**Analysis of Twitter Data with the help of Neo4j Graph Database and Python**

A step-by-step tutorial of how to create, manage and query/process graphs in Neo4j.



Photo from [internetdevels](https://internetdevels.com/blog/using-neo4j-graph-database-part1)

In today's data-driven world, the amount of information generated is growing at an unprecedented rate. Traditional databases are great at handling structured data, but they struggle with the sheer volume, variety, and complexity of today’s generated data. This is where graph databases come in. But what exactly are the *graph databases?*

Graph databases are designed to handle highly connected and complex data, making them an ideal choice for applications such as social networks, recommendation engines, and fraud detection systems. In a graph database, each node represents an entity, such as a person or a product, and each edge represents a relationship between those entities, such as a purchase or a friend connection.

Neo4j is a popular graph database that is designed to store and manage data in the form of graphs.

In this tutorial, we will explore how to use Neo4j and Python to analyze Twitter data. Specifically, we will discuss about:

* Installation and setup of Neo4j locally
* Retrieve Twitter data from a MongoDB database using Python
* Build nodes and relationships to populate the Neo4j Graph
* Perform queries to our graph

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**Installation and setup of Neo4j**

Firstly, let’s download and install Neo4j for desktop. You can find the installation link [here](https://neo4j.com/download/).

For Neo4j Desktop Edition, you need to fill in the below form and then press Download Desktop.

Graphical user interface, application, Word

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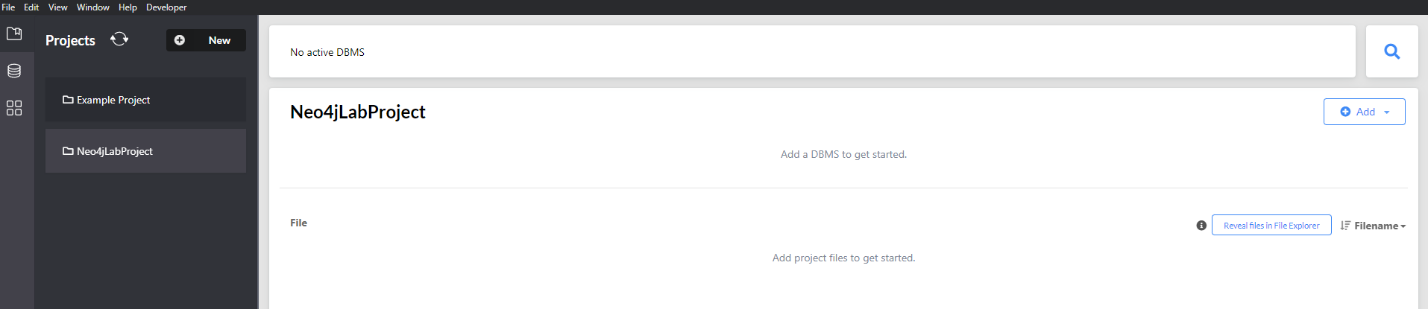
An .exe file will be downloaded inside your Downloads folder. When you open the Neo4j Desktop app, firstly you need to choose a folder to store the application data. After that, we are ready to create our first Neo4j project.

To do so, we press the “New” button and then we choose “Create Project”. We will name our project “Neo4jLabProject”.

A picture containing text

Description automatically generated

This will be the interface of our new project:



Now, we need to create a new local Database Management System (DBMS) that will be used to manage our graph. To achieve that, press the “Add” button and choose “Local DBMS”. Give a DBMS name and password and then press “Create”.

**Be careful!**

***Write down the DBMS name and password as we will need them later in order to connect to the database.***

It is recommended that we install some extra plugins that will be used later, before running the database. Specifically, we need to install the Graph Data Science library, which is a Neo4j library that provides extensive analytical capabilities based on graph algorithms. To install the library, go to the Plugins tab, select the “Graph Data Science Library” and press install.

Graphical user interface, application

Description automatically generated

Now we are ready to start our database, by pressing the blue “Start” button at the right side.

