Knowledge_Graph

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1 Assignment-2

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2 Question

Download the dataset provided in this webpage. Follow the instructions in the page and create a knowledge graph. Identify the important personalities and locations based on PageRank and Betweenness centrality.

3 Setup

[1]:

```
import re
import pandas as pd
import bs4
import requests
import spacy
from spacy import displacy
nlp = spacy.load('en_core_web_sm')

from spacy.matcher import Matcher
from spacy.tokens import Span

import networkx as nx
from networkx.algorithms.link_analysis.pagerank_alg import pagerank
from networkx.algorithms.centrality import betweenness_centrality

import matplotlib.pyplot as plt
from tqdm import tqdm

pd.set_option('display.max_colwidth', 200)
%matplotlib inline
```

[2]:

```
# import wikipedia sentences
candidate_sentences = pd.read_csv("wiki_sentences_v2.csv")
candidate_sentences.shape
```

```
[2]: (4318, 1)
```

4 Extract Entities (Subject & Object)

```
[3]: def get_entities(sent):

         # Finding named entities in sent
         doc = nlp(sent)
         entity_names = [ent.text for ent in doc.ents]
         entity_labels = [ent.label_ for ent in doc.ents]
         ## chunk 1
         ent1 = ""
         ent2 = ""

         prv_tok_dep = ""    # dependency tag of previous token in the sentence
         prv_tok_text = ""   # previous token in the sentence

         prefix = ""
         modifier = ""

         #############################################################

         for tok in nlp(sent):
             ## chunk 2
             # if token is a punctuation mark then move on to the next token
             if tok.dep_ != "punct":
                 # check: token is a compound word or not
                 if tok.dep_ == "compound":
                     prefix = tok.text
                     # if the previous word was also a 'compound' then add the␣
       ↪current word to it
                     if prv_tok_dep == "compound":
                         prefix = prv_tok_text + " "+ tok.text

             # check: token is a modifier or not
             if tok.dep_.endswith("mod") == True:
                 modifier = tok.text
                 # if the previous word was also a 'compound' then add the current␣
       ↪word to it
                 if prv_tok_dep == "compound":
                     modifier = prv_tok_text + " "+ tok.text

             ## chunk 3
             if tok.dep_.find("subj") == True:
                 ent1 = modifier +" "+ prefix + " "+ tok.text
                 prefix = ""
```

```
            modifier = ""
            prv_tok_dep = ""
            prv_tok_text = ""

        ## chunk 4
        if tok.dep_.find("obj") == True:
            ent2 = modifier +" "+ prefix +" "+ tok.text

        ## chunk 5
        # update variables
        prv_tok_dep = tok.dep_
        prv_tok_text = tok.text

    #############################################################
    for element in ent1.split(" "):
        entity_type_1 = 'None'
        if element in entity_names:
            index = entity_names.index(element)
            ent_label = entity_labels[index]
            if ent_label == 'NORP':
                entity_type_1 = 'Personality'
            elif ent_label == 'GPE':
                entity_type_1 = 'Location'

    for element in ent2.split(" "):
        entity_type_2 = 'None'
        if element in entity_names:
            index = entity_names.index(element)
            ent_label = entity_labels[index]
            if ent_label == 'NORP' or ent_label == 'ORG':
                entity_type_2 = 'Personality'
            elif ent_label == 'GPE':
                entity_type_2 = 'Location'

    return ((ent1.strip(), entity_type_1), (ent2.strip(), entity_type_2))
```

[4]:

```
# Extract entity pairs from each sentence
entity_pairs = []
entity_types = {}

for i in tqdm(candidate_sentences["sentence"]):
    entity_1, entity_2 = get_entities(i)
    entity_pairs.append([entity_1[0], entity_2[0]])
    entity_types[entity_1[0]] = entity_1[1]
    entity_types[entity_2[0]] = entity_2[1]
```

```
100%|                     | 4318/4318 [00:40<00:00, 105.88it/s]
```

5 Extract Relations (Verbs)

[5]:

```
def get_relation(sent):

    doc = nlp(sent)

    # Matcher class object
    matcher = Matcher(nlp.vocab)

    #define the pattern
    pattern = [{'DEP':'ROOT'},
            {'DEP':'prep','OP':"?"},
            {'DEP':'agent','OP':"?"},
            {'POS':'ADJ','OP':"?"}]

    matcher.add("matching_1", [pattern], on_match=None)

    matches = matcher(doc)
    k = len(matches) - 1

    span = doc[matches[k][1]:matches[k][2]]

    return(span.text)
```

