Graphs and the V's of Big Data

Graphs and the V's of Big Data

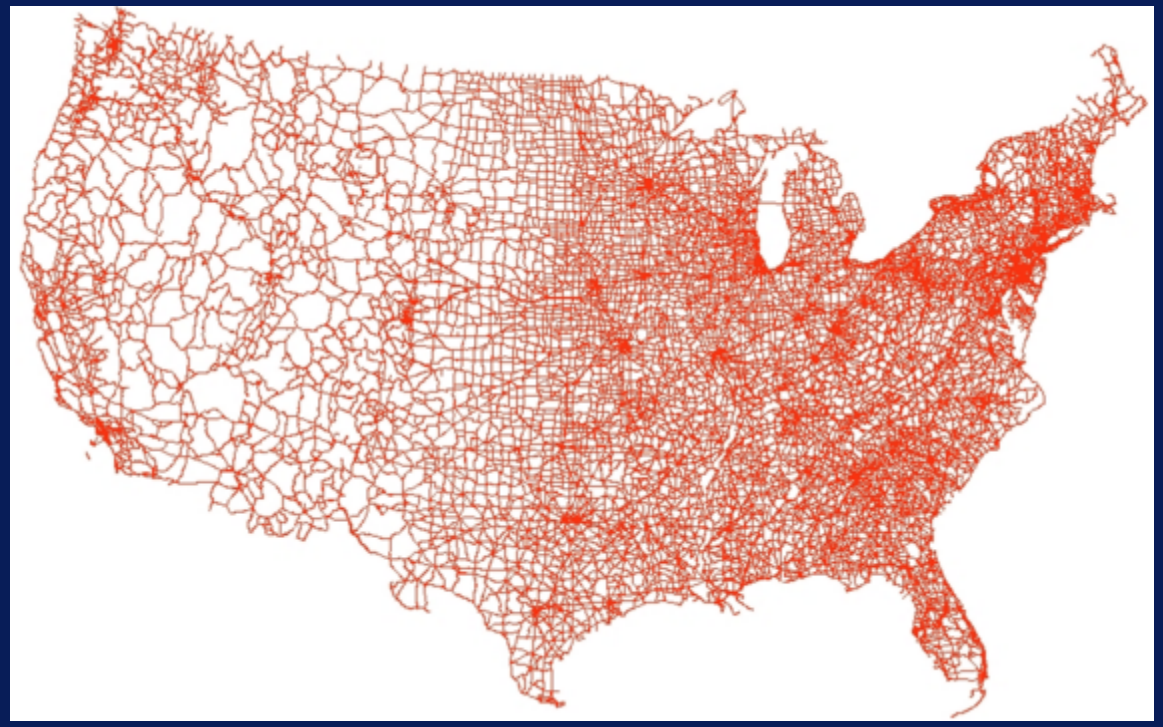
- **Concepts You Will Learn**
  - Algorithmic Complexity
  - Hard decision problems
  - Outcome metrics
  - Streaming edges

Graphs and the V's of Big Data

- Volume
- Velocity
- Variety
- Valence

Volume

- **Size**
  - # of nodes and edges



Volume

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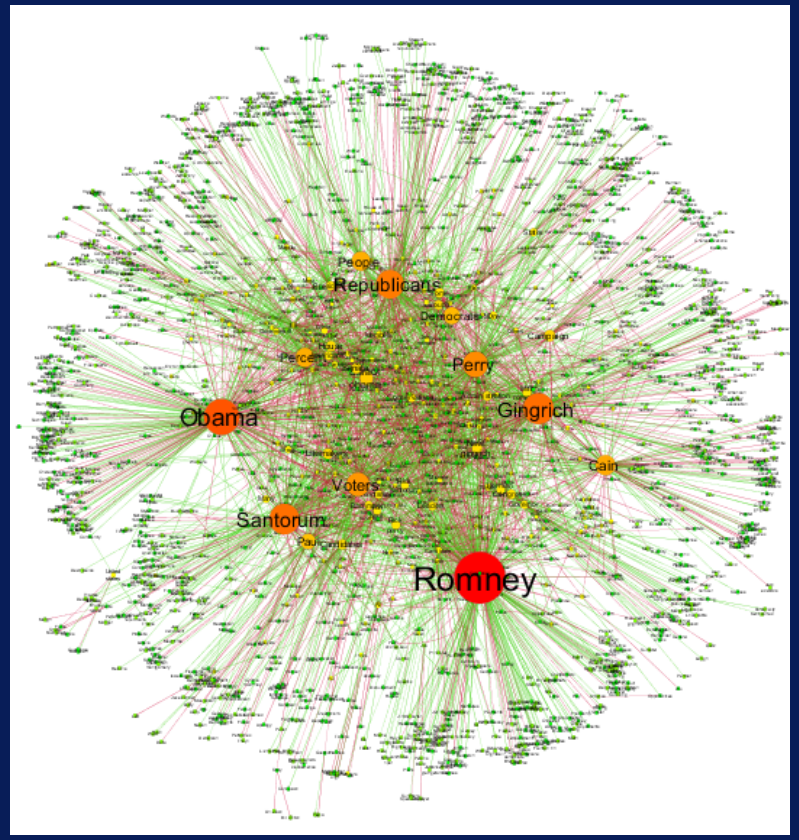

Volume

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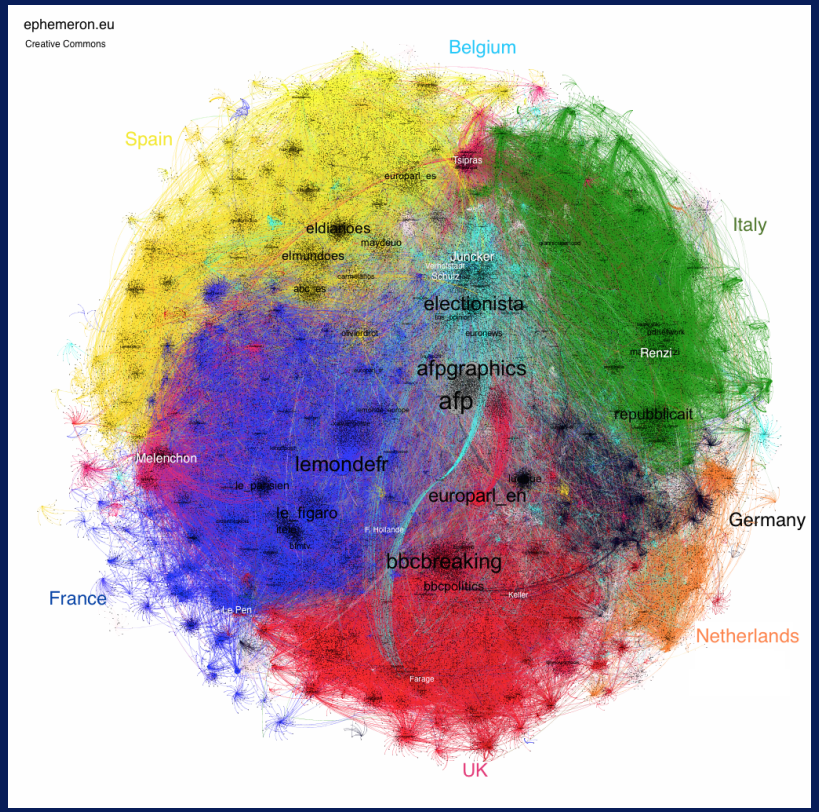
  - # of nodes and edges



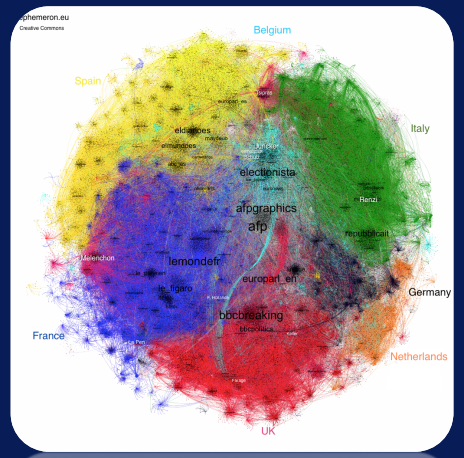
Importance of Volume

- Memory limitations
- Impact on Analytics

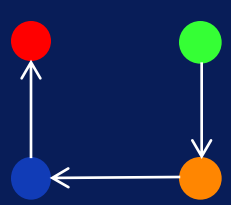
Velocity

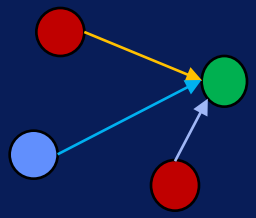
Velocity

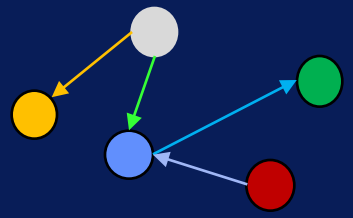

Time


Belgium
Spain
Italy
electionista
afpgraphics
afp
lemondefr
europarl_en
bbcbreaking
Germany
France
Netherlands
UK

