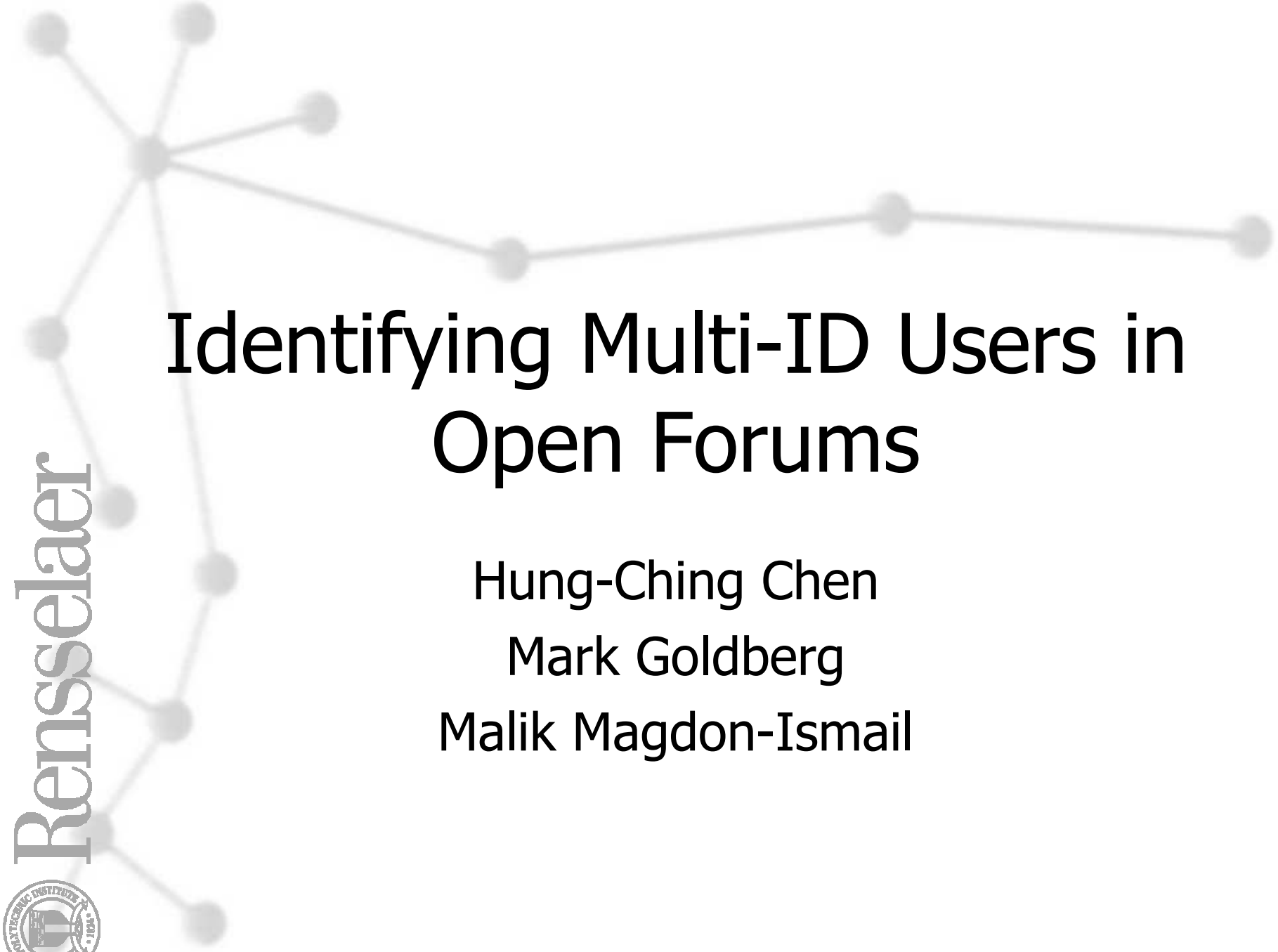


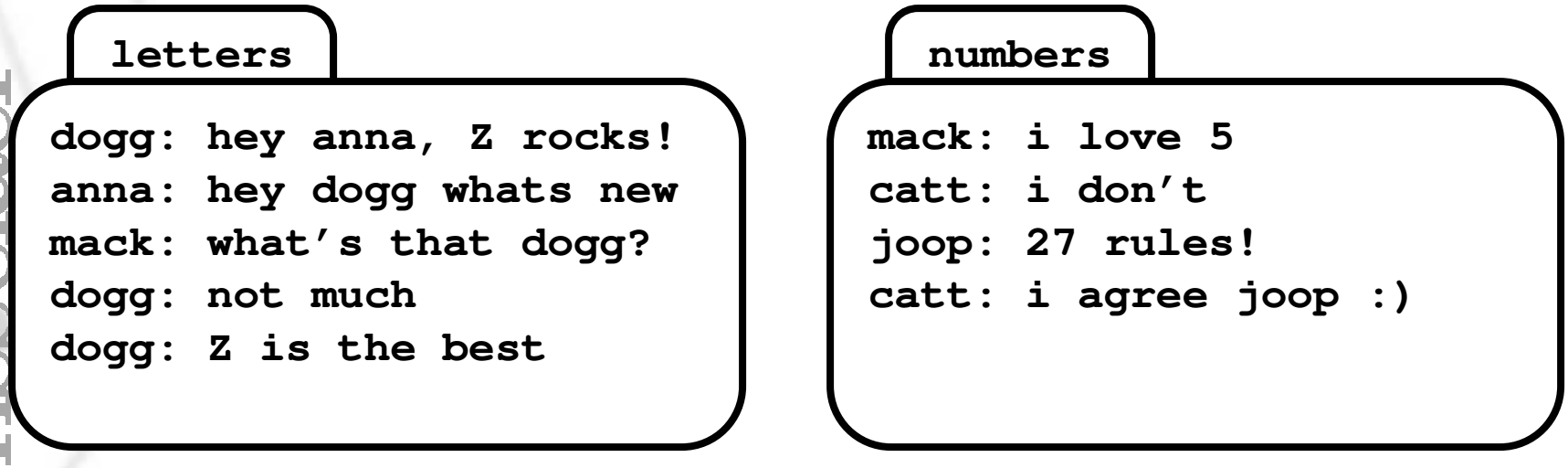
Identifying Multi-ID Users in Open Forums

