Graphen: Neo4j für Korrespondenzdaten

Workshop im Rahmen der Veranstaltungsreihe "Digital Humanities – Wie geht das?" des Referats für Digitale Forschungsdienste

Dr. Franziska Klemstein | 27.02.2023

Agenda

Graphen: Neo4j für Korrespondenzdaten

1. Vorstellungsrunde
2. Knoten und Kanten – Erste Schritte

– 10.30 Uhr Pause –

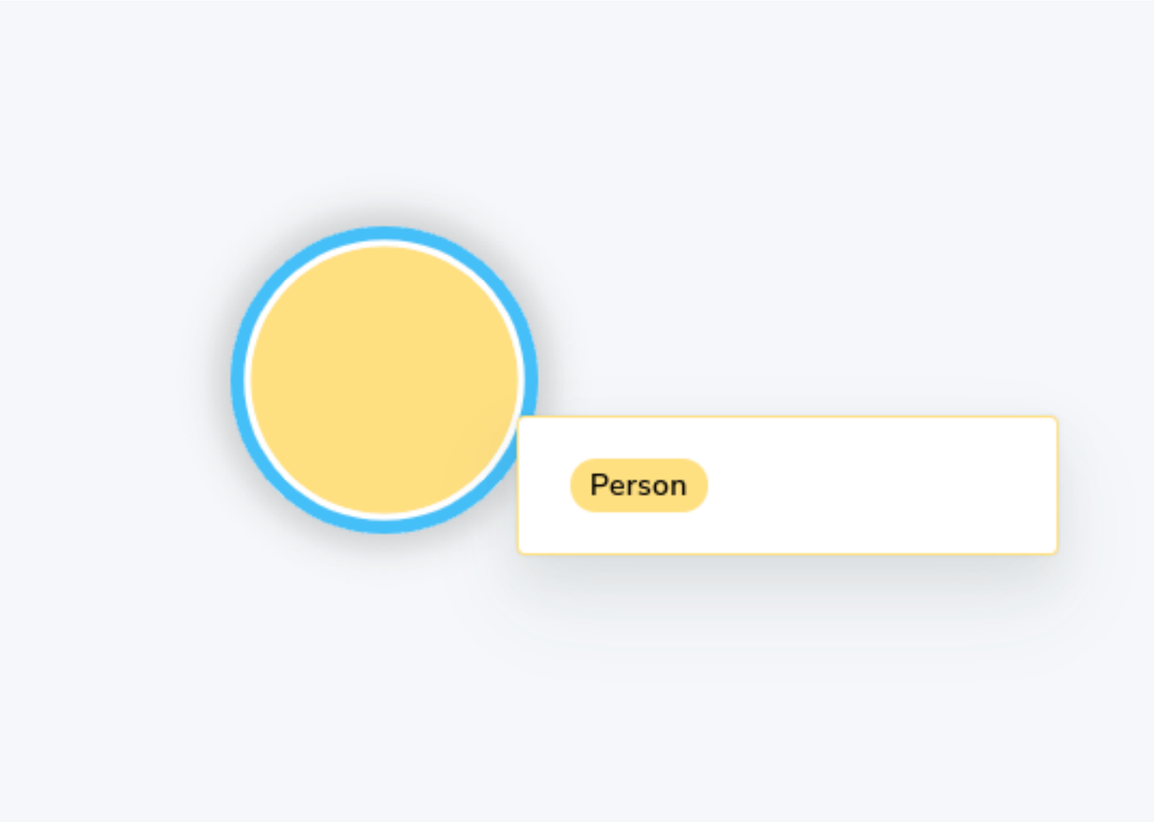
3. Datenimport mit csv-Dateien
4. Erweiterungen, Ergänzungen und Ausblick

Vorstellungsrunde

Interessen und Vorkenntnisse

Knoten und Kanten

Erste Schritte



Vorbereitung

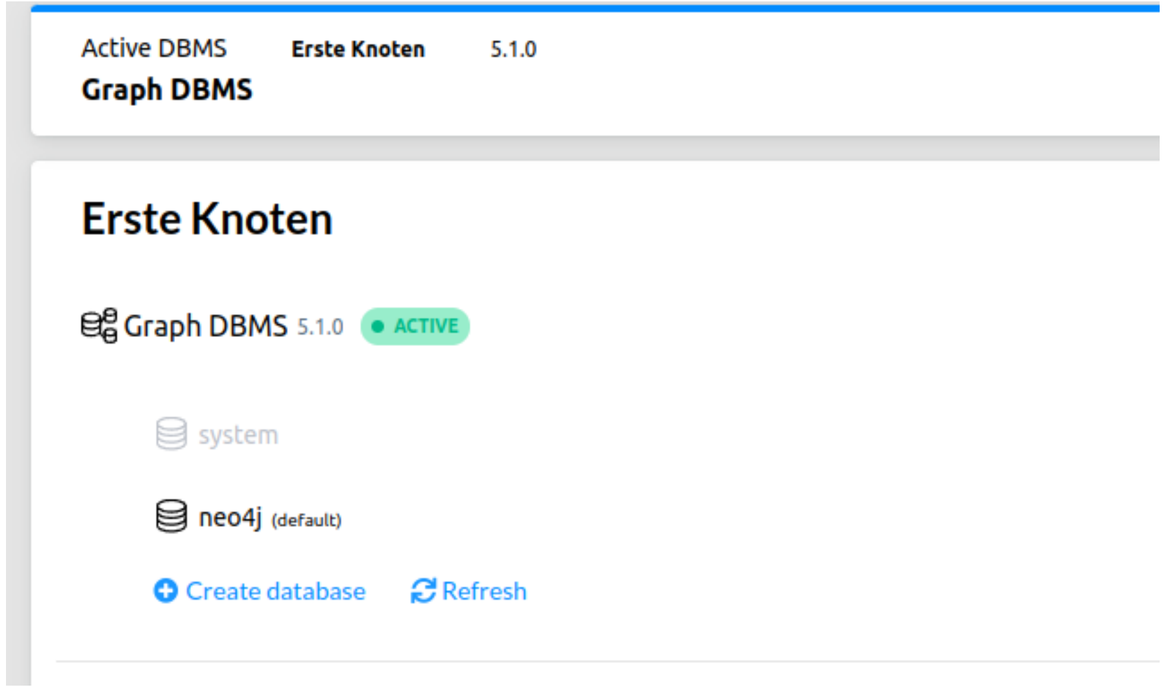
Startpunkt

- Download und Installation von neo4j

ODER

- neo4j-Registrierung im Browser:

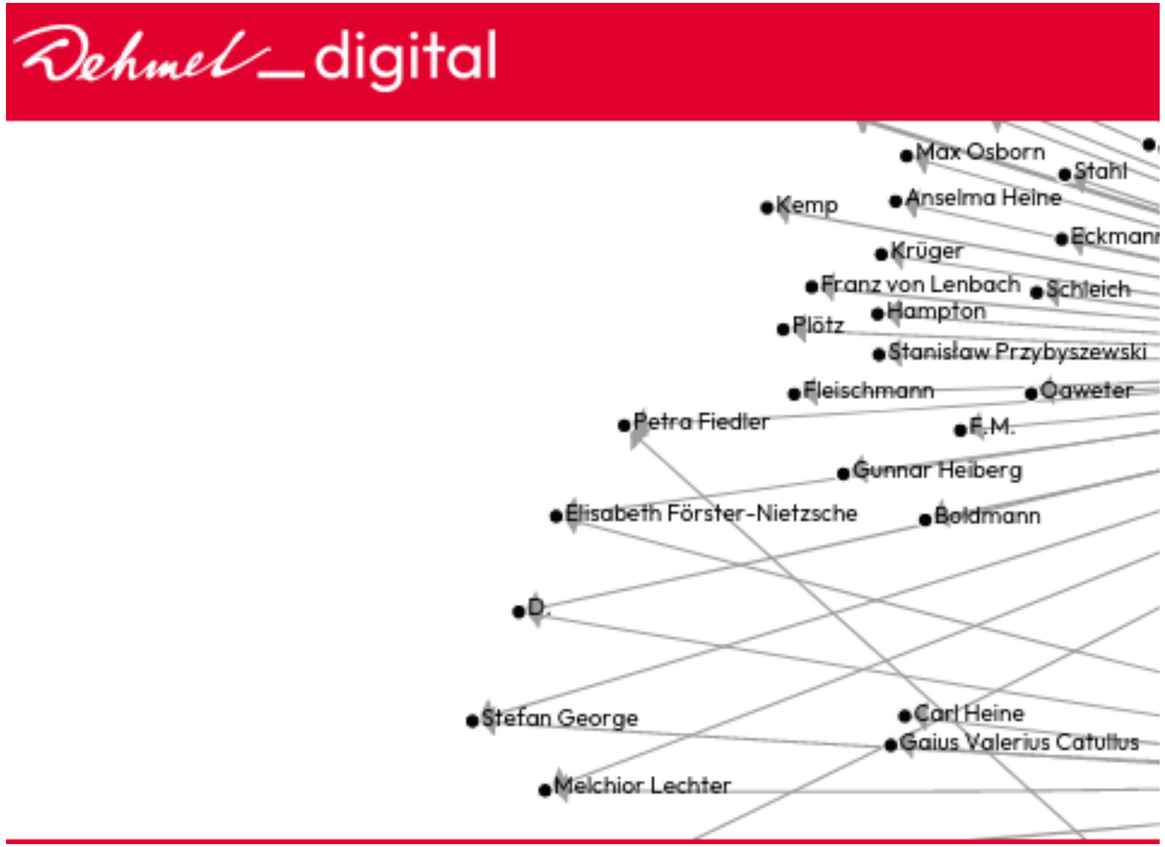
console.neo4j.io/



Beispielgraph

mit Daten von Dehmel-Digital

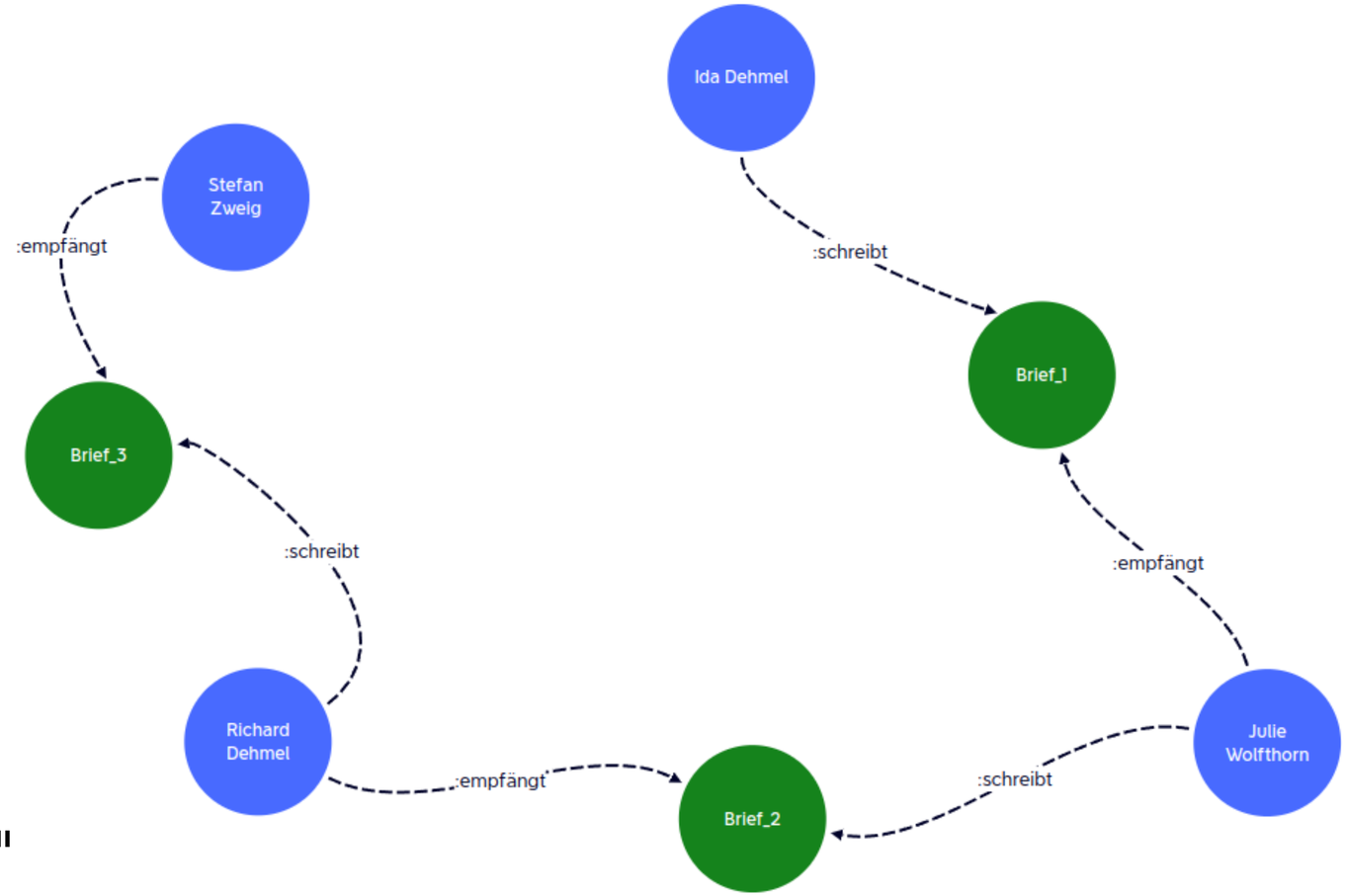
- Knoten und Knotentypen
- mit Labeln und Eigenschaften
- Kanten / Verbindungen / Relationen



