

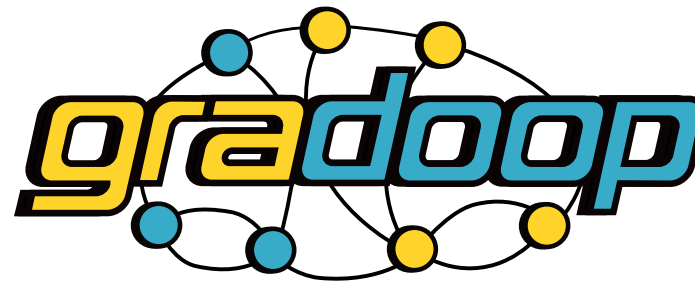
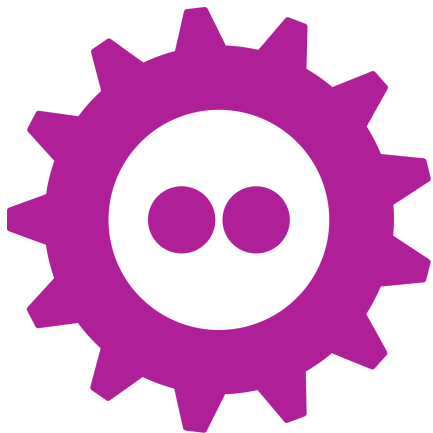


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# Temporal Graph Analytics with GRADOOP

Christopher Rost and Kevin Gomez  
Leipzig University



# About the speakers and the team



**Kevin,  
PhD Student**



**Christopher,  
PhD Student**



**Prof. Dr. Erhard Rahm,  
Database Chair**



**Timo,  
M.Sc. Student**



**Lucas,  
B.Sc. Student**

# We're hiring!

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SCALABLE DATA ANALYTICS  
AND ARTIFICIAL INTELLIGENCE

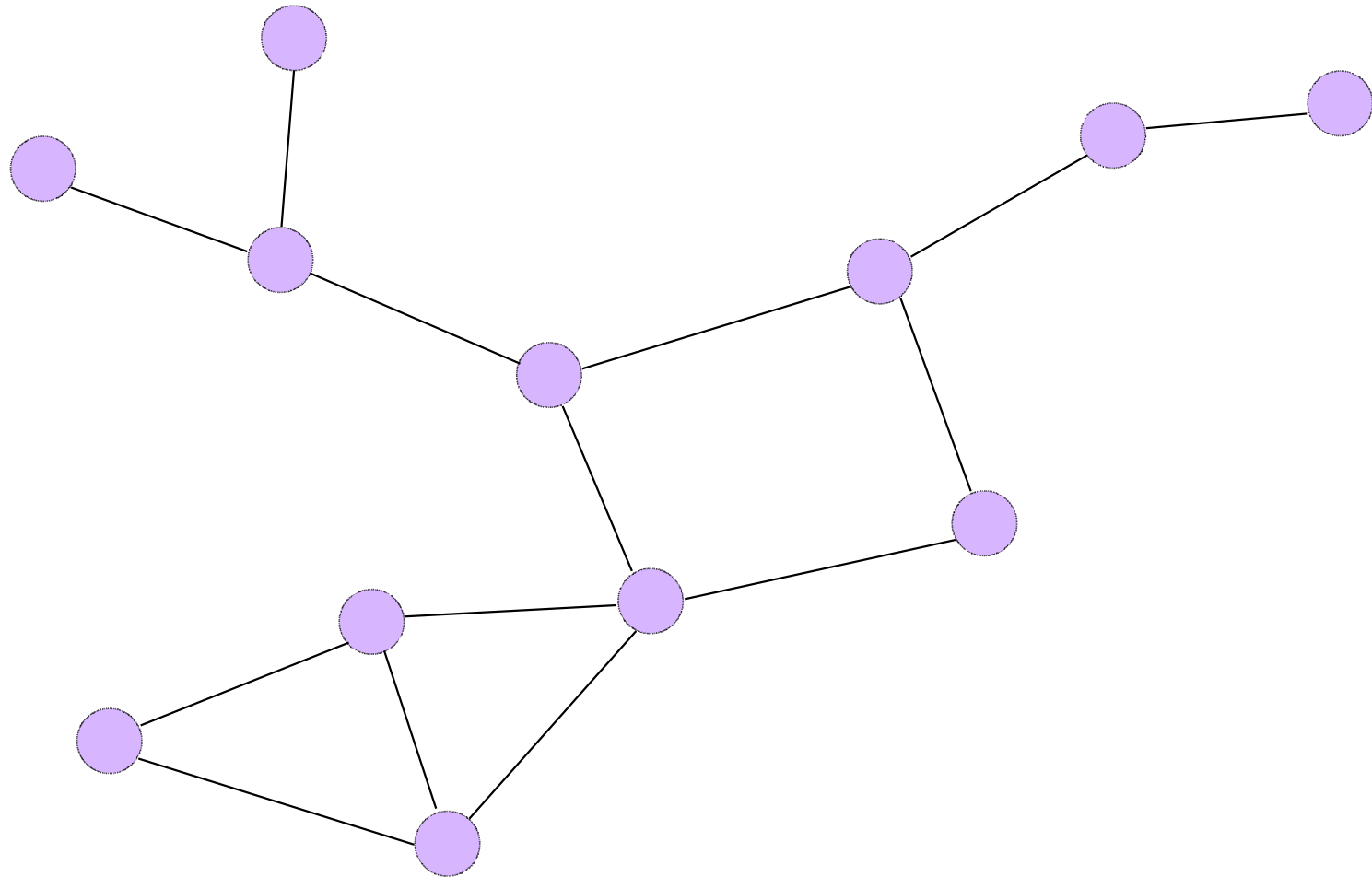


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- Open positions and projects (Developer and PhD Students)
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  - Machine Learning (Graph-ML, Privacy)
  - Image Recognition
  - Blockchain (Distributed-Ledger)
  - Graph Analytics

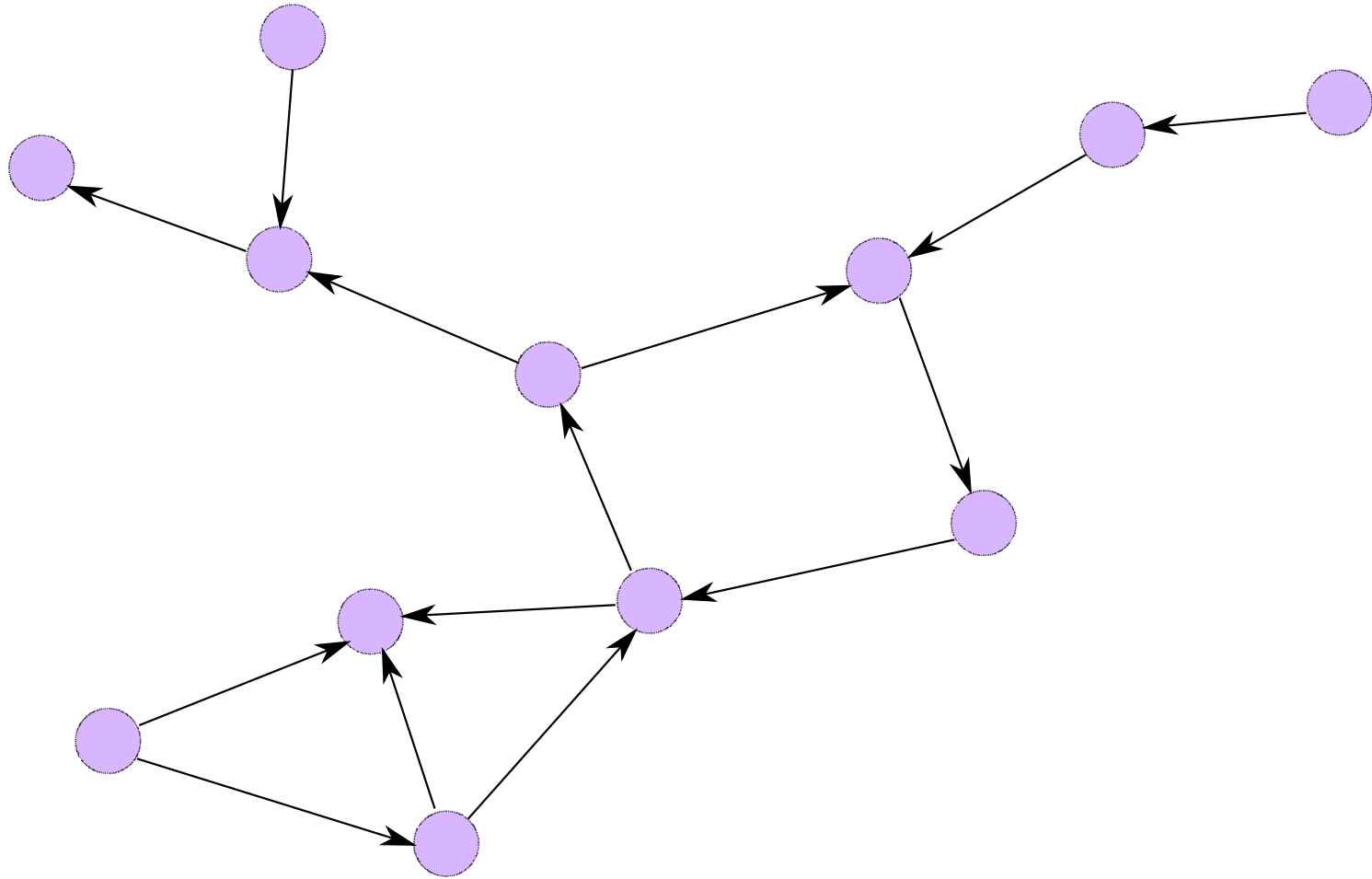
# Motivation



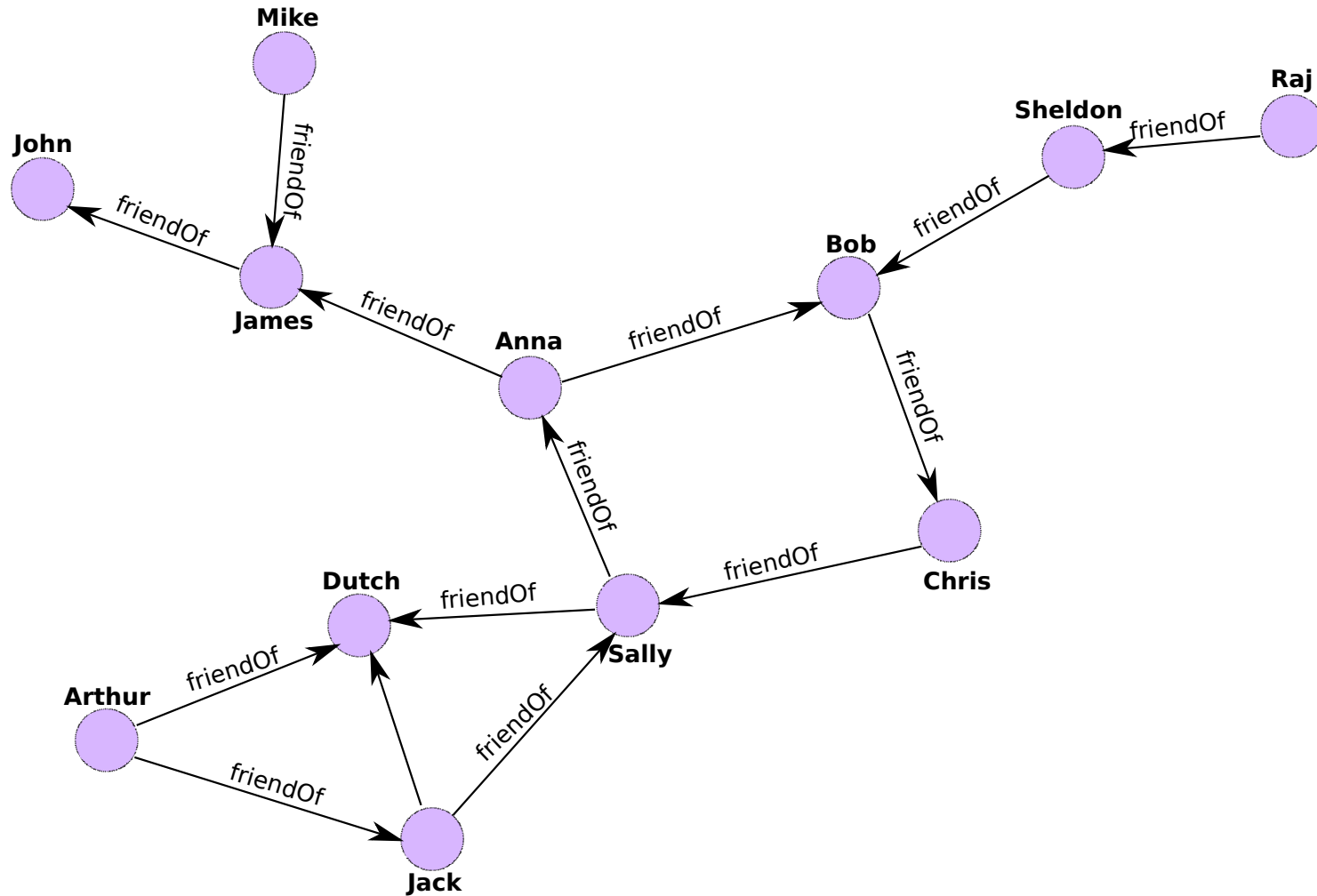
“Graphs are everywhere”



