dataset_intro

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1 Dataset Introduction - the Project Knowledge Graph

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1.1 1. Overview

- The knowledge graph is
  - mainly about **movies**,
  - derived from **Wikidata**,
  - **directed** and **connected**.
- Entities (movies, people, etc.)
  - common properties
    - **labels** (rdfs:label)
    - **types** (wd:P31)
    - **descriptions** (schema:description)
  - namespace:
    - **wikidata_entity**(http://www.wikidata.org/entity/);
- Predicates
  - common properties
    - **labels** (rdfs:label)
    - **descriptions** (schema:description)
  - namespaces:
    - **wikidata_property**(http://www.wikidata.org/prop/direct/)
    - **schema.org**(http://schema.org/)
    - **ddis.ch**(http://ddis.ch/atai/)
    - **rdfs**(http://www.w3.org/2000/01/rdf-schema#)
- Literal types in the graph (for some entities):
  - entity/predicate labels
  - descriptions
  - IMDb ratings
  - box office values
  - publication dates
  - WikiCommons image URLs
  - user-defined tags
- Linked external datasets (for some entities):
  - movie plot descriptions from MPST and OMDb,
  - textual user reviews from LMRD,

- images of movies (e.g., posters) and people (e.g., still images) from MovieNet;

The dataset is published at https://files.ifi.uzh.ch/ddis/teaching/2023/ATAI/dataset/

1.2 2. Data Analysis

1.2.1 2.1 Load the data

[1]:

```
!pip install rdflib
!pip install networkx
!pip install pandas
!pip install plotly
```

```
Requirement already satisfied: rdflib in /home/rosni/.local/lib/python3.8/site-
packages (7.0.0)
Requirement already satisfied: isodate<0.7.0,>=0.6.0 in
/home/rosni/.local/lib/python3.8/site-packages (from rdflib) (0.6.1)
Requirement already satisfied: pyparsing<4,>=2.1.0 in
/home/rosni/.local/lib/python3.8/site-packages (from rdflib) (3.0.9)
Requirement already satisfied: six in /usr/lib/python3/dist-packages (from
isodate<0.7.0,>=0.6.0->rdflib) (1.14.0)
Requirement already satisfied: networkx in
/home/rosni/.local/lib/python3.8/site-packages (2.6.3)
Requirement already satisfied: pandas in /home/rosni/.local/lib/python3.8/site-
packages (1.5.1)
Requirement already satisfied: python-dateutil>=2.8.1 in
/usr/local/lib/python3.8/dist-packages (from pandas) (2.8.2)
Requirement already satisfied: numpy>=1.20.3; python_version < "3.10" in
/home/rosni/.local/lib/python3.8/site-packages (from pandas) (1.24.4)
Requirement already satisfied: pytz>=2020.1 in
/home/rosni/.local/lib/python3.8/site-packages (from pandas) (2023.3.post1)
Requirement already satisfied: six>=1.5 in /usr/lib/python3/dist-packages (from
python-dateutil>=2.8.1->pandas) (1.14.0)
Requirement already satisfied: plotly in /home/rosni/.local/lib/python3.8/site-
packages (5.5.0)
Requirement already satisfied: tenacity>=6.2.0 in
/home/rosni/.local/lib/python3.8/site-packages (from plotly) (8.0.1)
Requirement already satisfied: six in /usr/lib/python3/dist-packages (from
plotly) (1.14.0)
```

[2]:

```
from rdflib.namespace import Namespace, RDF, RDFS, XSD
from rdflib.term import URIRef, Literal
import csv
import json
import networkx as nx
import pandas as pd
import rdflib
from collections import defaultdict, Counter
import locale
```

```
_ = locale.setlocale(locale.LC_ALL, '')
from _plotly_future_ import v4_subplots
from plotly.offline import download_plotlyjs, init_notebook_mode, plot, iplot
import plotly.graph_objs as go
init_notebook_mode(connected=True)
import plotly.io as pio
pio.renderers.default = 'jupyterlab+svg'
```

[3]:

```
graph = rdflib.Graph()
graph.parse('./14_graph.nt', format='turtle')
```

[3]:

```
<Graph identifier=Nc68458c89d18409a99e37e10c1720aad (<class
'rdflib.graph.Graph'>)>
```