This may take a few seconds. You will get notified when the database is active.

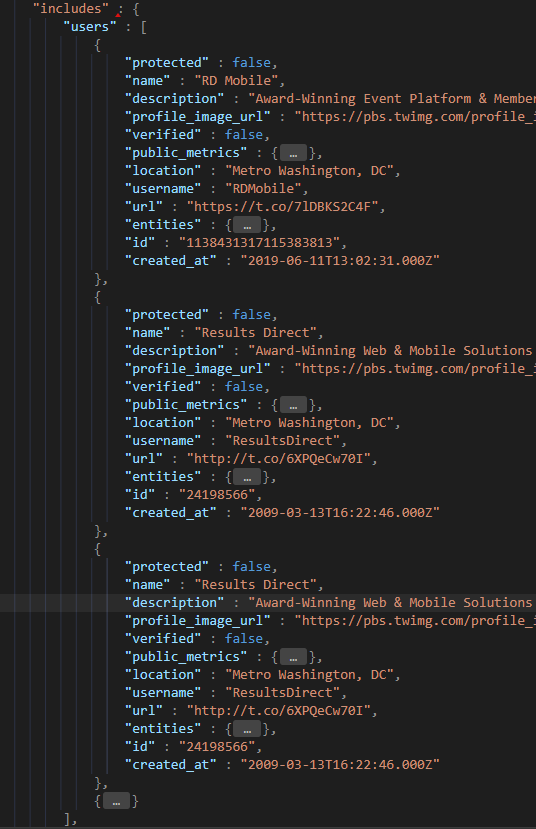
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**Dataset**

The dataset is a mongoexport JSON file, which contains 33,223 tweets retrieved from Twitter API.

Each document in our collection is either a tweet, a retweet, a quoted tweet or reply to tweet. The information of the type of the tweet can be taken from property “retweeted\_tweets”.

Let’s see an example of a retweet for better understanding:

 Text

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Users includes the user objects of the users mentioned in this tweet. Users[0] is a user object that always corresponds to the author of the tweet. Tweets[0] is the tweet under investigation (in this case the retweet) and the original tweet is tweet[1].