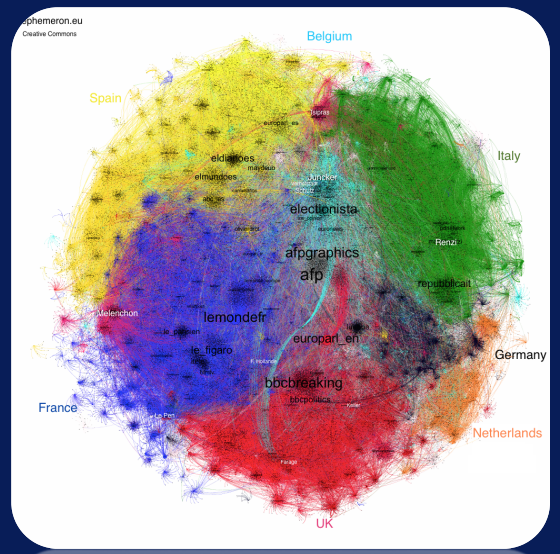
Velocity







Time



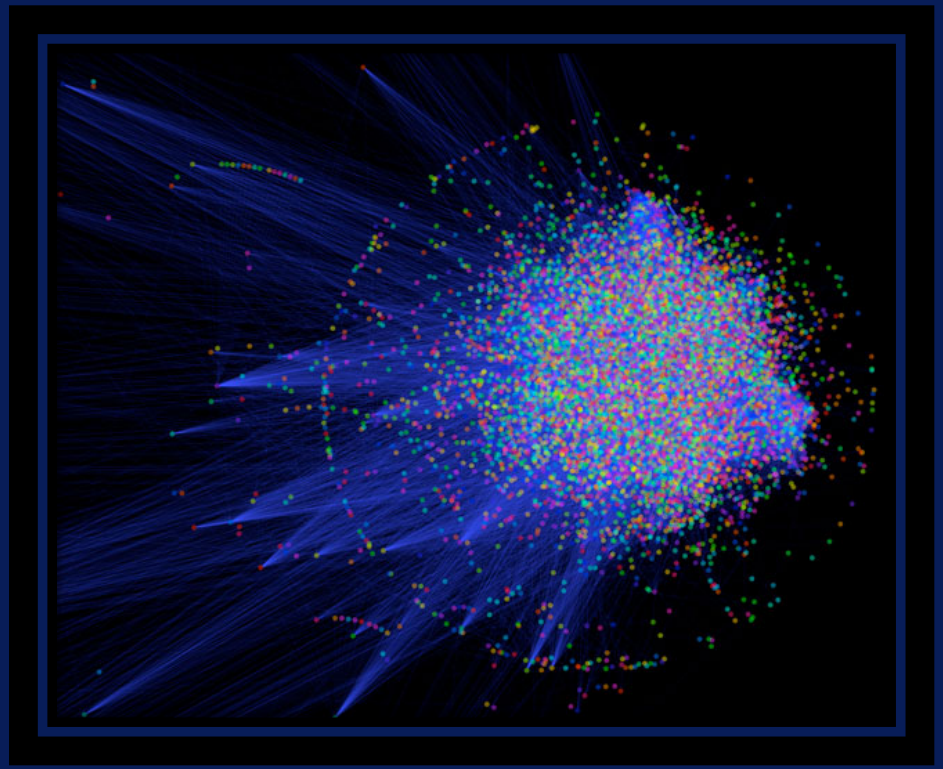
Velocity

- The rate at which a graph increases in size and complexity

Streaming edges into graphs

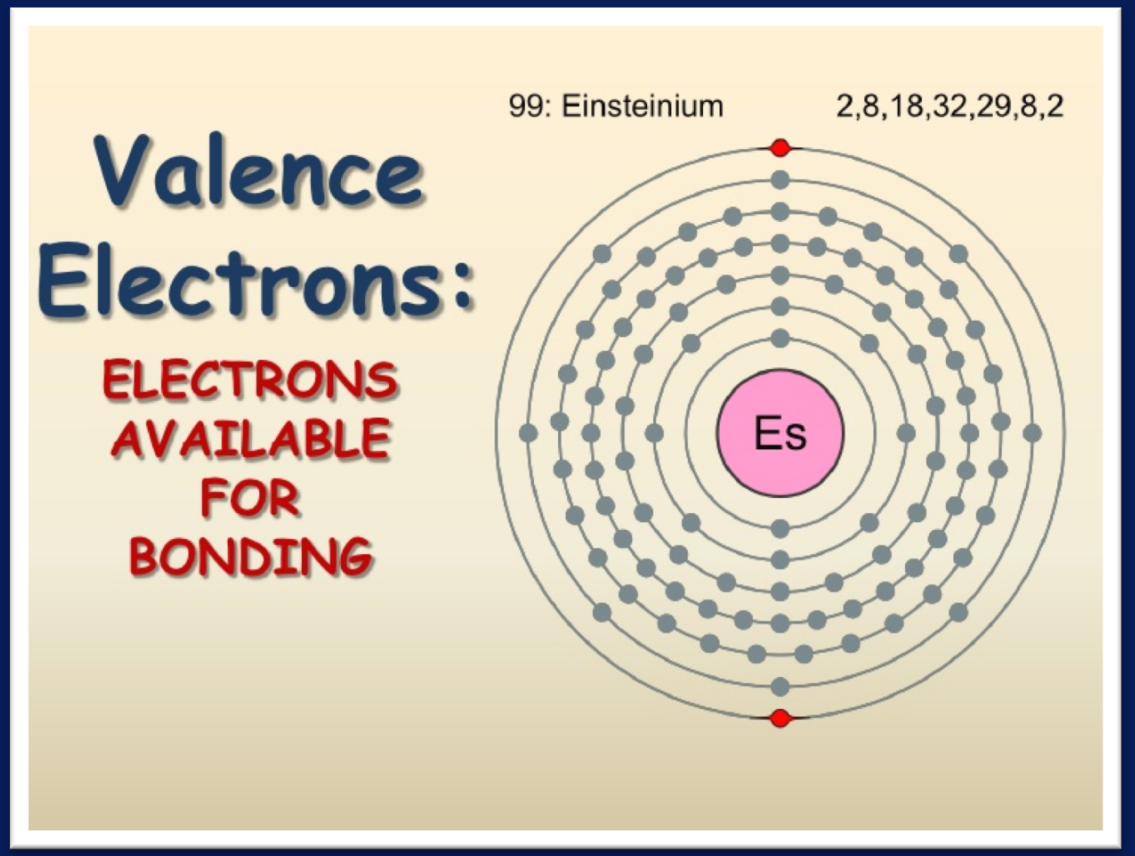
Variety

- Differences in the types and sources of data
- More non-uniform and complex



Valence

- In Chemistry



Valence

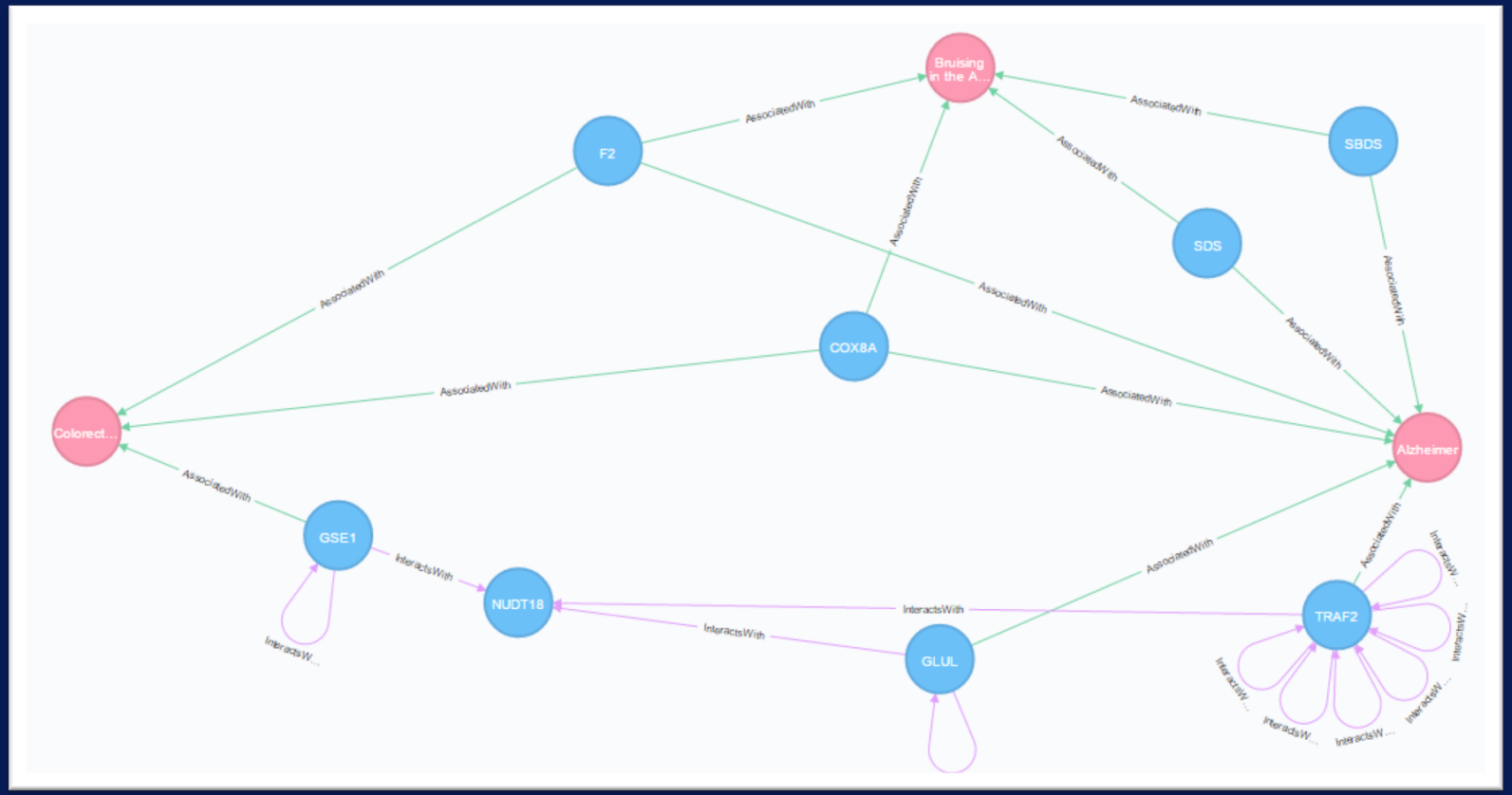