[6]:

```
# Extract relations from each sentence
relations = [get_relation(i) for i in tqdm(candidate_sentences['sentence'])]
```

```
100%|                    | 4318/4318 [00:20<00:00, 209.31it/s]
```

[7]:

```
# extract subject
source = [i[0] for i in entity_pairs]

# extract object
target = [i[1] for i in entity_pairs]

kg_df = pd.DataFrame({'source':source, 'target':target, 'edge':relations,
                      'source_type':[entity_types[x] for x in source],
                      'target_type':[entity_types[x] for x in target]})
```

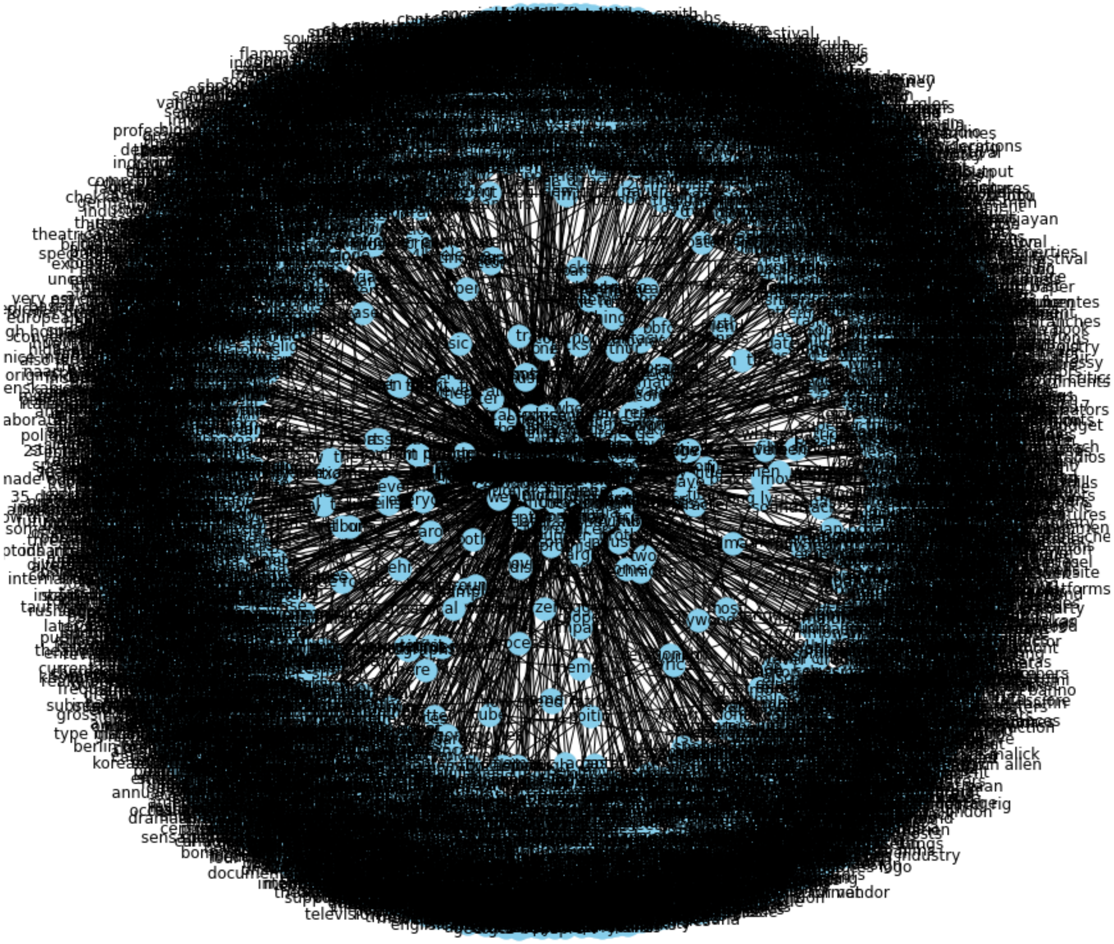
6 Plot Knowledge Graph

[8]:

```
# create a directed-graph from a dataframe
G=nx.from_pandas_edgelist(kg_df, "source", "target",
                          edge_attr=True, create_using=nx.DiGraph())
nx.set_node_attributes(G, values = entity_types, name='type')
```

```python
plt.figure(figsize=(12,12))

pos = nx.spring_layout(G)
nx.draw(G, with_labels=True, node_color='skyblue', edge_cmap=plt.cm.Blues, pos = pos)
plt.show()
```