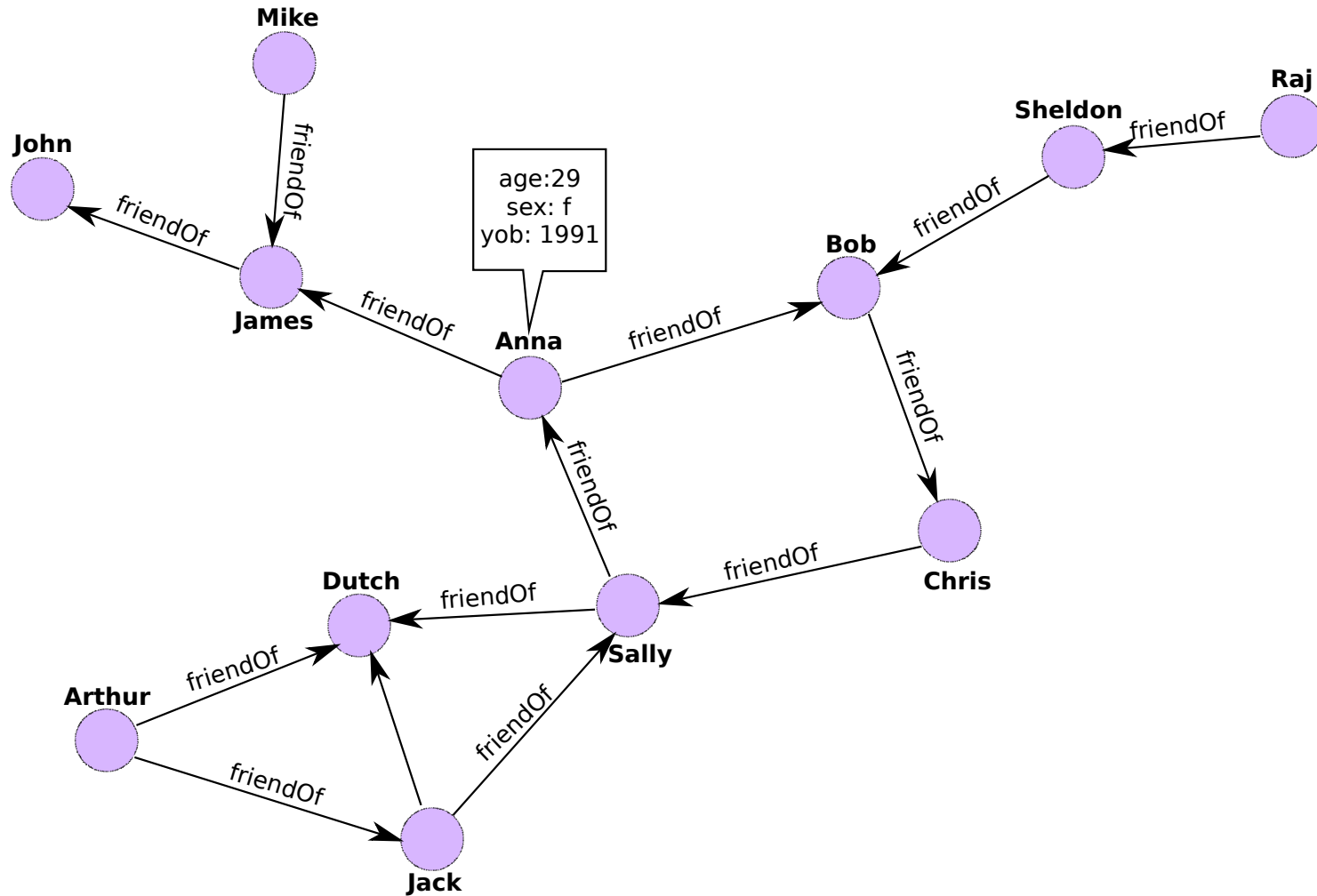
“Graphs are everywhere”



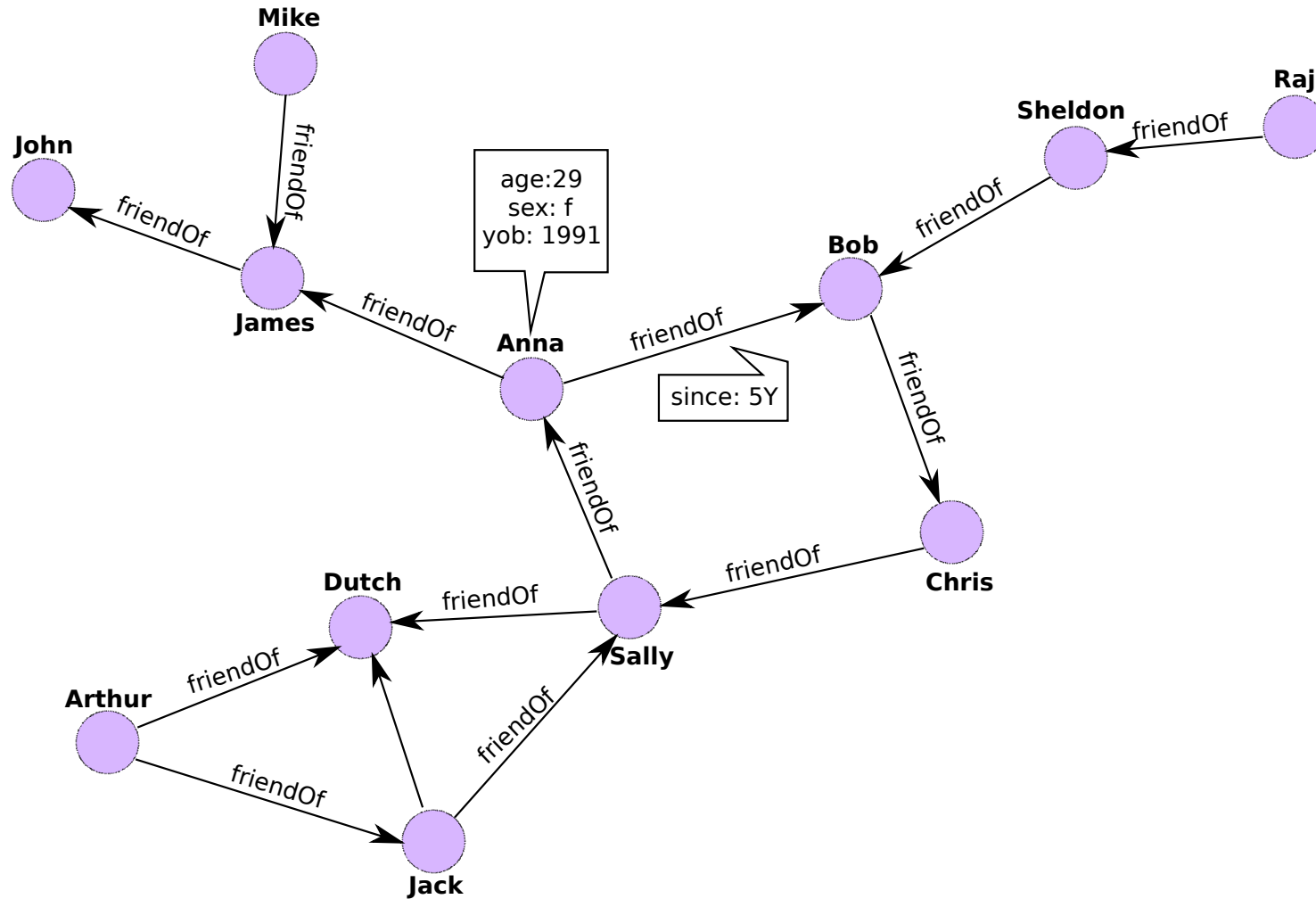
# “Graphs are everywhere”

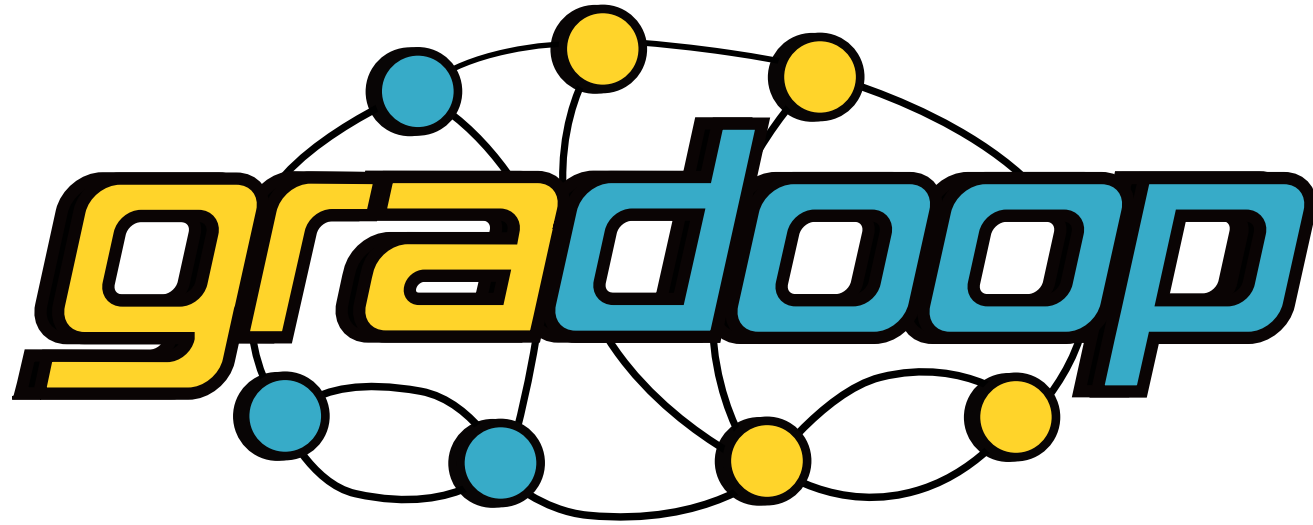


# “Graphs are everywhere”



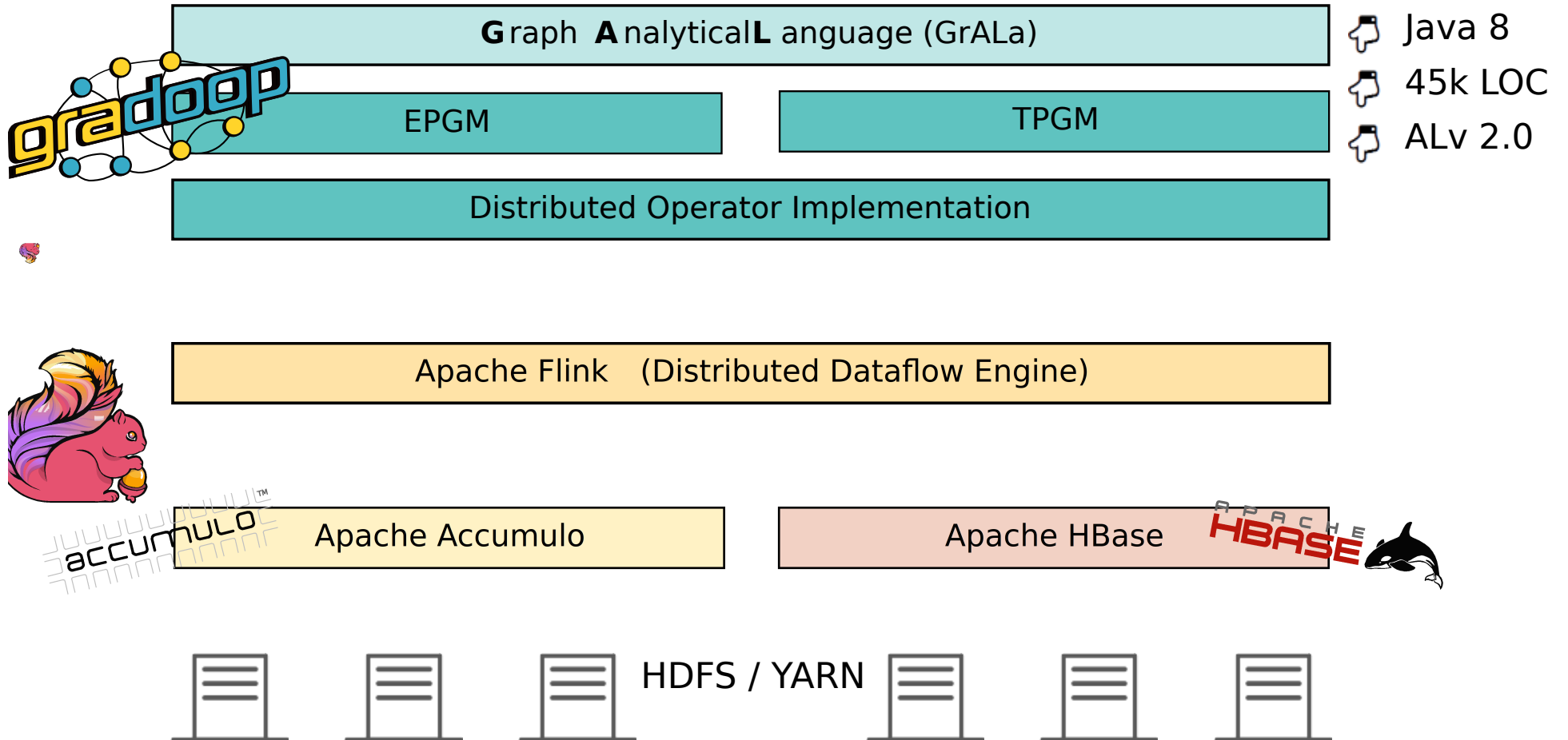
# “Graphs are everywhere”



