In [45]:
```
# Part A: Basic definitions and functions - we start by defining the basic cons
# to interact with the Neo4j database. For Part A, we will establish a connecti
# database. Create some nodes and relationships and run some queries.
```

In [46]:
```
# There are at least 2 libraries for accessing Neo4j via Python. There is the c
# Neo4j driver provided by the company which can be installed using pip (Python
# and via Anaconda for use with Jupyter: conda install -c conda-forge sqlalchem
# Currently using
# See https://neo4j.com/developer/python/#python-driver
from neo4j import GraphDatabase
import requests # Fetch and preview data from API
import json # parse JSON
from itertools import permutations
import pandas as pd
from datetime import datetime as dt # Parse dates
import os
import time
import seaborn
import ipywidgets
```

In [47]:
```
#Incorporate in filename
def fnGetFilename(prefix, extension):
    sTS = dt.now().strftime("%m%d%Y_%H%M%S")
    return prefix + "_" + sTS + "." + extension

# Test function
fnGetFilename("api-data", "json")
```

Out[47]:
```
'api-data_03232022_181019.json'
```

In [48]:
```
def fnGetFilepath(filename):
    # Path to the database file which on my machine is at /home/<user>/raw_data
    # Feel free to change.
    homeDir=os.getenv("HOME")
    filePath = os.path.join(homeDir, "raw_data", filename)
    return filePath

# Test function
fnGetFilepath(fnGetFilename("api-data", "json"))
```

Out[48]:
```
'/home/automaton/raw_data/api-data_03232022_181026.json'
```

In [5]:
```
# Part 1 can work with either a local or cloud-hosted db. But the amount of dat
# fully manage Aura Neo4j database server. If you use Aura, please don't forget
# Using a 3rd party library, ipywidgets, which has controls for common UI eleme
print("Part 1 Connection Settings")
dbPart1Host = ipywidgets.Text(value="", placeholder="", description="Host:", di
                              style=dict(description_width='initial'))
display(dbPart1Host)

dbPart1Username = ipywidgets.Text(value="neo4j", placeholder="", description="U
                              style=dict(description_width='initial'))
display(dbPart1Username)

dbPart1Password = ipywidgets.Password(value="", placeholder="", description="Pa
                                  style=dict(description_width='initial'))
```

```
display(dbPart1Password)

dbPart1Secure = ipywidgets.Checkbox(value=False, description='Secure connectior
display(dbPart1Secure)
```

```
Part 1 Connection Settings
Text(value='', description='Host:', placeholder='', style=DescriptionStyle(des
cription_width='initial'))
Text(value='neo4j', description='Username:', placeholder='', style=Description
Style(description_width='initial…
Password(description='Password:', placeholder='', style=DescriptionStyle(descr
iption_width='initial'))
Checkbox(value=False, description='Secure connection?', indent=False)
```

In [49]:
```
# Establish a connection to Aura, Neo4j's fully managed database on the cloud.
# limitations on memory usage. So using Aura for the smaller demonstration with
# the default for Cypher. Remaining code assumes valid connection
def fnConnect(hostTextbox, usernameTextbox, passwordTextbox, isSecureCheckbox):
    newConn = None
    try:
        # Check if widgets initialized
        if hostTextbox != None and usernameTextbox != None and passwordTextbox
            connType = "neo4j+s" if isSecureCheckbox.value else "neo4j"
            connStr = connType + "://" + hostTextbox.value + ":7687"
            print("Connecting to: ", connStr)
            newConn = GraphDatabase.driver(connStr, auth=(usernameTextbox.value
        else:
            print("Please run cell above and enter the database host, username
    except Exception as err:
        print("Unexpected exception while trying to connect to the db.")

    return newConn
```

In [50]:
```
conn = fnConnect(dbPart1Host, dbPart1Username, dbPart1Password, dbPart1Secure)
```

```
Connecting to:  neo4j+s://303352be.databases.neo4j.io:7687
```

In [51]:
```
# A simple function that creates a database query session and calls the user
# function to execute. This is using the transaction API which ensure
# atomicity and consistency which are technically not need for these simple exa
def fnUpdateQuery(conn, fnQuery, args={}):
    ret = None
    with conn.session() as session:
        ret = session.write_transaction(fnQuery, args)

    return ret
```

In [52]:
```
# Function that wraps read-only queries as transactions
def fnReadQuery(conn, fnQuery, args={}):
    ret = None
    with conn.session() as session:
        ret = session.read_transaction(fnQuery, args)

    return ret
```

In [53]:
```
# Reset the database by dropping all the nodes
def fnResetDB(transaction, args):
    return transaction.run("MATCH(n) DETACH DELETE(n)")
```