- **In Graphs**
  - A measure of **connectedness**

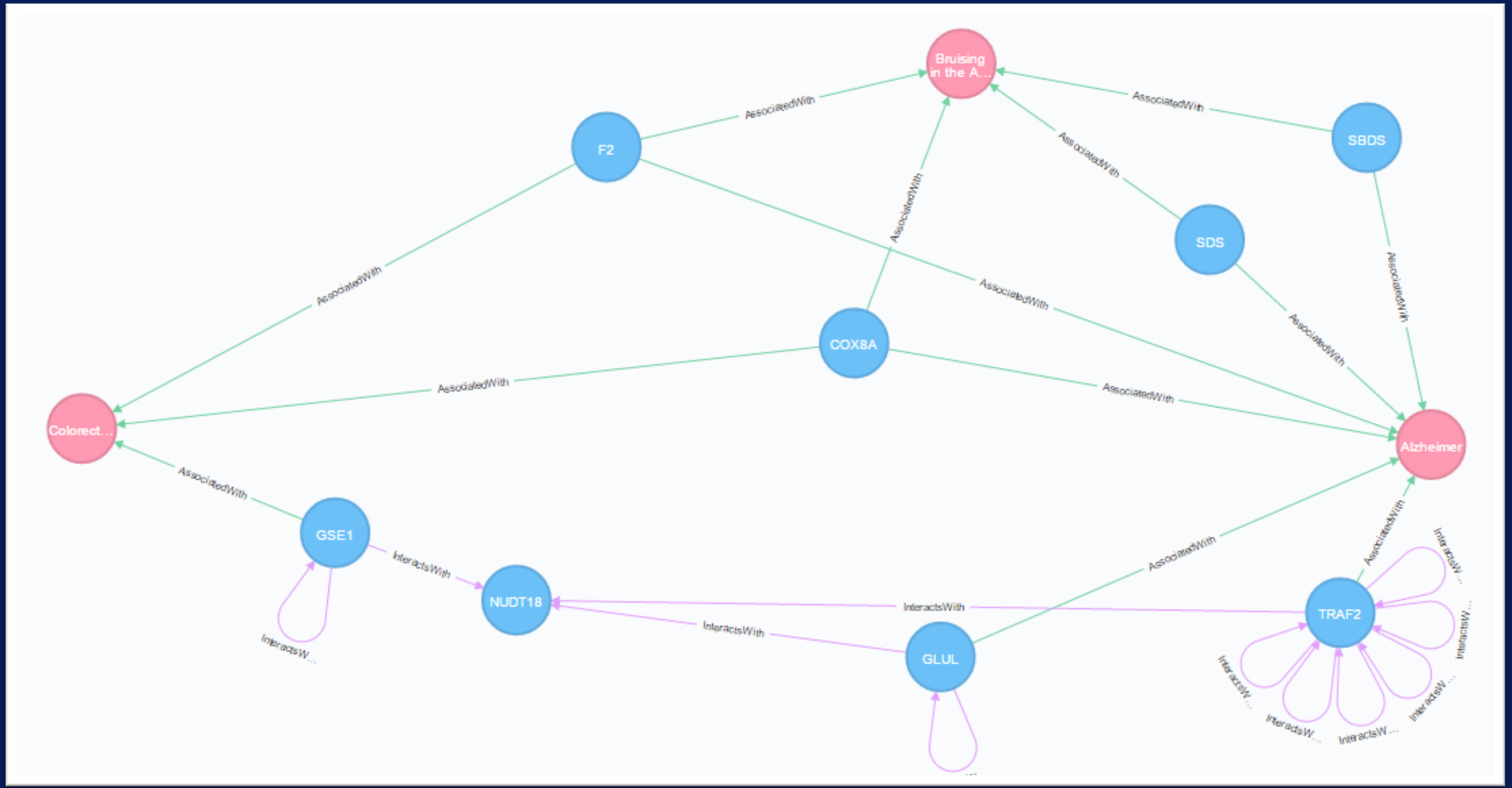
How Volume Impacts Graph Analytics

- Increases Algorithmic complexity
- Data-to-analysis time is too high

How Volume Impacts Graph Analytics

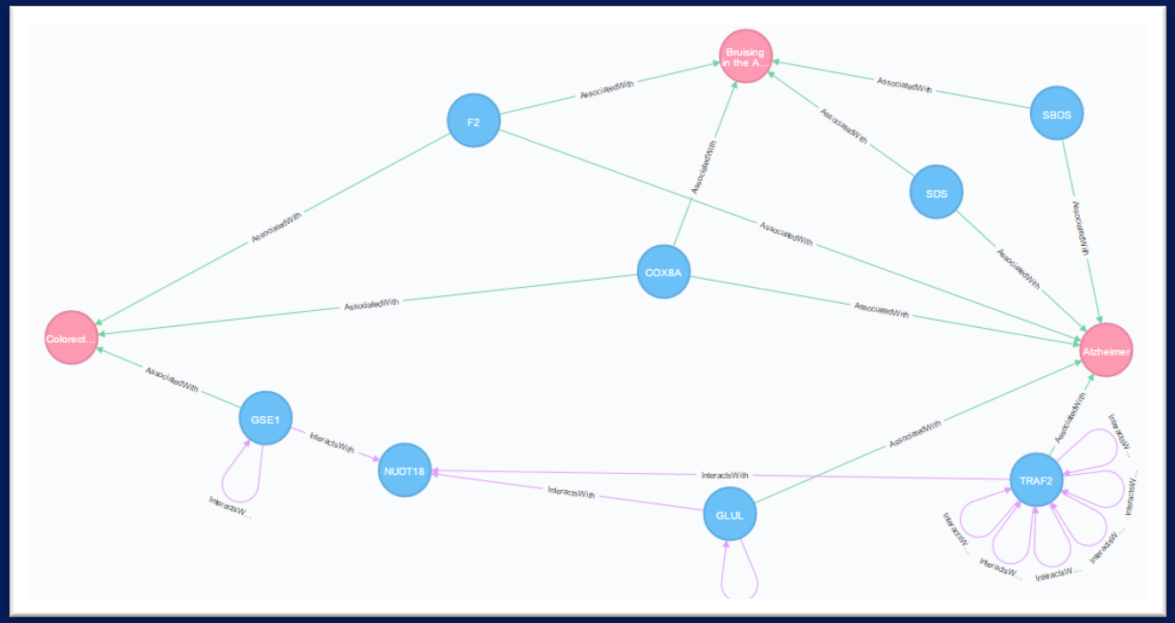
- **An example**
  - Problem: Find a Simple Path between “Alzheimer’s Disease” and “Colorectal Cancer