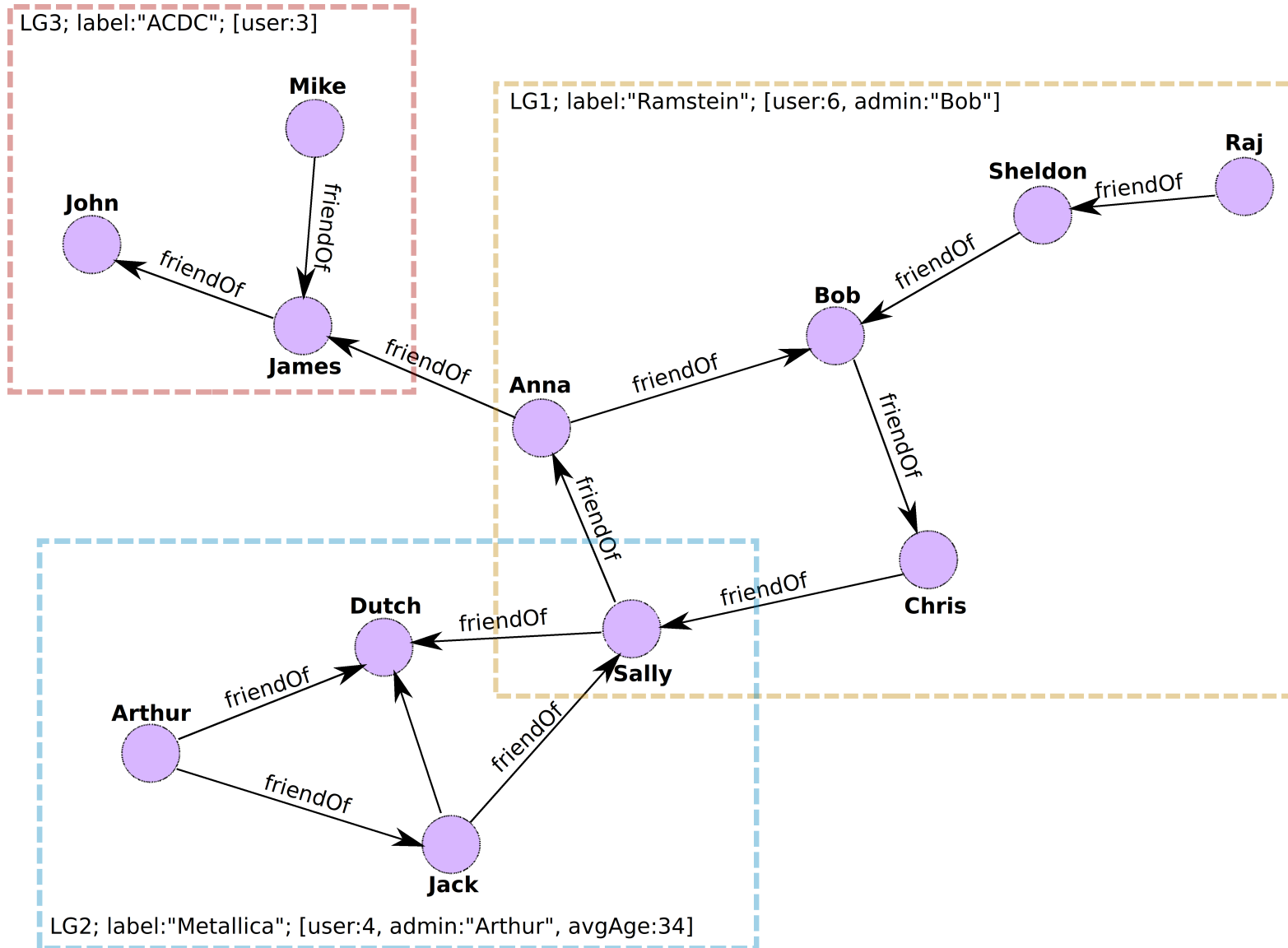


“A **open-source** framework and research platform for **efficient, distributed** and domain independent **management** and **analytics** of heterogeneous and temporal graph data.”