1.2.2 2.2 Graph Statistics

[4]:

```
# prefixes used in the graph
WD = Namespace('http://www.wikidata.org/entity/')
WDT = Namespace('http://www.wikidata.org/prop/direct/')
SCHEMA = Namespace('http://schema.org/')
DDIS = Namespace('http://ddis.ch/atai/')
```

[5]:

```
entities = set(graph.subjects()) | {s for s in graph.objects() if isinstance(s,␣
 ↪URIRef)}
predicates = set(graph.predicates())
literals = {s for s in graph.objects() if isinstance(s, Literal)}
with_type = set(graph.subjects(WDT['P31'], None))
with_super = set(graph.subjects(WDT['P279'], None))
types = set(graph.objects(None, WDT['P31']))
supers = set(graph.objects(None, WDT['P279']))
with_label = set(graph.subjects(RDFS.label, None))

n_ents = len(entities)
n_rels = len(predicates)
n_lits = len(literals)
t_tot = len(graph)
t_ent = len([1 for s,p,o in graph.triples((None, None, None)) if isinstance(o,␣
 ↪URIRef)])
t_lit = t_tot - t_ent
n_notype = len(entities - with_type - with_super)
n_notype_flt = len(entities - with_type - with_super - types - supers)

pd.DataFrame([
    ('number of entities', f'{n_ents:n}'),
    ('number of literals', f'{n_lits:n}'),
    ('number of predicates', f'{n_rels:n}'),
    ('number of triples', f'{t_tot:n}'),
    ('number of ent-ent triples', f'{t_ent:n}'),
    ('number of ent-lit triples', f'{t_lit:n}'),
    ('number of entities w/o label', f'{len(entities - with_label):n}'),
    ('number of predicates w/o label', f'{len(predicates - with_label):n}'),
    ('number of entities w/o type', f'{n_notype:n}'),
    ('number of instances w/o type', f'{n_notype_flt:n}'),
    ])
```

[5]:
```
                                 0          1
0               number of entities    159’154
1               number of literals    411’590
2             number of predicates        255
3                number of triples  2’056’777
4        number of ent-ent triples  1’498’899
5        number of ent-lit triples    557’878
6     number of entities w/o label      1’095
7   number of predicates w/o label          2
8      number of entities w/o type      5’761
9     number of instances w/o type        344
```

1.2.3 2.3 External Resource Statistics

[6]:
```
top250 = set(open('./imdb-top-250.t').read().split('\n')) - {''}

pd.DataFrame([
    ('Top-250 coverage', '{:n}'.format(
        len(top250 & {str(o) for o in graph.objects(None, WDT.P345) if o.
 ↪startswith('tt')}))),
    ('Entities with IMDb ID', '{:n}'.format(
        len({str(o) for o in graph.objects(None, WDT.P345) if o.
 ↪startswith('tt')}))),
    ('Plots linked to a movie', '{:n}'.format(
        len({qid for qid, plot in csv.reader(open('./plots.csv')) if␣
 ↪URIRef(qid) in entities}))),
    ('Comments linked to a movie', '{:n}'.format(
        len([qid for qid, rating, sentiment, comment in csv.reader(open('./
 ↪user-comments.csv')) if URIRef(qid) in entities]))),
    ('Movies having at least one comment', '{:n}'.format(
        len({qid for qid, rating, sentiment, comment in csv.reader(open('./
 ↪user-comments.csv')) if URIRef(qid) in entities}))),
    ])
```

[6]:
```
                                      0       1
0                      Top-250 coverage     243
1                 Entities with IMDb ID  27’882
```

```
2             Plots linked to a movie  10’366
3          Comments linked to a movie  26’491
4  Movies having at least one comment   2’454
```