Bruising in the A...
F2
SBDS
SDS
COX8A
Colorect...
Alzheimer
GSE1
NUDT18
GLUL
TRAF2
AssociatedWith
InteractsWith

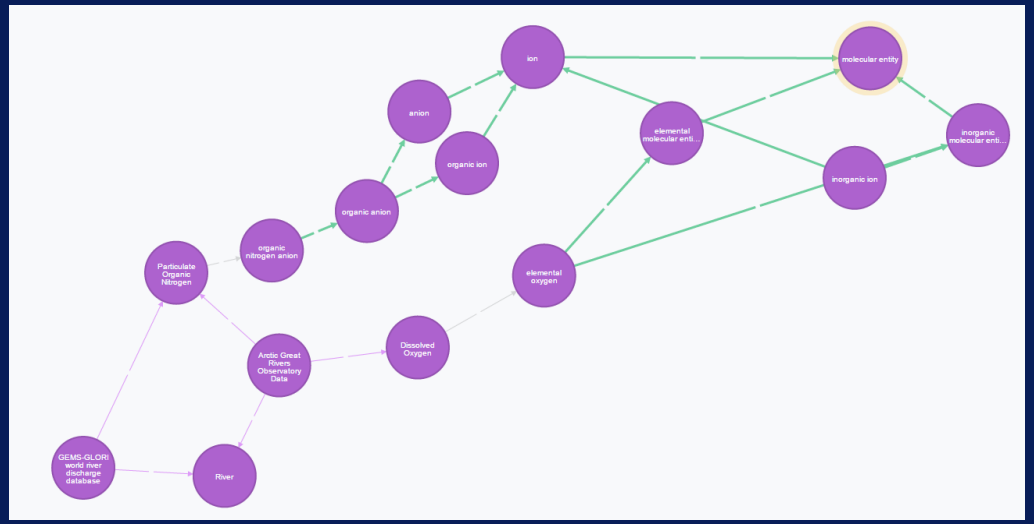
How Volume Impacts Graph Analytics

- Is there a simple path between “Alzheimer’s Disease” and “Colorectal Cancer”?
  - Well-known hard decision problem
- How many simple paths exist between “Alzheimer’s Disease” and “Colorectal Cancer”?
  - Size of result is *exponential in the number of nodes*



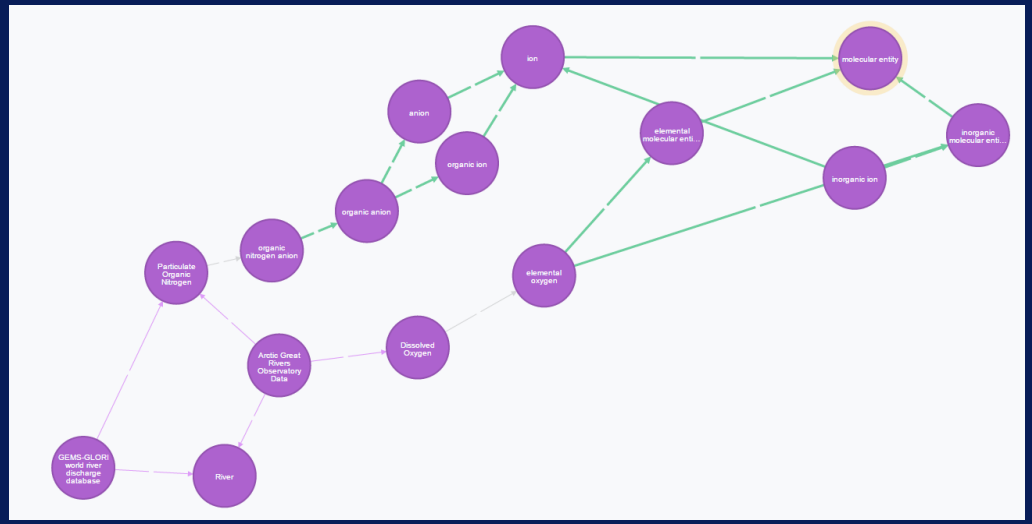
How Velocity Impacts Graph Analytics

- **Social Media**
  - Stream of Updates = Stream of Edges



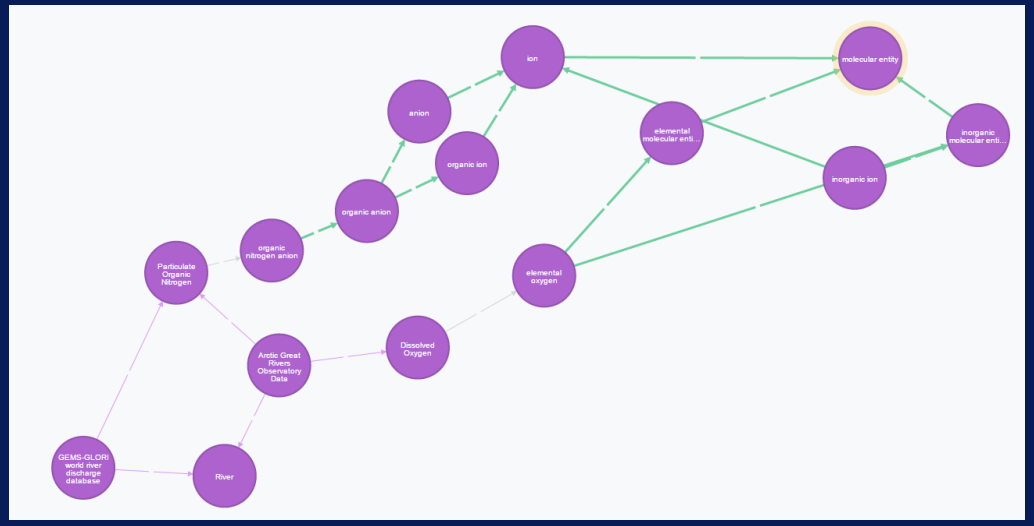
How Velocity Impacts Graph Analytics

- **Computing a Metric**
  - Shortest distance between two nodes
  - Count of strongly connected groups, e.g. a Facebook group