In [54]:
```
# Return all the nodes
def fnGetAllNodes(transaction, args):
    result = transaction.run("MATCH(n) RETURN (n)")
    return [record["n"] for record in result]
```

In [55]:
```
# A simple function that create a node for each Person and assigns the first ar
# Also adding an auto-generated unique ID, in fact a UUID, to make it easier to
def fnCreatePerson(transaction, args):
    result = transaction.run(
        "CREATE (a:Person {id: apoc.create.uuid(), firstName: $inFirstName, las
        inFirstName=args["firstName"], inLastName=args["lastName"])

    return result.single()[0]
```

In [56]:
```
def fnGetIdFromName(transaction, args):
    result = transaction.run("MATCH(n:Person) WHERE n.firstName ='" + args["fir
                             "' AND n.lastName ='" + args["lastName"] + "'
    return result.single()[0]
```

In [57]:
```
# Creating a generic association function that associates
# one person with one or more others
def fnAssociate(transaction, args):
    personId = args["personId"]
    association = args["association"]
    otherIds = args["otherIds"]

    # Create a one-way association by default from the person to the other
    for anotherId in otherIds:
        queryStr="""MATCH (a:Person), (b:Person) WHERE a.id = '{0}' AND b.id =
                    CREATE (a)-[r:{2}]->(b);""".format(personId, anotherId, ass

        transaction.run(queryStr)


# This is an example of a one-way associations since the worker is not also the
def fnWorksFor(transaction, args):
    fnAssociate(transaction, {"personId": args["personId"], "association": "wor
                              "otherIds": [args["bossId"]]})

    fnAssociate(transaction, {"personId": args["bossId"], "association": "emplo
                              "otherIds": [args["personId"]]})

# This is an example of a two way since obviously a friend of A is also A's fri
def fnFriendsWith(transaction, args):
    fnAssociate(transaction, {"personId": args["personId"], "association": "fri
                              "otherIds": [args["friendId"]]})

    fnAssociate(transaction, {"personId": args["friendId"], "association": "fri
                              "otherIds": [args["personId"]]})

def fnSiblings(transaction, args):
    pairings = list(permutations(args["siblingIds"], 2))
    for pair in pairings:
        fnAssociate(transaction, {"personId": pair[0], "association": "sibling'
                              "otherIds": [pair[1]]})
```

In [58]:
```
def fnDisassociate(transaction, args):
    query="MATCH (a:Person {id: '" + args["personId"] + "'})-[r: " + args["asso
```

```
    return transaction.run(query)

def fnUnfriend(transaction, args):
    fnDisassociate(transaction, {"personId": args["personId"], "association": '
                                 "otherId": args["friendId"]})

    fnDisassociate(transaction, {"personId": args["friendId"], "association": '
                                 "otherId": args["personId"]})
```

In [59]:
```
# Match all friends of the given person. Notice the arrow means we're
# returning those friends only once even though the relationship is bi-directio
def fnGetFriends(transaction, args):
    query="MATCH (a:Person {id: '" + args["personId"] + "'})-[r:friends_with]->
    result = transaction.run(query)
    return [record["b"] for record in result]

# Rank function is not easily obtainable with an emphemeral / read-only query
# So let's do it as a to step function. Get the rank based on current counts.
def fnGetRankByNumFriends(transaction, args):
    query="""MATCH (a:Person)-[r1:friends_with]-(b:Person)
                WITH a.firstName as fName, (count(b)/2) as fCount
                ORDER BY fCount DESC
                WITH COLLECT(DISTINCT {fCount:fCount}) as c
                unwind range(0, size(c)-1) as r
                return r as rank, c[r]["fCount"] as Friend_Count"""
    result = transaction.run(query)
    return [rank for rank in result]

# Use the ranking to order people based on the # of friends
def fnGetMostFriends(transaction, args):
    ranks = fnGetRankByNumFriends(transaction, args)
    query="""MATCH (a:Person)-[r1:friends_with]-(b:Person)
                WITH a.firstName as fName, (count(b)/2) as fCount
                ORDER BY fCount DESC
                WHERE fCount={0} RETURN fName""".format(ranks[0]["Friend_Count'
    result = transaction.run(query)
    return [record["fName"] for record in result]

# Reverse the ranking to get persons with the least # of friends
def fnGetLeastFriends(transaction, args):
    ranks = fnGetRankByNumFriends(transaction, args)
    query="""MATCH (a:Person)-[r1:friends_with]-(b:Person)
                WITH a.firstName as fName, (count(b)/2) as fCount
                ORDER BY fCount DESC
                WHERE fCount={0} RETURN fName""".format(ranks[-1]["Friend_Count
    result = transaction.run(query)
    return [record["fName"] for record in result]

# Match on all nodes where there exists no friendship relationships
def fnGetNoFriends(transaction, args):
    query="MATCH (a:Person) WHERE NOT (a)-[:friends_with]-() RETURN a.firstName
    result = transaction.run(query)
    return [record["a.firstName"] for record in result]
```