1.2.4 2.4 Literal Statistics

```
[7]: # literal predicates
     ent_lit_preds = {p for s,p,o in graph.triples((None, None, None)) if␣
      ↪isinstance(o, Literal)}
     ent_lit_preds
```

```
[7]: {rdflib.term.URIRef('http://ddis.ch/atai/rating'),
      rdflib.term.URIRef('http://ddis.ch/atai/tag'),
      rdflib.term.URIRef('http://schema.org/description'),
      rdflib.term.URIRef('http://www.w3.org/2000/01/rdf-schema#label'),
      rdflib.term.URIRef('http://www.wikidata.org/prop/direct/P18'),
      rdflib.term.URIRef('http://www.wikidata.org/prop/direct/P2142'),
      rdflib.term.URIRef('http://www.wikidata.org/prop/direct/P345'),
      rdflib.term.URIRef('http://www.wikidata.org/prop/direct/P577')}
```

```
[8]: # literal
     pd.DataFrame([
         ('# entities', '{:n}'.format(
             len(entities))),
         ('DDIS.rating', '{:n}'.format(
             len(set(graph.subjects(DDIS.rating, None))))),
         ('DDIS.tag', '{:n}'.format(
             len(set(graph.subjects(DDIS.tag, None))))),
         ('SCHEMA.description', '{:n}'.format(
             len({s for s in graph.subjects(SCHEMA.description, None) if s.
      ↪startswith(WD)}))),
         ('RDFS.label', '{:n}'.format(
             len({s for s in graph.subjects(RDFS.label, None) if s.
      ↪startswith(WD)}))),
         ('WDT.P18 (wikicommons image)', '{:n}'.format(
             len(set(graph.subjects(WDT.P18, None))))),
         ('WDT.P2142 (box office)', '{:n}'.format(
             len(set(graph.subjects(WDT.P2142, None))))),
         ('WDT.P345 (IMDb ID)', '{:n}'.format(
             len(set(graph.subjects(WDT.P345, None))))),
         ('WDT.P577 (publication date)', '{:n}'.format(
             len(set(graph.subjects(WDT.P577, None))))),
         ])
```

```
[8]:                              0        1
     0                  # entities  159’154
     1                 DDIS.rating    2’451
```

```
2                     DDIS.tag   10’366
3           SCHEMA.description  149’753
4                   RDFS.label  157’806
5  WDT.P18 (wikicommons image)   52’828
6       WDT.P2142 (box office)    1’881
7           WDT.P345 (IMDb ID)  123’596
8  WDT.P577 (publication date)   28’642
```

1.2.5 2.5 Graph Connectivity

[9]:

```
ng = nx.MultiDiGraph()
_ = ng.add_edges_from([
        (s, o, dict(pred=p)) for s,p,o in graph.triples((None, None, None)) if␣
 ↪isinstance(o, URIRef)
        ])

comp = list(nx.connected_components(ng.to_undirected()))

print("number of connected graphs: {}".format(len(comp)))
```

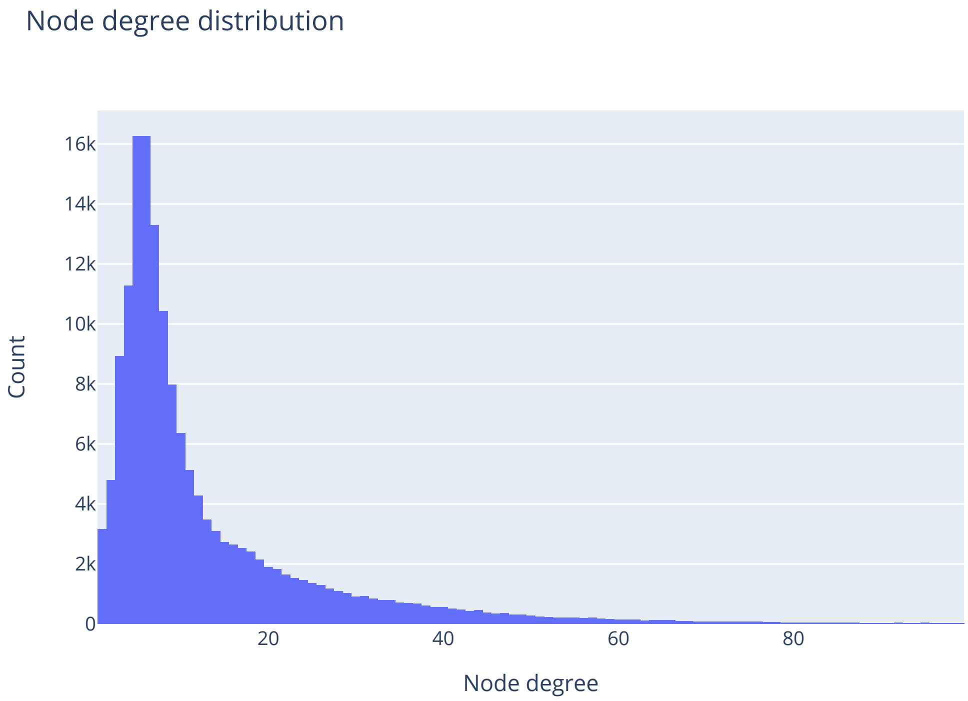
```
number of connected graphs: 1
```

1.2.6 2.6 Node Degree Distribution

- If the following figures cannot be displayed, terminate your current Jupyter server and install required extensions via the command `jupyter labextension install jupyterlab-plotly`.