[9]:
```python
# Betweenness Centrality
bn = betweenness_centrality(G)
bn = sorted(bn.items(), key=lambda item: item[1], reverse = True)
```

[10]:

```
# Top entities considering all kinds of nodes
print("Top 10 entites based on Betweenness centrality:")
bn[:10]
```

```
Top 10 entites based on Betweenness centrality:
```

[10]:

```
[('film', 0.001440642260991783),
 ('', 0.0013697462228097347),
 ('it', 0.0005731280424664372),
 ('this', 0.0003816507974873087),
 ('that', 0.00028048012303545964),
 ('music', 0.0001271824432769614),
 ('eilis', 0.00010396430117530981),
 ('films', 0.00010019807848145902),
 ('sequel', 7.718687169265637e-05),
 ('soundtrack', 7.577971156528355e-05)]
```

[11]:

```
# Pagerank Centrality
pr = pagerank(G)
pr = sorted(pr.items(), key=lambda item: item[1], reverse = True)
```

[12]:

```
# Top entities considering all kinds of nodes
print("Top 10 entites based on Page Rank centrality:")
pr[:10]
```

```
Top 10 entites based on Page Rank centrality:
```

[12]:

```
[('', 0.006427768843810376),
 ('film', 0.0036383935101247703),
 ('him', 0.0017784284109153136),
 ('it', 0.0017402905854115589),
 ('that', 0.0012468549227105698),
 ('december', 0.0011080809791448347),
 ('time', 0.0010417619936354497),
 ('april', 0.0010308549358775672),
 ('them', 0.0010217986208158698),
 ('november', 0.0009868703651856783)]
```