In [60]:
```
# Assume id is unique and assigns it to exactly only
def fnSetAge(transaction, args):
    query = "MATCH (a:Person {id:'" + args["personId"] + "'})" + "SET a.age={0}
    result = transaction.run(query)
```

```
    return result.single()[0]

# Let's find friends of friends and friends of siblings. Using union to combine
# but because this can result in duplicates, especially due to two-way relation
# filter out using DISTINCT
def fnRecommendFriends(transaction, args):
    query = "MATCH(a:Person {id:'" + args["personId"] + "'})-[r1:friends_with
                WHERE NOT EXISTS((a)-[r1:friends_with]-(ff1)) AND NOT EXISTS((a)
                RETURN DISTINCT ff1 as ff
                UNION ALL MATCH(b:Person {id:'" + args["personId"] + "'})-[r
                WHERE NOT EXISTS((b)-[r1:friends_with]-(ff2)) AND NOT EXISTS((b)
                RETURN DISTINCT ff2 as ff"
    result = transaction.run(query)
    return [record["ff"] for record in result]

# Similar to the function above but we add some "qualifications" (i.e. age)
# Will return over 18 and those without an age. IS NULL and NOT EXISTS are equi
def fnRecommendWorkers(transaction, args):
    query = "MATCH(a:Person {id:'" + args["personId"] + "'})-[r1:employs]-(e1
                WHERE NOT w1.age IS NULL OR w1.age >= 18
                RETURN DISTINCT w1 as w
                UNION ALL MATCH(b:Person {id:'" + args["personId"] + "'})-[r
                WHERE NOT w2.age IS NULL OR w2.age >= 18
                RETURN DISTINCT w2 as w"
    result = transaction.run(query)
    return [record["w"] for record in result]
```

In [61]:
```
# Simple utility function that converts a result set into a panda data frame
def fnGetFrameFromResultSet(result):
    return pd.DataFrame([dict(record) for record in result])
```

In [62]:
```
# In part A demonstrates basic Neo4j functions using some test data.
# Let's start with a clean slate by resetting the DB
fnUpdateQuery(conn, fnResetDB)

# Insert a couple of people
thomasId = fnUpdateQuery(conn, fnCreatePerson, {"firstName": "Thomas", "lastNam
williamId = fnUpdateQuery(conn, fnCreatePerson, {"firstName": "William", "lastN
marcusId = fnUpdateQuery(conn, fnCreatePerson, {"firstName": "Marcus", "lastNam
jammieId = fnUpdateQuery(conn, fnCreatePerson, {"firstName": "Jammie", "lastNam
harryId = fnUpdateQuery(conn, fnCreatePerson, {"firstName": "Harry", "lastName"
johnId = fnUpdateQuery(conn, fnCreatePerson, {"firstName": "John", "lastName":
paulId = fnUpdateQuery(conn, fnCreatePerson, {"firstName": "Paul", "lastName":
karlId = fnUpdateQuery(conn, fnCreatePerson, {"firstName": "Karl", "lastName":

# Get people records from nodes
people = fnReadQuery(conn, fnGetAllNodes)

# Convert to data frame to make things easier
dfPeople = fnGetFrameFromResultSet(people)
dfPeople.head()
```

Out[62]:

	firstName	lastName	id
0	Thomas	McPherson	bda6b865-ae50-4c48-81c9-b82b6424edba
1	William	Jones	2b32c584-9c30-4de9-88c5-ff8af92f7059
2	Marcus	Jones	8b8ae9fe-0466-49b9-a8af-d916939b89e3
3	Jammie	Jones	962b7fbb-0521-4c92-ac66-e4a98e3b7c12
4	Harry	Carson	b0d333e9-dc16-4a80-bf49-5b472b422dee

