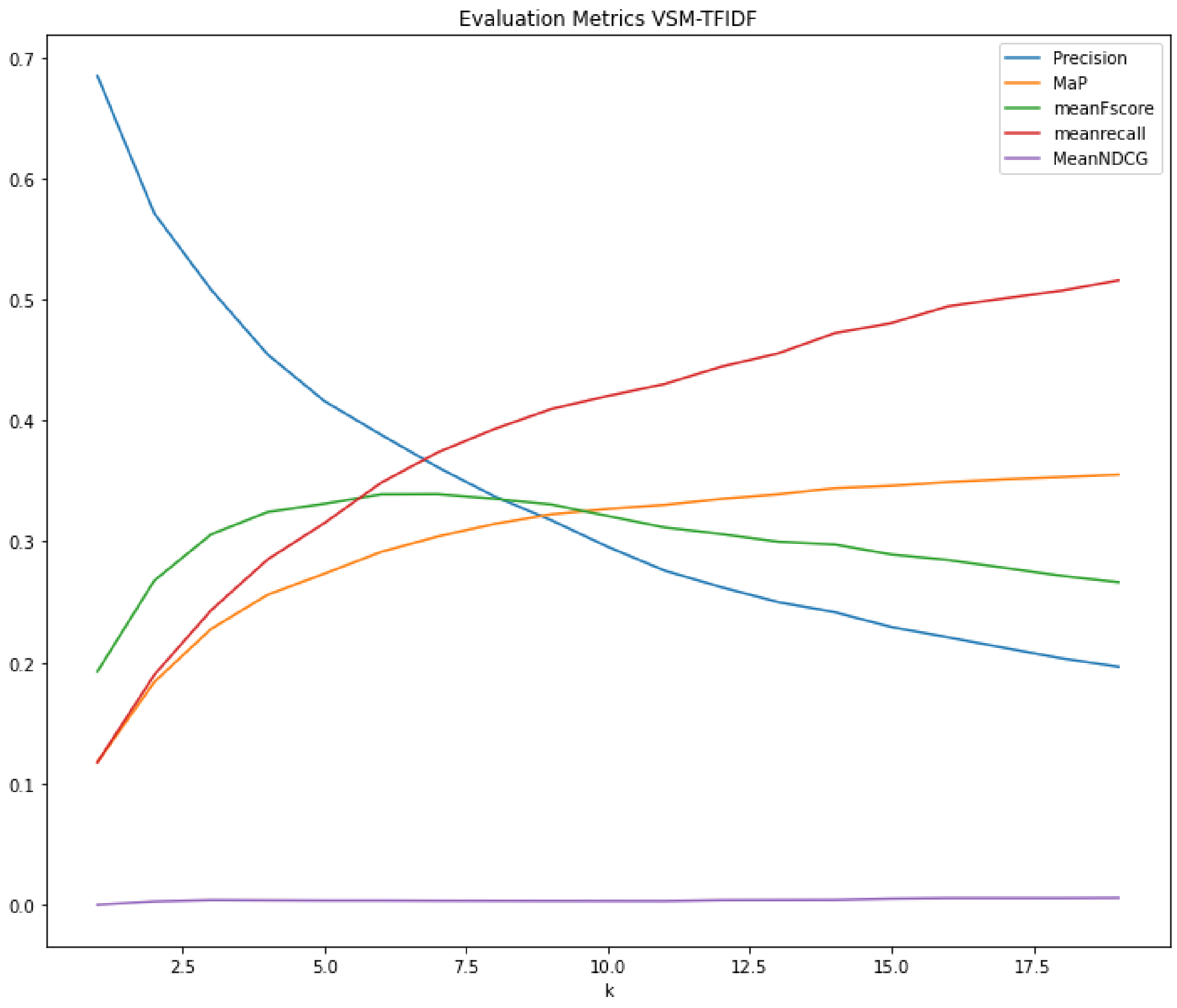