[10]:

```
iplot(
  dict(
    data=[go.Histogram(x=[deg for _, deg in ng.degree() if deg < 100])],
    layout=go.Layout(
        title='Node degree distribution',
        xaxis=dict(
            title='Node degree'),
        yaxis=dict(
            title='Count'),
)))
```



Node degree distribution

[11]:

```
pd.DataFrame([deg for _, deg in ng.degree()]).describe()
```

[11]:

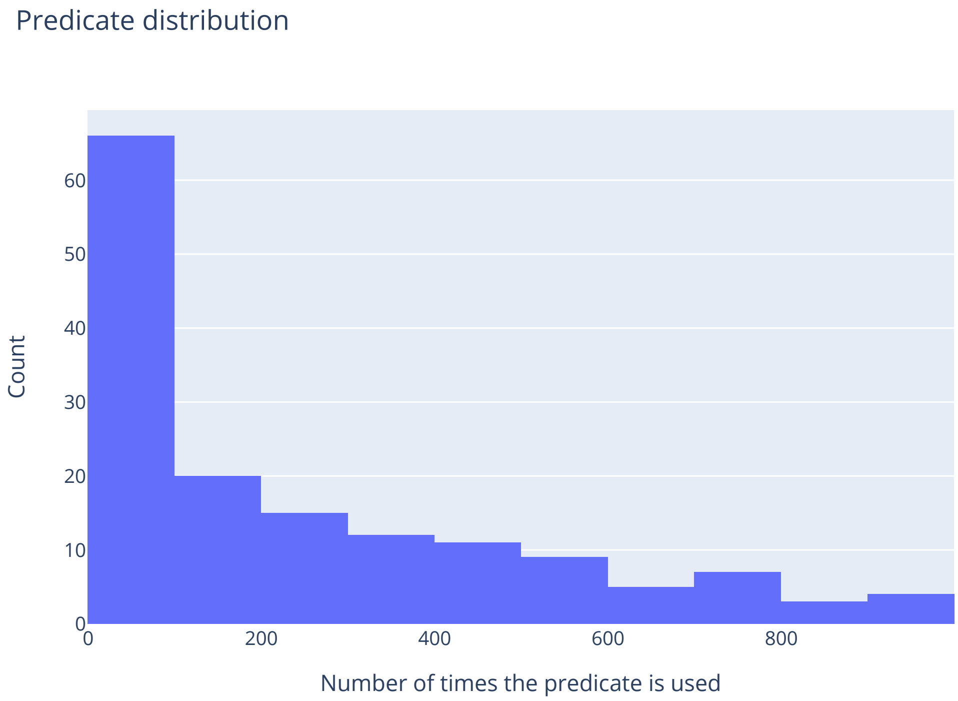
```
                   0
count  158900.000000
mean       18.865941
std       370.474405
min         1.000000
25%         5.000000
50%         8.000000
75%        16.000000
max    100432.000000
```

1.2.7 2.7 Relation Distribution

[12]:

```
pdeg = defaultdict(int)
for s,p,o in graph.triples((None, None, None)):
    pdeg[p] += 1

iplot(dict(
    data=[go.Histogram(x=[cnt for cnt in pdeg.values() if cnt < 1000])],
    layout=go.Layout(
        title='Predicate distribution',
        xaxis=dict(
            title='Number of times the predicate is used'),
        yaxis=dict(
            title='Count'),
)))
```


Predicate distribution

[13]:
```
pd.DataFrame(list(pdeg.values())).describe()
```

[13]:
```
                   0
count     255.000000
mean     8065.792157
std     28238.112826
min        29.000000
25%        94.500000
50%       537.000000
75%      2673.000000
max    288856.000000
```