In [63]:
```
# Get the IDs from first and last name, in this case assumed to uniquely identi
# Note we returned the IDs above on record creation.
thomasId = fnReadQuery(conn, fnGetIdFromName, {"firstName": "Thomas", "lastName
williamId = fnReadQuery(conn, fnGetIdFromName, {"firstName": "William", "lastNa

# Let's fetch the IDs by querying
print("Thomas and William's Ids are %s, %s" % (thomasId, williamId))

# Now let's create some relationships. Since we created the IDs we can use thos
# Let's build some friendships
fnUpdateQuery(conn, fnFriendsWith, {"personId": thomasId, "friendId": williamId
fnUpdateQuery(conn, fnFriendsWith, {"personId": thomasId, "friendId": jammieId})
fnUpdateQuery(conn, fnFriendsWith, {"personId": harryId, "friendId": thomasId})
fnUpdateQuery(conn, fnFriendsWith, {"personId": paulId, "friendId": harryId})
fnUpdateQuery(conn, fnFriendsWith, {"personId": karlId, "friendId": paulId})
fnUpdateQuery(conn, fnFriendsWith, {"personId": karlId, "friendId": harryId})

# And work relationships
fnUpdateQuery(conn, fnWorksFor, {"personId": jammieId, "bossId": johnId})

# And family
fnUpdateQuery(conn, fnSiblings, {"siblingIds": [williamId, marcusId, jammieId]})
```

```
Thomas and William's Ids are bda6b865-ae50-4c48-81c9-b82b6424edba, 2b32c584-9c
30-4de9-88c5-ff8af92f7059
```

In [64]:
```
# And now let's do so basic queries that take advantage of graph database.
friends = fnReadQuery(conn, fnGetFriends, {"personId": harryId})
dfFriends = fnGetFrameFromResultSet(friends)
print("Harry's friends are ", ",".join(dfFriends["firstName"]))
print()

# Who has the most friends?
theMost = fnReadQuery(conn, fnGetMostFriends)
print("The most friends: ", theMost)

theLeast = fnReadQuery(conn, fnGetLeastFriends)
print("The least friends: ", theLeast)
```

```
Harry's friends are  Karl,Paul,Thomas

The most friends:  ['Thomas', 'Harry']
The least friends:  ['William', 'Jammie']
```

In [65]:
```
# Now let's break the connection - i.e. unfriend
fnUpdateQuery(conn, fnUnfriend, {"personId": karlId, "friendId": harryId})

# And now who has the most friends?
theMost = fnReadQuery(conn, fnGetMostFriends)
```

```
print("And now, the most friends: ", theMost)

# No friends at all?
noFriends = fnReadQuery(conn, fnGetNoFriends)
print(noFriends, " have not friends at all.")
print()

# Recommend some friends for Marcus and Jammie?
newFriends = fnReadQuery(conn, fnRecommendFriends, {"personId": marcusId})
dfNewFriends = fnGetFrameFromResultSet(newFriends)
print("Suggest friends for Marcus:\n", dfNewFriends)
print()

newFriends = fnReadQuery(conn, fnRecommendFriends, {"personId": jammieId})
dfNewFriends = fnGetFrameFromResultSet(newFriends)
print("Suggest friends for Jammie:\n", dfNewFriends)
```

```
And now, the most friends:  ['Thomas']
['Marcus', 'John']  have not friends at all.

Suggest friends for Marcus:
   firstName   lastName                                    id
0     Thomas  McPherson  bda6b865-ae50-4c48-81c9-b82b6424edba

Suggest friends for Jammie:
   firstName   lastName                                    id
0      Harry     Carson  b0d333e9-dc16-4a80-bf49-5b472b422dee
1     Jammie      Jones  962b7fbb-0521-4c92-ac66-e4a98e3b7c12
2    William      Jones  2b32c584-9c30-4de9-88c5-ff8af92f7059
3     Thomas  McPherson  bda6b865-ae50-4c48-81c9-b82b6424edba
```

In [66]:
```
# And let's enhance our people database with some additional information
# by setting the age.
fnUpdateQuery(conn, fnSetAge, {"personId": jammieId, "age": 24})
fnUpdateQuery(conn, fnSetAge, {"personId": thomasId, "age": 29})
fnUpdateQuery(conn, fnSetAge, {"personId": williamId, "age": 25})
fnUpdateQuery(conn, fnSetAge, {"personId": harryId, "age": 26})
fnUpdateQuery(conn, fnSetAge, {"personId": marcusId, "age": 17})

newWorkers = fnReadQuery(conn, fnRecommendWorkers, {"personId": johnId})
dfNewWorkers = fnGetFrameFromResultSet(newFriends)
print(dfNewWorkers)
```

```
  firstName   lastName                                    id
0      Harry     Carson  b0d333e9-dc16-4a80-bf49-5b472b422dee
1     Jammie      Jones  962b7fbb-0521-4c92-ac66-e4a98e3b7c12
2    William      Jones  2b32c584-9c30-4de9-88c5-ff8af92f7059
3     Thomas  McPherson  bda6b865-ae50-4c48-81c9-b82b6424edba
```