# Architecture

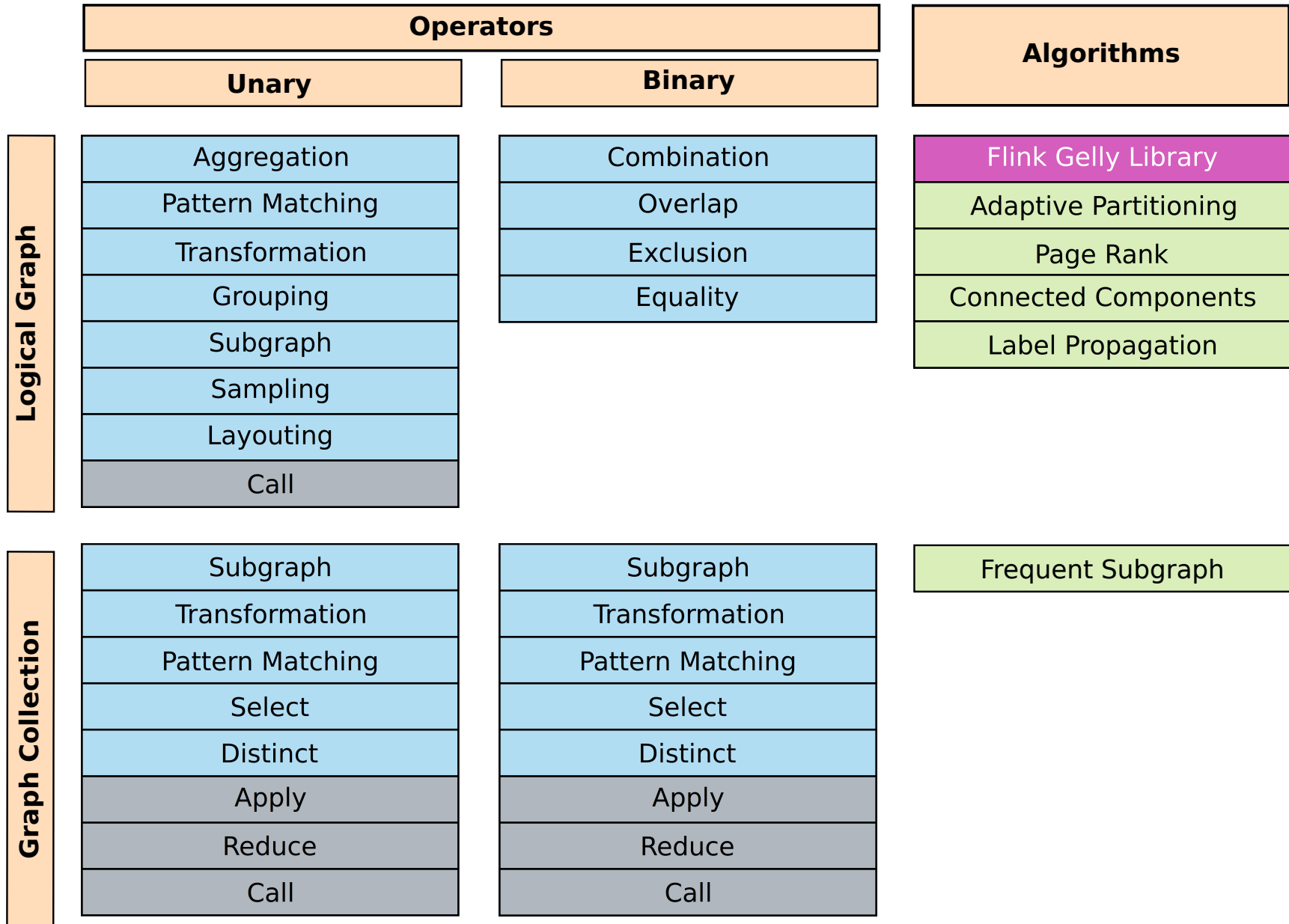


# Graphs and collections of graphs

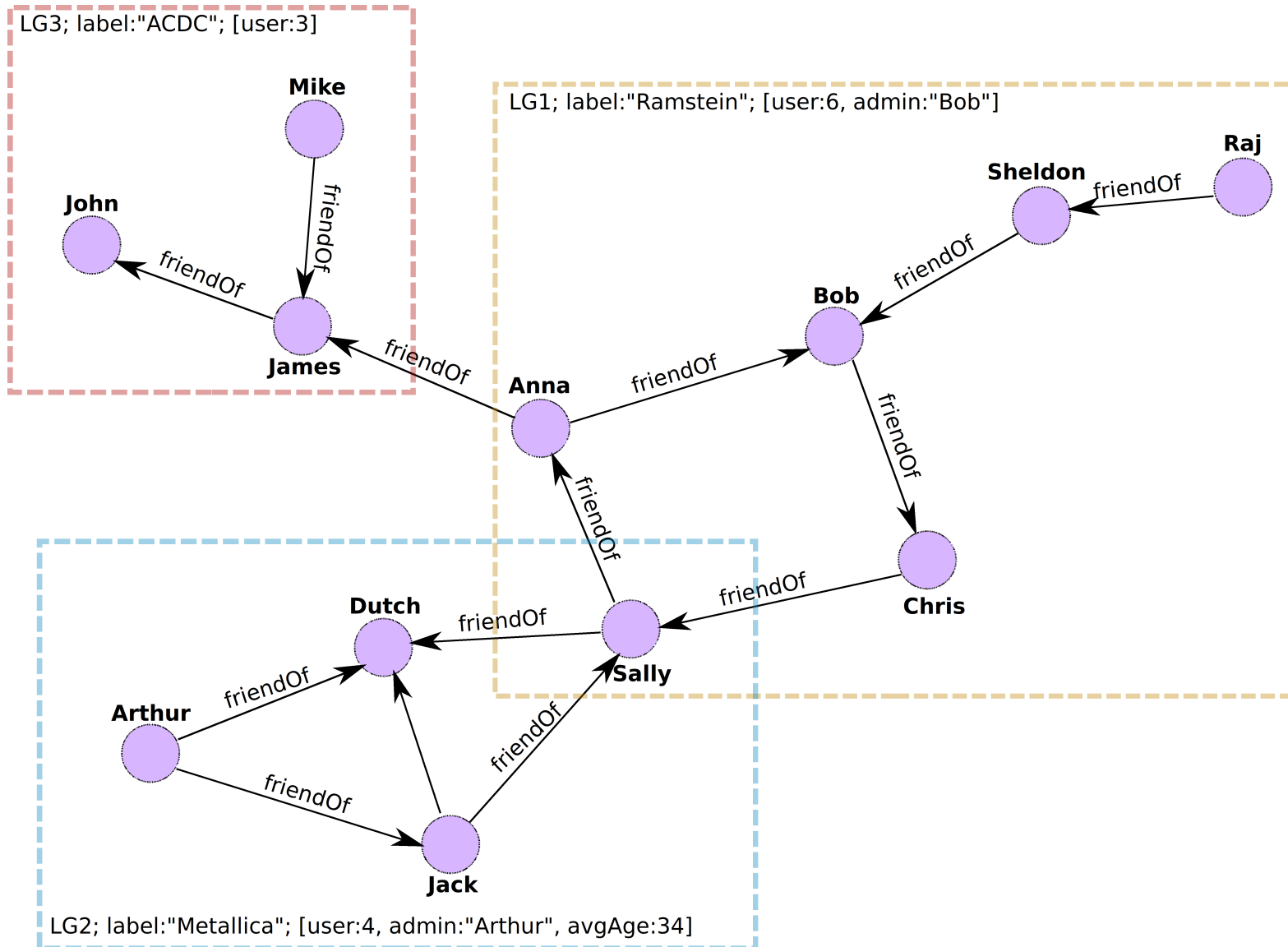




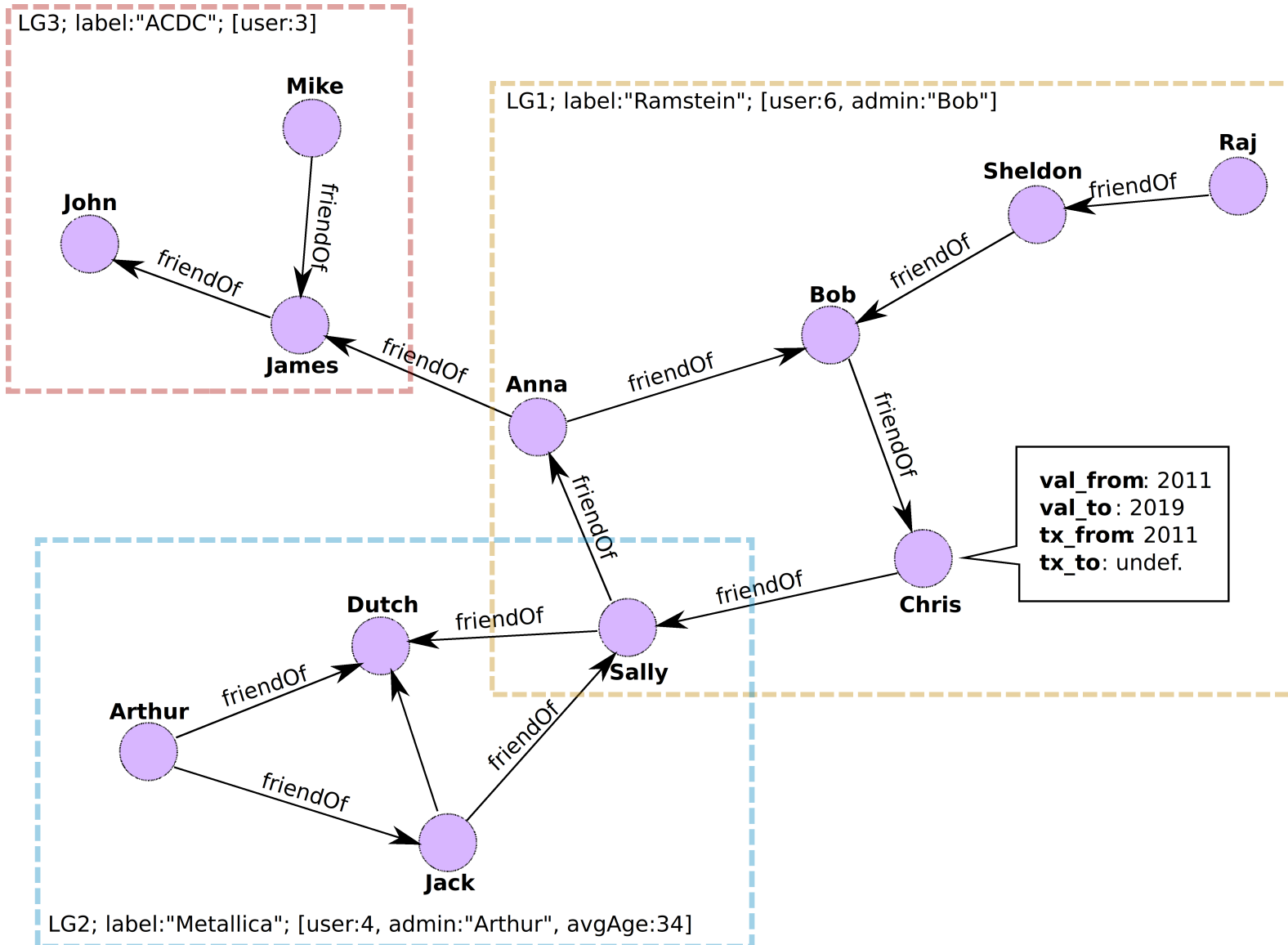
# Operators



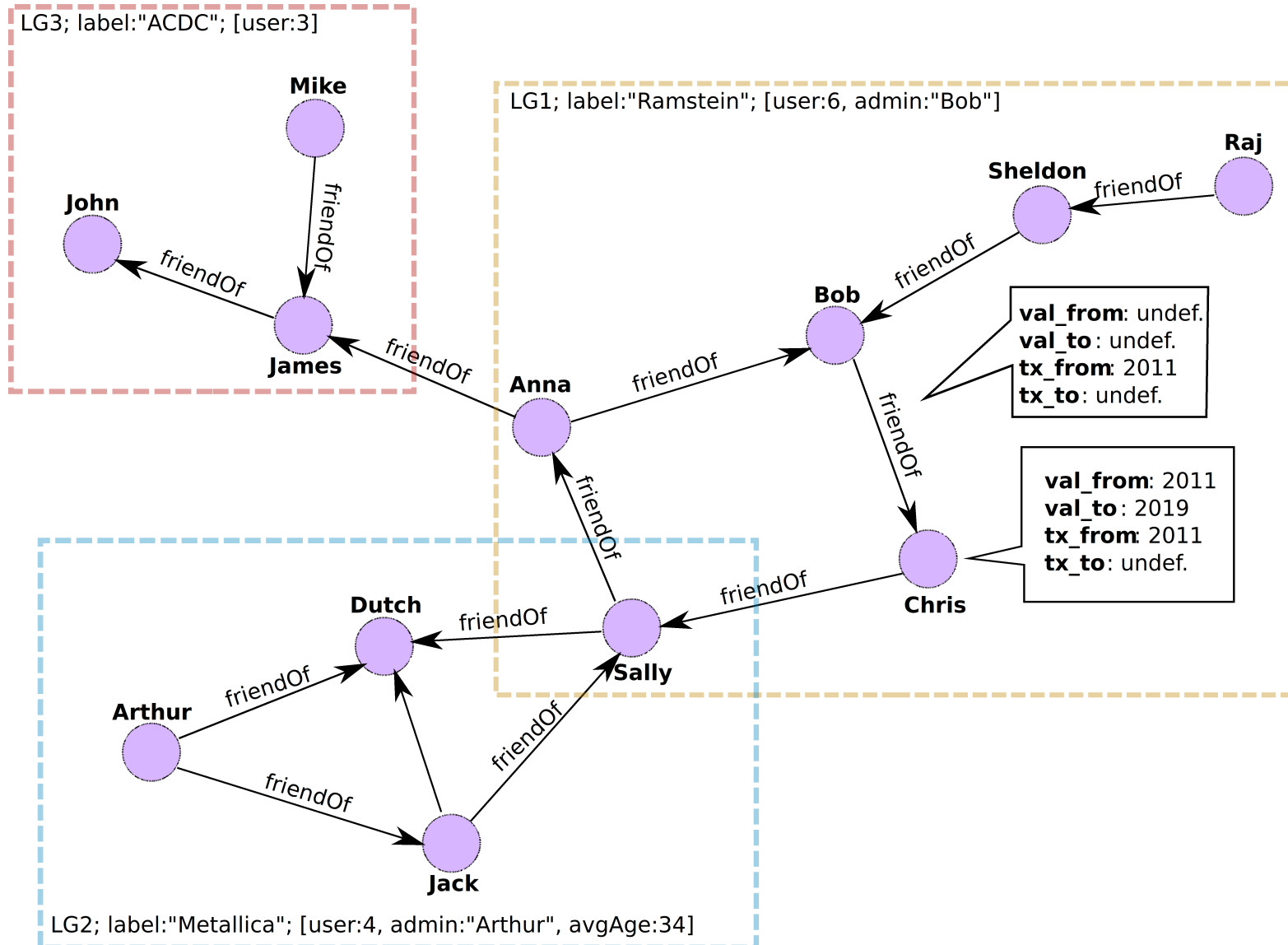
# Temporal extension



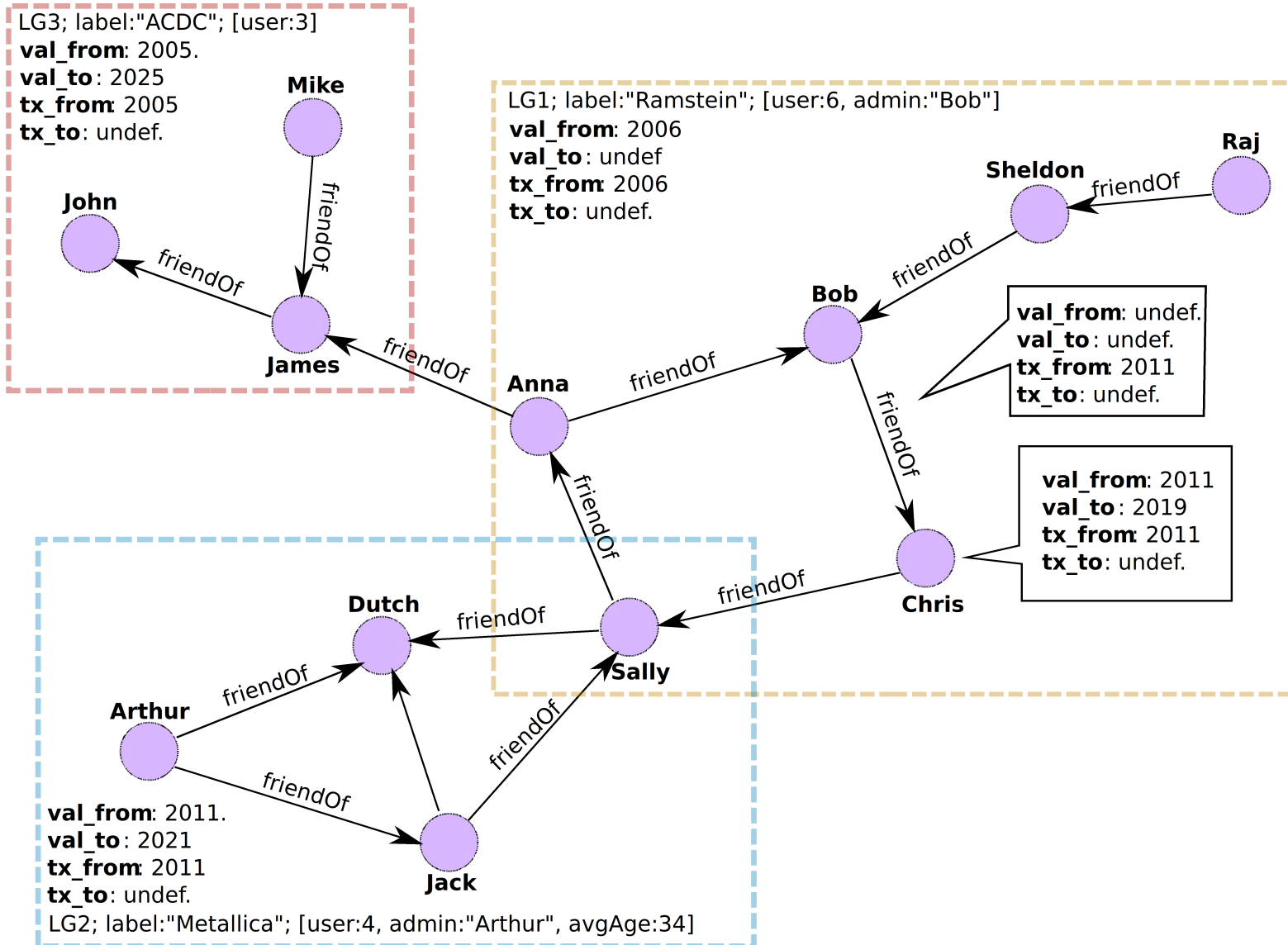
# Temporal extension



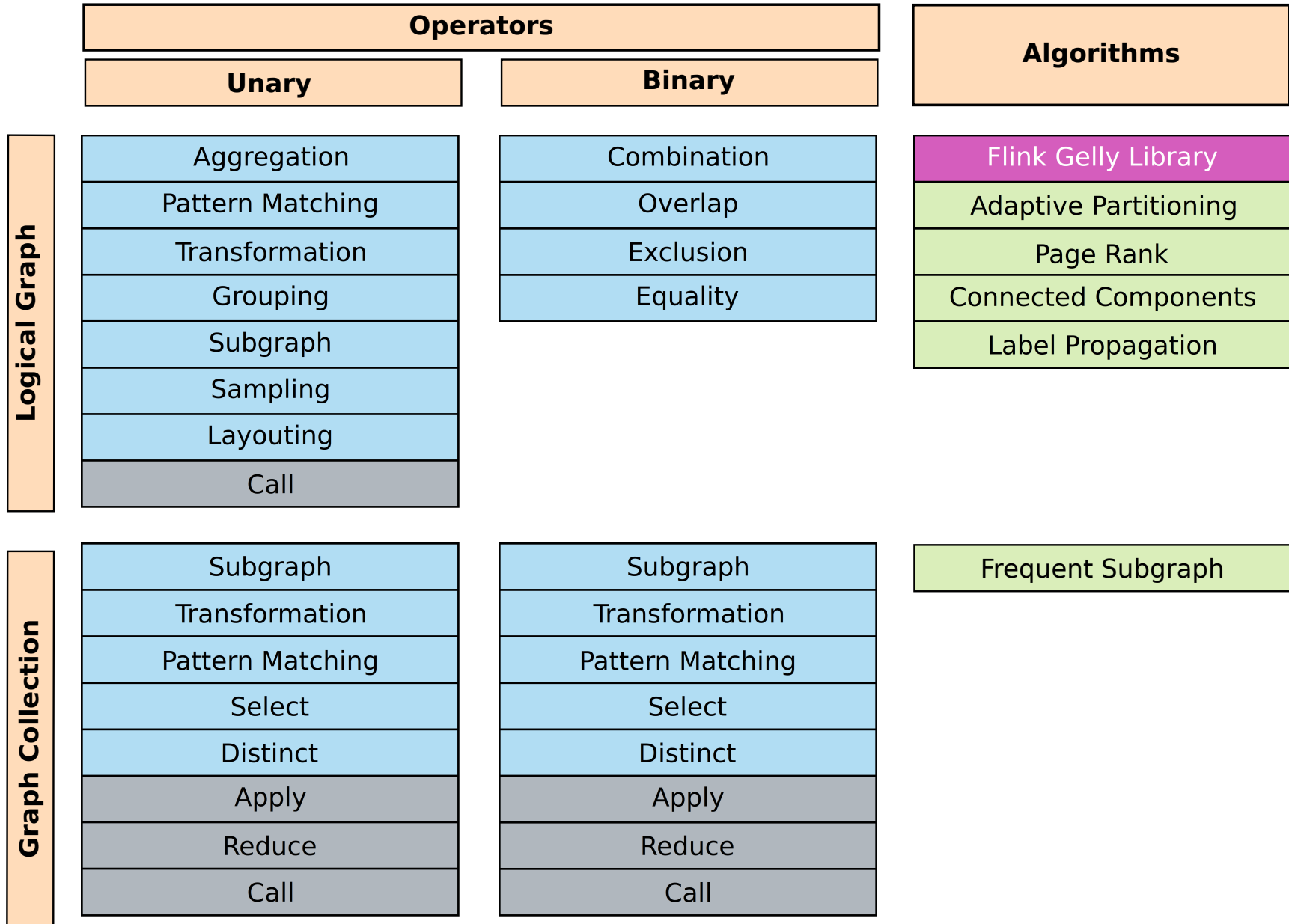
# Temporal extension



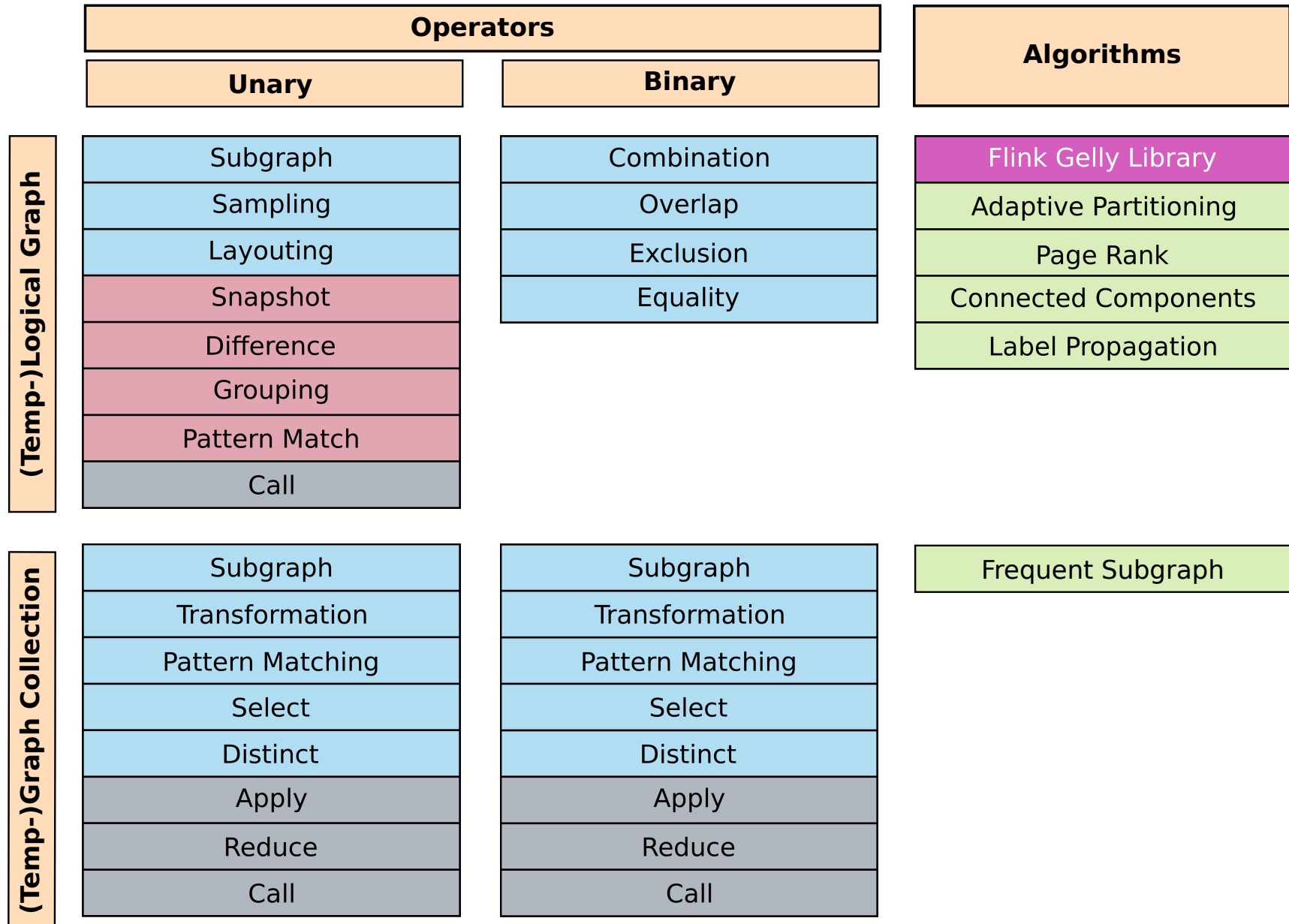
# Temporal extension



# Time dependent operators



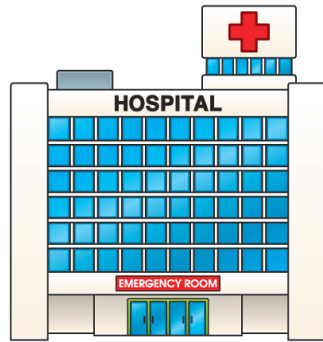