Hung-Ching Chen
Mark Goldberg
Malik Magdon-Ismail

Rensselaer

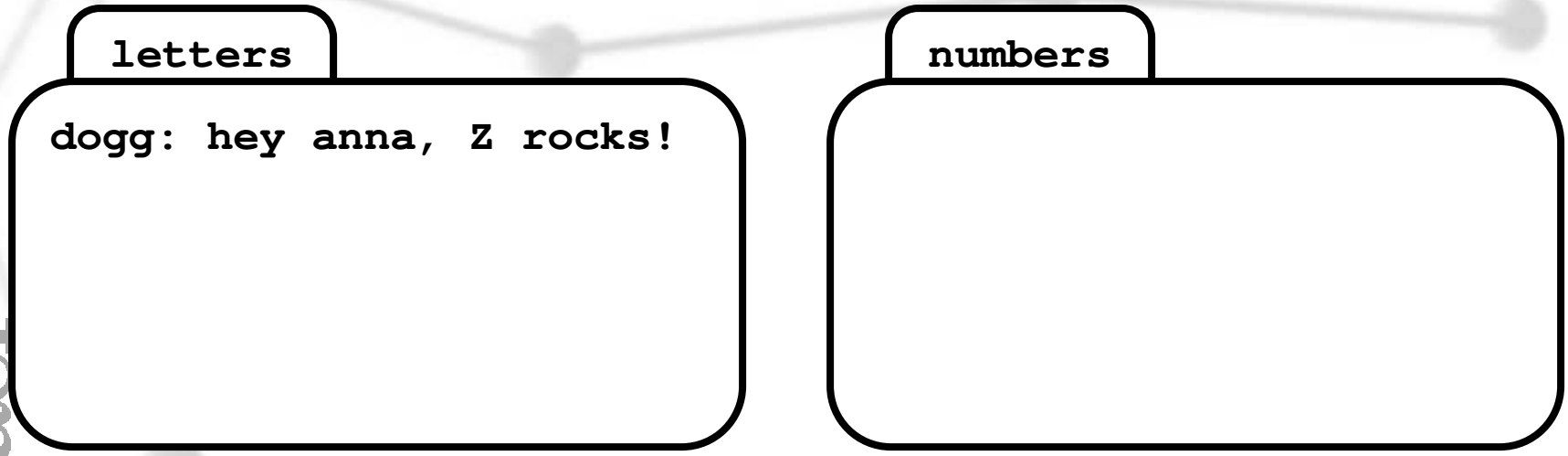
Who is Using Multiple IDs?