In [67]:
```
# Cleanup the connection
conn.close()
```

In [25]:
```
# Part B: Now let's work with a more complex dataset. Neo4j has provided a sand
# includes the dataset, cloud db, integrated graphical shell and walkthrough of
# This can be found here: https://medium.com/neo4j/introducing-the-neo4j-stackd

# For this part of the excercise, will be querying the data via REST, importing
```

In [68]:
```
# Stack exchange APIs allows for the creation of custom filters to define which
# seen here: https://api.stackexchange.com/2.2/filters/!5-i6Zw8Y)4W7vpy91PMYsKM
```

```
def fnGetAPIFilter():
    return "!5-i6Zw8Y)4W7vpy91PMYsKM-k9yzEsSC1_Uxlf"
```

In [69]:
```
# Function to fetch
def fnGetURL(keyword, page):
    return "https://api.stackexchange.com/2.2/questions?pagesize=100&order=desc

fnGetURL("neo4j", "13")
```

Out[69]:
```
'https://api.stackexchange.com/2.2/questions?pagesize=100&order=desc&sort=crea
tion&filter=!5-i6Zw8Y)4W7vpy91PMYsKM-k9yzEsSC1_Uxlf&site=stackoverflow&tagged=
neo4j&page=13'
```

In [70]:
```
# We're using APOC is a plugin to inject JSON data into Neo4j. APOC is built ir
# but there are some security restrictions especially with loading files. This
#
# This is a fairly complicated query that is actually just a series of chained
# and attribution for each question.
def fnInsertNeo4jQuestions(transaction, args):
    # To avoid issues with API, we store the file with all the records on AWS
    url = args["url"] #fnGetURL(args["keyword"], args["page"])

    # 1. Convert the list of objects in JSON into questions (top level object)
    # 2. Assign the title and link as property to each question node
    # 3. For each tag in question, get the tag and merge (assign to) the associ
    # 4. Extract the answer as a separate node
    # 5. Extract the author of the question

    # Please note that there is bogus data like inconsistently encoded userID,
    # Compensate for that in a simple way by looking for a NULL relationship.
    queryStr = "CALL apoc.load.json('" + url + """') YIELD value
                UNWIND value.items AS q

                MERGE (question:Question {uuid:q.question_id})
                  ON CREATE SET question.title = q.title,
                    question.link = q.share_link,
                    question.creation_date = q.creation_date,
                    question.accepted_answer_id=q.accepted_answer_id,
                    question.view_count=q.view_count,
                    question.answer_count=q.answer_count,
                    question.body_markdown=q.body_markdown

                // who asked the question
                MERGE (owner:User {uuid:coalesce(q.owner.user_id,'deleted')})
                  ON CREATE SET owner.display_name = q.owner.display_name
                MERGE (owner)-[:ASKED]->(question)

                // what tags do the questions have
                FOREACH (tagName IN q.tags |
                  MERGE (tag:Tag {name:tagName})
                    ON CREATE SET tag.link = "https://stackoverflow.com/questic
                  MERGE (question)-[:TAGGED]->(tag))

                // who answered the questions?
                FOREACH (a IN q.answers |
                   MERGE (question)<-[:ANSWERED]-(answer:Answer {uuid:a.answer_
                    ON CREATE SET answer.is_accepted = a.is_accepted,
                    answer.link=a.share_link,
                    answer.title=a.title,
                    answer.body_markdown=a.body_markdown,
```

```
                    answer.score=a.score,
                    answer.favorite_score=a.favorite_score,
                    answer.view_count=a.view_count
                   MERGE (answerer:User {uuid:coalesce(a.owner.user_id,'deleted
                    ON CREATE SET answerer.display_name = a.owner.display_name
                   MERGE (answer)<-[:PROVIDED]-(answerer)
                )

                // who commented on the question
                FOREACH (c in q.comments |
                  MERGE (question)<-[:COMMENTED_ON]-(comment:Comment {uuid:c.co
                    ON CREATE SET comment.link=c.link, comment.score=c.score
                  MERGE (commenter:User {uuid:coalesce(c.owner.user_id,'deleted
                    ON CREATE SET commenter.display_name = c.owner.display_name
                  MERGE (comment)<-[:COMMENTED]-(commenter)
                );
            """
    result = transaction.run(queryStr)
```

In [71]:
```
# Pull all questions and associated answers and comments for the keyword "neo4j
keyword = "neo4j"
```