# Time dependent operators



# Use case: spread of airborne pathogens



Accident



Oncology



Surgery



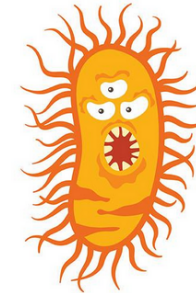
Cardiology

RFID))

## **Contact tracking**

Sensors capturing who is close to whom at what time.

{empID1, empID2, t\_from, t\_to}

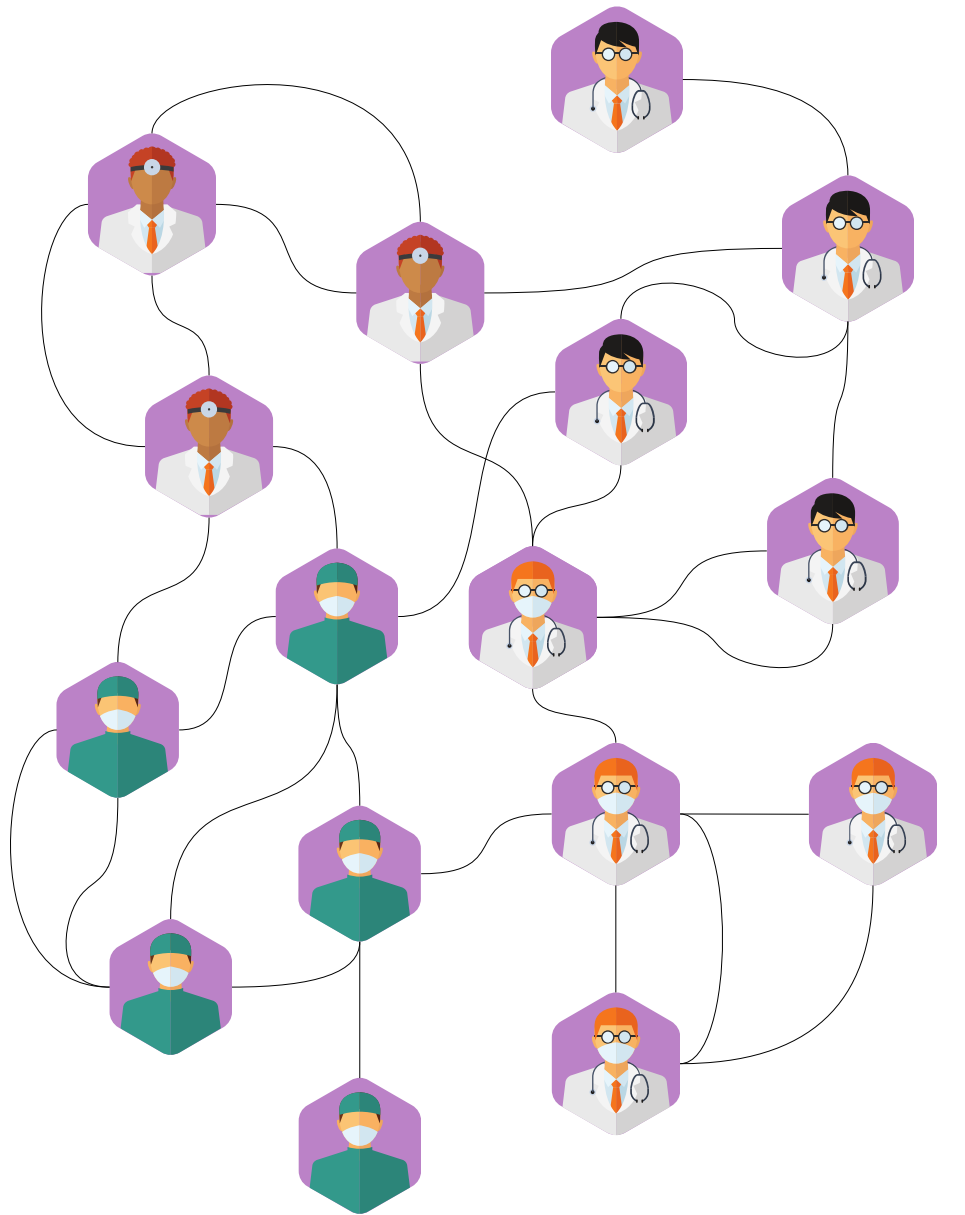


## ***Virus X***

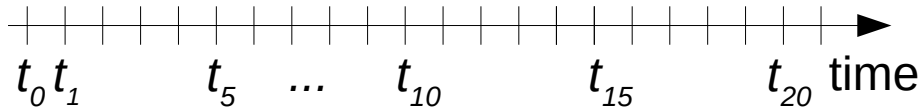
Symptoms: 3<sup>rd</sup> eye growing  
Transmission: if contact > 5 min  
Incubation period: 5 time units