Beispielgraph

Ein erstes Modell

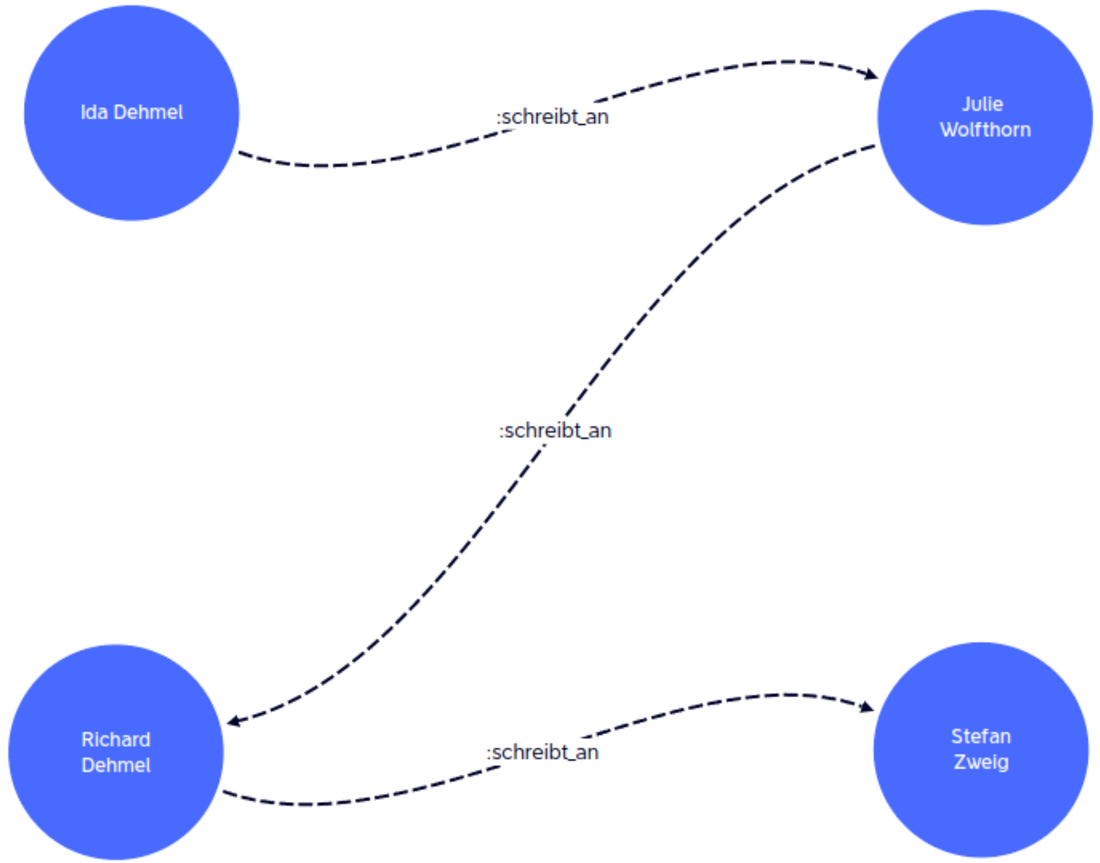
- Knotentyp: Person, Brief
- Label: Person, Brief
- Eigenschaften: Name, Bezeichnung
- Kantentypen: "schreibt", "empfängt"
- Kanteneigenschaften; "keine"



Beispielgraph

Ein zweites Modell

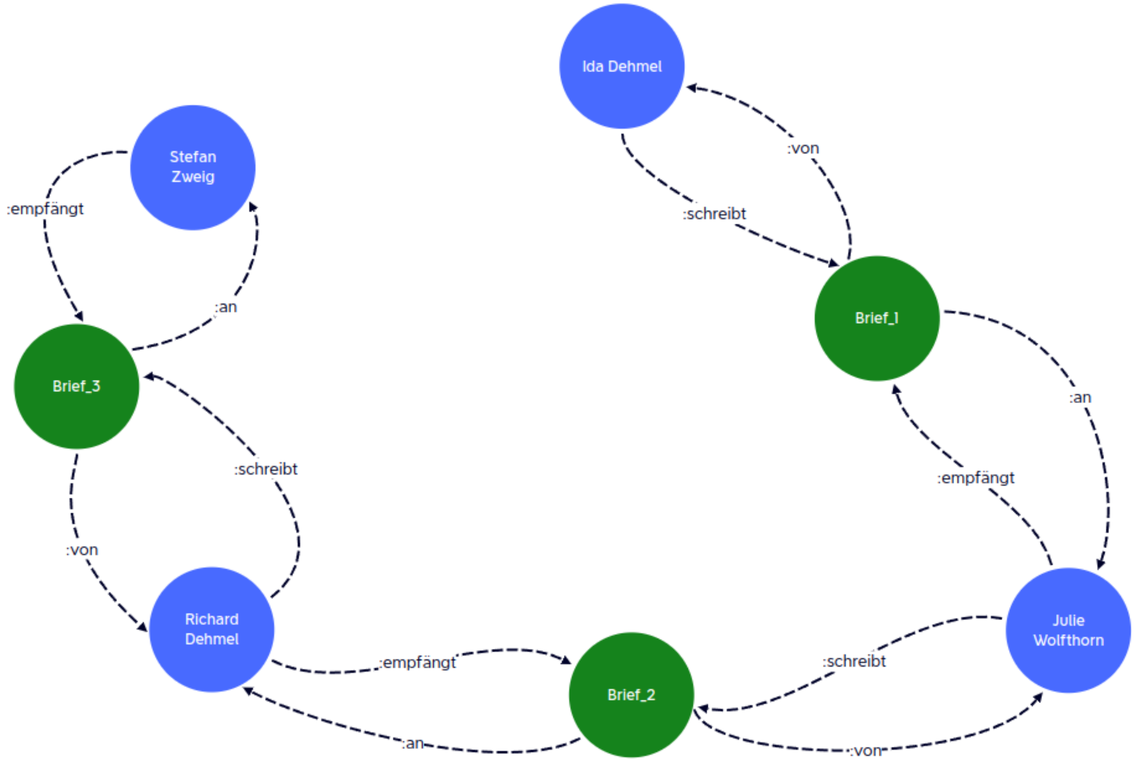
- Knotentyp: Person
- Label: Person
- Eigenschaften: Name
- Kantentyp: "schreibt_an"
- Kanteneigenschaften: keine



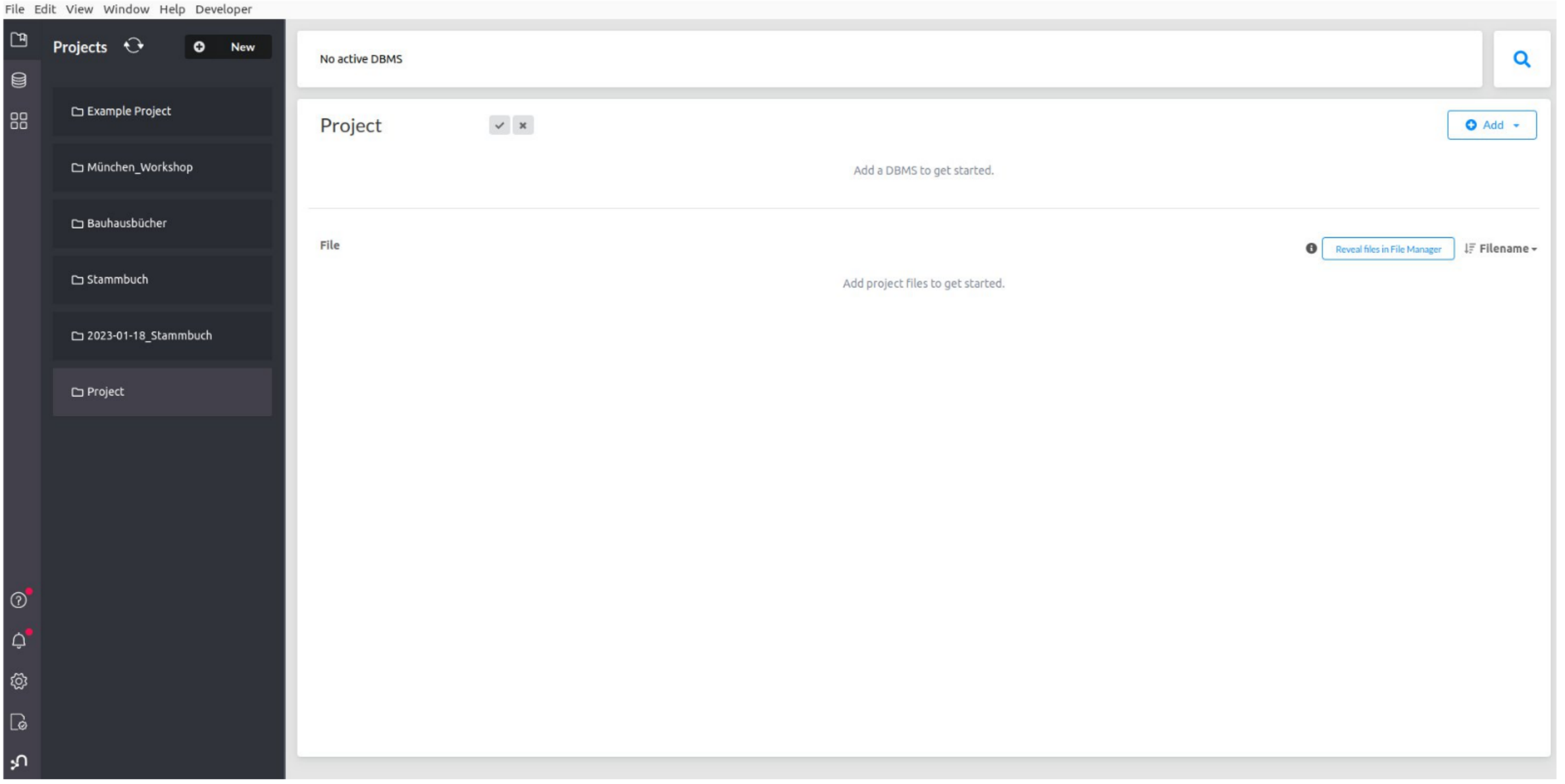
Beispielgraph

Ein drittes Modell

- Knotentyp: Person, Brief
- Label: Person, Brief
- Eigenschaften: Name, Bezeichnung
- Kantentypen: "schreibt", "empfängt", "an","von"
- Kanteneigenschaften: keine




Let's get started


File Edit View Window Help Developer
Projects
New
Example Project
München_Workshop
Bauhausbücher
Stammbuch
2023-01-18_Stammbuch
Project
No active DBMS
Project
Add
Add a DBMS to get started.
File
Reveal files in File Manager
Filename
Add project files to get started.

File Edit View Window Help Developer

Projects

New

- Example Project
- München_Workshop
- Bauhausbücher
- Stammbuch
- 2023-01-18_Stammbuch
- New-Project

No active DBMS

New-Project

Add

- Local DBMS
- Remote connection
- File

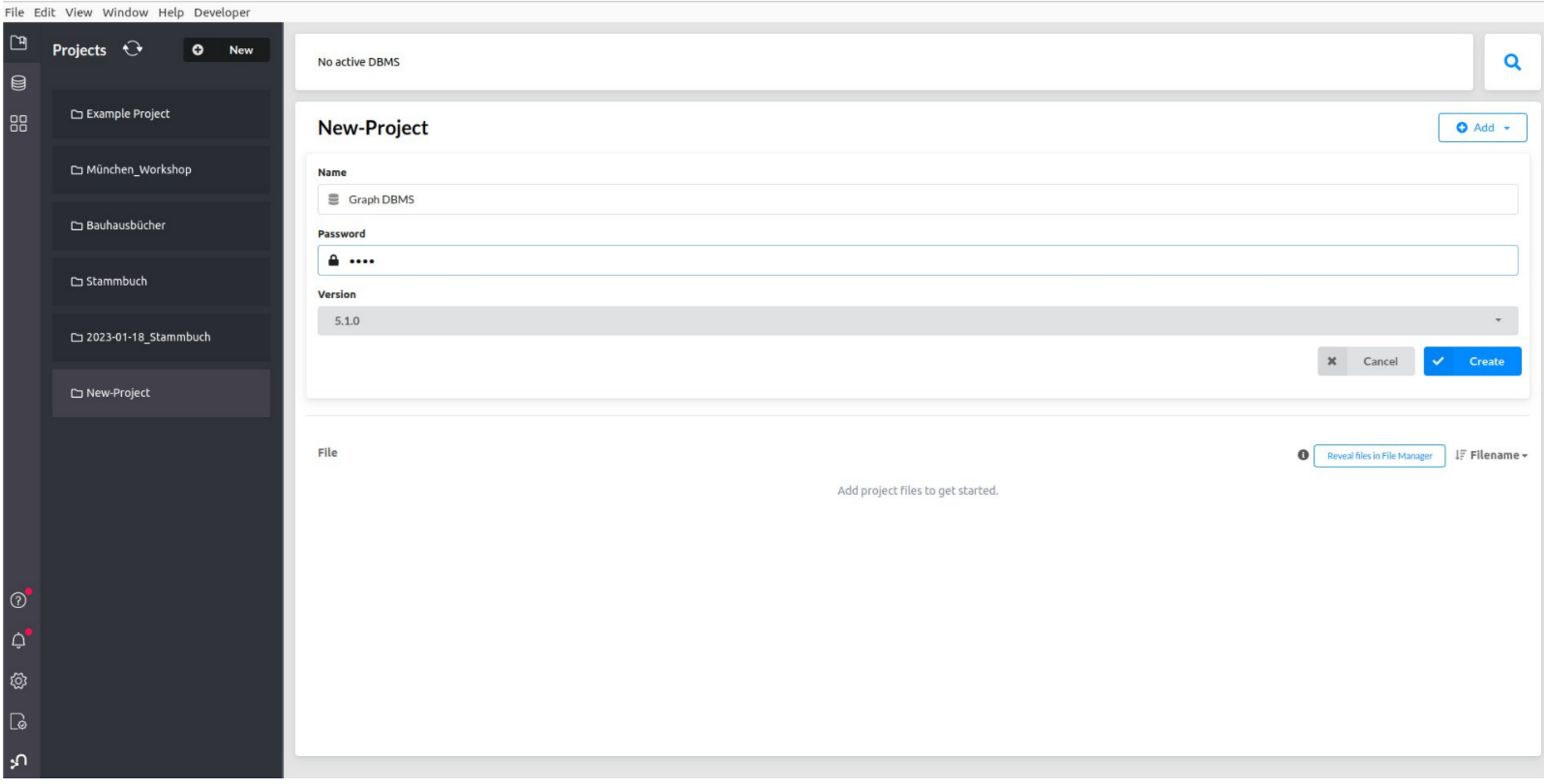
Add a DBMS to get started.