In [72]:
```
def fnFetchStackoverflowQA(saveFile, keyword, iPage):
    # Fetch all questions for this keyword. This is done via the helper functio
    # which formats URL with the search term.
    print("Fetching and writing page %d" % iPage)
    url = fnGetURL(keyword, str(iPage))
    #print(url)

    # Let's preview the JSON data representing the questions and answers
    response = requests.get(url)

    # Confirm 200 if data was successfully fetched
    print(response)

    # Convert response data to json
    qaData = json.loads(response.content.decode('utf-8'))

    # Items are the actual Questions with comments, answers
    if "items" in qaData:
        items = qaData["items"]

        # Sneak a peak (testing)
        #if iPage == 1:
        #    print(json.dumps(qaData["items"][0:1], indent=2))

        bFirst = iPage == 1
        # Append each object to file so we have a single list of items
        with open(pathToRawData, "a") as outfile:
            for item in items:
                if not bFirst:
                    outfile.write(",")
                bFirst = False
                json.dump(item, outfile)


    # API is paginated and returns results in pages of at most 100 records
    return "has_more" in qaData and qaData["has_more"] == True
```

In [31]:
```
# This will read the Q&A from the API and write to a file. Currently, it's writ
# JSON file and that file is getting uploaded to S3 MANUALLY. Once in S3 it's p
# accessible so we can use it with APOC to load the data.

# Save the JSON data to avoid having to reload from API
pathToRawData = fnGetFilepath(fnGetFilename("stackoverflow-" + keyword, "json")

# The [P]arent object which will contain list of json
with open(pathToRawData, "w") as outfile:
    outfile.write('{"items":[')

iPage = 1

# Pages above 25 require auth token. So let's get as much as possible.
# Assume there is at least 1 page of results. List may have 0 records
# if the tag was not used.
hasMore = True
while hasMore and iPage <= 25:
    hasMore = fnFetchStackoverflowQA(pathToRawData, keyword, iPage)
    iPage = iPage + 1
    # Avoid API throttling (30 per second) by slowing down the requests
    time.sleep(4)

    url = fnGetURL(keyword, str(iPage))

    response = requests.get(url)

# "Close" parent object
with open(pathToRawData, "a") as outfile:
    outfile.write(']}')
```

```
Fetching and writing page 1
<Response [200]>
Fetching and writing page 2
<Response [200]>
Fetching and writing page 3
<Response [200]>
Fetching and writing page 4
<Response [200]>
Fetching and writing page 5
<Response [200]>
Fetching and writing page 6
<Response [200]>
Fetching and writing page 7
<Response [200]>
Fetching and writing page 8
<Response [200]>
Fetching and writing page 9
<Response [200]>
Fetching and writing page 10
<Response [200]>
Fetching and writing page 11
<Response [200]>
Fetching and writing page 12
<Response [200]>
Fetching and writing page 13
<Response [200]>
Fetching and writing page 14
<Response [200]>
Fetching and writing page 15
<Response [200]>
Fetching and writing page 16
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<Response [200]>
Fetching and writing page 18
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Fetching and writing page 19
<Response [200]>
Fetching and writing page 20
<Response [200]>
Fetching and writing page 21
<Response [200]>
Fetching and writing page 22
<Response [200]>
Fetching and writing page 23
<Response [200]>
Fetching and writing page 24
<Response [200]>
Fetching and writing page 25
<Response [200]>
```

In [33]:

```
# Part 2 dataset is a bit more substantial and when using the free version of A
# a memory limit of 250 MBs or so. Suggest using a self-hosted database. Some c
# that could be cleaned up if UI elements could be reused.
print("Part 2 Connection Settings")
dbPart2Host = ipywidgets.Text(value="", placeholder="", description="Host:", di
                              style=dict(description_width='initial'))
display(dbPart2Host)

dbPart2Username = ipywidgets.Text(value="neo4j", placeholder="", description="U
```

```
                                    style=dict(description_width='initial'))
display(dbPart2Username)

dbPart2Password = ipywidgets.Password(value="", placeholder="", description="Pa
                                      style=dict(description_width='initial'))
display(dbPart2Password)

dbPart2Secure = ipywidgets.Checkbox(value=False, description='Secure connectior
display(dbPart2Secure)
```

```
Part 2 Connection Settings
Text(value='', description='Host:', placeholder='', style=DescriptionStyle(des
cription_width='initial'))
Text(value='neo4j', description='Username:', placeholder='', style=Description
Style(description_width='initial…
Password(description='Password:', placeholder='', style=DescriptionStyle(descr
iption_width='initial'))
Checkbox(value=False, description='Secure connection?', indent=False)
```

In [73]:
```
# Reusing the connection function from above
conn2 = fnConnect(dbPart2Host, dbPart2Username, dbPart2Password, dbPart2Secure)
```

```
Connecting to:  neo4j://paris.local.datascape.org:7687
```