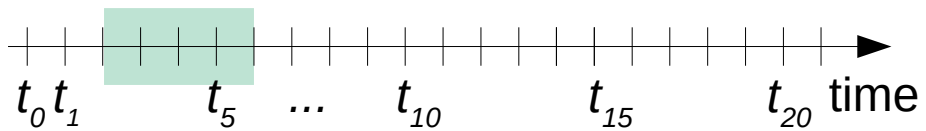
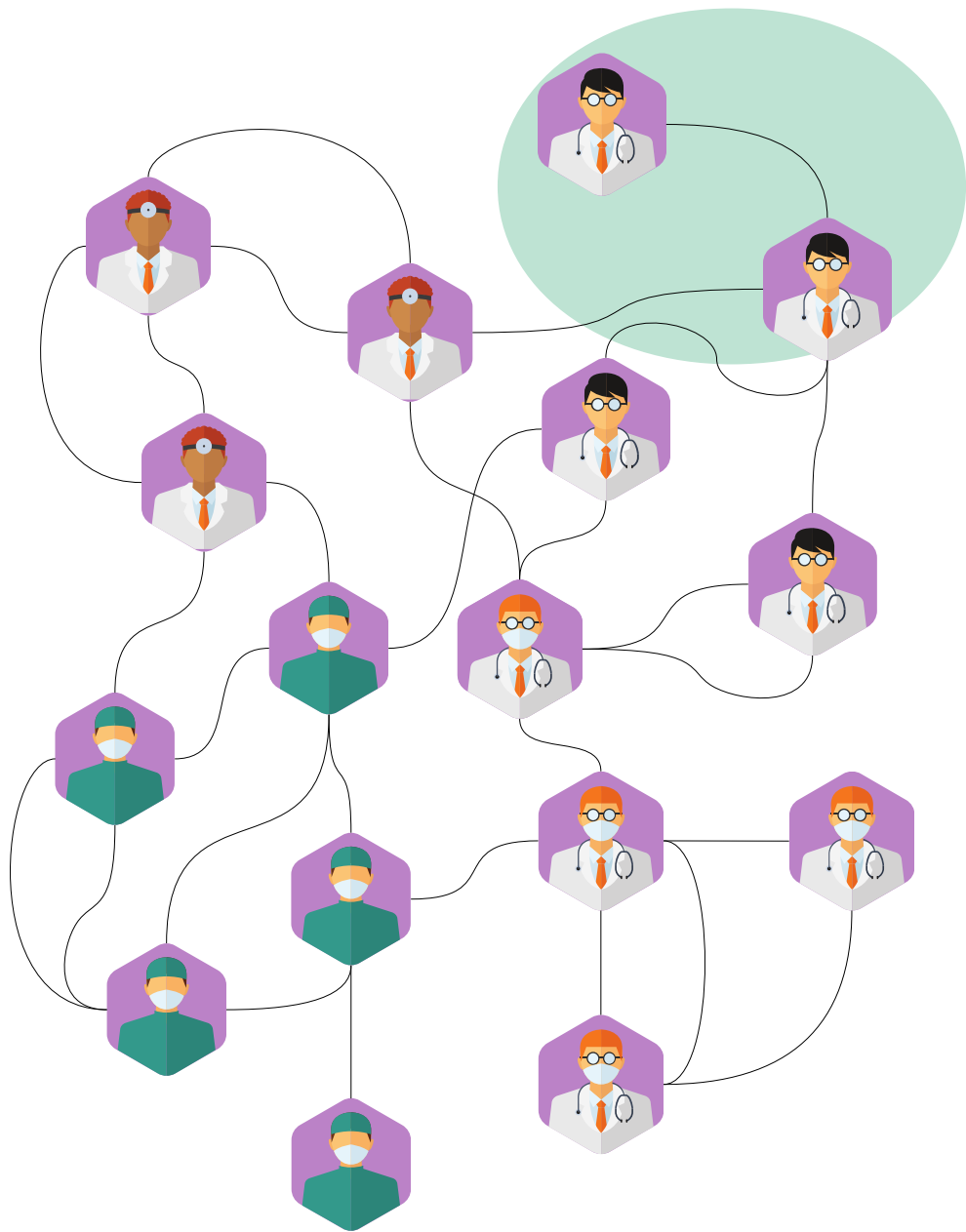
*In case of an infection, which hospital services are at risk of contracting the virus X?*





```
TemporalGraph contacts =  
    mySource.getTemporalGraph();
```



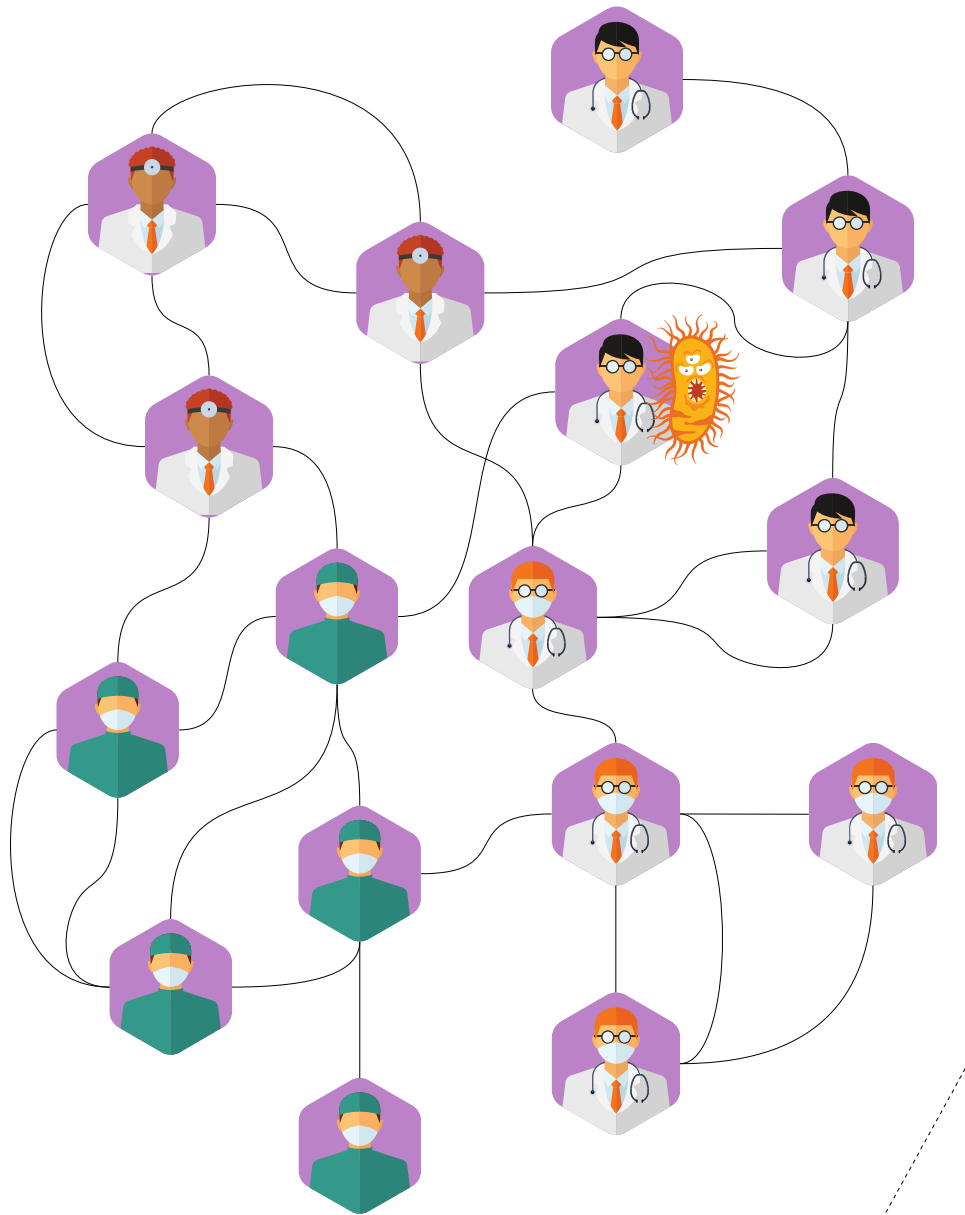


**contact**  
 $[t_2, t_6)$

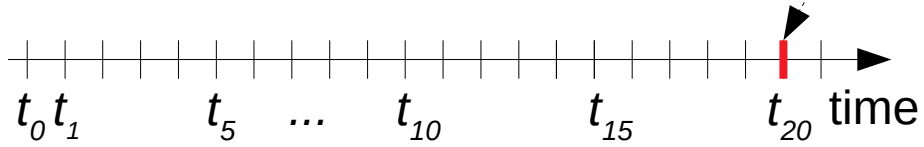

**Employee**  
 $[-, -)$   
 id: 32432  
 srv: Oncology

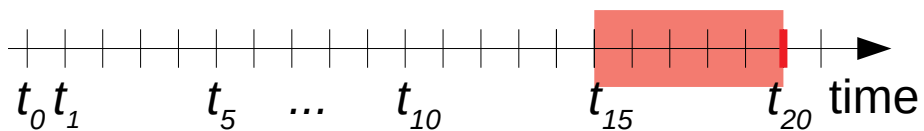
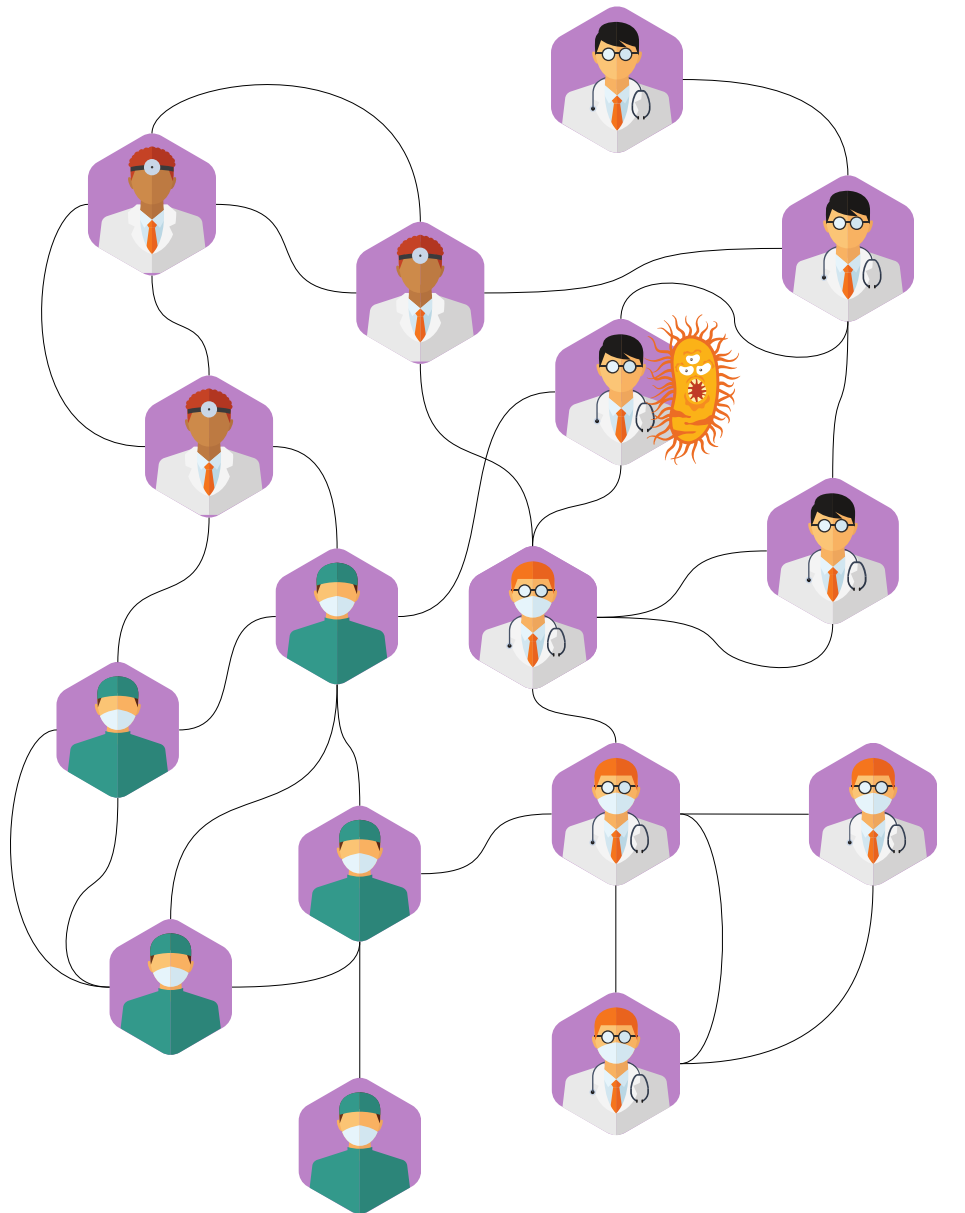


**Employee**  
 $[-, -)$   
 id: 99934  
 srv: Oncology



**Breaking news:**  
Employee of oncology  
infected by VirusX.  
  
Detected at  $t_{20}$ .