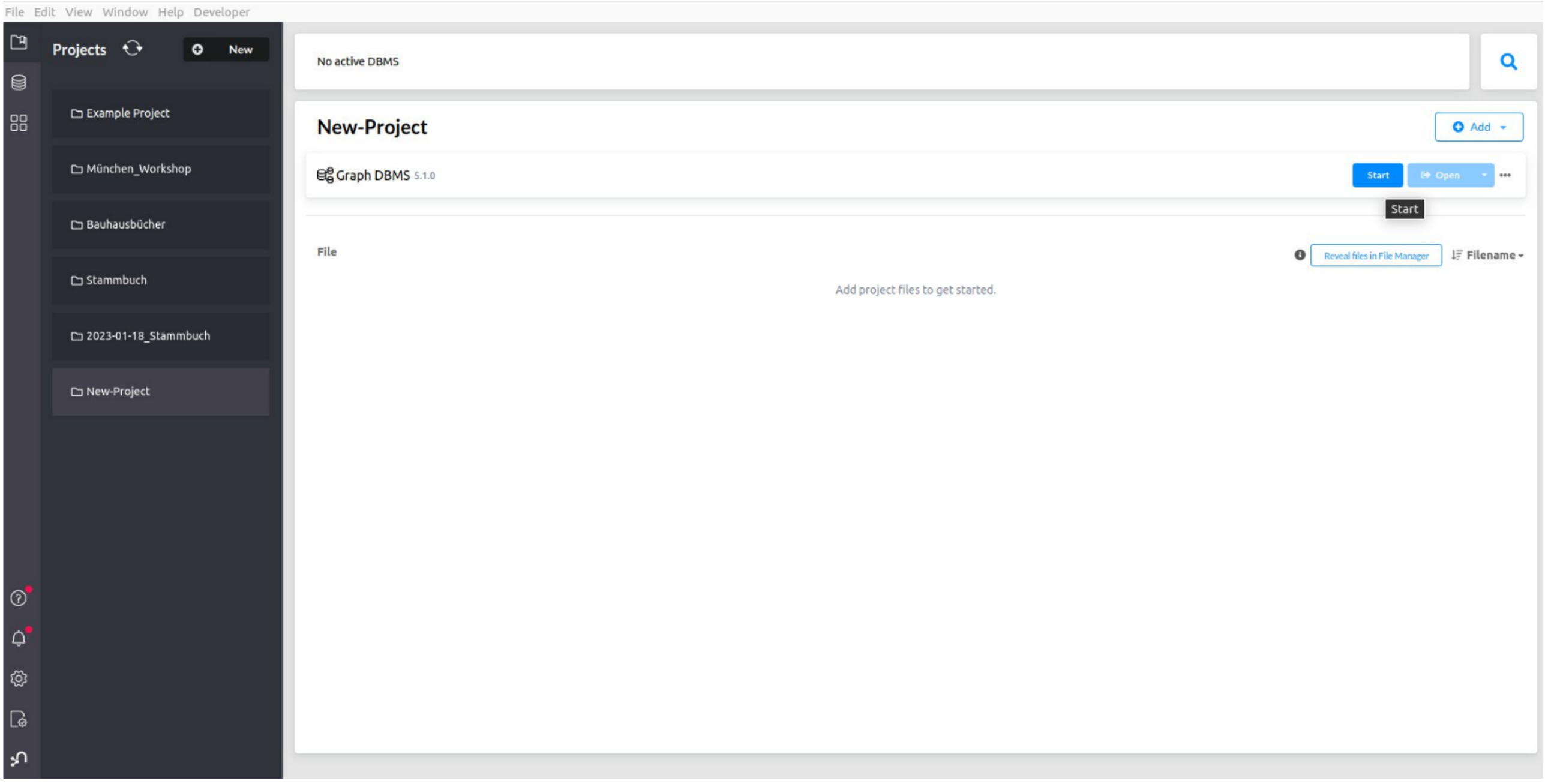
File

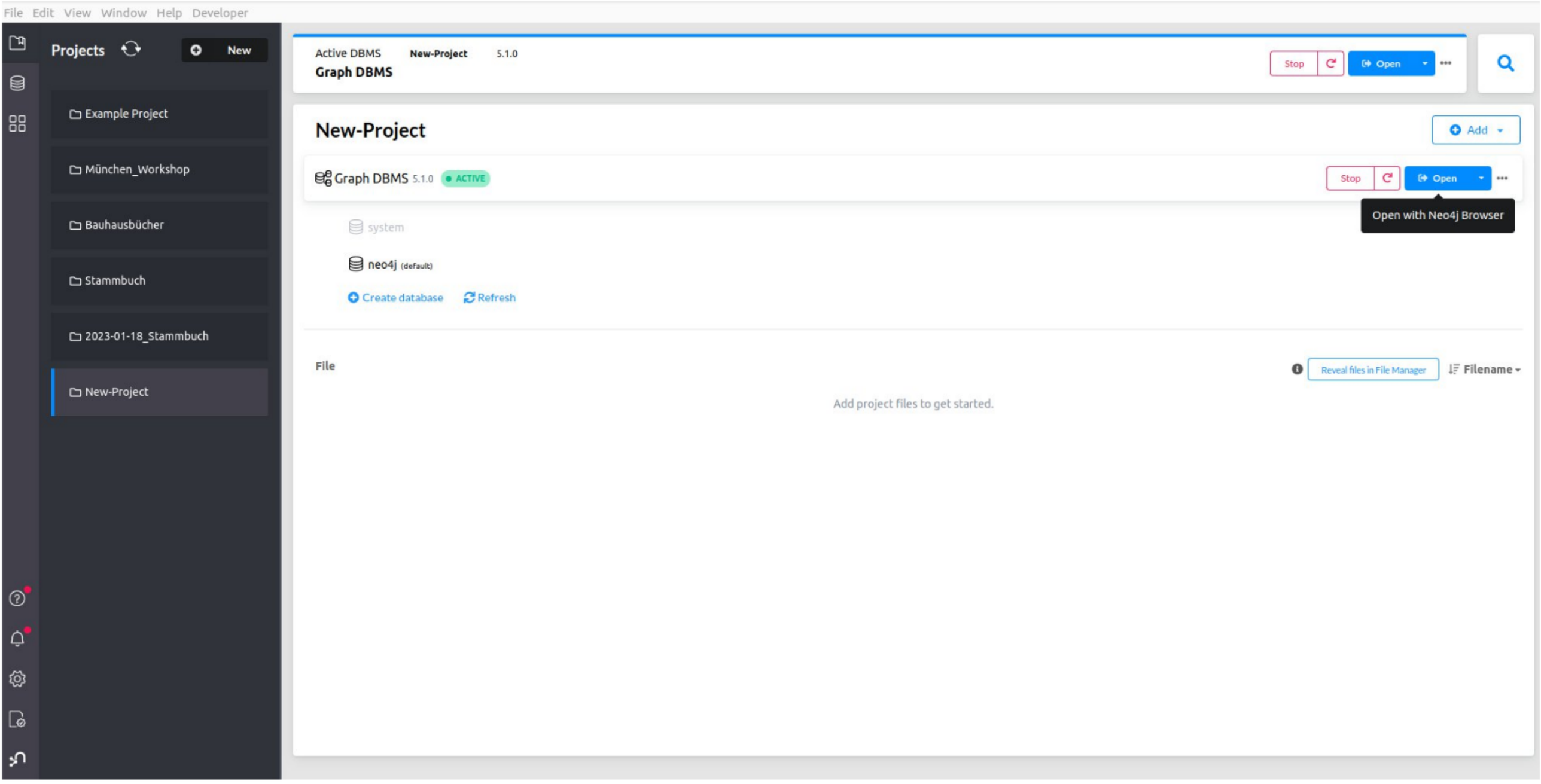
Reveal files in File Manager

Filename

Add project files to get started.


File Edit View Window Help Developer
Projects
New
Example Project
München_Workshop
Bauhausbücher
Stammbuch
2023-01-18_Stammbuch
New-Project
No active DBMS
New-Project
Add
Name
Graph DBMS
Password
••••
Version
5.1.0
Cancel
Create
File
Reveal files in File Manager
Filename
Add project files to get started.


File Edit View Window Help Developer
Projects
New
Example Project
München_Workshop
Bauhausbücher
Stammbuch
2023-01-18_Stammbuch
New-Project
No active DBMS
New-Project
Add
Graph DBMS 5.1.0
Start
Open
Start
File
Reveal files in File Manager
Filename
Add project files to get started.


File Edit View Window Help Developer
Projects
New
Example Project
München_Workshop
Bauhausbücher
Stammbuch
2023-01-18_Stammbuch
New-Project
Active DBMS
New-Project
5.1.0
Graph DBMS
Stop
Open
New-Project
Add
Graph DBMS 5.1.0
ACTIVE
Stop
Open
Open with Neo4j Browser
system
neo4j (default)
Create database
Refresh
File
Reveal files in File Manager
Filename
Add project files to get started.

File Edit View Window Help Developer

neo4j$

$:play start

neo4j

Getting started with Neo4j Browser

Neo4j Browser user interface guide

Get started

Try Neo4j with live data

A complete example graph that demonstrates common query patterns.

Actors & movies in cross-referenced pop culture.

Open guide

Cypher basics

Intro to Graphs with Cypher

What is a graph database?
How can I query a graph?

Start querying

Sign up for a free Neo4j cloud instance with neo4j aura

$:server status

Connection status

This is your current connection information.

You are connected as user `neo4j`

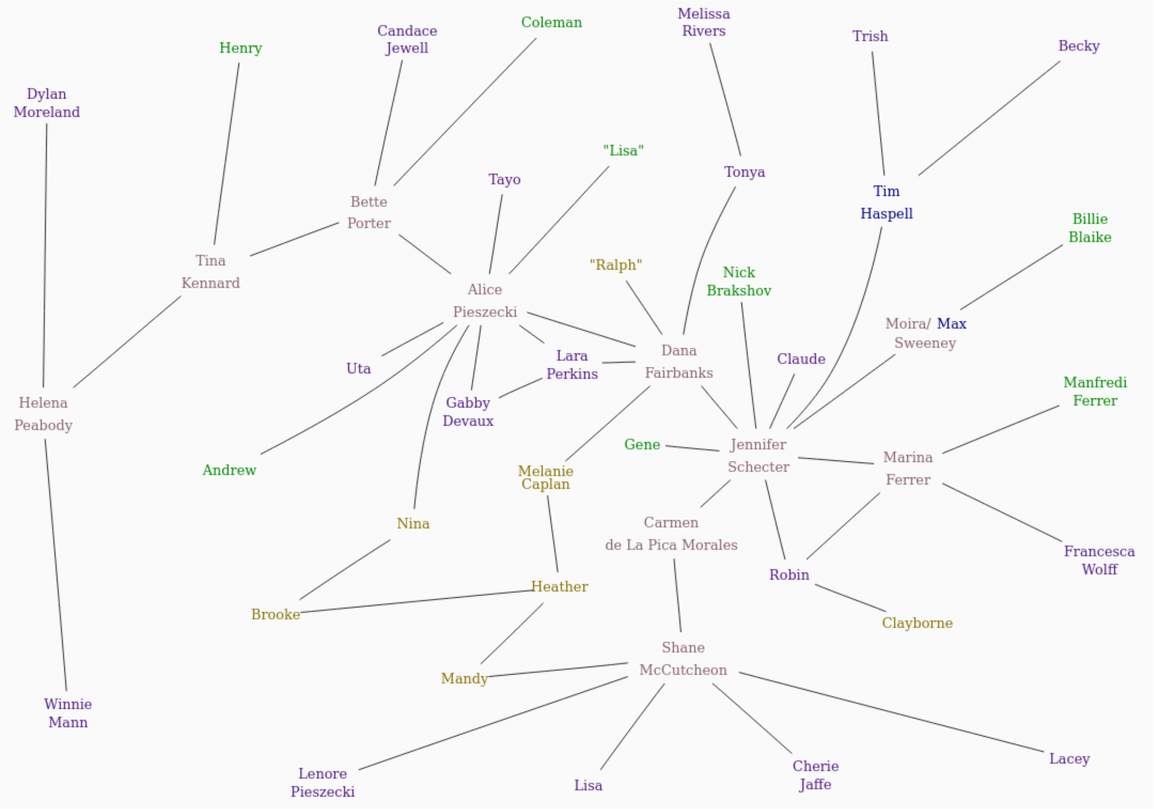
to `bolt://localhost:7687`

Connection credentials are stored in your web browser.