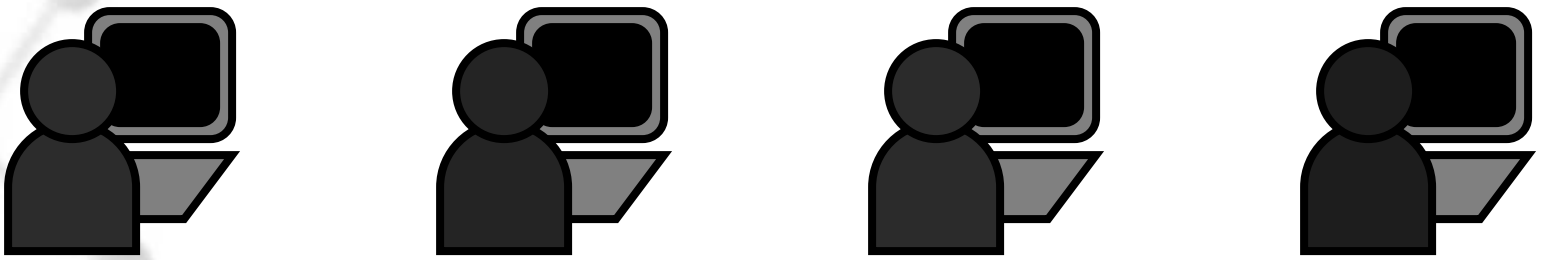
Consider two chatrooms, “letters” and “numbers”