1.2.8 2.8 Entity types

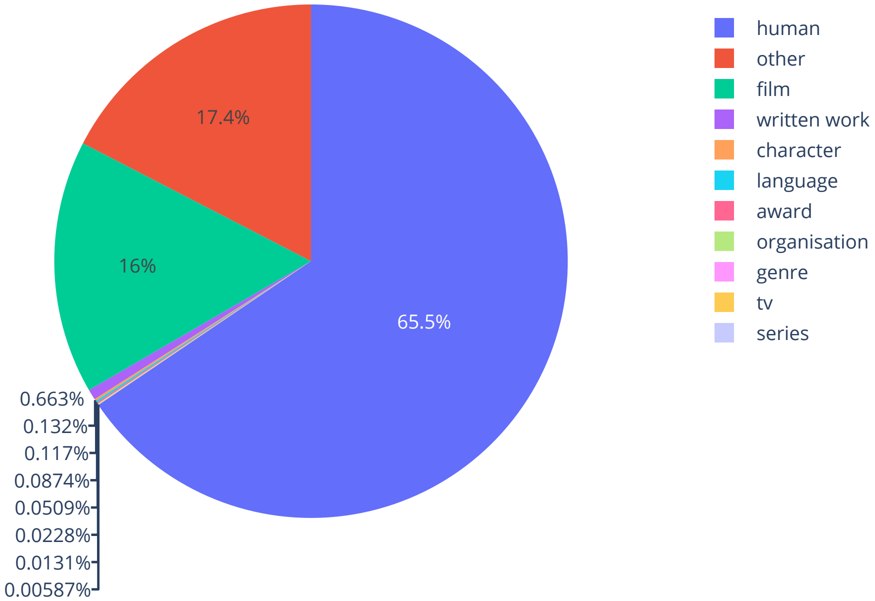
[14]:

```
roots = {
    WD['Q8242']:        'literature',
    WD['Q5']:           'human',
    WD['Q483394']:      'genre',
    WD['Q95074']:       'character',
    WD['Q11424']:       'film',
    WD['Q15416']:       'tv',
    WD['Q618779']:      'award',
    WD['Q27096213']:    'geographic',
    WD['Q43229']:       'organisation',
    WD['Q34770']:       'language',
    WD['Q7725310']:     'series',
    WD['Q47461344']:    'written work',
}
```

[15]:

```
# Histogram w.r.t what's in the actual published graph
ecats = defaultdict(set)
for s, o in graph.subject_objects(WDT.P31):
    c = roots.get(o, 'other')
    ecats[c].add(s)

chist = {c: len(ents) for c, ents in ecats.items()}
labels, values = zip(*chist.items())
iplot(dict(data=[go.Pie(labels=labels, values=values)]))
```



1.3 3. SPARQL query examples

```
[16]: # top user-rated movies
      [str(s) for s, in graph.query('''
          PREFIX ddis: <http://ddis.ch/atai/>
          PREFIX wd: <http://www.wikidata.org/entity/>
          PREFIX wdt: <http://www.wikidata.org/prop/direct/>
          PREFIX schema: <http://schema.org/>

          SELECT ?lbl WHERE {
              SELECT ?movie ?lbl ?rating WHERE {
                  ?movie wdt:P31 wd:Q11424 .
                  ?movie ddis:rating ?rating .
                  ?movie rdfs:label ?lbl .
              }
              ORDER BY DESC(?rating)
              LIMIT 20
          }
          ''')]
```

```
[16]: ['Forrest Gump',
        'The Lord of the Rings: The Fellowship of the Ring',
        'Heart of a Dog',
        'Kannathil Muthamittal',
        'Once Upon a Time in America',
        'Oldboy',
        'The Great Dictator',
        'Apocalypse Now',
        'The Shining',
        'The Cranes Are Flying',
        'Shwaas',
        'Khosla Ka Ghosla',
        'Inglourious Basterds',
        'Good Will Hunting',
        'Full Metal Jacket',
        'The Ascent',
        'War and Peace',
        '2001: A Space Odyssey',
        'Scarface',
        'Star Wars: Episode VI - Return of the Jedi']
```

```
[17]: # bottom user-rated movies
      [str(s) for s, in graph.query('''
          PREFIX ddis: <http://ddis.ch/atai/>
          PREFIX wd: <http://www.wikidata.org/entity/>
          PREFIX wdt: <http://www.wikidata.org/prop/direct/>
          PREFIX schema: <http://schema.org/>

          SELECT ?lbl WHERE {
              SELECT ?movie ?lbl ?rating WHERE {
                  ?movie wdt:P31 wd:Q11424 .
                  ?movie ddis:rating ?rating .
                  ?movie rdfs:label ?lbl .
              }
              ORDER BY ASC(?rating)
              LIMIT 10
          }
          ''')]
```

```
[17]: ['Vampire Assassin',
        'Vampires vs. Zombies',
        'Aag',
        'Joystick Nation - Generation Hip Hop',
        'Going Overboard',
        "Alex l'ariete",
        'House of the Dead',
        'Killers',
        "Ghosts Can't Do It",
        'Snakes on a Train']
```