Graphen

Relationen, Netzwerke, Verbindungen

- "Die Welt ist ein Graph"
  (Michael Hunger, neo4j)
- Graphentheorie: Leonard Euler
- Graphdatenbanken: Teil der "NoSQL-Bewegung"
- Das Datenmodell besteht aus Knoten, die mittels gerichteter, getypter Verbindungen miteinander verknüpft sind. Beide können beliebige Mengen von Attribut-Wert-Paaren (Properties) enthalten. Daher wird dieses Datenmodell auch als „Property-Graph“ bezeichnet



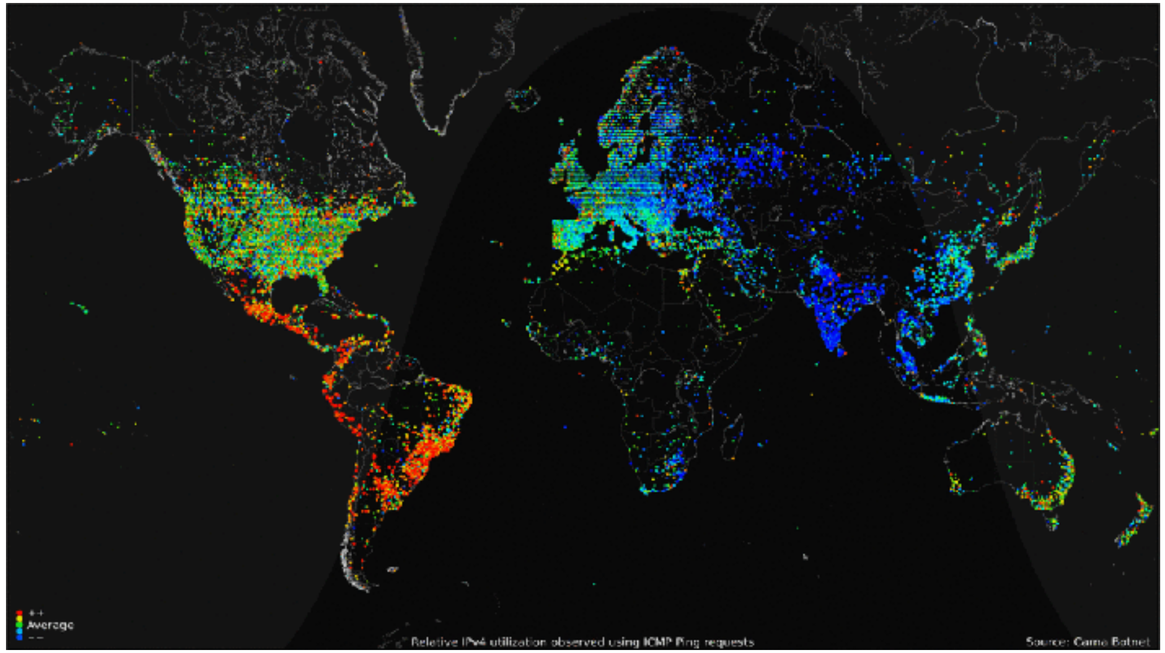
Bildquelle: Silje Ljosland Bakke: The Chart from the TV series The L Word. https://commons.wikimedia.org/wiki/File:TheLWord_TheChart.svg?uselang=de#/media/File:TheLWord_TheChart.svg

Die Welt ist ein Graph

Übung 1

Zeichnet / überlegt euch ein Netzwerk:

- Welche Knotentypen mit welchen Eigenschaften sollte es geben?
- Welche Relationen/Kanten?
- Wie sollte der Graph gerichtet sein?
- Was wären mögliche Abfragen?

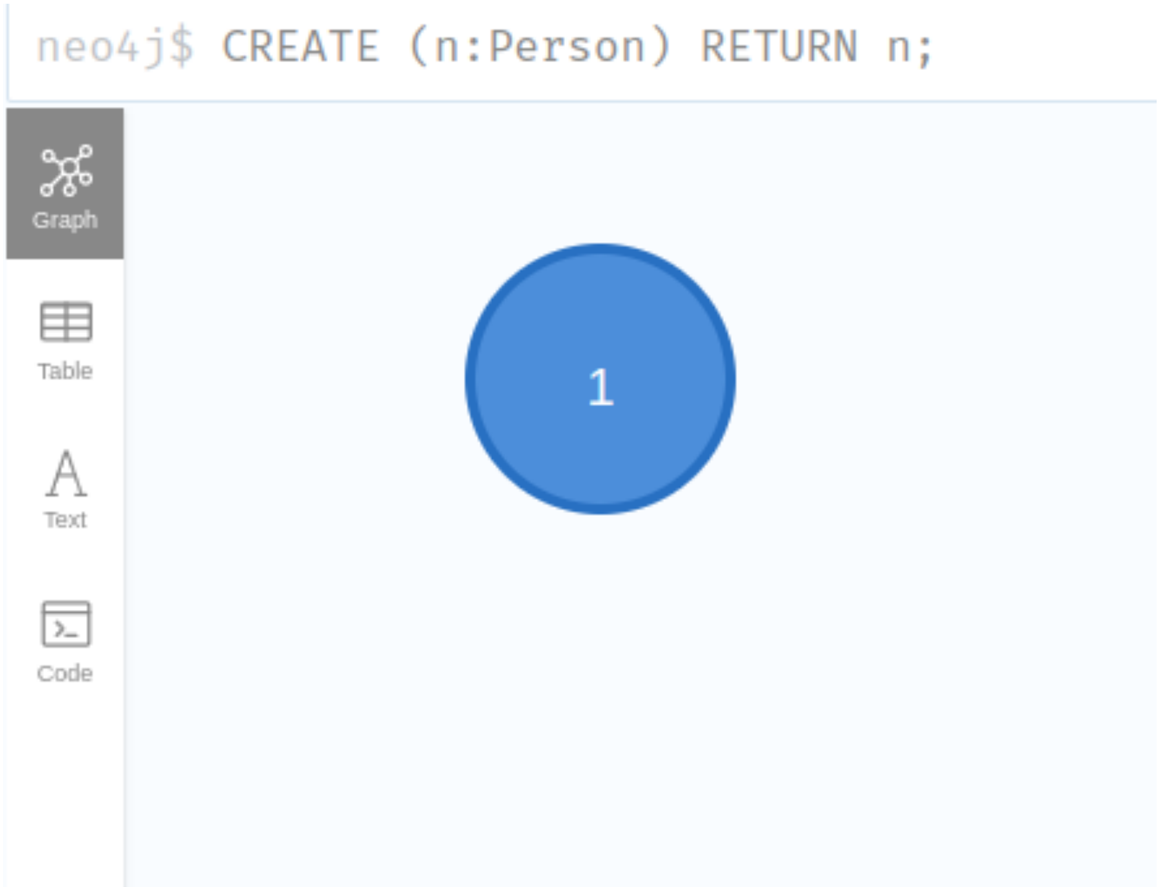


World map of 24 hour relative average utilization of IPv4 addresses observed using ICMP ping requests
https://om.co/gigaom/check-out-this-visual-map-that-shows-24-hours-of-internet-usage-around-the-world/

Knoten

Der einfachste mögliche Graph

- Knoten werden verwendet, um Entitäten darzustellen
- Knoten können (mehrere) Label besitzen
- Knoten können Eigenschaften haben



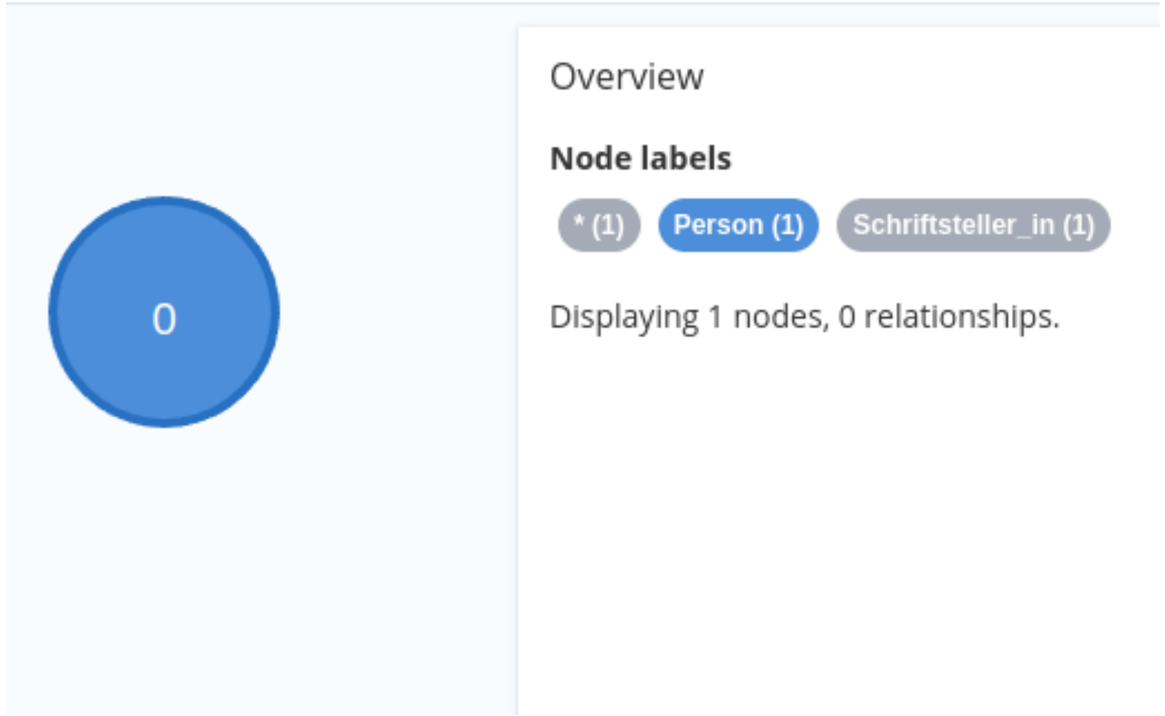
Knoten

mit einem Label

- CREATE (n:Person)
  RETURN n;

mit mehreren Label

- CREATE (n:Person:Schriftsteller_in)
  RETURN n;



```
CREATE (:Person {name:'Ida Dehmel', GND:'https://d-nb.info/gnd/118679228'})*

CREATE (:Person {name:'Ida Dehmel', GND:'https://d-nb.info/gnd/118679228'})

RETURN n;
```

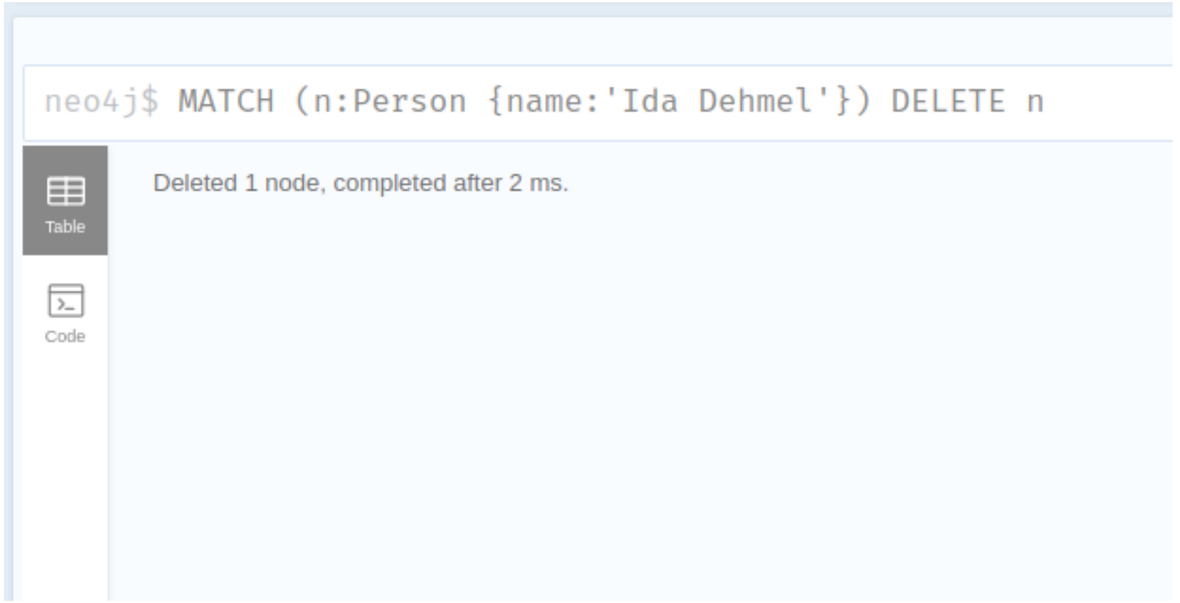
Label Eigenschaft Eigenschaft

*Knoten mit denselben Label-Bezeichnungen und denselben Eigenschaften können auch mehrfach angelegt werden

Knoten löschen (Option A):

MATCH (n:Person {name:'Ida Dehmel'})

DELETE n;