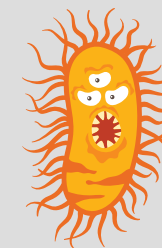




**Breaking news:**

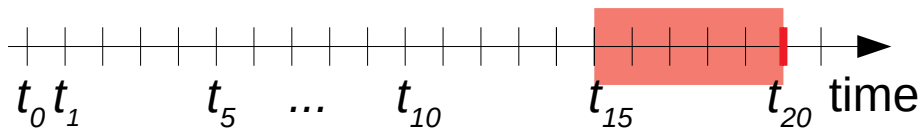
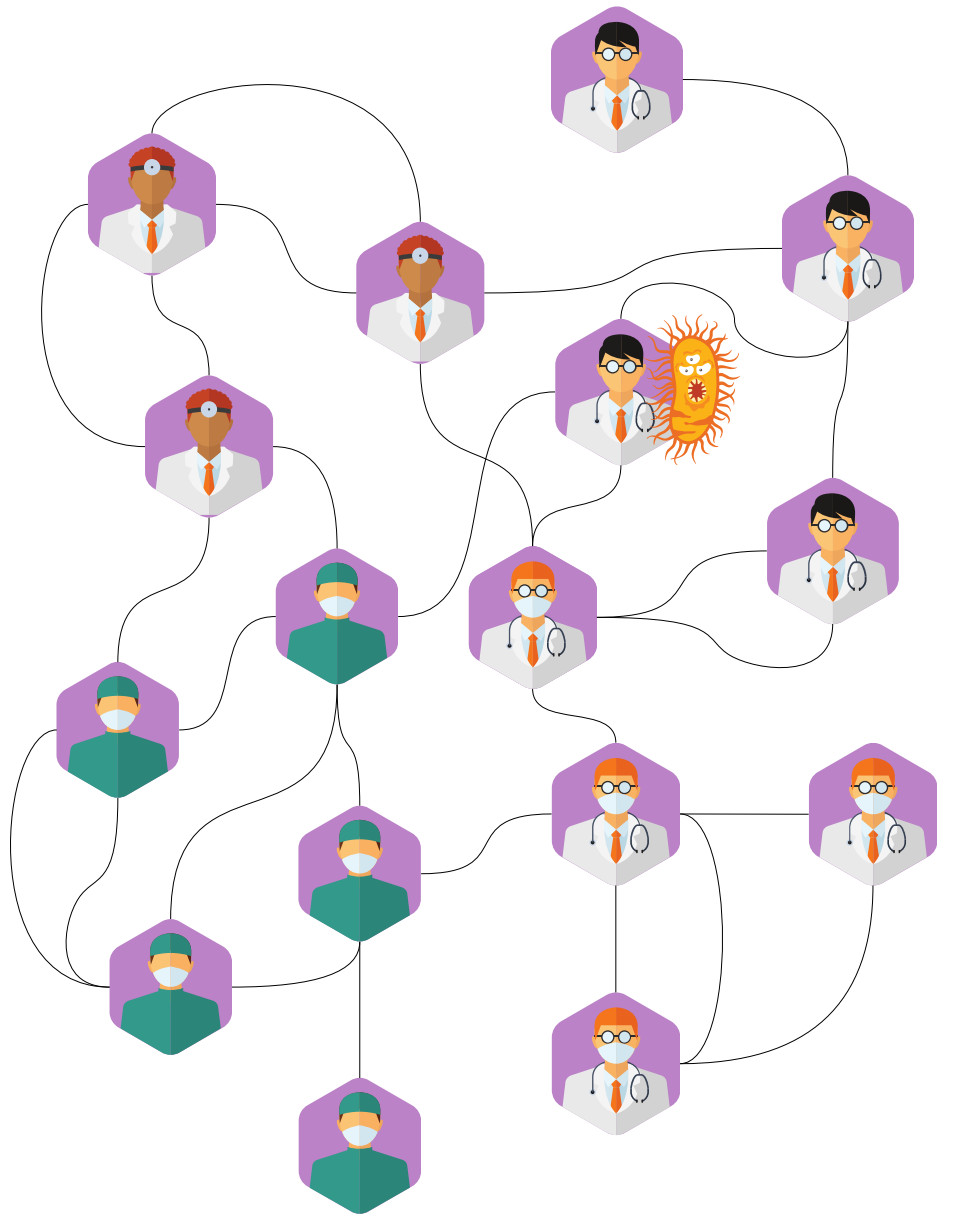
Employee of oncology  
infected by VirusX.

Detected at  $t_{20}$ .



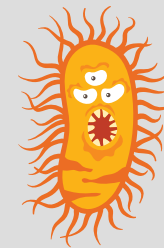
**Virus X**

Symptoms: 3<sup>rd</sup> eye growing  
Transmission: if contact > 5 min  
Incubation period: **5 time units**



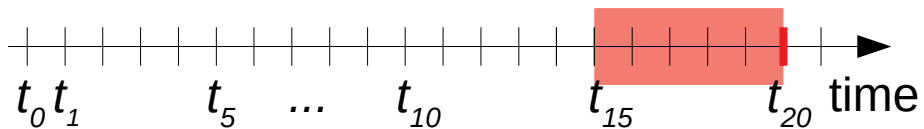
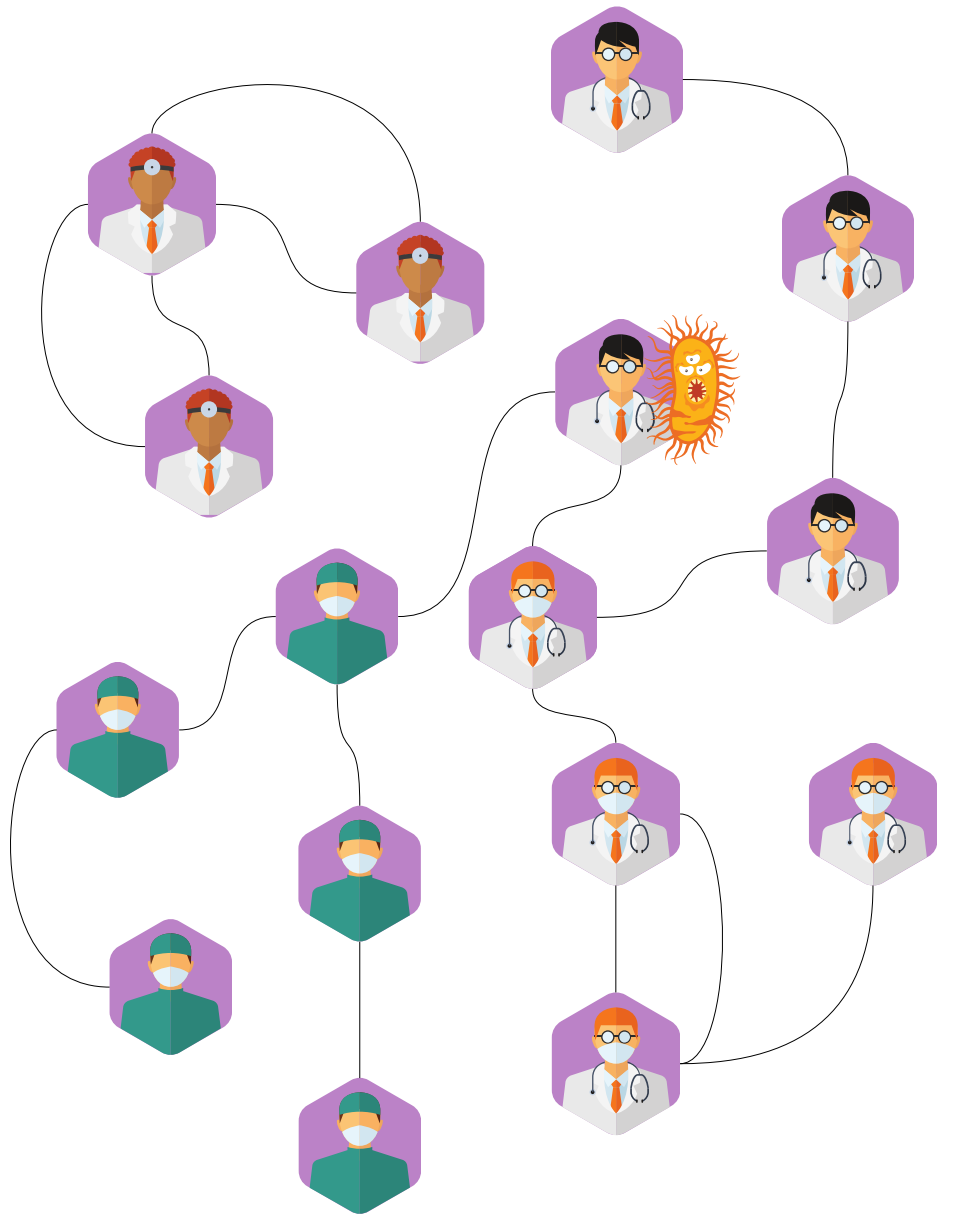
```
TemporalGraph contacts =
    mySource.getTemporalGraph();

contacts = contacts.snapshot(
    new FromTo(t15, t20));
```



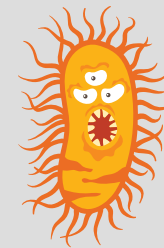
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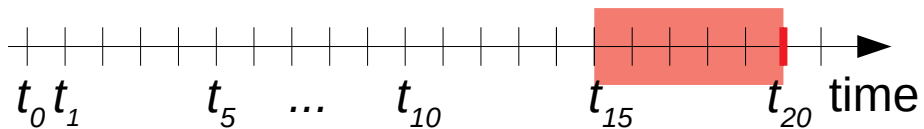
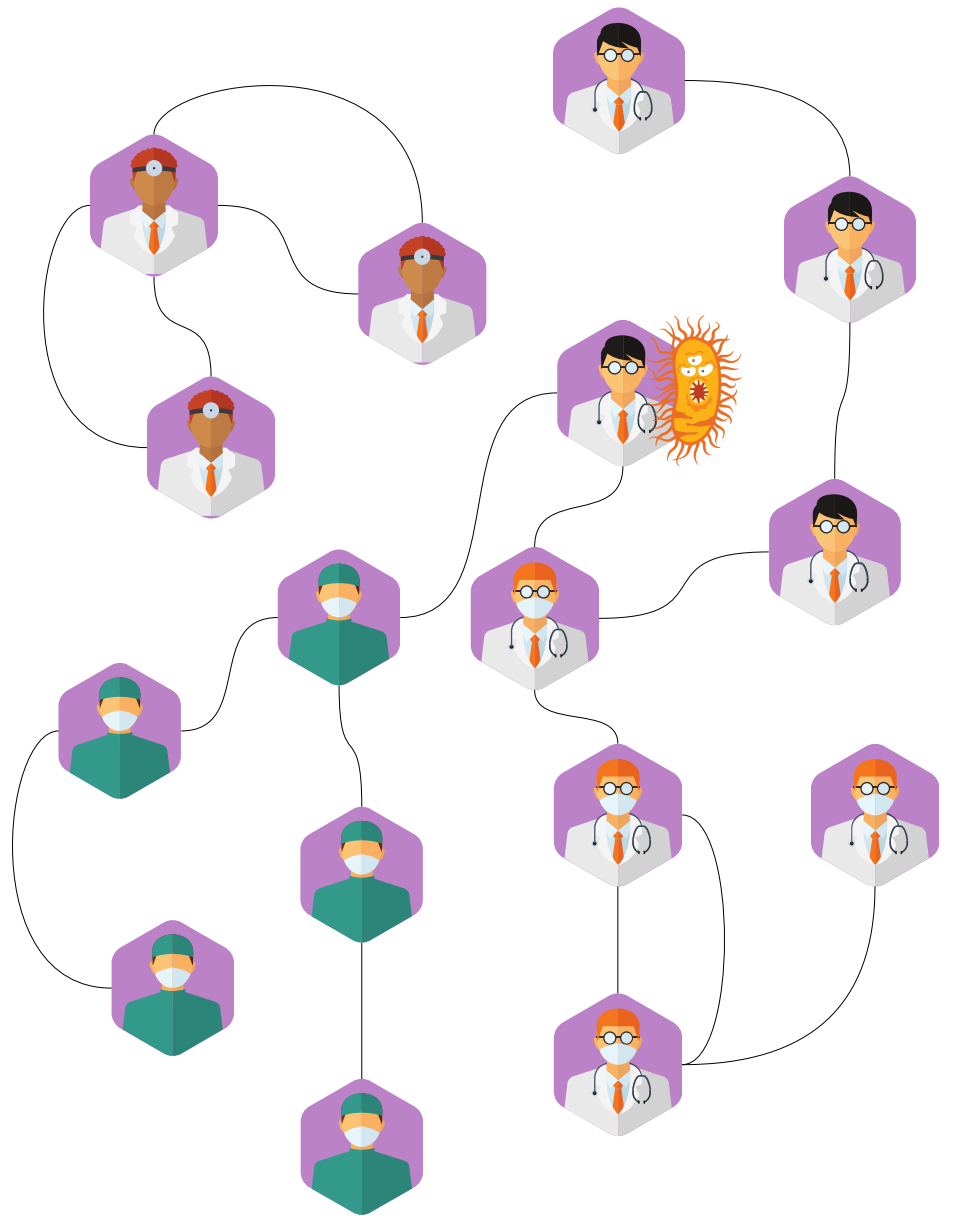
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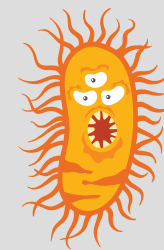
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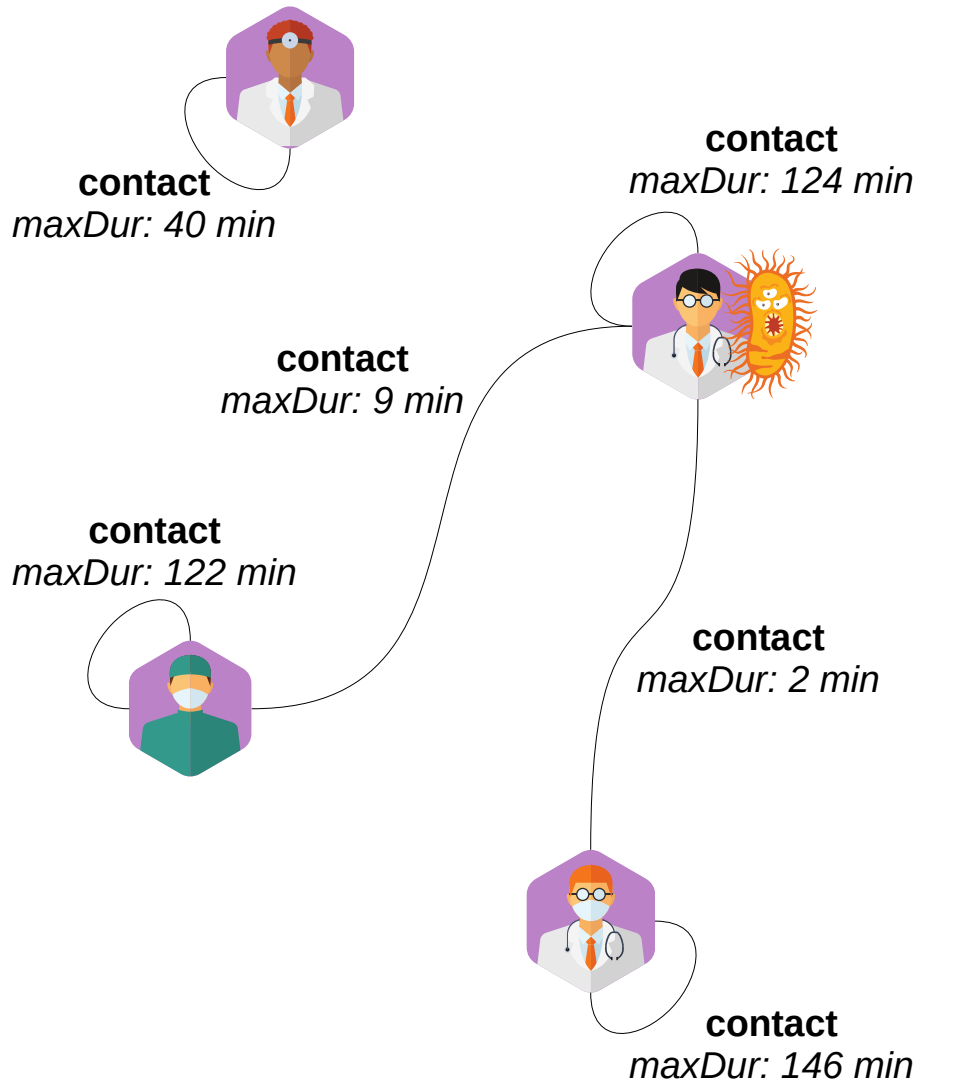
contacts = contacts.snapshot(
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***Virus X***