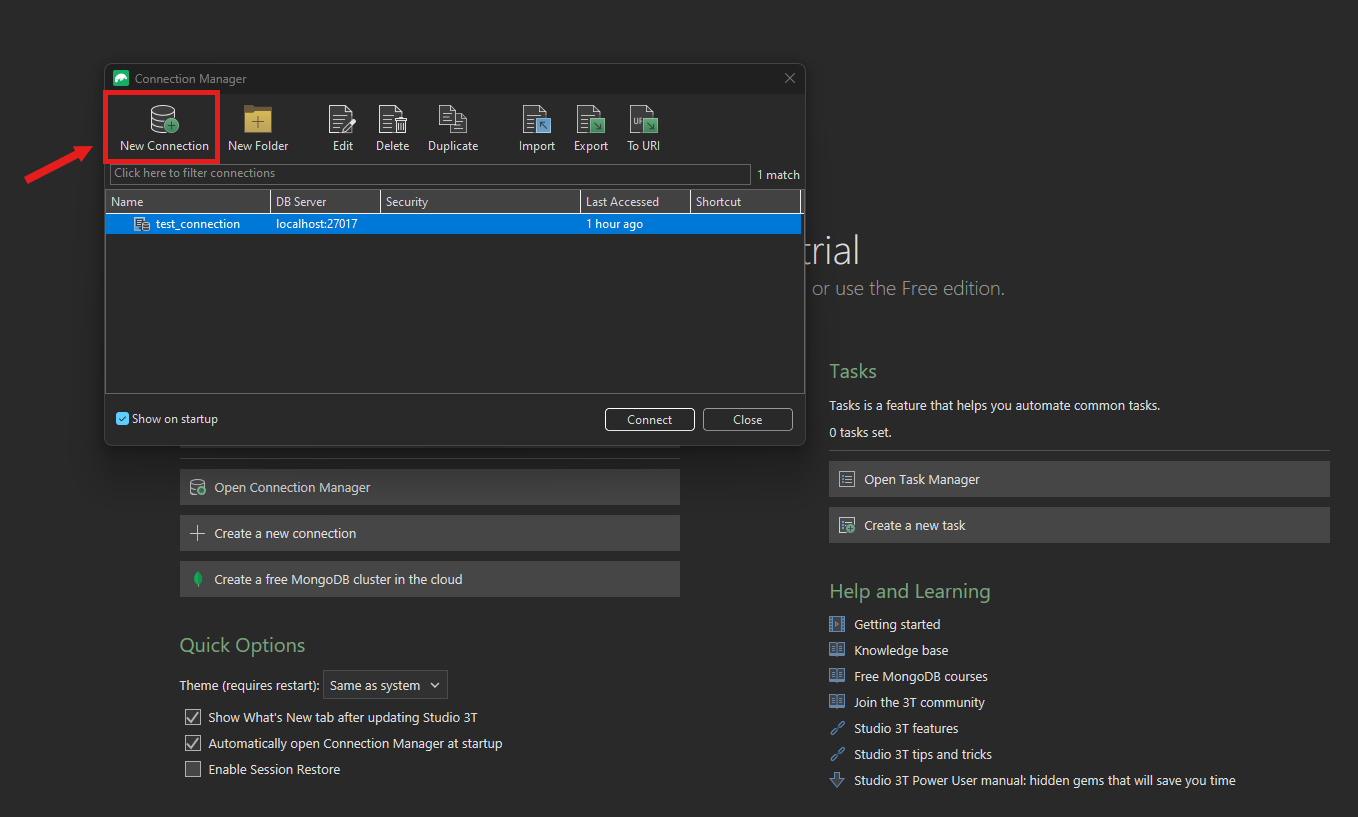
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**MongoDB**

We will use MongoDB to extract the data from the mongoexport JSON file. You can download MongoDB from the link [here](https://www.mongodb.com/try/download/community). We also need a GUI to have a clearer view of the dataset. We use [Studio 3T](https://studio3t.com/), but also [MongoDB Compass](https://www.mongodb.com/products/compass) is a quite popular choice.

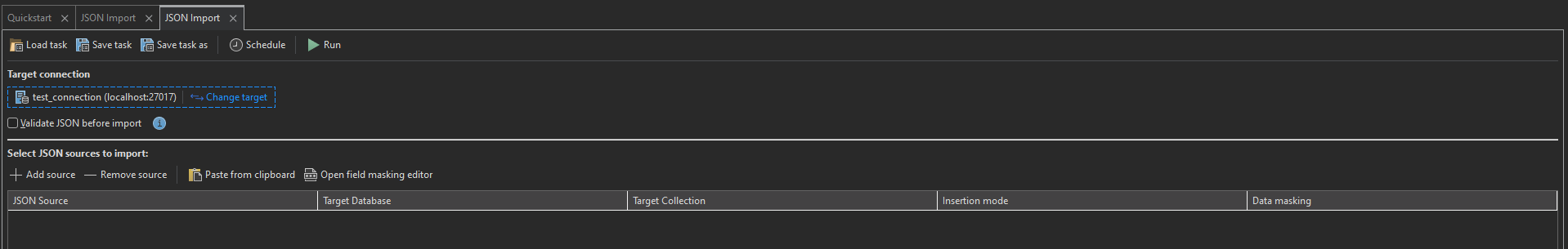
Once the installation has been completed, you need to create a 3T account and then we are ready to create our connection.

The Connection Manager windows appears automatically on startup. Click “New Connection” and then select “Manually configure my connection settings”. Use the default properties and just choose a *Connection name*. Click “Save” and our new connection is ready!



Now we are ready to import the dataset.