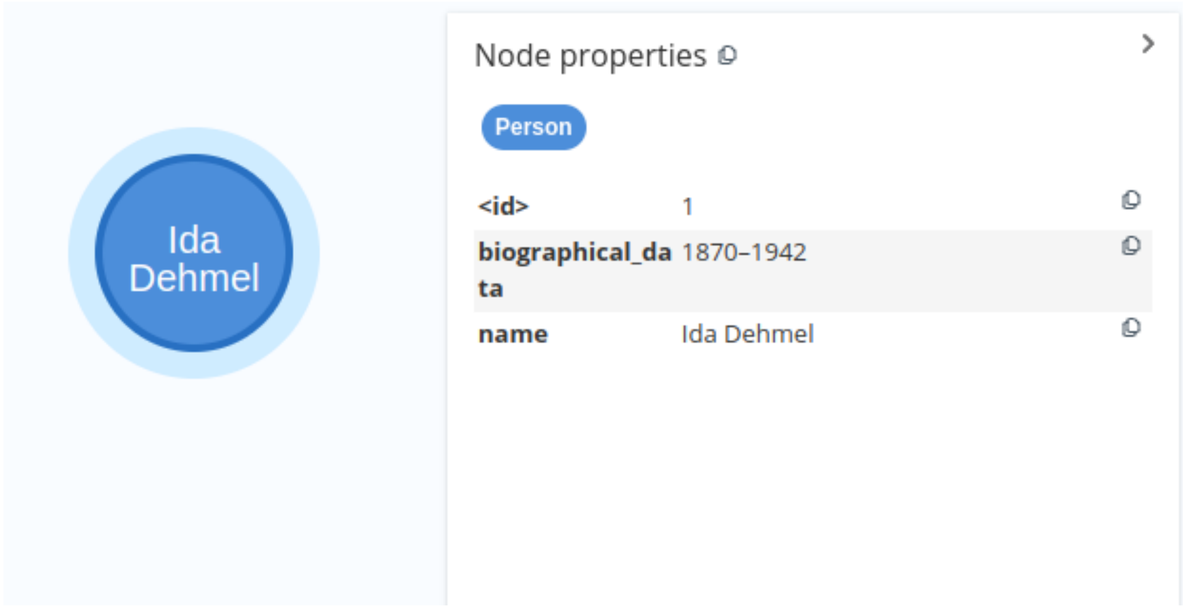


Knoten löschen (Option B):

MATCH (n:Person)
WHERE ID(n)=0
DELETE n

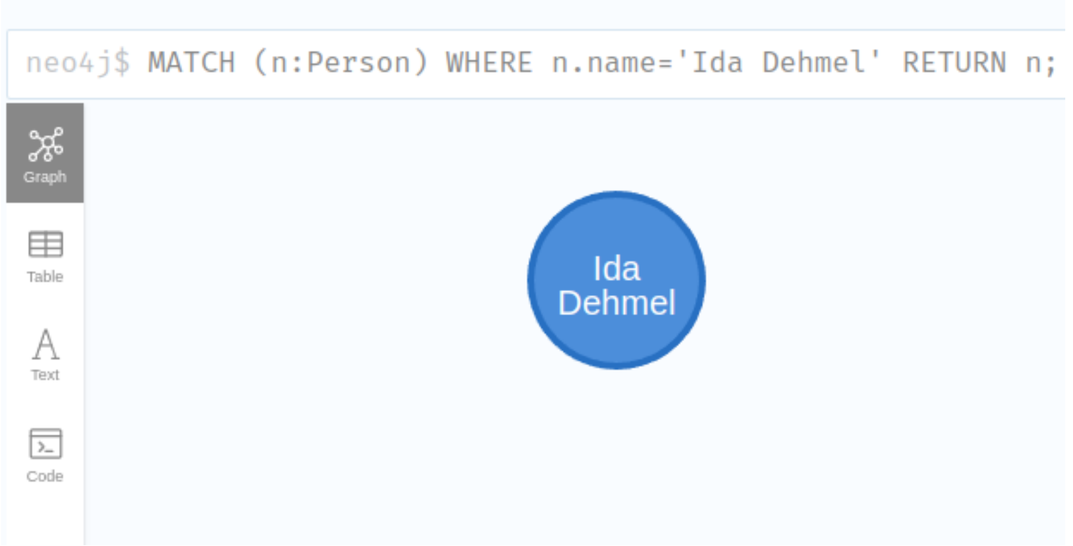
Eigenschaft ergänzen:

```
MATCH (n:Person {name:'Ida Dehmel'})

SET n.biographical_data = '1870-1942'


RETURN n;
```



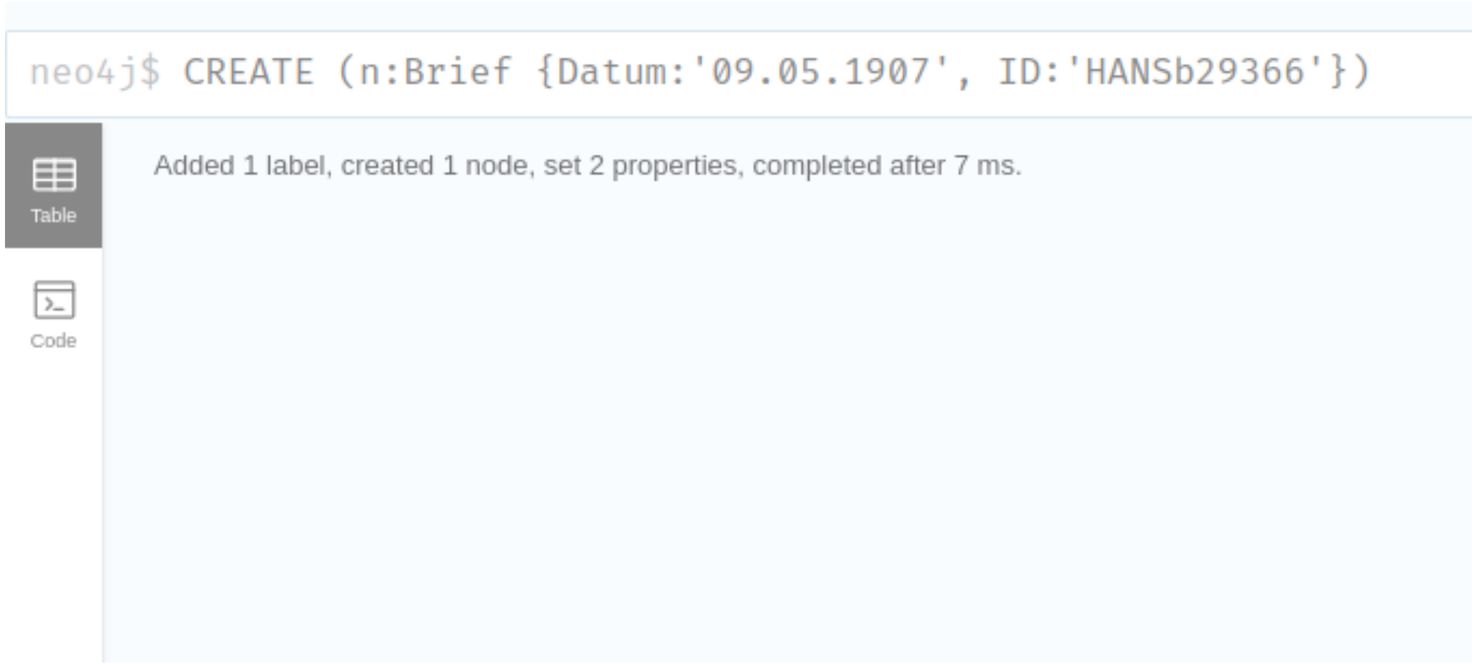
Nach spezifischen Eigenschaften abfragen:

```
MATCH (n:Person)
WHERE n.name = 'Ida Dehmel'

RETURN n;
```



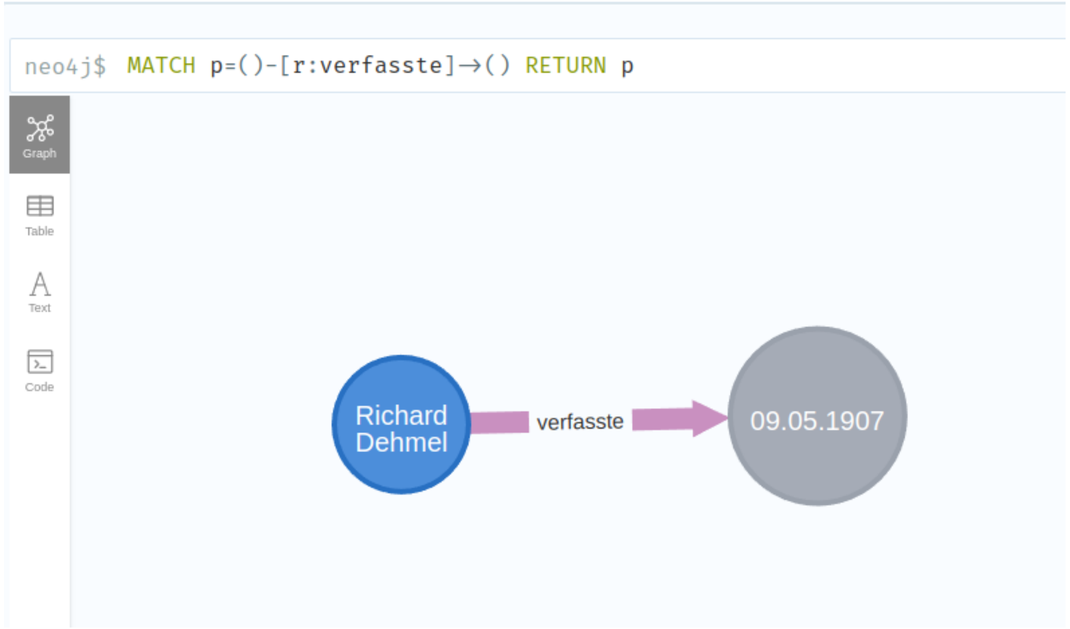
Weiteren Knotentyp erstellen

Knotentyp: Brief



Kante / Relation zwischen zwei Knoten erstellen:

```
MATCH (n:Person), (b:Brief)

WHERE n.name='Richard Dehmel'
AND b.ID='HANSb29366'

CREATE (n)-[:verfasste]->(b)
```

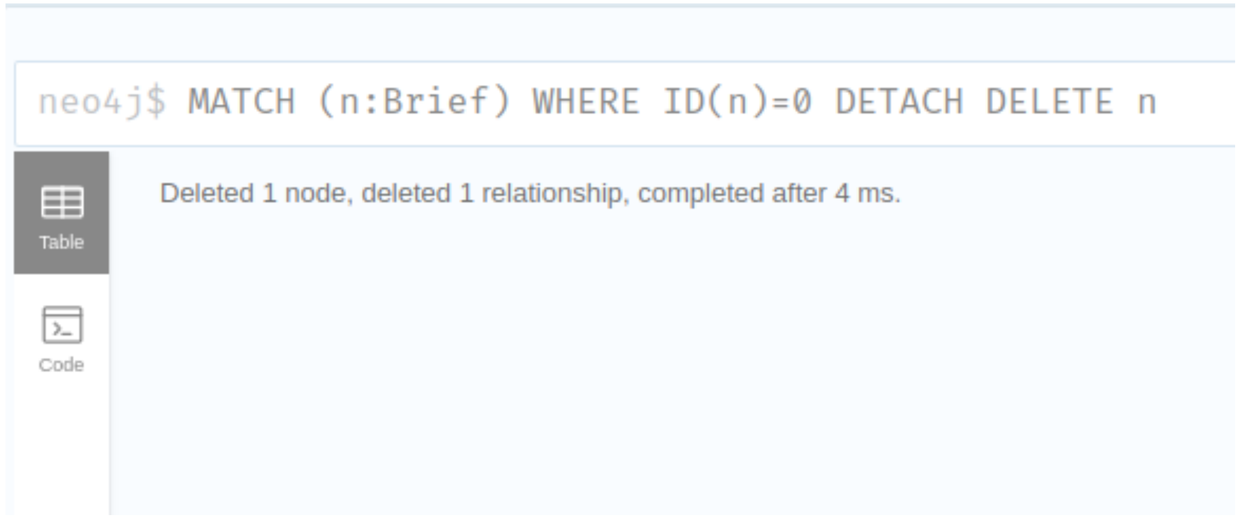


Knoten löschen (Option C):

MATCH (n:Brief)

WHERE ID(n)=0

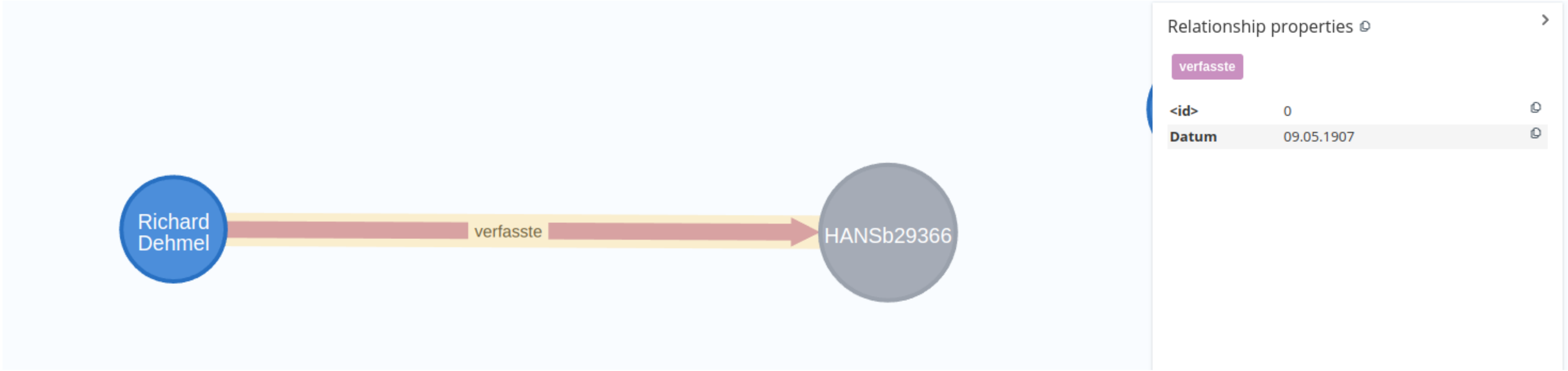
DETACH DELETE n



Kante mit Eigenschaften:

MATCH (n:Person {name:'Richard Dehmel'}), (b:Brief)

CREATE (n)-[:verfasste {Datum:'09.05.1907'}]->(b)

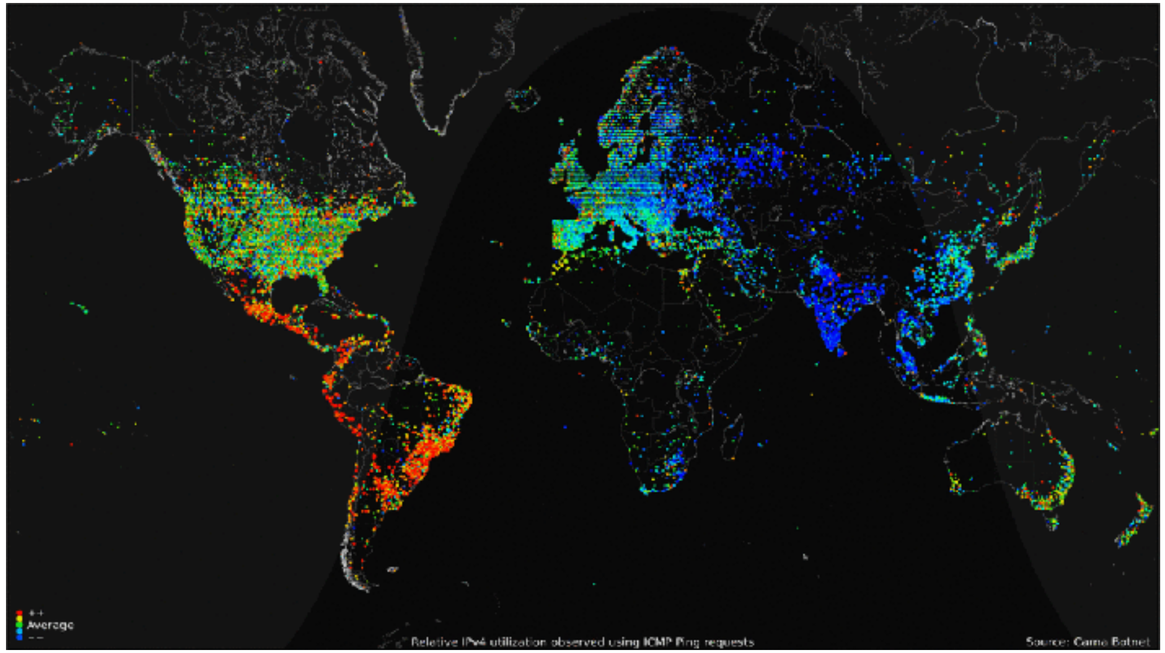


Die Welt ist ein Graph

Übung 2

Überdenkt und überarbeitet euer Netzwerk:

- Welche Relationen sollen wie abgebildet werden?
- Welche Entitäten/Knoten benötigen welche Eigenschaften?
- Was wären mögliche Abfragen?



World map of 24 hour relative average utilization of IPv4 addresses observed using ICMP ping requests
https://om.co/gigaom/check-out-this-visual-map-that-shows-24-hours-of-internet-usage-around-the-world/


PAUSE

Datenimport

mit csv-Dateien

CSV-Tabellen

Vorbereitung der Tabellen

HANS_ID	Author	Author_ID	Recipient	Recipient_ID	Production_Place
HANSb336471	Liliencron, Detlev von	gnd_118572954	Dehmel, Richard	gnd_118679236	
HANSb317396	Wolfthorn, Julie	gnd_1012920224	Dehmel, Ida	gnd_118679228	
HANSb22737	Behrens, Peter	gnd_118508466	Dehmel, Richard	gnd_118679236	Neubabelsberg
HANSb336227	Dehmel, Ida|Dehmel, Richard	gnd_118679228|gnd_118679236	Liliencron, Detlev von	gnd_118572954	Hamburg-Blankenese
HANSb315297	Wolfthorn, Julie	gnd_1012920224	Dehmel, Ida	gnd_118679228	Berlin
HANSb336015	Dehmel, Richard	gnd_118679236	Zweig, Stefan	gnd_118637479	
HANSb315263	Wolfthorn, Julie	gnd_1012920224	Dehmel, Ida	gnd_118679228	Berlin
HANSb17272	Liliencron, Detlev von	gnd_118572954	Dehmel, Richard	gnd_118679236	
HANSb336485	Liliencron, Detlev von	gnd_118572954	Dehmel, Richard	gnd_118679236	Hamburg-Rahlstedt
HANSb312845	Dehmel, Richard	gnd_118679236	Behrens, Peter	gnd_118508466	Hamburg-Blankenese
HANSb336482	Liliencron, Detlev von	gnd_118572954	Dehmel, Richard	gnd_118679236	Hamburg-Rahlstedt
HANSb17275	Liliencron, Detlev von	gnd_118572954	Dehmel, Richard	gnd_118679236	Hamburg-Rahlstedt
HANSb315264	Wolfthorn, Julie	gnd_1012920224	Dehmel, Ida	gnd_118679228	Berlin
HANSig398	Behrens, Peter|Dehmel, Richard	gnd_118508466|gnd_118679236	Dehmel, Richard	gnd_118679236	Darmstadt
HANSb17423	Liliencron, Detlev von	gnd_118572954	Dehmel, Richard	gnd_118679236	Hamburg-Rahlstedt
HANSb336012	Zweig, Stefan	gnd_118637479	Dehmel, Richard	gnd_118679236	Rangun
HANSb315290	Wolfthorn, Julie	gnd_1012920224	Dehmel, Ida	gnd_118679228	Berlin
HANSb336476	Liliencron, Detlev von	gnd_118572954	Dehmel, Richard	gnd_118679236	Hamburg-Rahlstedt
HANSb312842	Dehmel, Richard	gnd_118679236	Behrens, Peter	gnd_118508466	Hamburg-Blankenese
HANSb336449	Liliencron, Detlev von	gnd_118572954	Dehmel, Richard	gnd_118679236	Hamburg-Rahlstedt
HANSb315252	Wolfthorn, Julie	gnd_1012920224	Dehmel, Ida	gnd_118679228	Colmar
HANSb337102	Liliencron, Detlev von	gnd_118572954	Dehmel, Richard	gnd_118679236	
HANSb336024	Zweig, Stefan	gnd_118637479	Dehmel, Richard	gnd_118679236	Wien
HANSb336216	Dehmel, Richard	gnd_118679236	Liliencron, Detlev von	gnd_118572954	Hamburg-Blankenese
HANSb22739	Behrens, Peter|Bachmann, Alf	gnd_118508466|gnd_119107457	Dehmel, Richard	gnd_118679236	Düsseldorf

CSV

Github-Import

- Github-Daten via "Raw"-Button aufrufen
- Link kopieren und in neo4j-Prompt einsetzen

```
LOAD CSV FROM "https://raw.githubusercontent.com/FranziskaDigital/Dehmel_Test/main/Personen_GND.csv?token=GHSAT0AAAAAAB7JKATI2IBTNCMVV7563MW4Y73QWHQ" AS row
fieldterminator ';'
    CREATE (p:Person {name:row[0], gnd:row[1]})
```

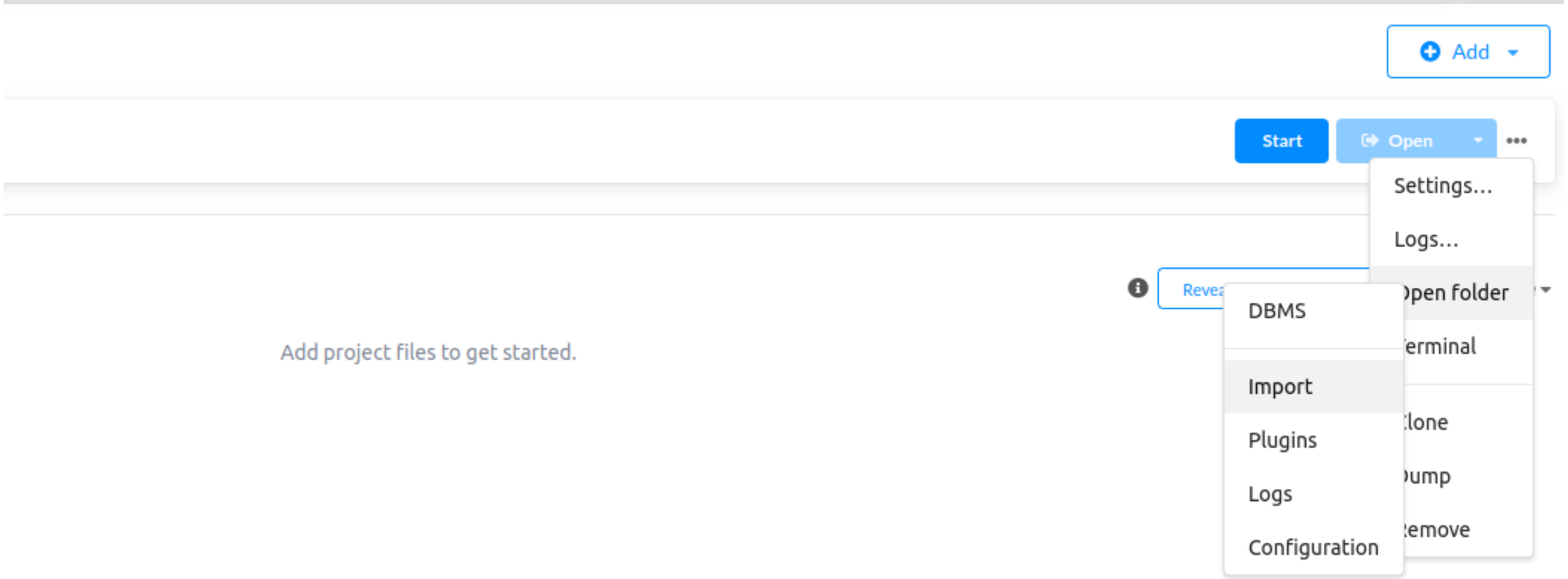
Added 88 labels, created 88 nodes, set 176 properties, completed after 276 ms.

CSV

Import von lokalem Speicherort

Datei in neo4j-Import-Ordner legen

DB starten



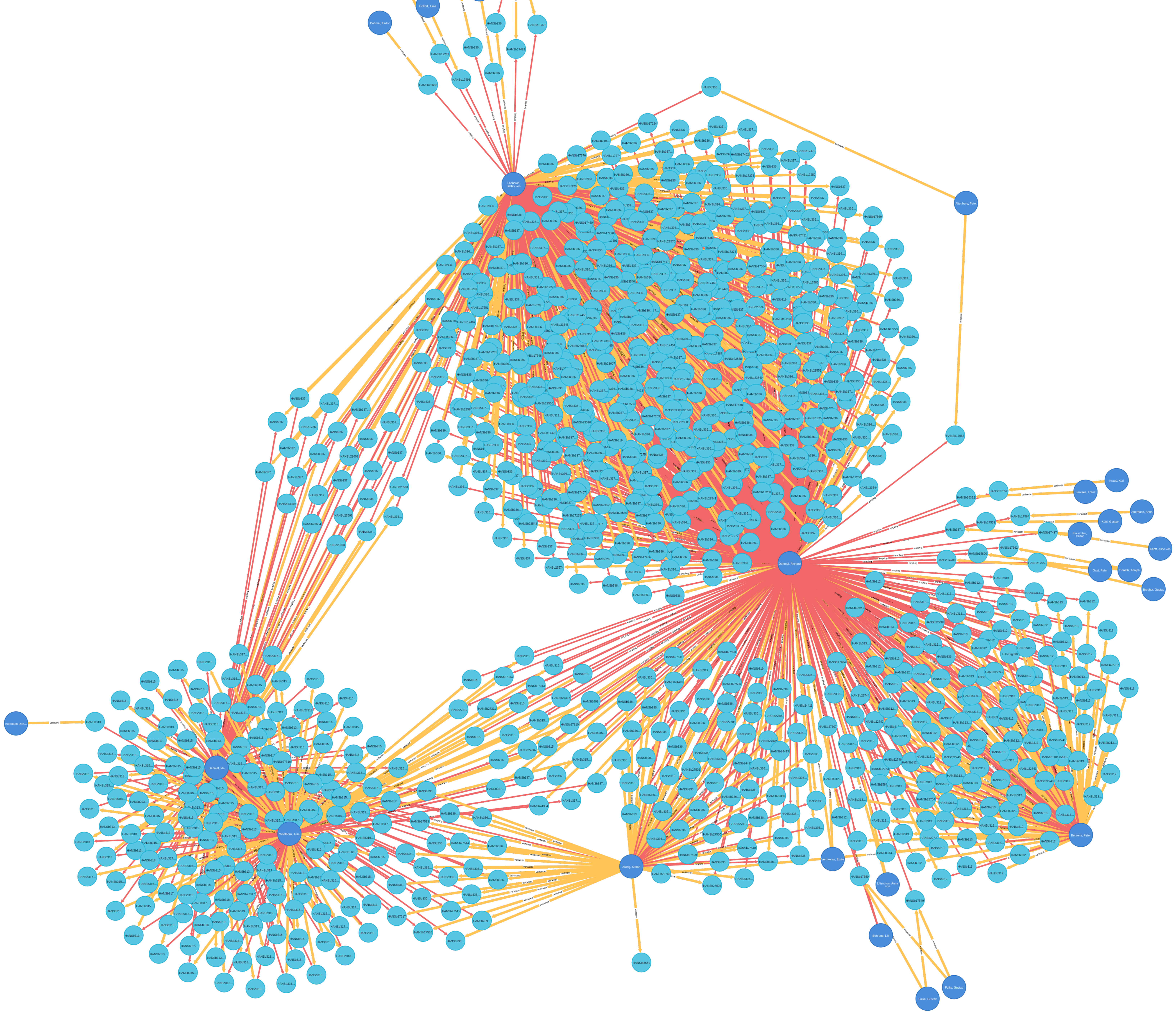
CSV-Import von lokalem Speicherort

```
LOAD CSV FROM "file:///Briefe.csv" AS row fieldterminator ";"
    CREATE (:Brief {ID:row[0], Autor_in:row[1], Empfaenger_in:row[3]})
```