Rensselaer

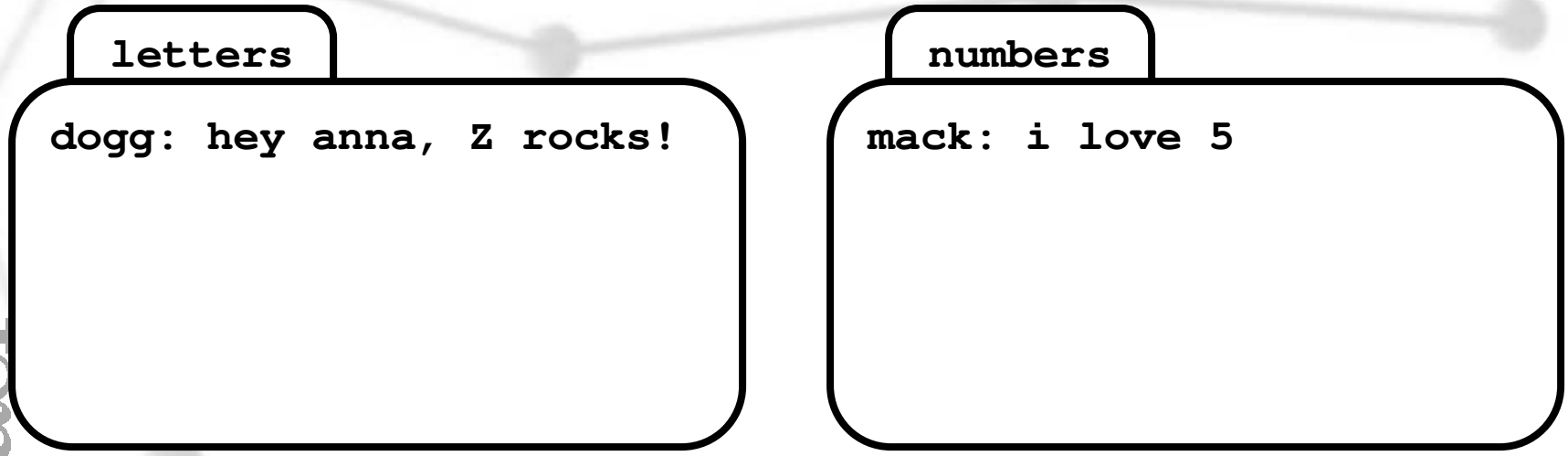
Multi-ID Users

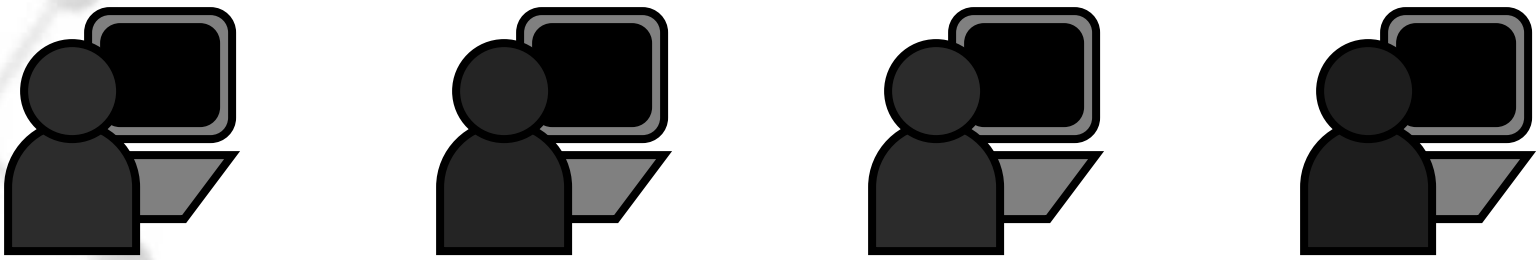




Rensselaer

Multi-ID Users





Rensselaer

Multi-ID Users

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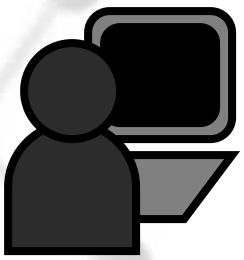

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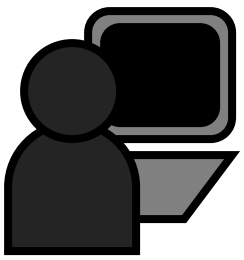
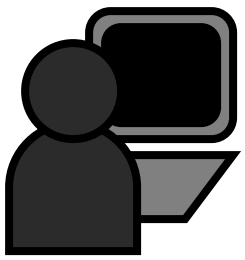
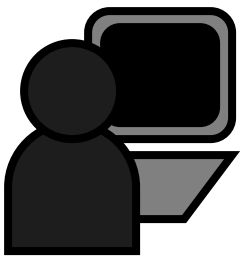


mack



dogg/catt



joop

Rensselaer

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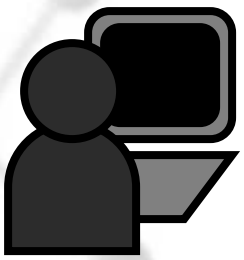

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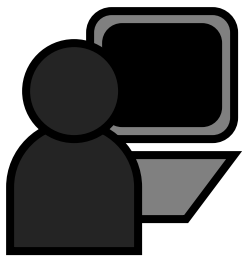

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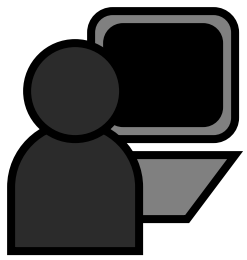

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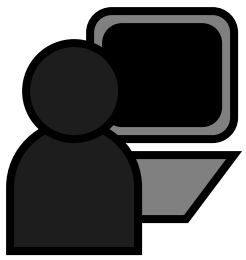

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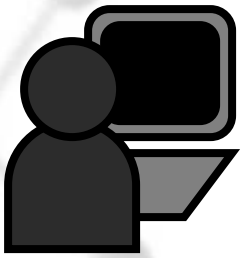

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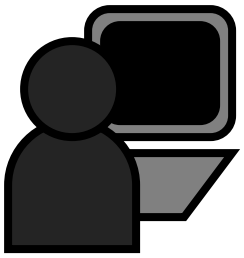

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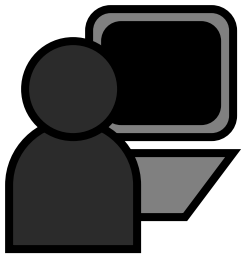

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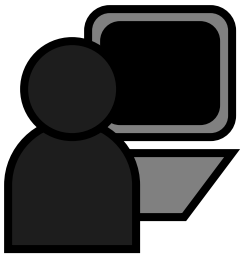

joop

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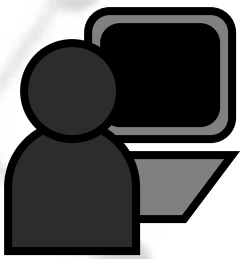