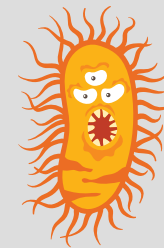
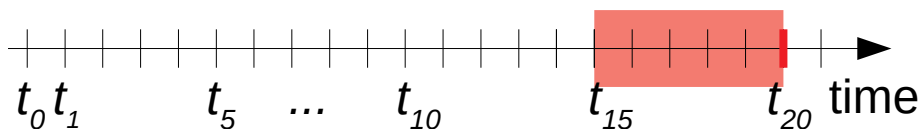
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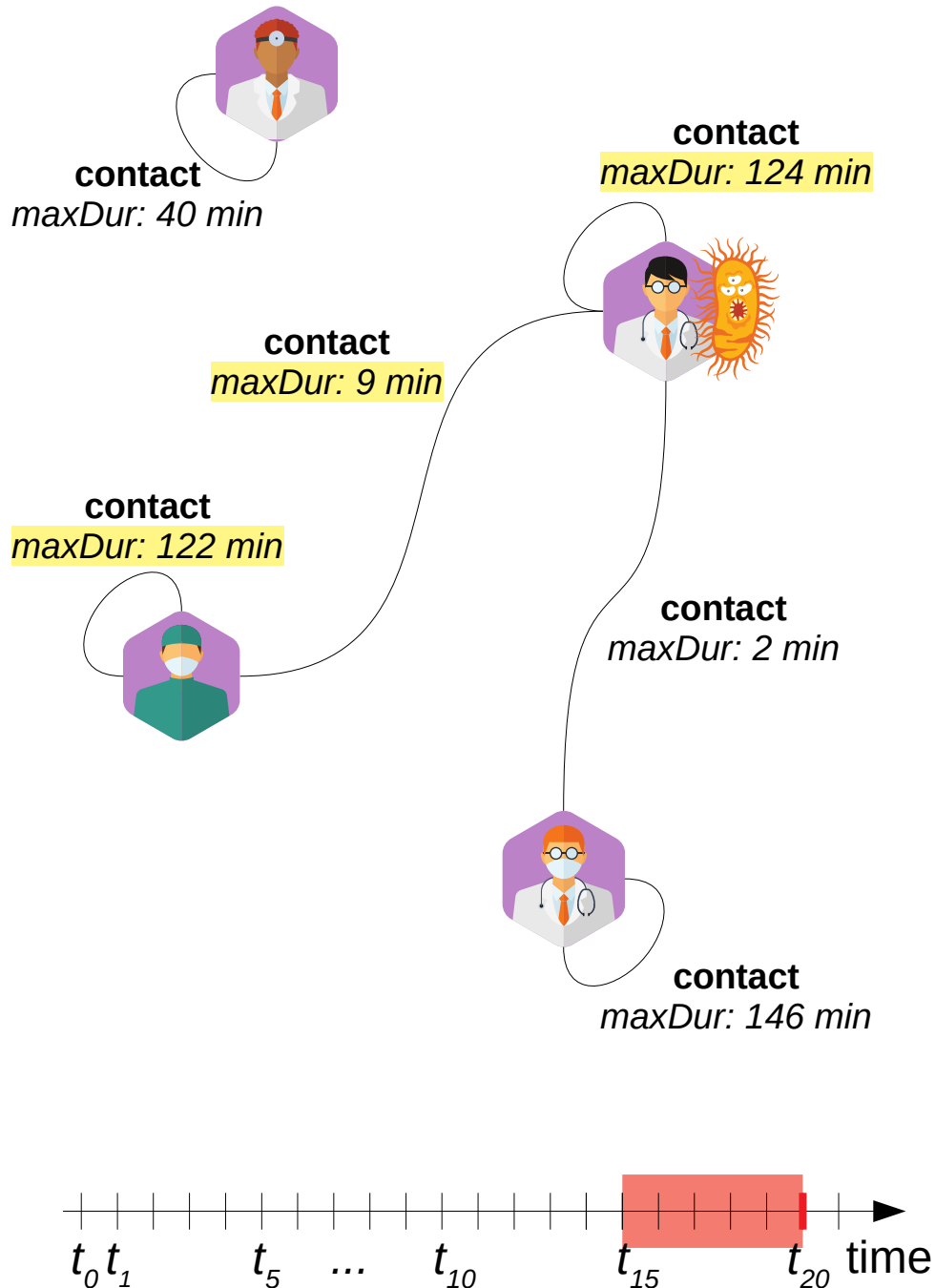
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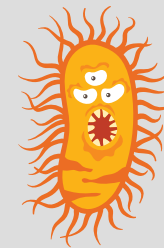




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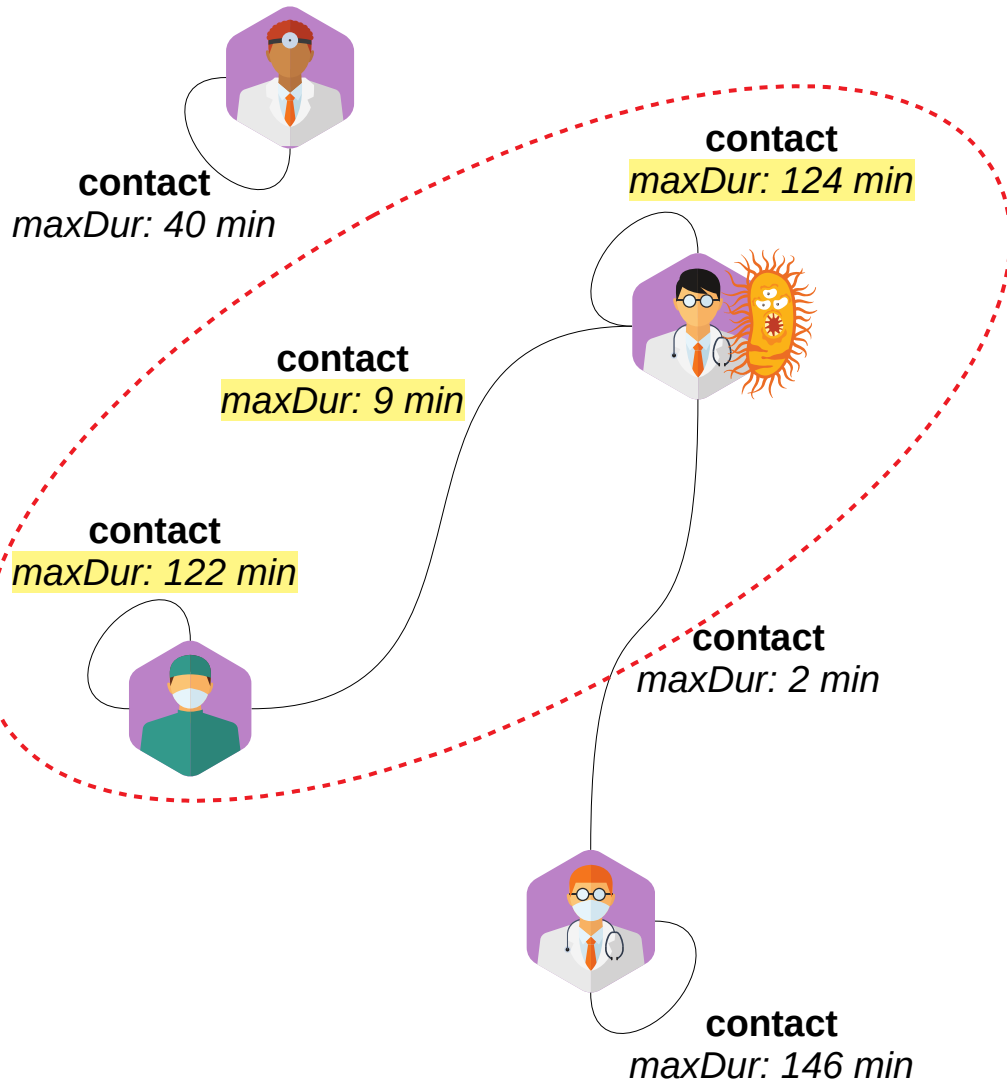
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### **Virus X**

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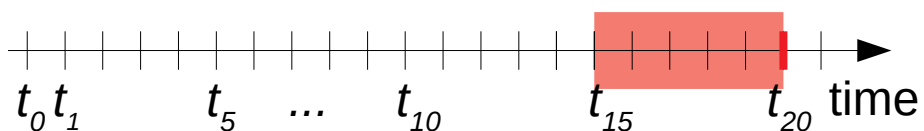
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    [],
    (e → e.getLabel()),
    [new MaxDuration()]);
```

### **Breaking news:**

Employees of oncology  
and surgery quarantined  
because of VirusX.



# Conclusion

- Distributed graph analysis system
- Temporal property graph model
  - Bitemporal support
  - Logical graphs and graph collections
  - Composing operators and algorithms
- Declarative workflow creation
  
- Visit Gradoop: <http://gradoop.com>
- Read our Wiki: <https://github.com/dbs-leipzig/gradoop/wiki>
- Start: <https://github.com/dbs-leipzig/gradoop/wiki/Getting-started>
- Try the examples: <https://github.com/dbs-leipzig/gradoop/wiki/Examples>