Relationen erstellen

nach CSV-Import

```
MATCH (b:Briefe), (p:Person)

WHERE b.Autor_in = p.Name

CREATE (p)-[:verfasste]->(b)
```

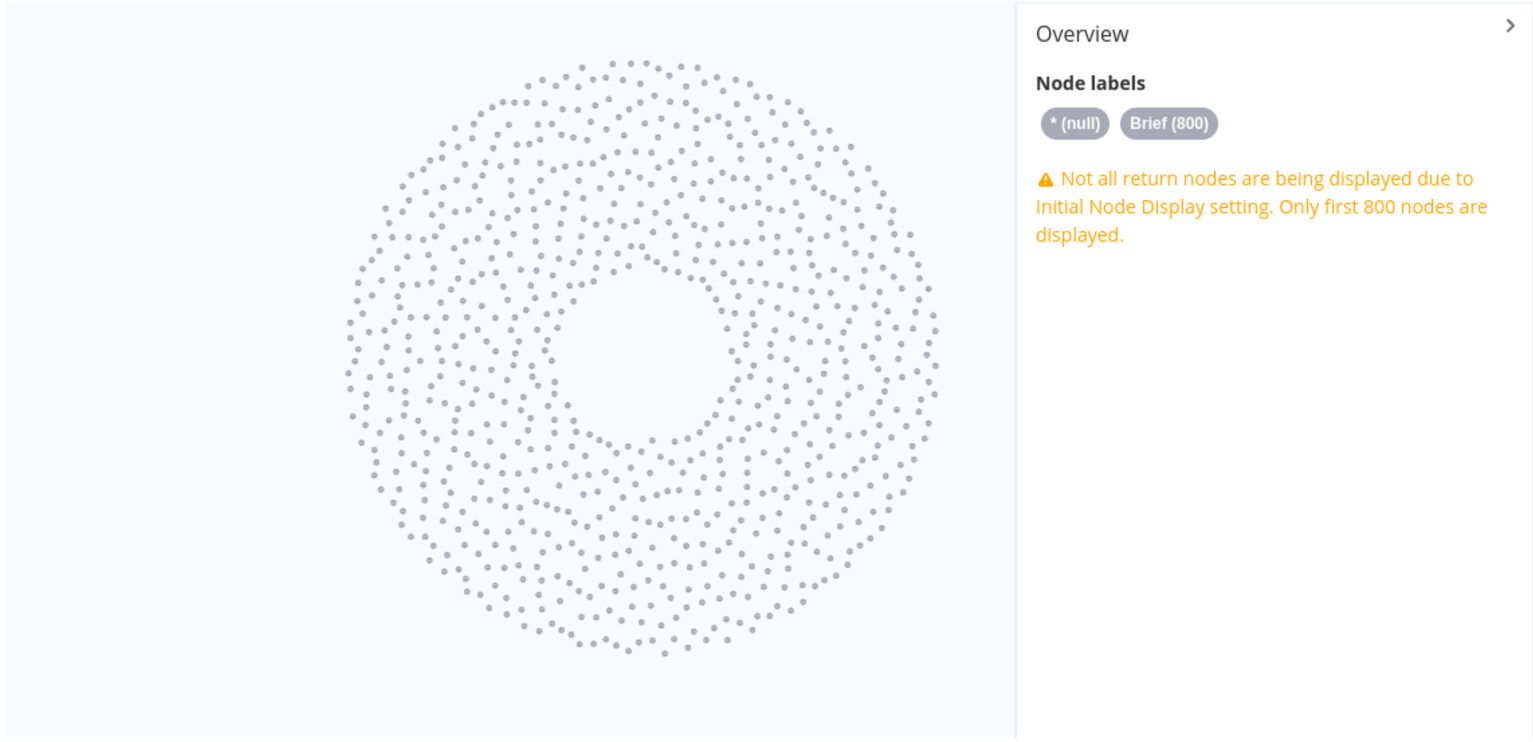


Holtorf, Alma
Dehmel, Fedor
Liliencron, Detlev von
Altenberg, Peter
Dehmel, Richard
Kraus, Karl
Servaes, Franz
Auerbach, Anna
Kühl, Gustav
Flaischlen, Cäsar
Kapff, Aline von
Gast, Peter
Donath, Adolph
Brecher, Gustav
Auerbach-Deh…
Dehmel, Ida
Wolfthorn, Julie
Zweig, Stefan
Verhaeren, Emile
Liliencron, Anna von
Behrens, Peter
Behrens, Lilli
Falke, Gustav
Falke, Gustav
verfasste
empfing

Abfragen

nach Knotentyp / Label

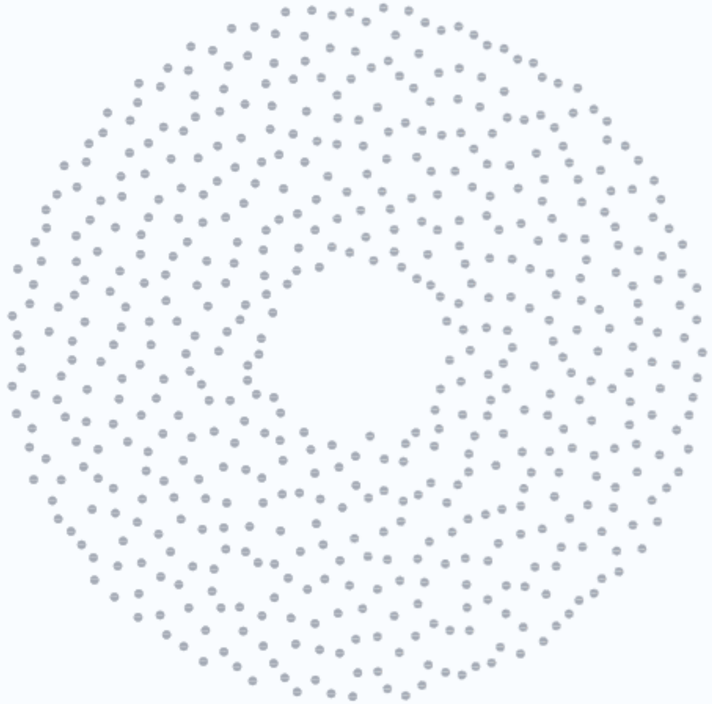
MATCH (n:Brief) RETURN n



Abfragen

nach Eigenschaft

```
1 MATCH (n:Brief)
2 WHERE n.Empfaenger_in='Dehmel, Richard'
3     RETURN n
```



Graph
Table
Text
Code

Overview

Node labels

* (558) Brief (558)

Displaying 558 nodes, 0 relationships.

Abfragen

nach Relation

```
MATCH p=()-[r:verfasste]->() RETURN p
```

Abfragen

nach Häufigkeit

```
MATCH (a:Person)-[v:verfasste]->(b:Briefe)
WITH a, count(v) as Relation, collect (v) as verfasste WHERE Relation >1

RETURN a as Person, Relation as Anzahl ORDER BY Anzahl DESC
```

```
1 MATCH (a:Person)-[v:verfasste]→(b:Briefe) WITH a, count(v) as Relation, collect(v) as verfasste WHERE Relation >1
2 RETURN a as Person, Relation as Anzahl ORDER BY Anzahl DESC
```

Graph | Table | Text | Code

"Person"	"Anzahl"
{"GND":"gnd_118572954","Name":"Liliencron, Detlev von"}	397
{"GND":"gnd_118679236","Name":"Dehmel, Richard"}	171
{"GND":"gnd_1012920224","Name":"Wolfthorn, Julie"}	129
{"GND":"gnd_118508466","Name":"Behrens, Peter"}	105
{"GND":"gnd_118637479","Name":"Zweig, Stefan"}	69
{"GND":"gnd_118679228","Name":"Dehmel, Ida"}	55
{"GND":"gnd_118502255","Name":"Altenberg, Peter"}	2
{"GND":"gnd_118685929","Name":"Falke, Gustav"}	2
{"GND":"gnd_11947042X","Name":"Donath, Adolph"}	2
{"GND":"gnd_118685929","Name":"Falke, Gustav"}	2

MAX COLUMN WIDTH:

Abfragen

Triangle Count

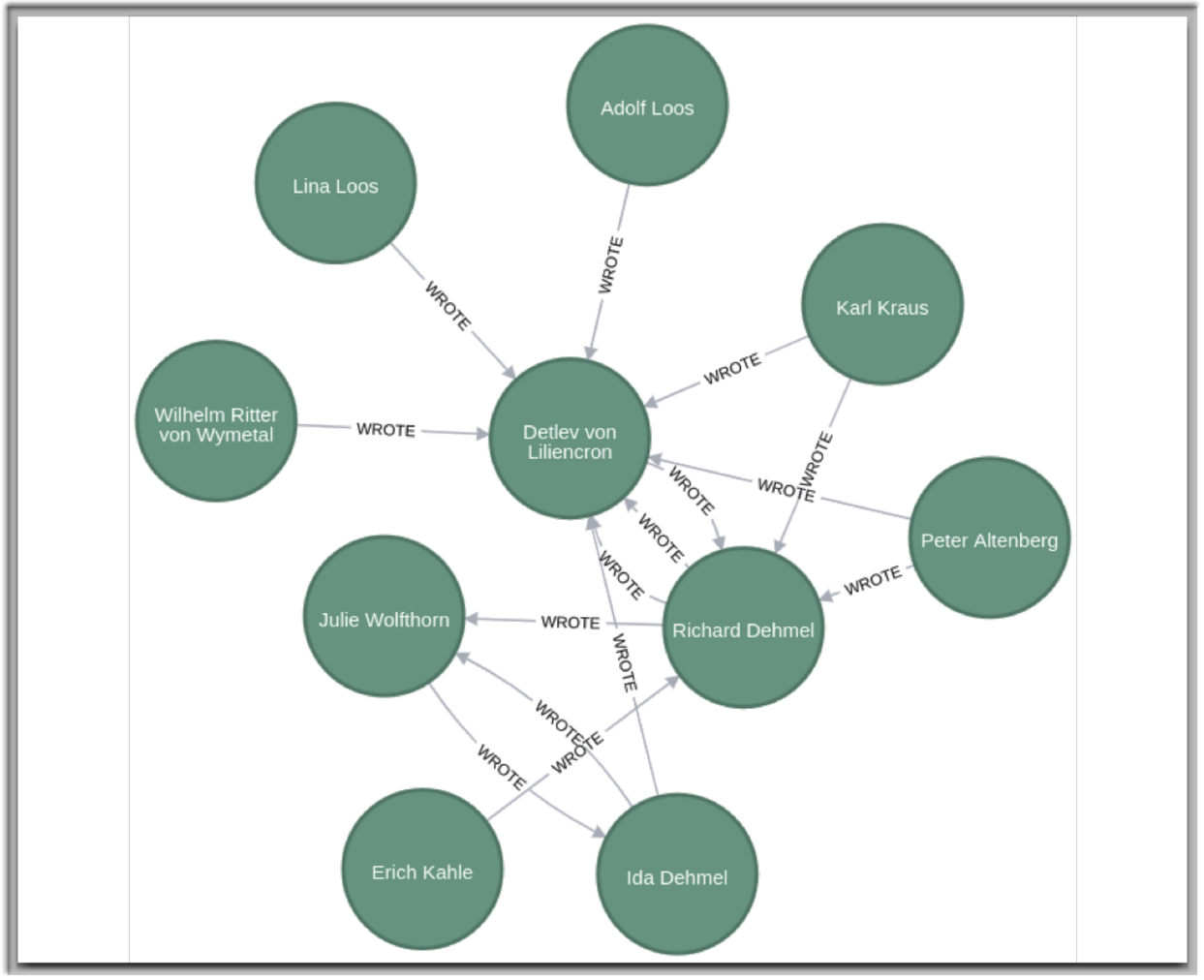
```
CALL gds.graph.project(
  'Dehmel_Project',
  'Person',
  {
    verfasste: {
      orientation: 'UNDIRECTED'
    }
  }
)
```