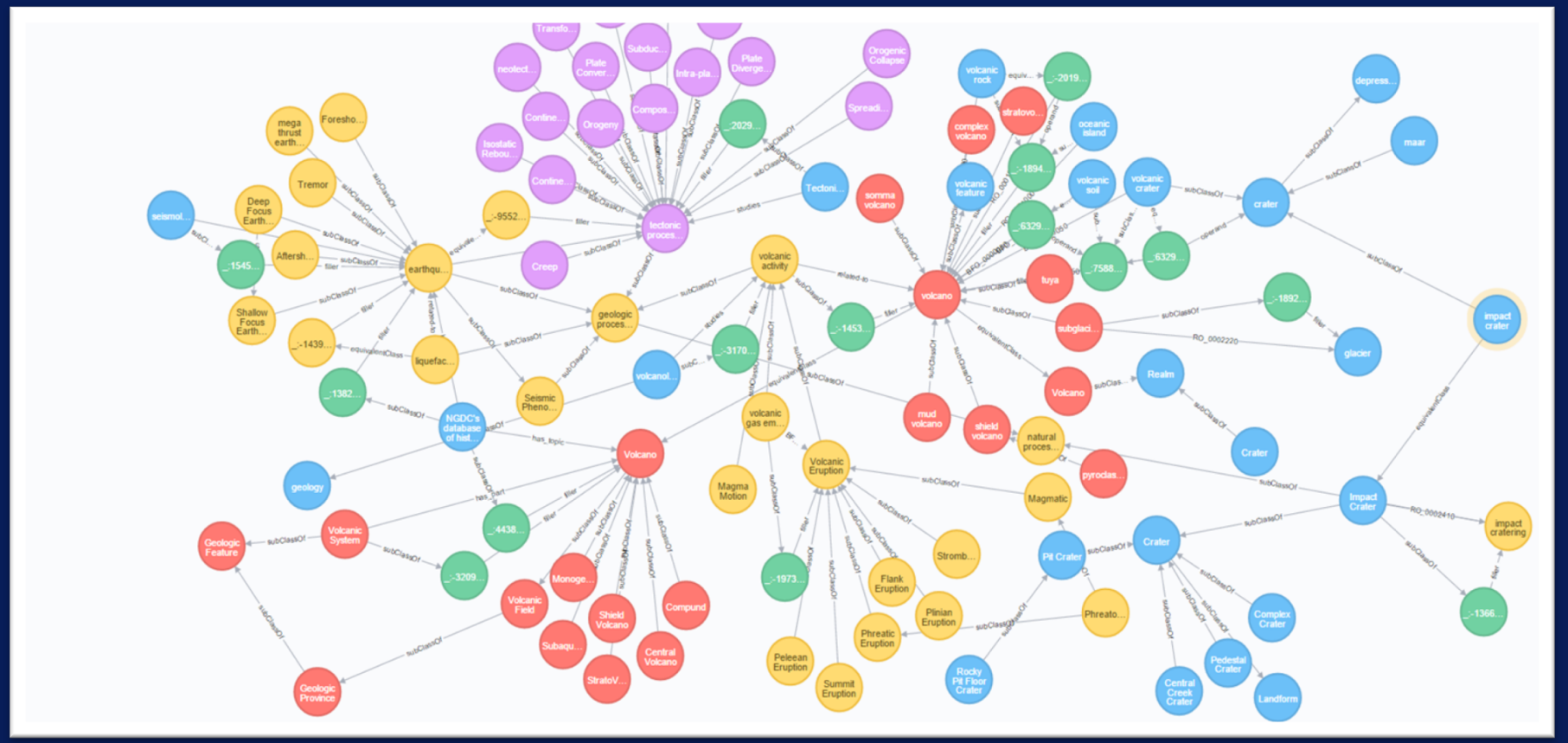
Velocity

- **A continuous stream does not fit in memory**
  - How can these metrics be computed on the edge-stream with limited memory?



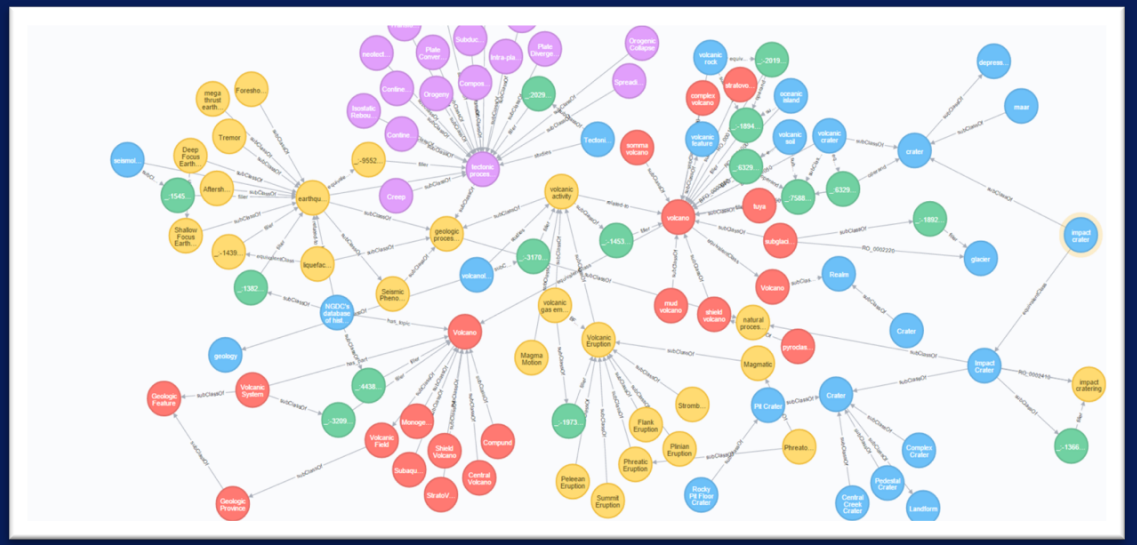
Variety…

…aka Heterogeneity



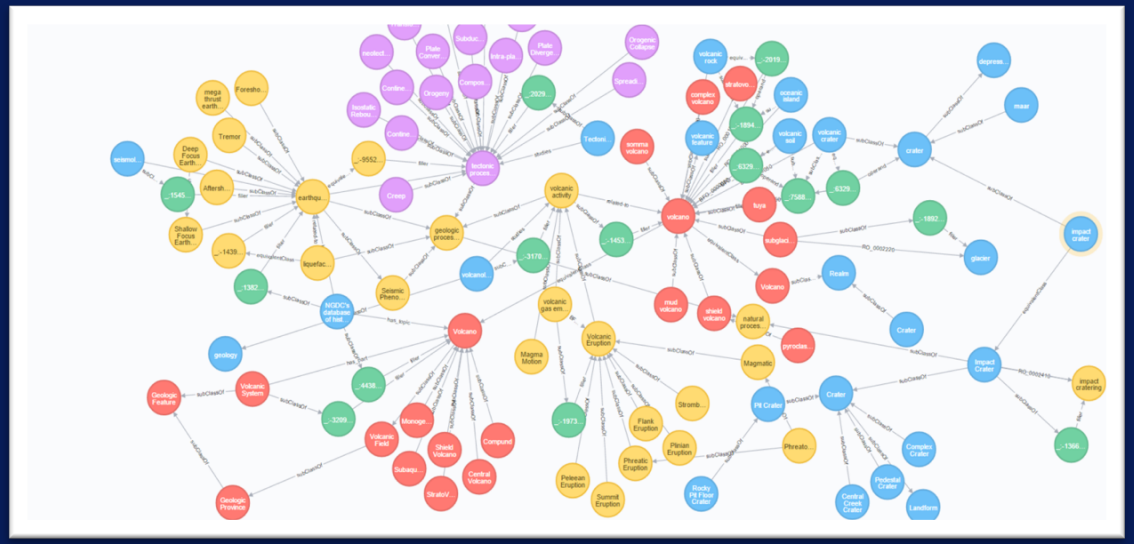
Variety

- Two aspects to consider



Variety

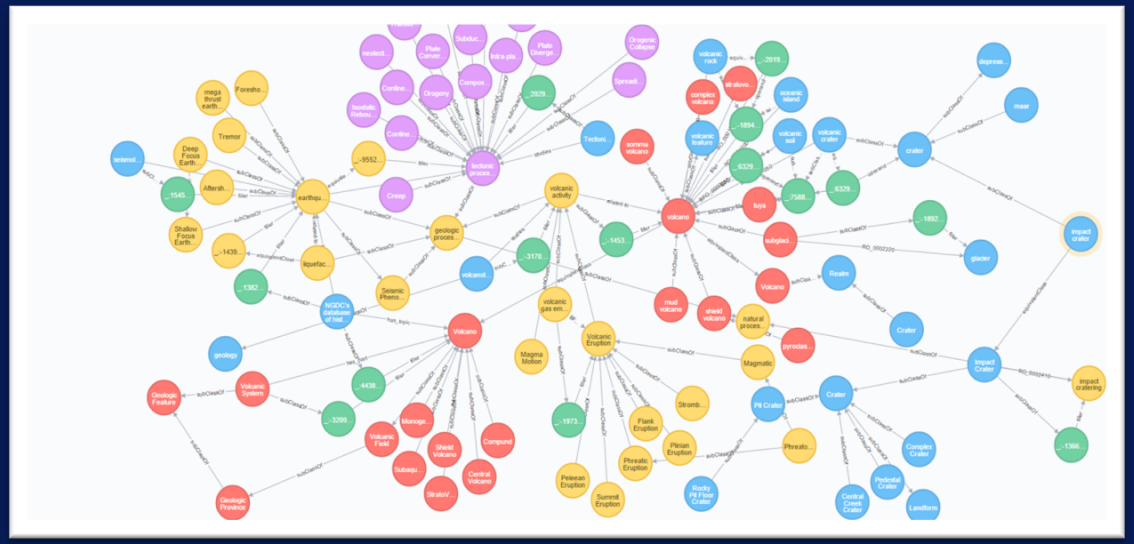
- Graph data is often created through integration