[18]:

```
# some info about a Apocalypse Now

header = '''
    PREFIX ddis: <http://ddis.ch/atai/>
    PREFIX wd: <http://www.wikidata.org/entity/>
    PREFIX wdt: <http://www.wikidata.org/prop/direct/>
    PREFIX schema: <http://schema.org/>
'''

tuple_list = list(graph.query(header + '''
    SELECT * WHERE {
        ?movie rdfs:label "Apocalypse Now"@en .
        ?movie wdt:P57/rdfs:label ?director .
        OPTIONAL { ?movie ddis:rating ?rating } .
        OPTIONAL { ?movie wdt:P577 ?value}
    }
    '''))

first_tuple = tuple_list[0]

print(f"First tuple: {first_tuple}")
print('------------')

for elements in first_tuple:
    print(elements)
```

```
First tuple: (rdflib.term.URIRef('http://www.wikidata.org/entity/Q182692'),
rdflib.term.Literal('8.4',
datatype=rdflib.term.URIRef('http://www.w3.org/2001/XMLSchema#decimal')),
rdflib.term.Literal('1979-05-10',
datatype=rdflib.term.URIRef('http://www.w3.org/2001/XMLSchema#date')),
rdflib.term.Literal('Francis Ford Coppola', lang='en'))
------------
http://www.wikidata.org/entity/Q182692
8.4
1979-05-10
Francis Ford Coppola
```

[19]:

```
# dealing with optional parameters
tuple_list = list(graph.query(header + '''
    SELECT ?lbl ?rating WHERE {
        ?movie rdfs:label ?lbl .
        ?movie wdt:P57/rdfs:label ?director .
        OPTIONAL { ?movie ddis:rating ?rating } .
        OPTIONAL { ?movie wdt:P577 ?value}
    }
    LIMIT 10
    '''))

# unpacking the tuple in the loop
for (movie_label, rating) in tuple_list:
    if rating:
        print(f"{movie_label} has a rating of {rating}  ")
    else:
        print(f"{movie_label} has no rating  ")
```

```
Jan Dara has no rating
Queens of Langkasuka has no rating
Three has no rating
Moondram Pirai has no rating
Buffalo Bill and the Indians, or Sitting Bull's History Lesson has no rating
Dr. T & the Women has no rating
McCabe & Mrs. Miller has a rating of 7.7
Nashville has no rating
Fool for Love has a rating of 6.1
The Gingerbread Man has a rating of 5.7
```

[20]:

```
# all movies directed by Terry Gilliam
[str(s) for s,  in graph.query('''
    PREFIX ddis: <http://ddis.ch/atai/>
    PREFIX wd: <http://www.wikidata.org/entity/>
    PREFIX wdt: <http://www.wikidata.org/prop/direct/>
    PREFIX schema: <http://schema.org/>

    SELECT ?lbl WHERE {
        ?director rdfs:label "Terry Gilliam"@en .
        ?movie wdt:P57 ?director .
        ?movie rdfs:label ?lbl
    }
    ''')]
```

[20]:

```
['Time Bandits',
 'Tideland',
 "Monty Python's The Meaning of Life",
 'Brazil',
 'The Wholly Family',
 'The Fisher King',
 'The Imaginarium of Doctor Parnassus',
 'The Zero Theorem',
 'The Adventures of Baron Munchausen',
 'Jabberwocky',
 '12 Monkeys',
 'The Man Who Killed Don Quixote',
 'The Brothers Grimm',
 'Fear and Loathing in Las Vegas',
 'Monty Python and the Holy Grail']
```