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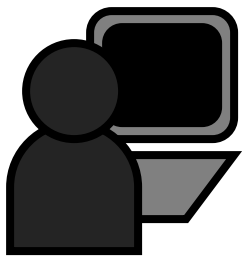

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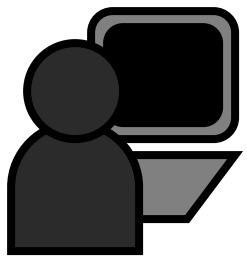

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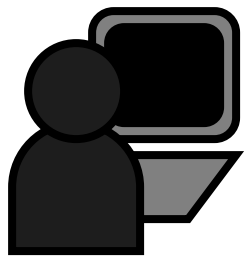

joop

Rensselaer

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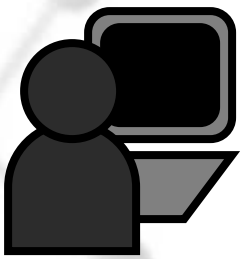

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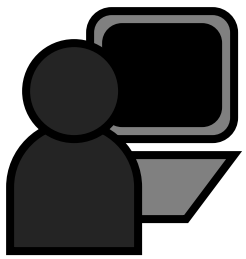

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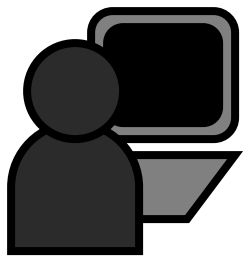

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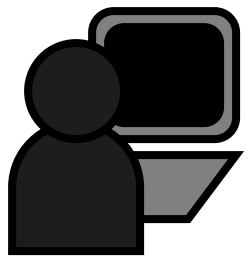

joop

Rensselaer

Multi-ID Users

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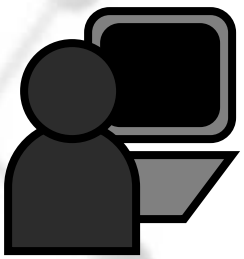

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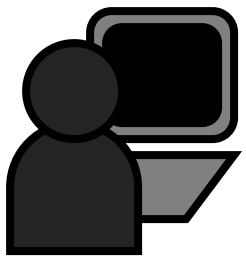

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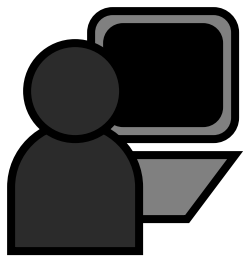

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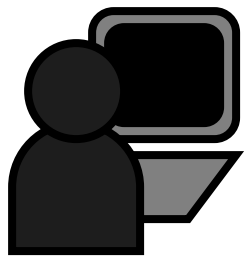

joop

Rensselaer

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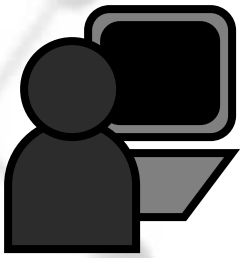

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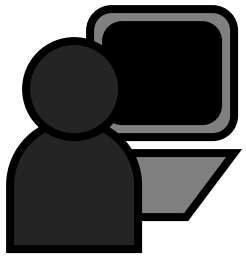

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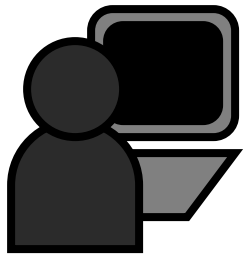

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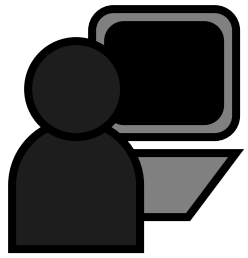

joop

Rensselaer

Overview

- A model of a public forum
- Two efficient statistics-based algorithms for identification of multi-ID users
- Simulation results