Variety

- Graph data is often created through integration

Relational



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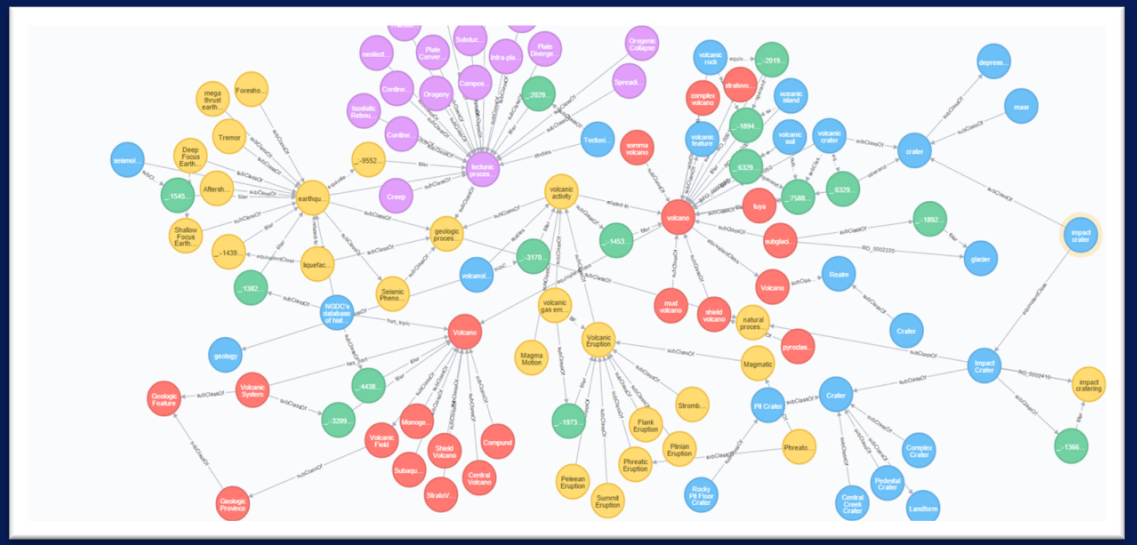
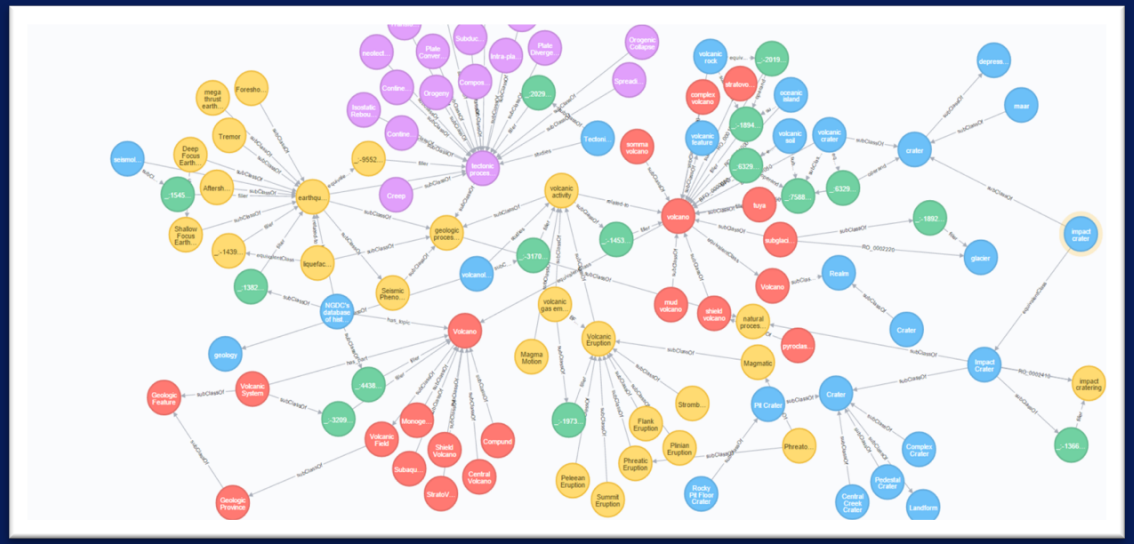


Relational

XML/JSON

Variety

- Graph data is often created through integration



Relational

XML/JSON

Graph-structured

Variety

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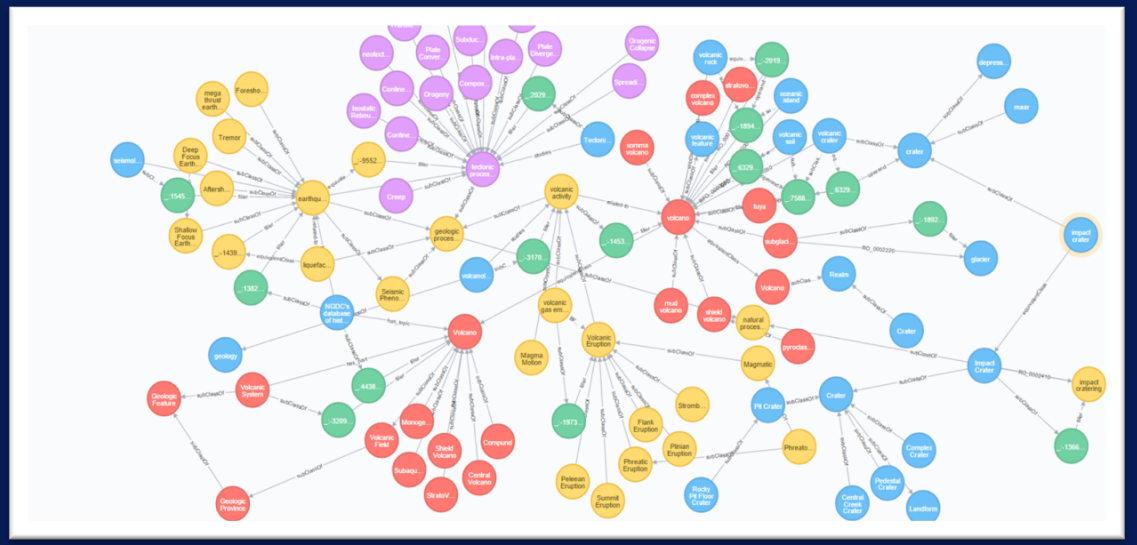