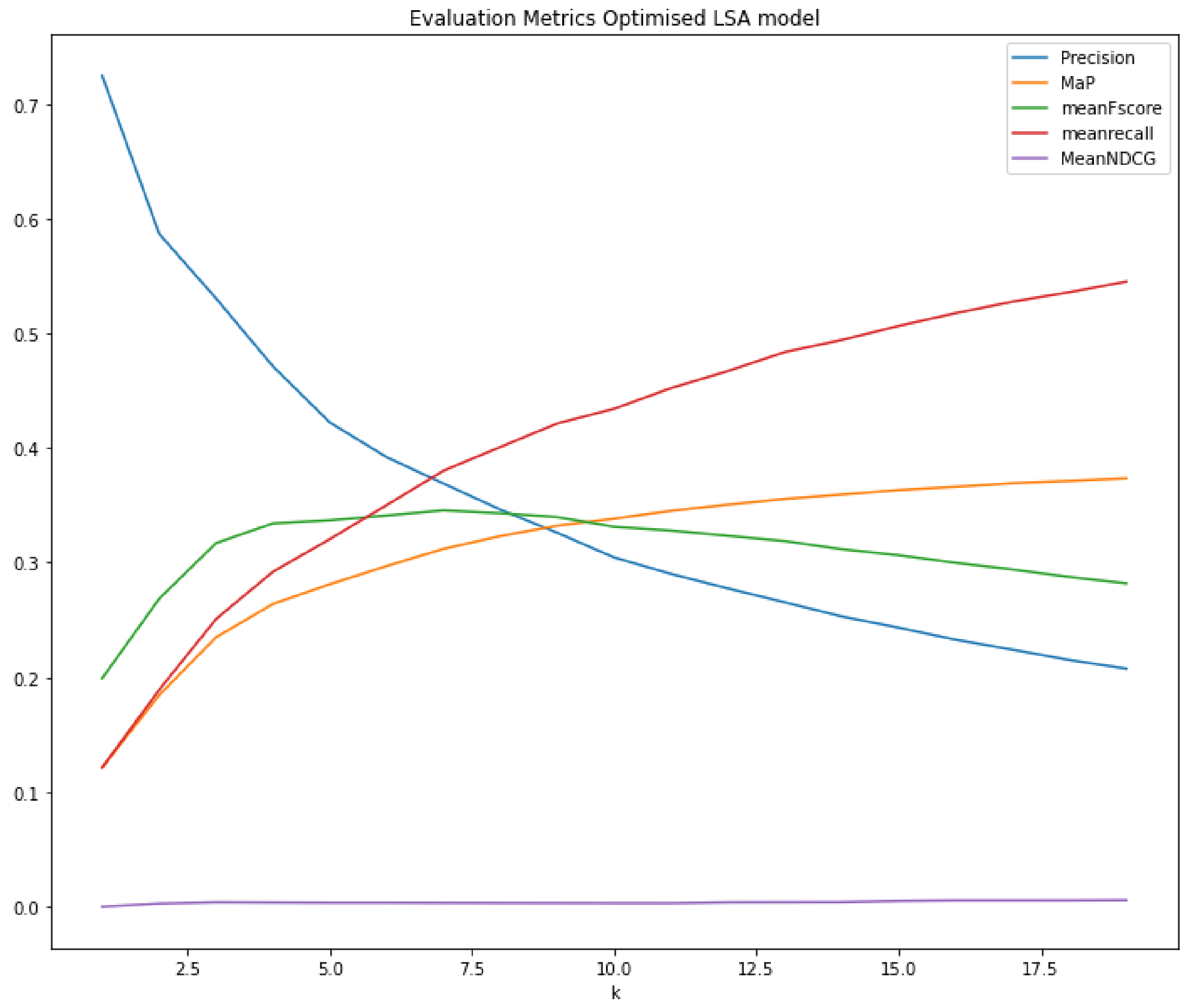