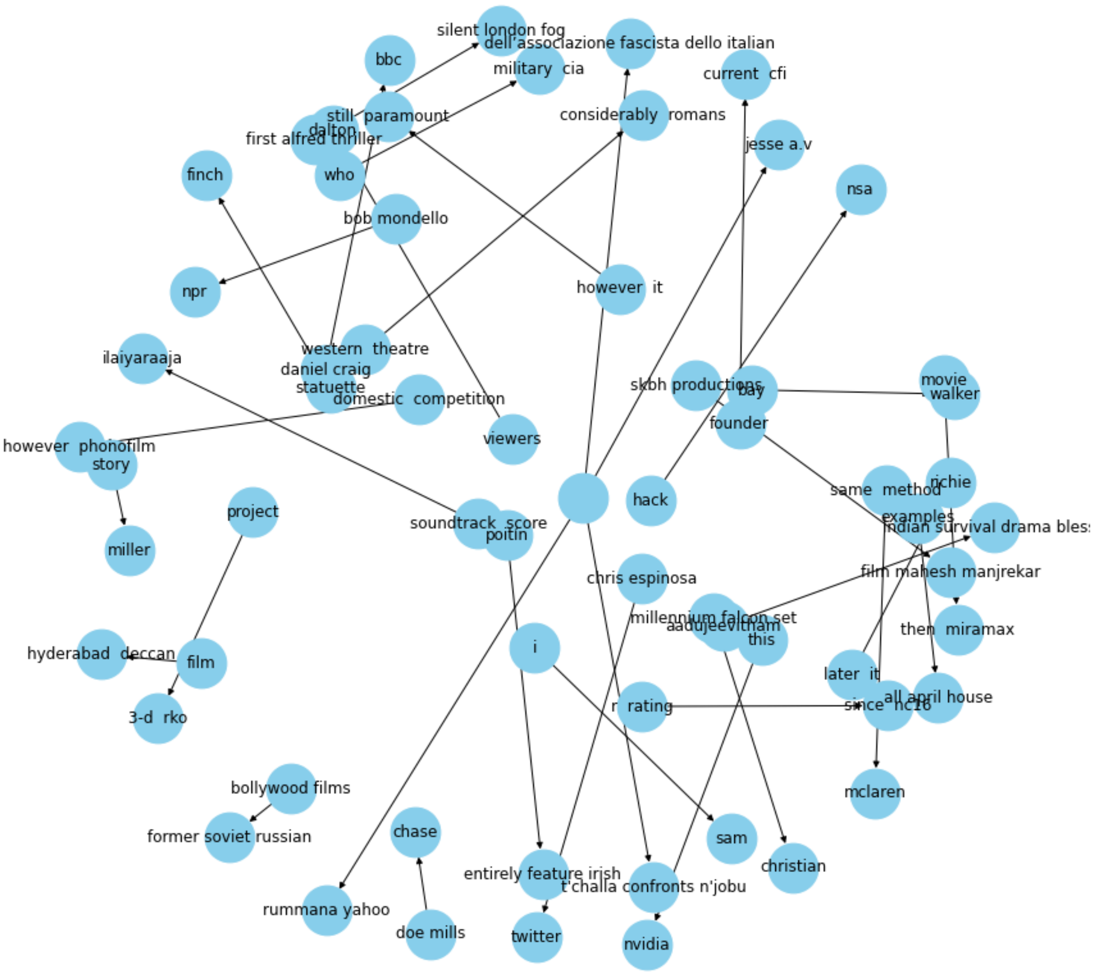
7 Plotting Sub Graphs

7.1 Personality Entites

[13]:

```
# Plotting relations with target "Personality" Entites only
G=nx.from_pandas_edgelist(kg_df[kg_df['target_type']=="Personality"], "source",␣
 ↪"target",
                          edge_attr=True, create_using=nx.DiGraph())
```

```
plt.figure(figsize=(12,12))
pos = nx.spring_layout(G, k = 0.5) # k regulates the distance between nodes
nx.draw(G, with_labels=True, node_color='skyblue', node_size=1500,␣
 ↪edge_cmap=plt.cm.Blues, pos = pos)
plt.show()
```



[14]:
```
# Betweenness Centrality
bn = betweenness_centrality(G)
bn = sorted(bn.items(), key=lambda item: item[1], reverse = True)
```

[15]:
```
# Top entities
print("Top 10 entites based on Betweenness centrality:")
bn[:10]
```

```
Top 10 entites based on Betweenness centrality:
```

```
[15]: [('examples', 0.0),
       ('all april house', 0.0),
       ('first alfred thriller', 0.0),
       ('silent london fog', 0.0),
       ('same  method', 0.0),
       ('mclaren', 0.0),
       ('story', 0.0),
       ('miller', 0.0),
       ('western  theatre', 0.0),
       ('considerably  romans', 0.0)]
```

```
[16]: # Pagerank Centrality
      pr = pagerank(G)
      pr = sorted(pr.items(), key=lambda item: item[1], reverse = True)
```

```
[17]: # Top entities
      print("Top 10 entites based on Page Rank centrality:")
      pr[:10]
```

```
Top 10 entites based on Page Rank centrality:
```