[21]:

```
# neo-noir movies featuring Ryan Gosling
[str(s) for s, in graph.query('''
    PREFIX ddis: <http://ddis.ch/atai/>
    PREFIX wd: <http://www.wikidata.org/entity/>
    PREFIX wdt: <http://www.wikidata.org/prop/direct/>
    PREFIX schema: <http://schema.org/>

    SELECT ?lbl WHERE {
        ?genre rdfs:label "neo-noir"@en .
        ?actor rdfs:label "Ryan Gosling"@en .
        ?movie wdt:P136 ?genre .
        ?movie wdt:P161 ?actor .
        ?movie rdfs:label ?lbl .
    }
    ''')]
```

[21]:

```
['Only God Forgives', 'Drive', 'Blade Runner 2049']
```

[22]:

```
# movies with largest cast member list
[(str(s), int(nc)) for s, nc in graph.query('''
    PREFIX ddis: <http://ddis.ch/atai/>
    PREFIX wd: <http://www.wikidata.org/entity/>
    PREFIX wdt: <http://www.wikidata.org/prop/direct/>
    PREFIX schema: <http://schema.org/>

    SELECT ?lbl ?nc WHERE {
        SELECT ?movie ?lbl (count(?cast) as ?nc) WHERE {
            ?movie wdt:P31 wd:Q11424 .
            ?movie rdfs:label ?lbl .
            ?movie wdt:P161 ?cast .
        }
        GROUP BY ?movie
        ORDER BY DESC(?nc)
        LIMIT 10
    }
    ''')]
```

[22]:

```
[('Mamma Mia! Here We Go Again', 224),
 ('Ali', 121),
 ('Forrest Gump', 118),
 ('Terror in the Aisles', 110),
 ('Iron Man 3', 108),
 ('The Longest Day', 104),
 ('Avengers: Endgame', 100),
 ('Captain America: Civil War', 98),
 ('Around the World in 80 Days', 93),
 ('Captain America: The First Avenger', 93)]
```

[23]:
```
# cast of Moon
[str(s) for s, in graph.query('''
    PREFIX ddis: <http://ddis.ch/atai/>
    PREFIX wd: <http://www.wikidata.org/entity/>
    PREFIX wdt: <http://www.wikidata.org/prop/direct/>
    PREFIX schema: <http://schema.org/>

    SELECT ?lbl WHERE {
        ?movie rdfs:label "Moon"@en .
        ?movie wdt:P161 ?cast .
        ?cast rdfs:label ?lbl .
    }
    ''')]
```

[23]:
```
['Matt Berry',
 'Kaya Scodelario',
 'Kevin Spacey',
 'Sam Rockwell',
 'Benedict Wong',
 'Dominique McElligott',
 'Robin Chalk']
```

[24]:
```
# winners of Cannes best movie (Palme d'Or)
a = [(str(d), str(s)) for s, d in graph.query(header + '''
    SELECT ?lbl ?pubdate WHERE {
        ?award rdfs:label "Palme d'Or"@en .
        ?movie wdt:P166 ?award .
        ?movie rdfs:label ?lbl .
        ?movie wdt:P577 ?pubdate .
        FILTER (?pubdate > "2011-01-01"^^xsd:date)
    }
    ORDER BY DESC(?pubdate)
    ''')]

# this can be also written as (notice the ";"):
b = [(str(d), str(s)) for s, d in graph.query(header + '''
    SELECT ?lbl ?pubdate WHERE {
      ?award rdfs:label "Palme d'Or"@en.
      ?movie wdt:P166 ?award; rdfs:label ?lbl; wdt:P577 ?pubdate.
      FILTER(?pubdate > "2011-01-01"^^xsd:date)
    }
    ORDER BY DESC (?pubdate)
    ''')]

assert (a == b)
a
```

```
[24]: [('2021-07-14', 'Titane'),
       ('2019-05-21', 'Parasite'),
       ('2018-05-13', 'Shoplifters'),
       ('2017-05-20', 'The Square'),
       ('2016-10-21', 'I, Daniel Blake'),
       ('2015-10-22', 'Dheepan'),
       ('2014-05-16', 'Winter Sleep'),
       ('2013-05-23', 'Blue Is the Warmest Colour'),
       ('2012-01-01', 'Amour'),
       ('2011-05-16', 'The Tree of Life')]
```

```
[ ]:
```