In [60]:
```
plot_model(model1,'Evaluation Metrics VSM-TFIDF')
```



LSA

In [61]:
```
doc_ord_opt_lsa=order[2]
eval_model_opt_lsa=eval_met(doc_ord_opt_lsa)
```

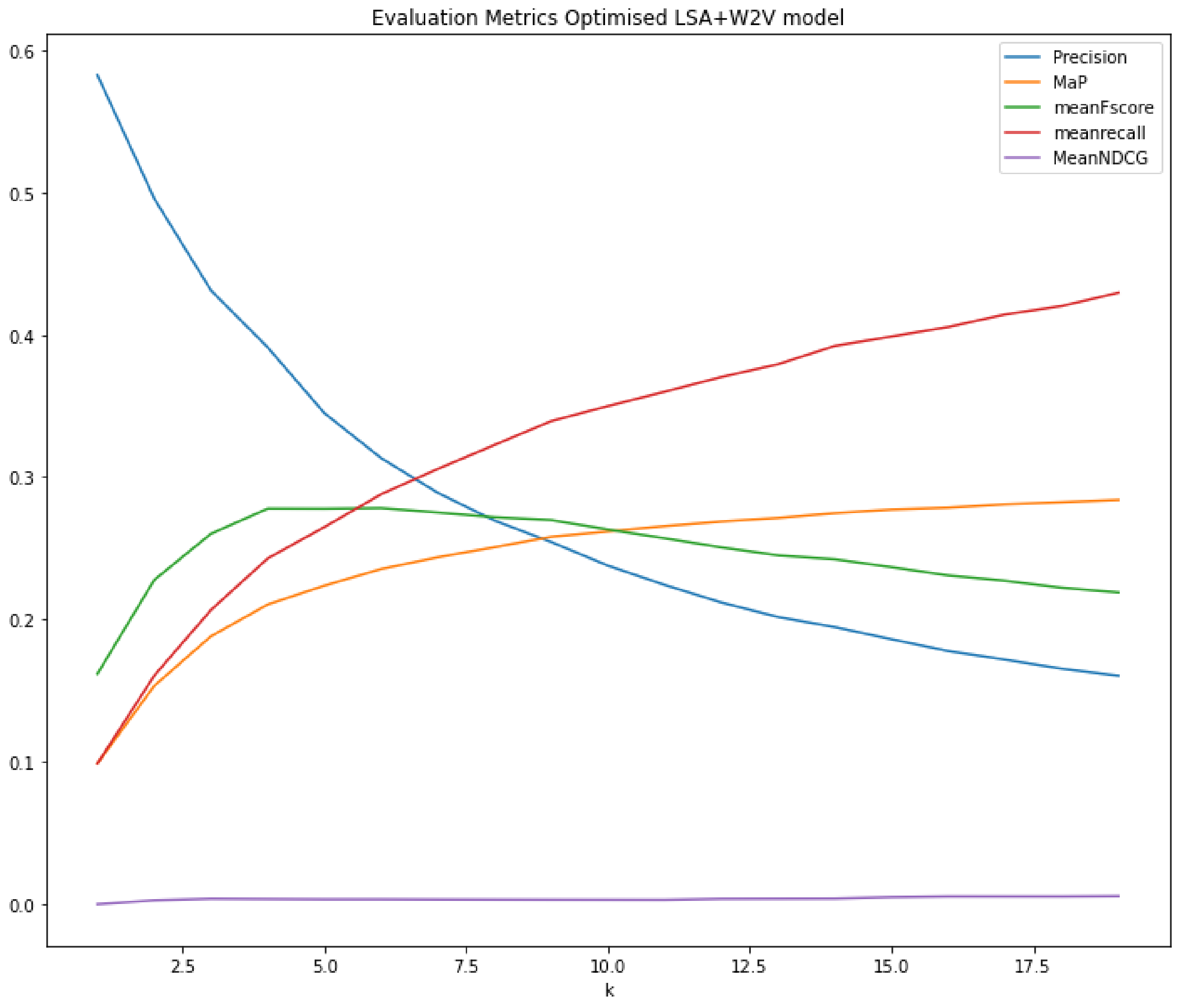
In [62]:
```
plot_model(eval_model_opt_lsa,'Evaluation Metrics Optimised LSA model')
```



LSA + Word2Vec

```
In [65]: eval_lsa_w2v_opt=eval_met(order2[2])
```

```
In [66]: plot_model(eval_lsa_w2v_opt,'Evaluation Metrics Optimised LSA+W2V model')
```



Word 2 Vec

In [69]:
```
w2v_eval=eval_met(doc_ord_mod4)
plot_model(w2v_eval,'Evaluation Metrics W2V Model')
```

```
/home/rishaab/Desktop/SEM8/CS6370/project/Code/evaluation.py:32: FutureWarning: The b
ehavior of `series[i:j]` with an integer-dtype index is deprecated. In a future versi
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  for docID in query_doc_IDs_ordered[:k]:
```