In the Global toolbar, click “Import” and then choose JSON. Click “Configure” and you will see the below interface:



In the Target Connection, choose the connection that we made before. Then, press “+ Add source” and select the JSON file with the dataset. Then click “Run” and wait until the process finishes. Once it finishes, you will see a new database inside the connection branch, with the name of the folder that JSON is inside.

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**Populate Graph**

Awesome, now that we imported the data to MongoDb, let’s start building our graph!

In order to populate the Neo4j graph using Python, firstly we chose to extract the dataset into a .bson file and then use this file for the creation of the neo4j database.

Open the dropdown menu of the new database that we made before, and inside the “Collections” folder, choose the JSON file (dataset). Then click the “Export” button in the Global toolbar and select BSON.

A screenshot of a computer

Description automatically generated

When you press “Configure”, you can choose the destination path of the .bson file. Then, click “Run” and wait until the process finishes.

To load the data in Python you need to decode the .bson file. To do so, open a Jupyter Notebook and install pymongo package.



Then import “bson” library and read the .bson file and decode it as shown:



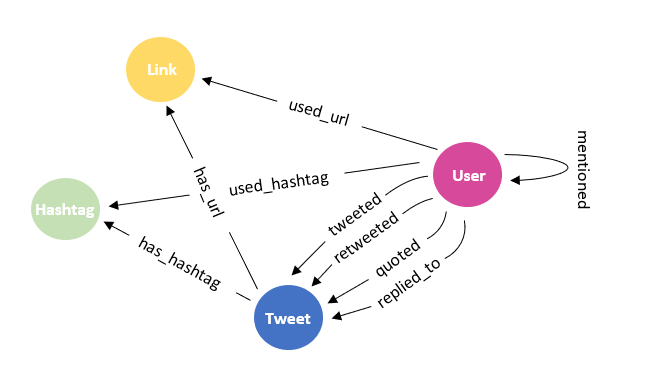
Graphical user interface

Description automatically generated

Now, it’s about time to introduce the Nodes and the Relationships of our graph!

**Nodes & Relationships**

The data model that we used to represent our Twitter data in Neo4j is depicted in the figure below. Each node and relationship will be discussed separately.



**Nodes**

Now let's create our nodes. Always be careful not to create double nodes!

To populate Neo4j with all the nodes, we use py2neo Python library.



Firstly, we iterate over the different documents of the data, we retrieve the information needed from every document and store them into sets.

**Hashtag**: For the node Hashtag, we only added the property ***tag***, where tag is the name of the hashtag. All tags are converted to lowercase for our queries to be case insensitive. Hashtags are taken from the includes.tweets[0].entities.hashtags.tag when the hashtags and tag properties exist.

**Link**: For the node Link, we only added the property ***url***, where url is the name of the url. Urls are taken from the includes.tweets[0].entities.urls.expanded\_url when the urls and expanded\_url properties exist.

**Tweet:** For the node Tweet, we added the ***properties id***, ***created\_at***, ***reply\_count***, ***type*** and ***author\_id***. Type and author\_id properties are used later to facilitate creating the relationships between users and tweets. The tweet nodes only consist of Tweets[0], which is the tweet under investigation as stated above. Tweet data are taken from the following paths:

* includes.tweets[0].id
* includes.tweets[0].created\_at
* includes.tweets[0].author\_id
* includes.tweets[0].public\_metrics.reply\_count
* includes.tweets[0].referenced\_tweets[0].type

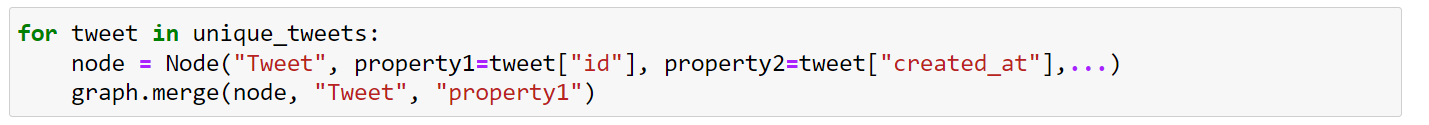
User**:** For the node User, we added the properties ***id***, ***username*** and ***followers\_count***. The user nodes consist of User[0], which is the author of the tweet and of the users mentioned in the tweet. User data are taken from the following paths:

* includes.users[0].id
* includes.users [0].username
* includes.users[0].public\_metrics.followers\_count

Mentioned users are taken at a second step from:

* data.entities.mentions.id
* data.entities.mentions.username

After storing the information of the nodes into sets (for uniqueness) , we use py2neo to generate neo4j nodes. The merge function in py2neo is used to either create a new node or update an existing one based on some specified criteria. In this case, the merge function is used to avoid creating duplicate nodes in the graph. The property1 parameter is used to specify the unique identifier of the node.



**Relationships**

Having our nodes, we can create the relationships between them. Firstly, we create 4 different relationships between User and Tweet to represent the kind of Tweet based on the property Tweet.type (tweet, retweet, reply or quote).





Similarly, to create ‘quoted’ and ‘replied\_to’ relationships, modify the query in the above figure, so that t.type equals 'quoted' and 'replied\_to' accordingly.

In addition, we iterate over the documents to create relationships between User, Tweet, Hashtag and Link.

**HAS\_HASHTAG:** represents hashtag that is included on tweet.

**USED\_HASHTAG:** represents hashtags that is used by user.

**HAS\_URL:** represents url that is included on tweet.

**USED\_URL:** represents urls that is used by user.

**MENTIONS:** refers to user that is mentioned in tweet by another user. If the mentioned user does not exist in the graph, we will generate a new node for the user. It is important to check if the mentioned user does not already exist in the network and then add a new User node.

A picture containing timeline

Description automatically generated

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**Queries**

You can now run some cypher queries on the created Neo4J database. Keep in mind that you must have already generated the graph using the methods described in the previous sections. Here are some examples of queries that we have applied on our database.

1. **Get the total number of tweets**



Result: A picture containing diagram

Description automatically generated

1. **Get the total number of hashtags (case insensitive)**



Result: A picture containing shape

Description automatically generated

1. **Get the 20 most popular URLs in descending order**

Text

Description automatically generated with medium confidence

Result:

Text

Description automatically generated

1. **Get the followers count of each user**

A picture containing Word

Description automatically generated

Result (not all users are presented):

Table

Description automatically generated

1. **Get the number of tweets & retweets per hour**

Graphical user interface, text, application

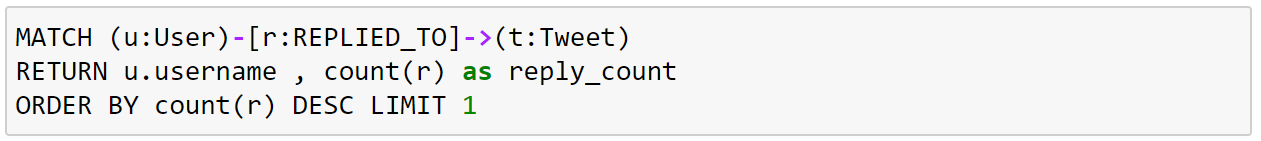
Description automatically generated

Result:

Table

Description automatically generated

1. **Get the user with the most replies**



A screenshot of a computer

Description automatically generated with low confidence

Result:

1. **Get the top-20 hashtags that co-occur with the hashtag that has been used the most**

Graphical user interface, text, application, email

Description automatically generated

Result:

Text, letter

Description automatically generated

1. **Get the most “important” user in the dataset. Use PageRank algorithm. Apply the algorithm in the mention network**

For this query, you need to have installed the Graph Data Science Library on neo4j Desktop. We create a graph called “mentionGraph” based on the “MENTIONS” relationship.