In [74]:
```
# Initialize the database by flush all the records
fnUpdateQuery(conn2, fnResetDB)

# Sample JSON file was created from the function above which fetches data from
# S3 bucket.
url = "http://s3.msds.rutgers.org.s3-website-us-east-1.amazonaws.com/special_tc
fnUpdateQuery(conn2, fnInsertNeo4jQuestions, {"url": url})
```

In [75]:
```
# Start with some basic statics. To simplify the code code the query inline usi
# Get the # of users, questions, answers and tags (categories)
result = fnReadQuery(conn2, lambda transaction, args :
                     transaction.run("MATCH(n:User) RETURN count(n)").single()[
print("Number of users: ", result)

result = fnReadQuery(conn2, lambda transaction, args :
                     transaction.run("MATCH(n:Question) RETURN count(n)").singl
print("Number of questions: ", result)

result = fnReadQuery(conn2, lambda transaction, args :
                     transaction.run("MATCH(n:Answer) RETURN count(n)").single(
print("Number of answers: ", result)

result = fnReadQuery(conn2, lambda transaction, args :
                     transaction.run("MATCH(n:Comment) RETURN count(n)").single
print("Number of comments: ", result)
print()

# And a simpler way to get all the node-tags
dfNodes = fnReadQuery(conn2, lambda transaction, args :
                     fnGetFrameFromResultSet(
                         transaction.run("MATCH(n) RETURN labels(n) as label, c

print("Number of nodes: ", dfNodes)
```

```
Number of users:  2108
Number of questions:  2494
Number of answers:  2260
Number of comments:  2362

Number of nodes:          label  count(*)
0      [User]      2108
1    [Answer]      2260
2   [Comment]      2362
3  [Question]      2494
4       [Tag]       671
```

In [76]:
```
# Now let's see what are the 20 most popular tags for Neo4j
dfTagCounts = fnReadQuery(conn2, lambda transaction, args :
                    fnGetFrameFromResultSet(
                        transaction.run("""MATCH(n:Question)-[r:TAGGED]-(t:Tag
                                           RETURN t.name, count(*) as tagCour
                                           ORDER BY tagCount DESC LIMIT 20"""
                    ))

print(dfTagCounts)
```

```
                t.name  tagCount
0                neo4j      2494
1               cypher      1122
2           neo4j-apoc       206
3      graph-databases       164
4               python       146
5                 java       139
6    spring-data-neo4j       109
7                graph       107
8              graphql        79
9             database        76
10        spring-boot        75
11             py2neo        69
12            node.js        63
13         javascript        55
14             docker        52
15             spring        49
16                csv        40
17               json        33
18  graph-data-science        32
19                 c#        32
```

In [77]:
```
# And who are the top users who asked the most questions
dfQCounts = fnReadQuery(conn2, lambda transaction, args :
                    fnGetFrameFromResultSet(
                        transaction.run("""MATCH(u:User)-[r:ASKED]-(q:Questior
                                           RETURN u.display_name, count(*) as
                                           ORDER BY qCount DESC LIMIT 10""")
                    ))
print(dfQCounts)
```

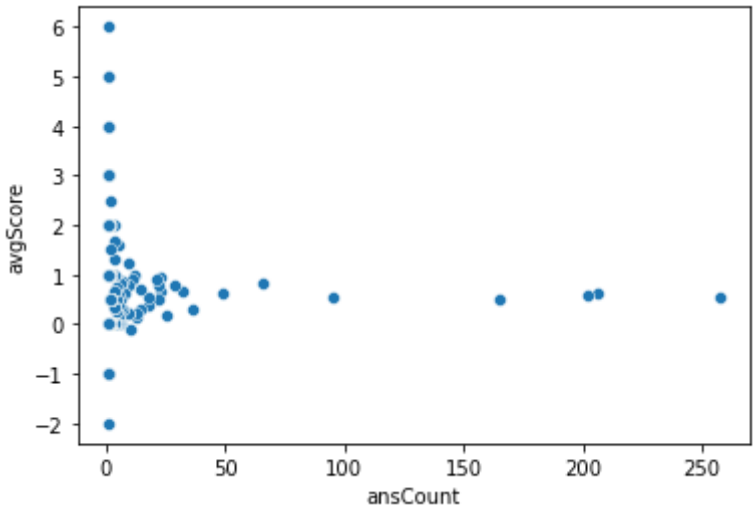
```
  u.display_name  qCount
0           LJRB      20
1    Thingamajig      15
2            A. L      13
3   Aerodynamika      12
4          Ooker      12
5         marlon      11
6   user11333043      11
7  Armen Sanoyan      11
8           Sama      11
9       David542      10
```