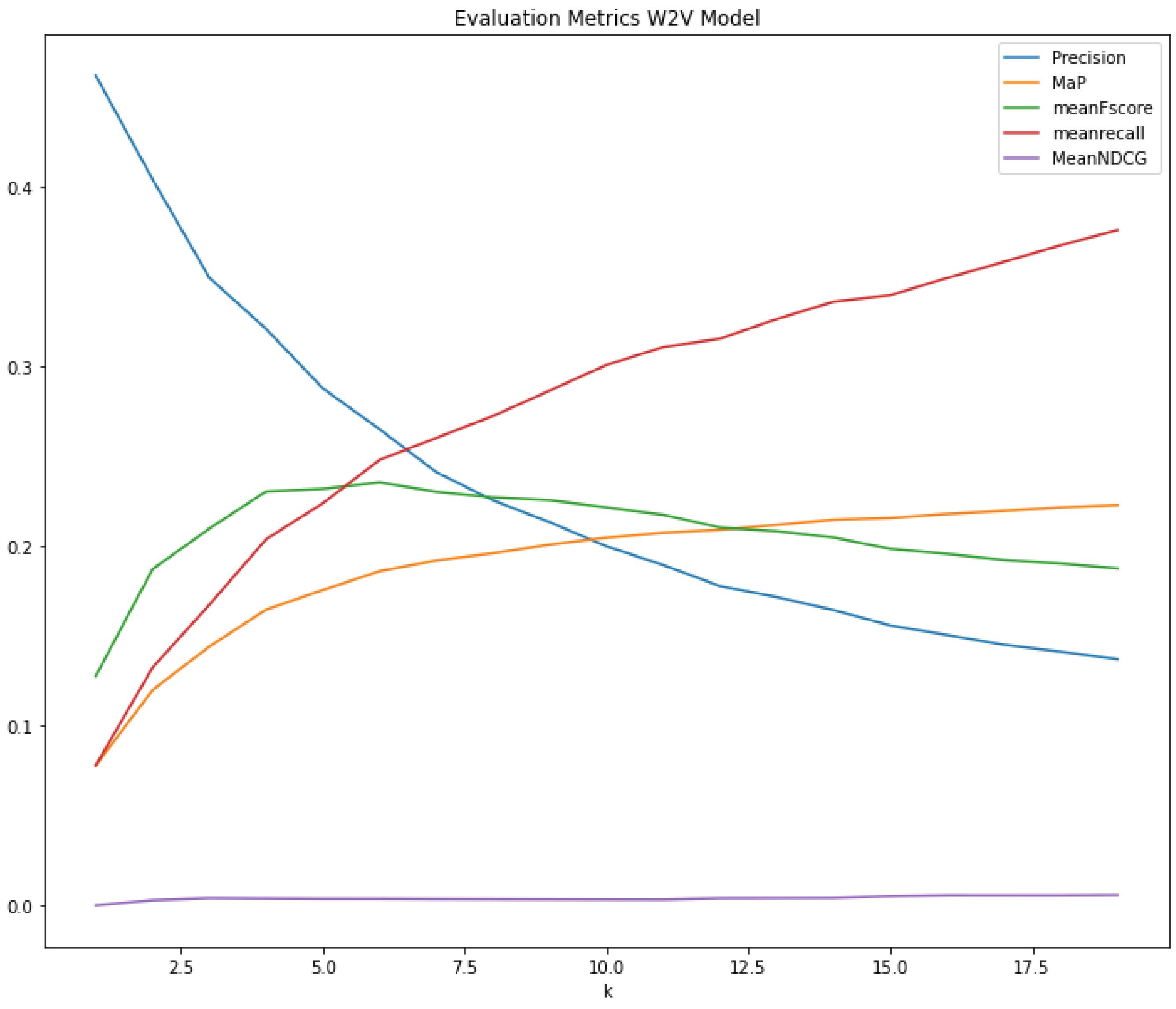

Results

```
In [82]: results=pd.concat([model1.iloc[9:10],eval_model_opt_lsa[9:10],eval_lsa_w2v_opt[9:10],
         results['Model']=['TFIDF',"LSA","LSA+W2V","W2V"]
         results.set_index('Model',inplace=True)
```

```
In [84]: print('The Evaluation Metric values @ k=10')
         print(results)
```

```
The Evaluation Metric values @ k=10
          Precision       MaP  meanFscore  meanrecall  MeanNDCG
Model
TFIDF      0.295556  0.326918    0.321014    0.420230  0.003142
LSA        0.304444  0.338259    0.331191    0.434138  0.003142
LSA+W2V    0.237778  0.261831    0.263169    0.349854  0.003142
W2V        0.200000  0.204791    0.221611    0.301034  0.003142
```