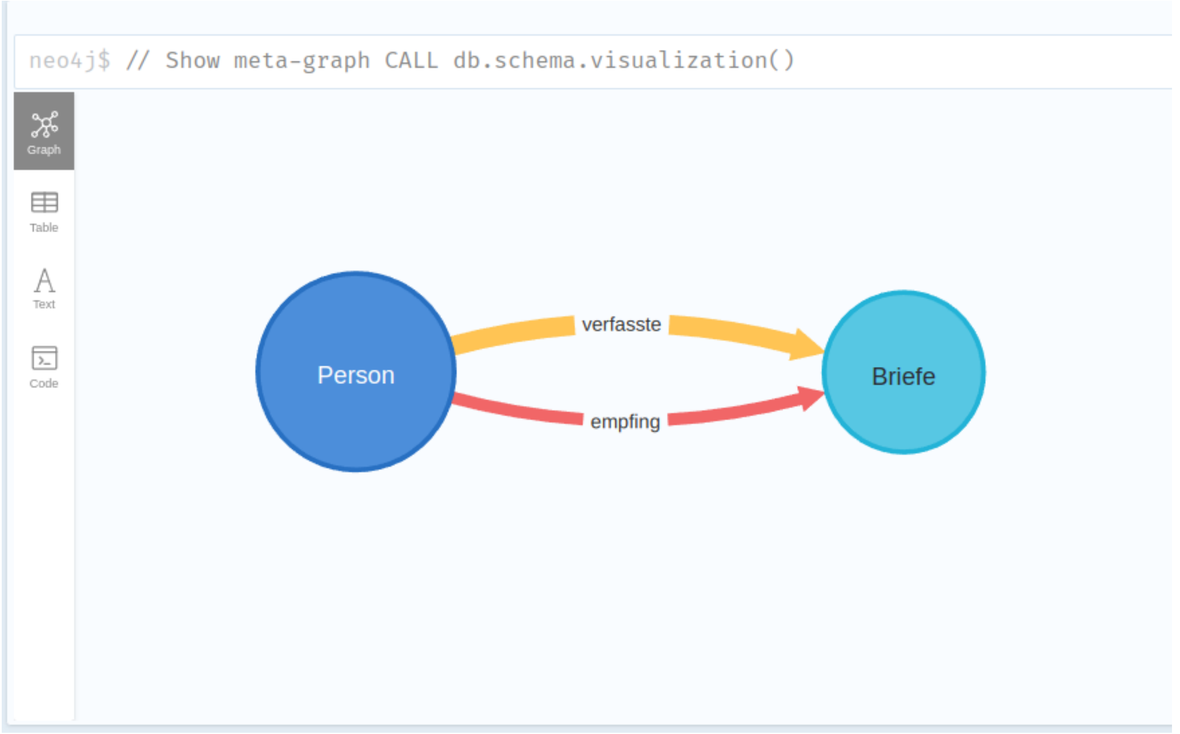
Table

Text

Code

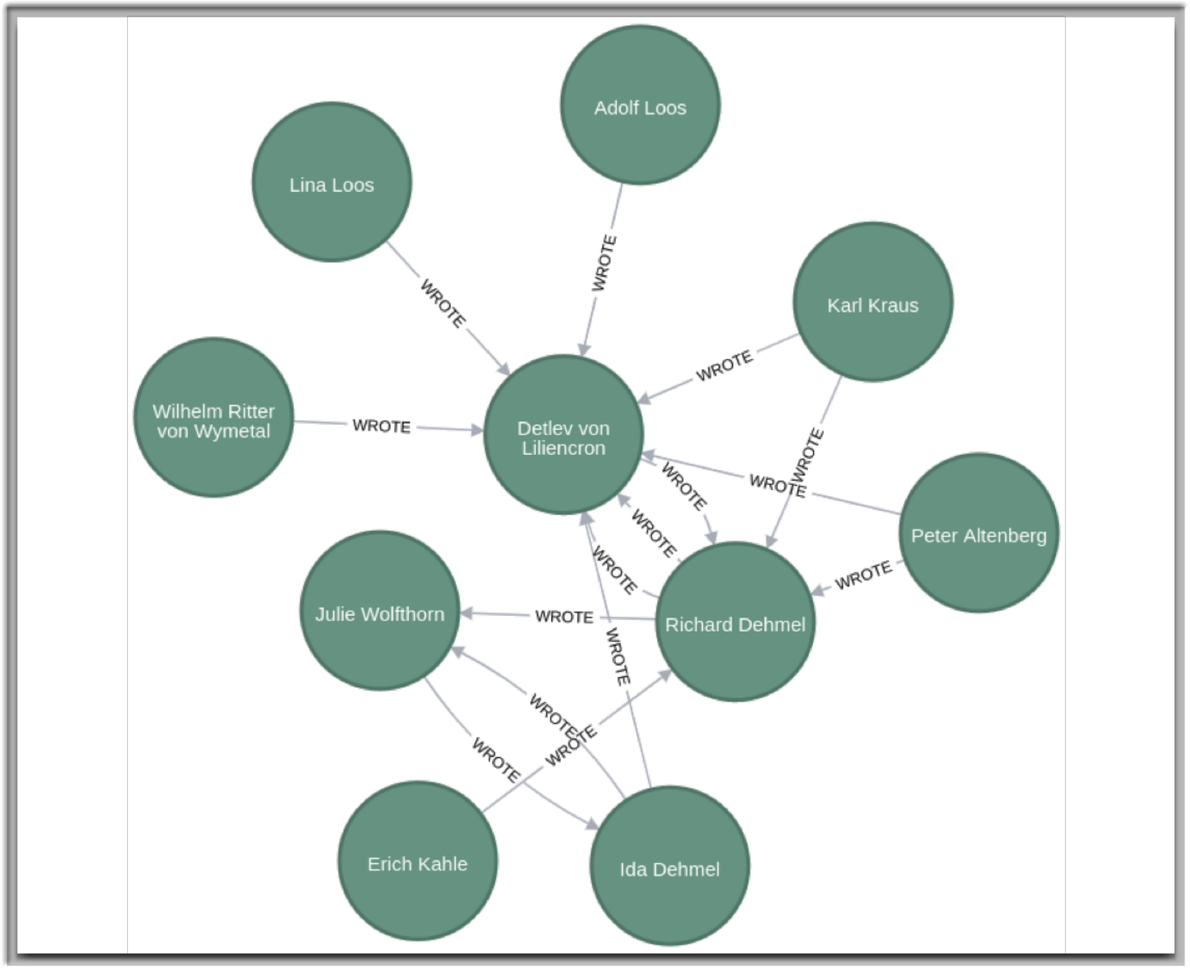
"nodeProjection"	"relationshipProjection"	"graphName"	"nodeCount"	"relationshipCount"	"projectMillis"
{"Person":{"label":"Person","properties":{}}}	{"verfasste":{"orientation":"UNDIRECTED","indexInverse":false,"aggregation":"DEFAULT","type":"verfasste","properties":{}}}	"Dehmel_Project"	88	0	595


Adolf Loos
Lina Loos
Karl Kraus
Wilhelm Ritter von Wymetal
Detlev von Liliencron
Peter Altenberg
Julie Wolfthorn
Richard Dehmel
Erich Kahle
Ida Dehmel
WROTE


neo4j$ // Show meta-graph CALL db.schema.visualization()
Graph
Table
Text
Code
Person
verfasste
empfing
Briefe

Abfragen

Triangle Count



nodeA	nodeB	nodeC
Detlev von Liliencron	Peter Altenberg	Richard Dehmel
Detlev von Liliencron	Karl Kraus	Richard Dehmel

Name	triangleCount
Detlev von Liliencron	2
Richard Dehmel	2
Peter Altenberg	1
Karl Kraus	1
Julie Wolfthorn	0
Adolf Loos	0
Lina Loos	0
Wilhelm Ritter von Wymetal	0
Erich Kahle	0
Ida Dehmel	0

Weitere Infos dazu:
https://neo4j.com/docs/graph-data-science/current/algorithms/triangle-count/#algorithms-triangle-count-examples-stream

Abfragen

Clustering Coefficient

```
CALL gds.localClusteringCoefficient.stream('Dehmel_Project')
YIELD nodeId, localClusteringCoefficient
RETURN gds.util.asNode(nodeId).Name AS Name, localClusteringCoefficient
ORDER BY localClusteringCoefficient DESC
```

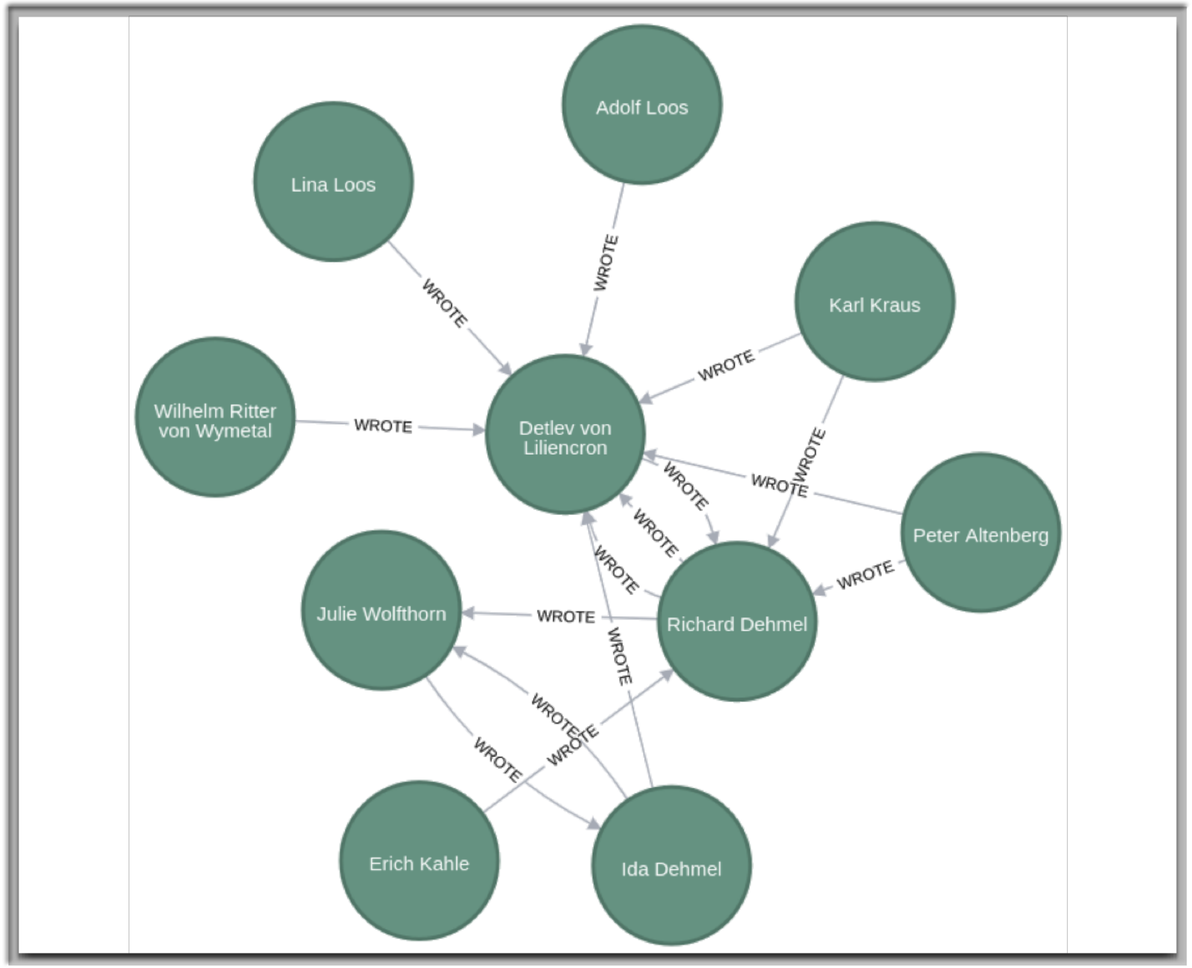
Table | Text | Code

	Name	localClusteringCoefficient
1	"Altenberg, Peter"	0.0
2	"Dehmel, Ida"	0.0
3	"Dehmel, Richard"	0.0
4	"Kraus, Karl"	0.0
5	"Loos, Adolf"	0.0
6	"Loos, Lina"	0.0
7		

Started streaming 88 records after 1 ms and completed after 9 ms.

Abfragen

Clustering Coefficient



Name	localClusteringCoefficient
Peter Altenberg	1.0
Karl Kraus	1.0
Richard Dehmel	0.2
Detlev von Liliencron	0.09523809523809523
Julie Wolfthorn	0.0
Adolf Loos	0.0
Lina Loos	0.0
Wilhelm Ritter von Wymetal	0.0
Erich Kahle	0.0
Ida Dehmel	0.0

Erweiterungen, Ergänzungen und Ausblick

Mögliche Erweiterungen

Anpassungen am Datenmodell

- Daten und Modell immer wieder abgleichen und überprüfen
- Möglichkeit der Erweiterung überprüfen
- sinnvolle Erweiterungen können sein: Beziehungen zwischen Personen, Ortsangaben, Zugehörigkeiten zu Institutionen u.ä.
- Eigenschaften können zu Knoten ergänzt werden, um Abfragen zu erweitern oder zu präzisieren