A picture containing text

Description automatically generated

Graphical user interface, text

Description automatically generated



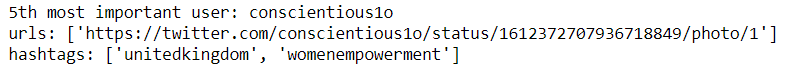
Result:

1. **For the 5th most important user, get the list of hashtags and URLs that have** **been posted (if no hashtags or URLs - check another user e.g. 6th, 7th , etc..)**

Graphical user interface, text

Description automatically generated

Result:



1. **Get the user communities that have been created based on the users’ interactions and visualize them (Louvain algorithm)**

Next, we apply the Louvain algorithm to the "mentionGraph". This algorithm generates a new property called "communityId," which indicates the community to which a user belongs.

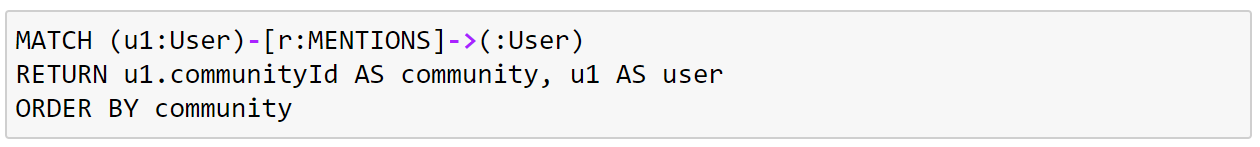
Graphical user interface, text

Description automatically generated with medium confidence

Result: Total number of communities: 4606

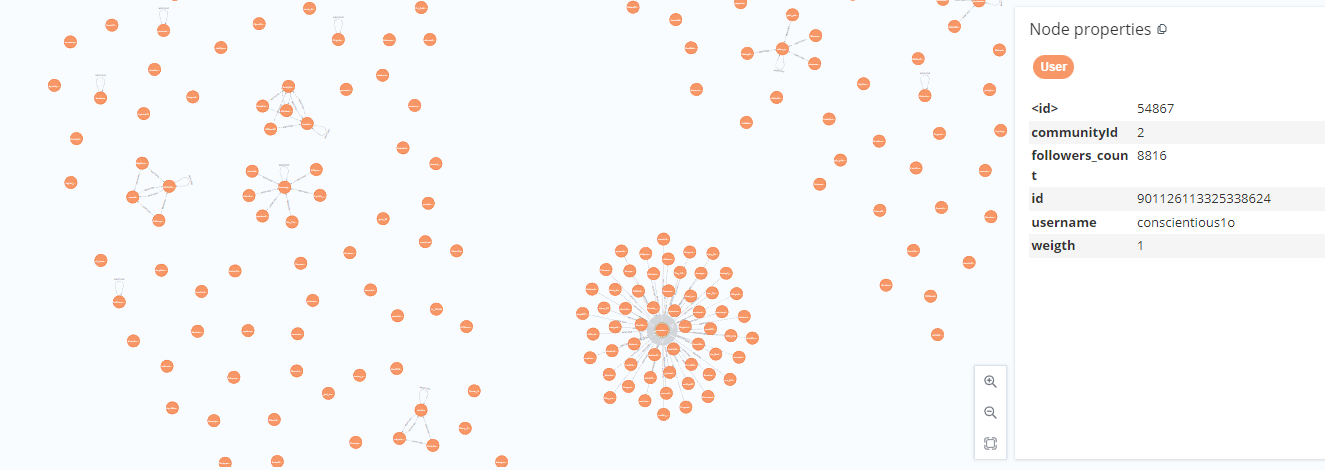
Total number of communities with multiple users: 2882

To visualize communities, we run the following query in neo4j:



Result:

The displayed image is a segment of the final graph, as the actual outcome is considerably larger.



1. **Get the most popular hashtag for each community**

Text

Description automatically generated

Result (not all communities are presented):

Table

Description automatically generated

1. **Get the top 10 users who have tweeted the highest number of tweets that contain at least one hashtag and one URL**

Text

Description automatically generated

Result:

Table

Description automatically generated with medium confidence

I hope you found this information useful and thanks for reading!

Authors

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