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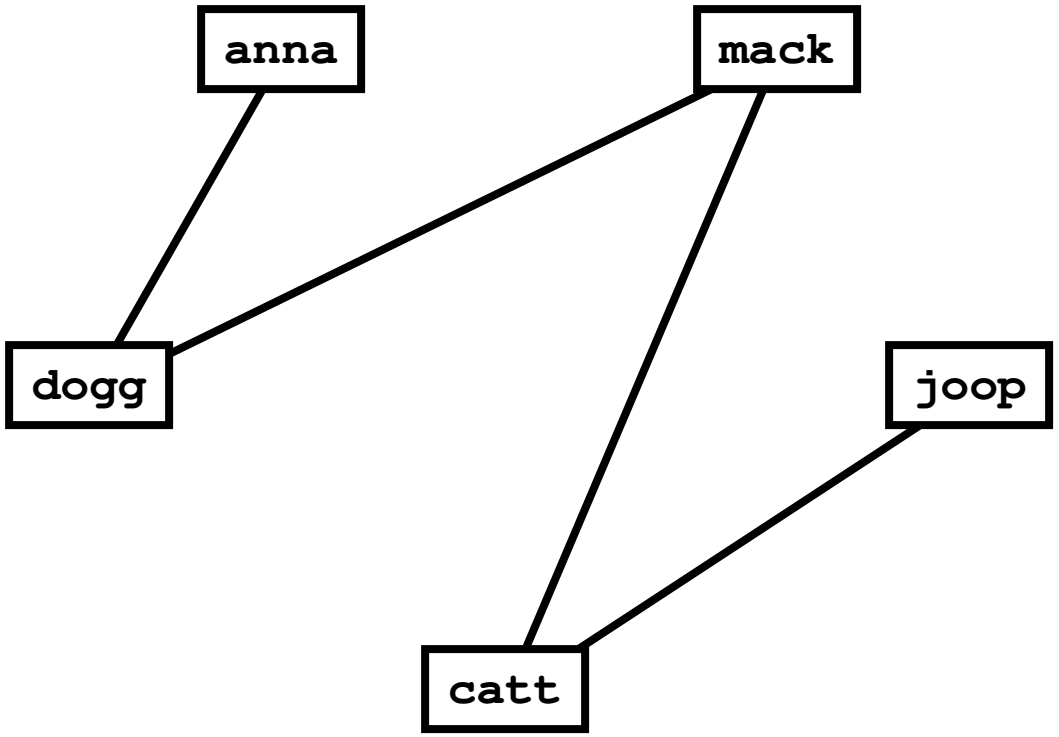
A Model of a Public Forum

- Every actor has one response queue
- Common average and variance of response delay
- The server has a queue to process messages with very short delay

Model Friendship Graph



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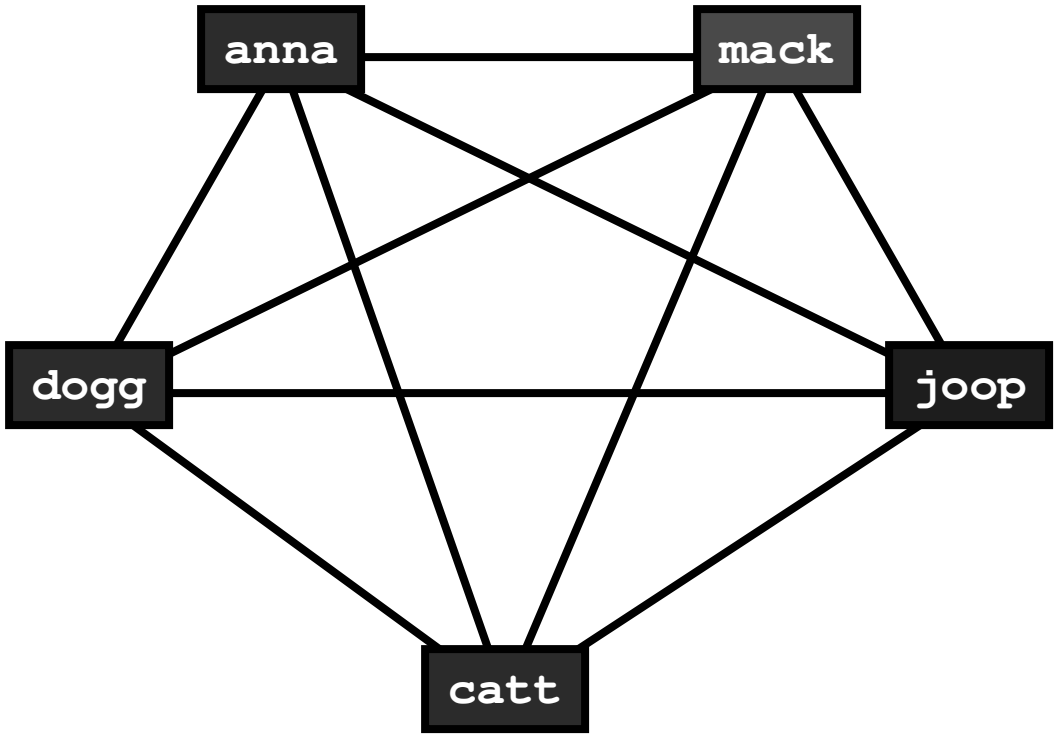
Model Alias Graph