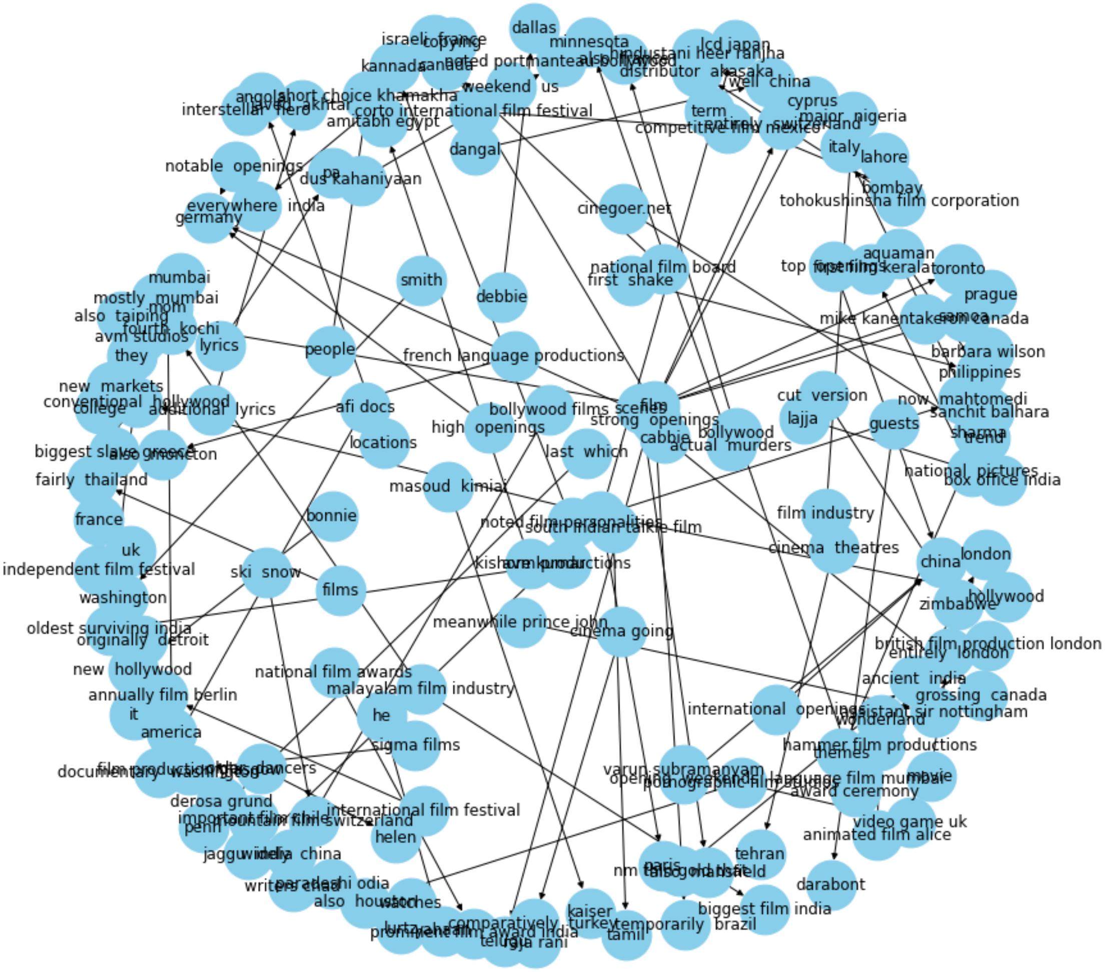
```
[17]: [('all april house', 0.020252015364126713),
       ('silent london fog', 0.020252015364126713),
       ('mclaren', 0.020252015364126713),
       ('miller', 0.020252015364126713),
       ('considerably  romans', 0.020252015364126713),
       ('film mahesh manjrekar', 0.020252015364126713),
       ('ilaiyaraaja', 0.020252015364126713),
       ('indian survival drama blessy', 0.020252015364126713),
       ('3-d  rko', 0.020252015364126713),
       ('nvidia', 0.020252015364126713)]
```

7.2 Location Entities

```
[18]: # Plotting relations with target "Location" Entites only

      G=nx.from_pandas_edgelist(kg_df[kg_df['target_type']=="Location"], "source",␣
       ↪"target",
                                  edge_attr=True, create_using=nx.DiGraph())

      plt.figure(figsize=(12,12))
      pos = nx.spring_layout(G, k = 0.5)
      nx.draw(G, with_labels=True, node_color='skyblue', node_size=1500,␣
       ↪edge_cmap=plt.cm.Blues, pos = pos)
      plt.show()
```



[19]:
```
# Betweenness Centrality
bn = betweenness_centrality(G)
bn = sorted(bn.items(), key=lambda item: item[1], reverse = True)
```

[20]:
```
# Top entities
print("Top 10 entites based on Betweenness centrality:")
bn[:10]
```

```
Top 10 entites based on Betweenness centrality:
```

[20]:
```
[('last  which', 0.0),
 ('penn', 0.0),
 ('', 0.0),
 ('paris', 0.0),
 ('national film awards', 0.0),
 ('prominent film award india', 0.0),
 ('new  markets', 0.0),
 ('france', 0.0),
 ('first  shake', 0.0),
 ('philippines', 0.0)]
```

```
[21]: # Pagerank Centrality
      pr = pagerank(G)
      pr = sorted(pr.items(), key=lambda item: item[1], reverse = True)
```

```
[22]: # Top entities
      print("Top 10 entites based on Page Rank centrality:")
      pr[:10]
```

```
Top 10 entites based on Page Rank centrality:
```

```
[22]: [('china', 0.015596634939584221),
       ('germany', 0.015596634939584221),
       ('philippines', 0.011862369818150255),
       ('oldest surviving india', 0.011862369818150255),
       ('washington', 0.009372859737194277),
       ('penn', 0.00812810469671629),
       ('prominent film award india', 0.00812810469671629),
       ('france', 0.00812810469671629),
       ('video game uk', 0.00812810469671629),
       ('uk', 0.00812810469671629)]
```