Relational

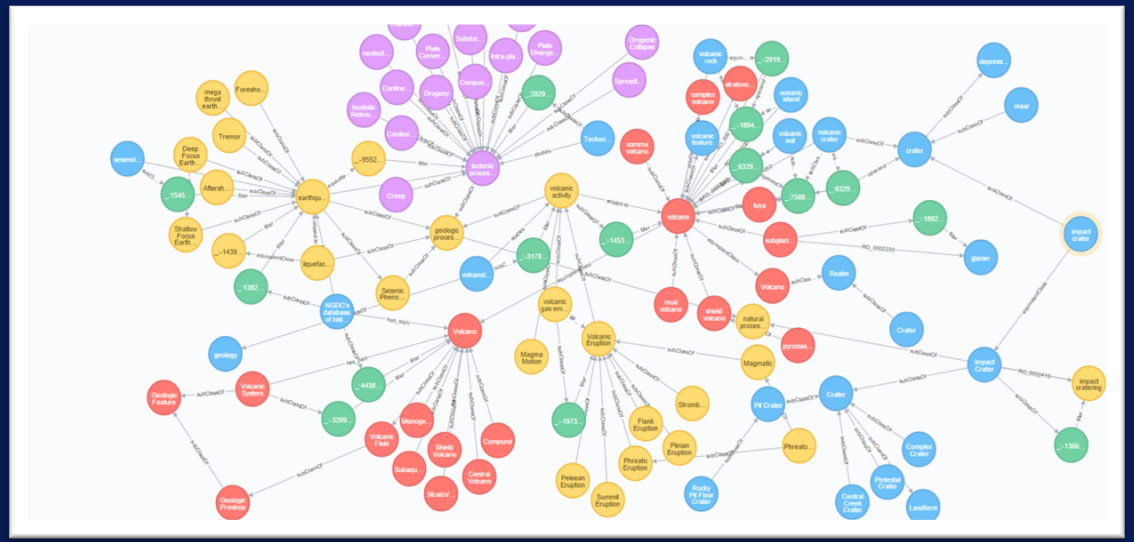
XML/JSON

Graph-structured

Document

Variety

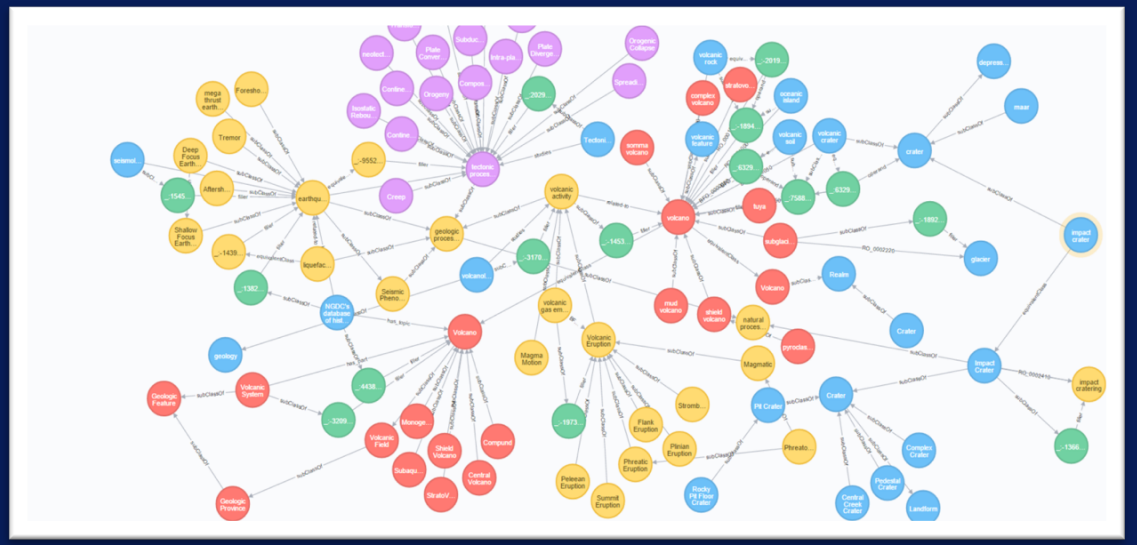
- Different kinds of graphs may have very different meanings



Variety

- Different kinds of graphs may have very different meanings

Social Networks



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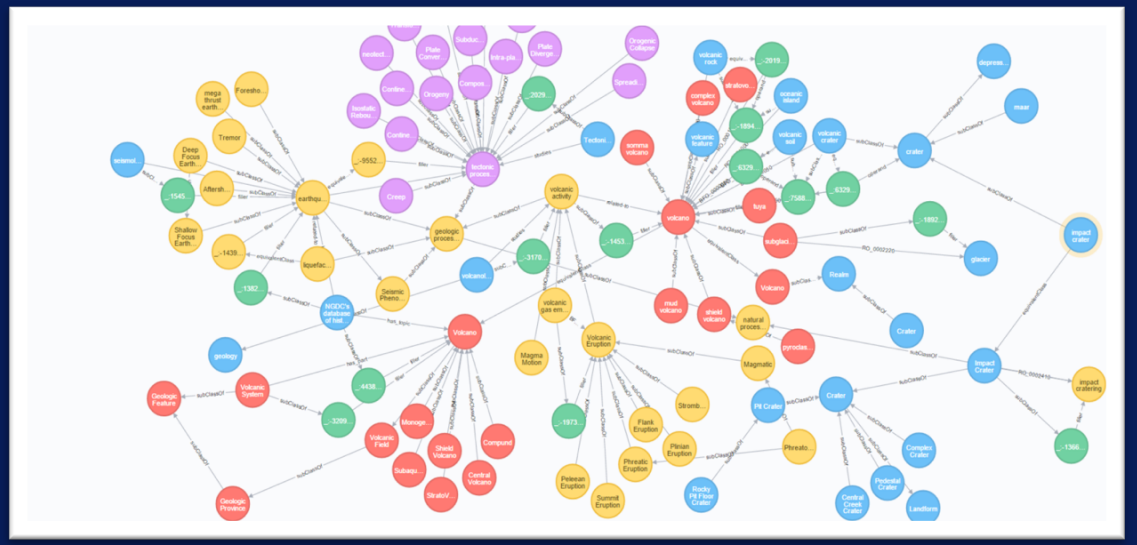

Social Networks

Citation Networks

Variety

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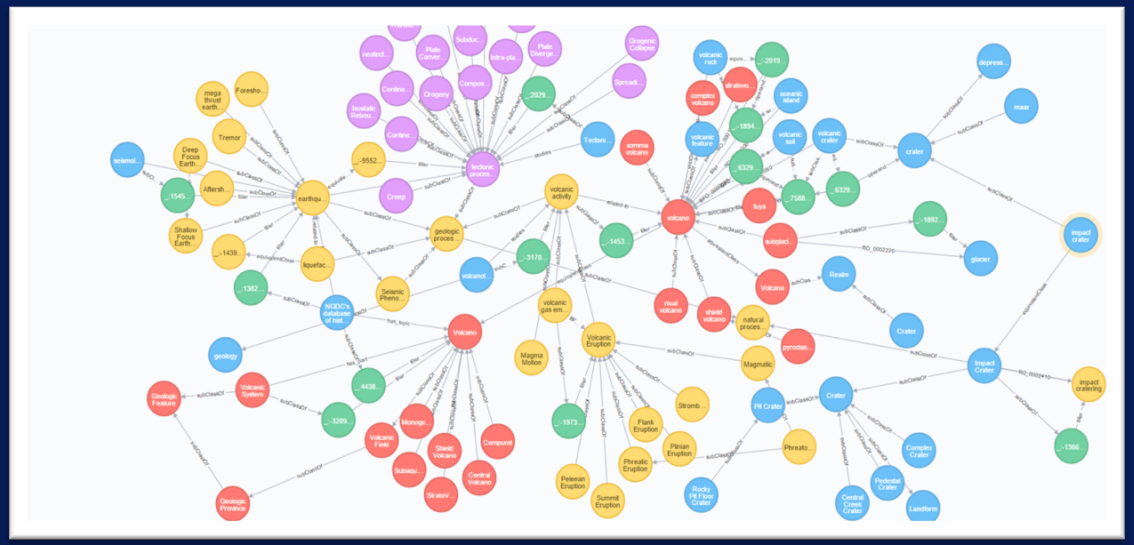