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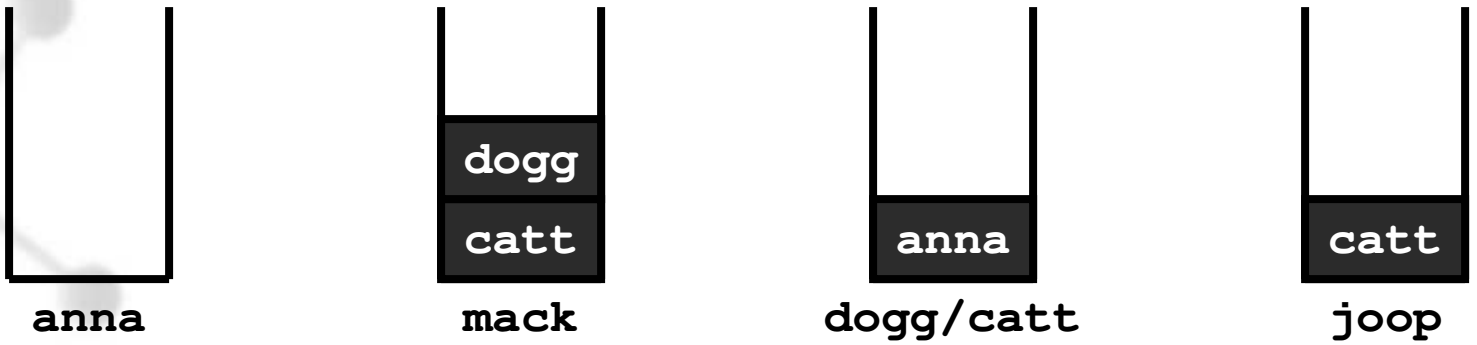
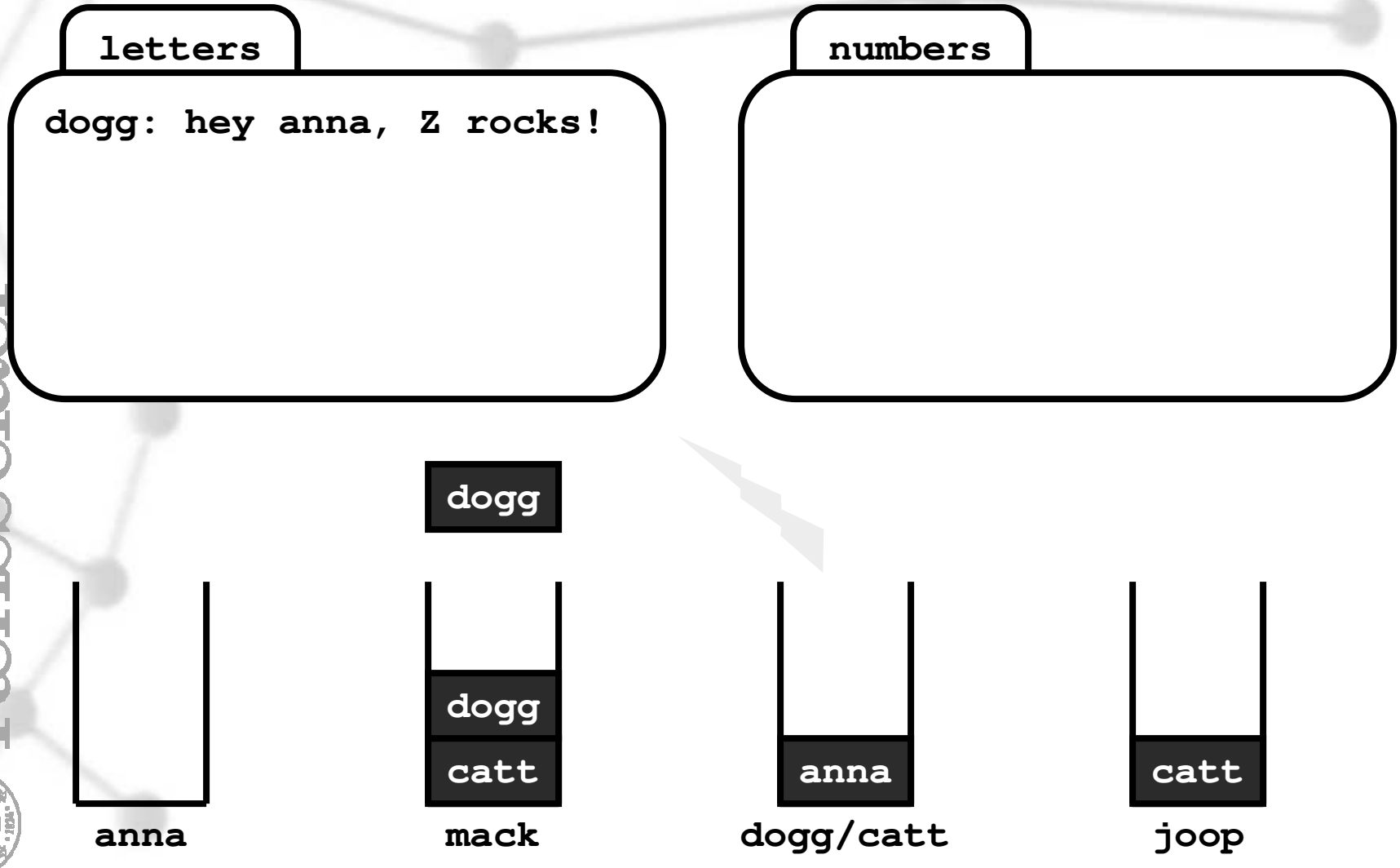
Multi-ID Users