In [78]:
```
# And who answered the most questions and how they scored (based on average of
dfAnswer = fnReadQuery(conn2, lambda transaction, args :
                       fnGetFrameFromResultSet(
                           transaction.run("""MATCH(u:User)-[r:PROVIDED]-(a:Answe
                                              RETURN u.display_name as name, cou
                                              ORDER BY ansCount DESC, avgScore"'
                       ))
display(dfAnswer.head(10))

# Let's see the distribution of
seaborn.scatterplot(data=dfAnswer, x="ansCount", y="avgScore")
```

	name	ansCount	avgScore
0	cybersam	257	0.564202
1	Graphileon	206	0.616505
2	Tomaž Bratanič	202	0.599010
3	jose_bacoy	165	0.496970
4	InverseFalcon	95	0.536842
5	Christophe Willemsen	66	0.818182
6	fbiville	49	0.632653
7	David A Stumpf	36	0.305556
8	meistermeier	32	0.687500
9	Luanne	29	0.793103

Out[78]:
```
<AxesSubplot:xlabel='ansCount', ylabel='avgScore'>
```



In [79]:
```
# Who would be best to ask about Neo4j or where confidence is high that the ans
# Who scored well? Defined as avg >= 1 and answered at least 5 questions
dfAnsweredWell = fnReadQuery(conn2, lambda transaction, args :
                      fnGetFrameFromResultSet(
                          transaction.run("""MATCH(u:User)-[r:PROVIDED]-(a:Answe
                                             WITH u.display_name as name, count
                                             WHERE ansCount > 5 and avgScore >
                                             RETURN name, ansCount, avgScore
                                             ORDER BY ansCount DESC, avgScore A
                      ))
dfAnsweredWell.head(10)
```

Out[79]:

	name	ansCount	avgScore
0	Michael Hunger	23	0.956522
1	Nigel Small	21	0.904762
2	stellasia	12	1.000000
3	Håkan Löfqvist	11	0.909091
4	Mafor	9	1.222222

In [80]:
```
# Who scored poorly and maybe should be ignored? Defined as avg < .5 and answer
dfAnsweredPoorly = fnReadQuery(conn2, lambda transaction, args :
                      fnGetFrameFromResultSet(
                          transaction.run("""MATCH(u:User)-[r:PROVIDED]-(a:Answe
                                             WITH u.display_name as name, count
                                             WHERE ansCount > 5 and avgScore <
                                             RETURN name, ansCount, avgScore
                                             ORDER BY ansCount DESC, avgScore A
                      ))
dfAnsweredPoorly.head(10)
```

Out[80]:

	name	ansCount	avgScore
0	plastic	25	0.200000
1	norihide.shimatani	13	0.153846
2	hoyski	13	0.230769
3	Adrian Keister	10	-0.100000
4	A. L	9	0.222222
5	manonthemat	9	0.222222
6	Lukasmp3	9	0.222222
7	Michael Porter	6	0.000000

In [81]:
```
# Is there a pattern where certain users questions are answered by the same per
dfBuddies = fnReadQuery(conn2, lambda transaction, args :
                        fnGetFrameFromResultSet(
                            transaction.run("""MATCH (u:User)-[PROVIDED]->()-[a:AN
                                               WHERE NOT u.display_name = u2.displ
                                               RETURN u.display_name as responder,
                                                   count(*) as pairCount
                                               ORDER BY pairCount desc LIMIT 10;"'
                        ))
dfBuddies.head(10)
```

Out[81]:

	responder	questioner	pairCount
0	cybersam	LJRB	7
1	Tomaž Bratanič	LJRB	5
2	Graphileon	A. L	5
3	cybersam	Sean	4
4	Tomaž Bratanič	SteveS	4
5	Charlotte Skardon	Prateek	4
6	cybersam	ck22	4
7	Graphileon	Ooker	4
8	Tomaž Bratanič	user2167741	3
9	Graphileon	crazyfrog	3

In [82]:
```
# Questions that were answered quickly and by whom
dfUnanswered = fnReadQuery(conn2, lambda transaction, args :
                        fnGetFrameFromResultSet(
                            transaction.run("""MATCH (q:Question)-[:TAGGED]->(t:Ta
                                               WHERE NOT t.name in ['""" + keywor
                                                   AND NOT (q)<-[:ANSWERED]-()
                                               RETURN t.name as tag, count(q) as
                                               ORDER BY unansweredCount DESC LIMI
                        ))
dfUnanswered.head(10)
```

Out[82]:

	tag	unansweredCount
0	cypher	174
1	java	55
2	neo4j-apoc	52
3	python	36
4	spring-data-neo4j	35
5	spring-boot	34
6	graphql	27
7	graph-databases	26
8	graph	20
9	spring	19

In [83]:
```
# Cleanup connection
conn2.close()
```

In [ ]:
```

```