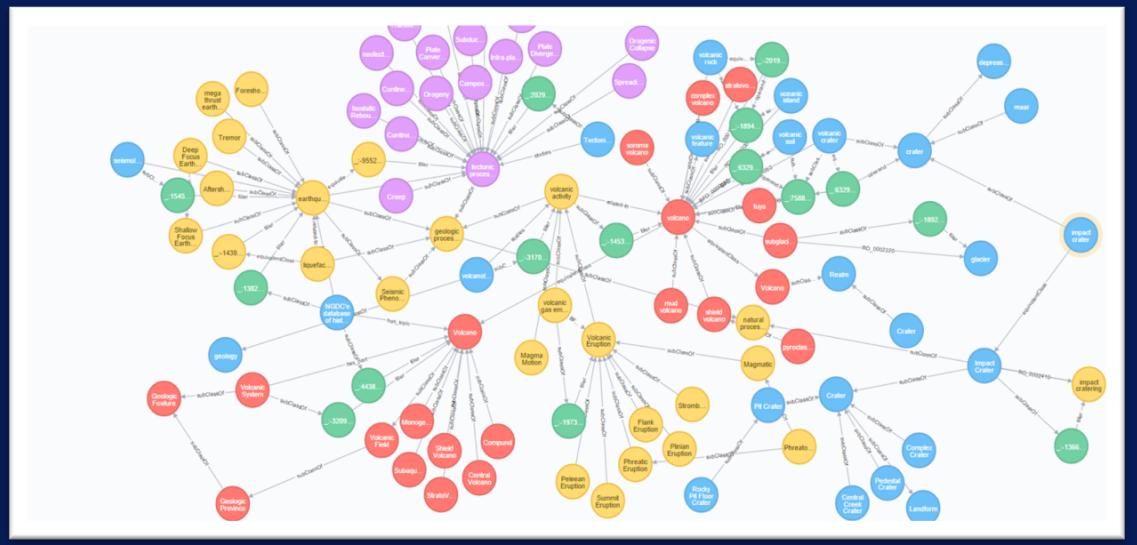
Social Networks

Citation Networks

Interaction Networks

Variety

- Different kinds of graphs may have very different meanings



Social Networks

Citation Networks

Interaction Networks

Semantic Web/
Linked Data

Variety

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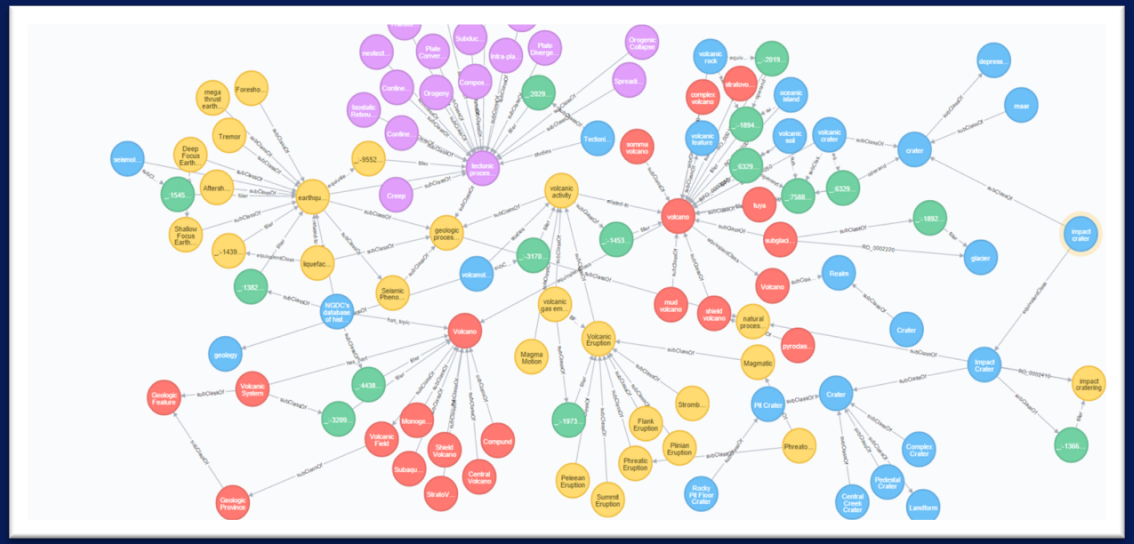


Social Networks

Citation Networks

Interaction Networks

Semantic Web/
Linked Data

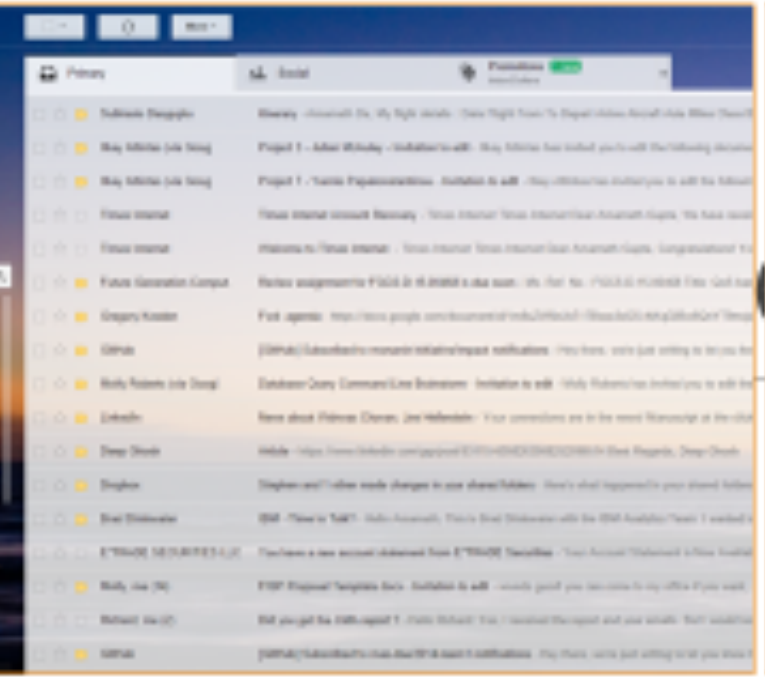
Ontologies

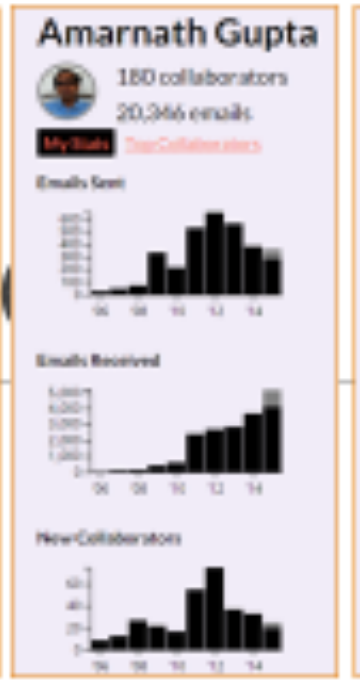
Valence

- **Degree of connectedness or interdependence**
  - Higher valence implies that the data elements are strongly related
  - This relatedness is significantly exploited in analytics

Valence

- **In many cases, valence increases with time**
  - Parts of the graph become denser
  - Average distance between arbitrary node pairs decreases




Amarnath Gupta
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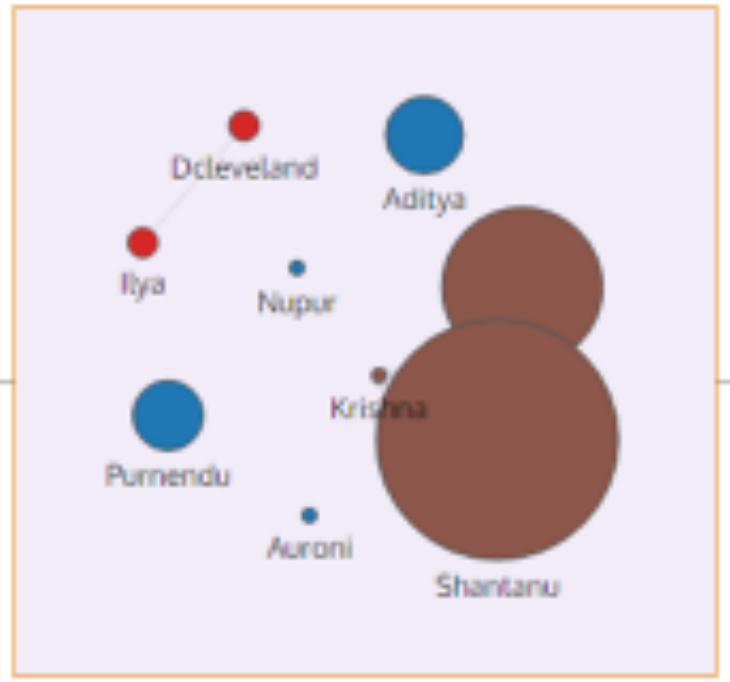
20,366 emails
My Stats
Top Collaborators
Emails Sent
Emails Received
New Collaborators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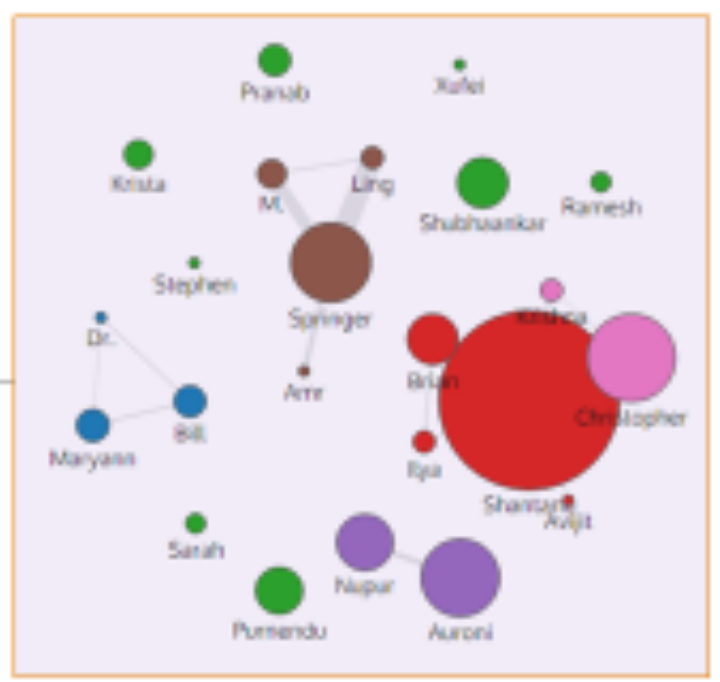
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