- One response queue for each actor



Multi-ID Users



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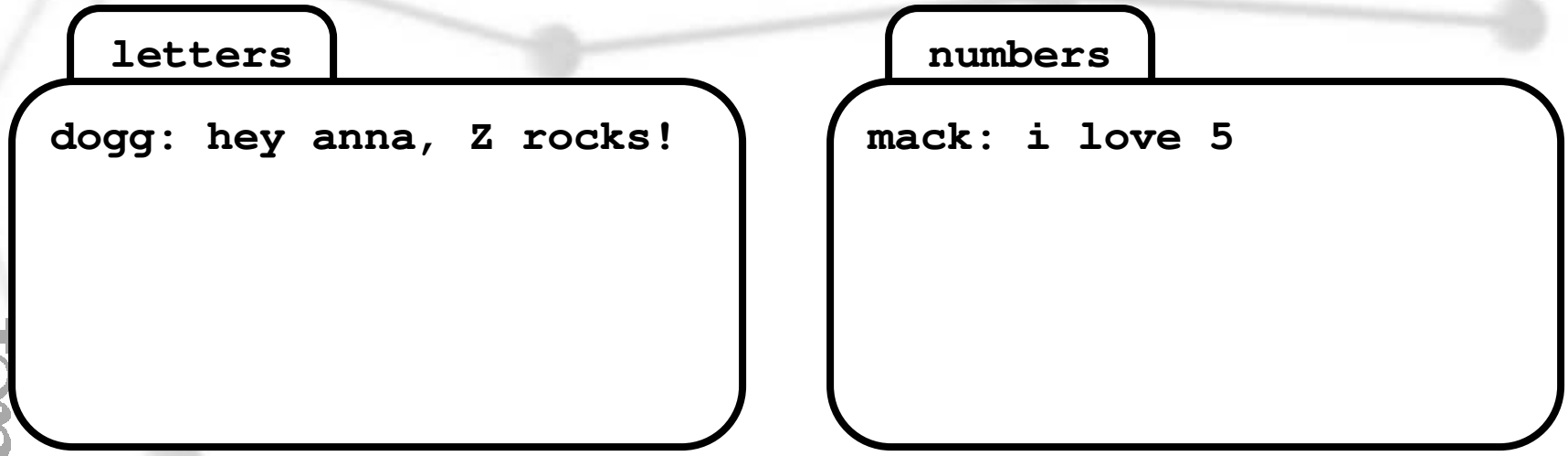

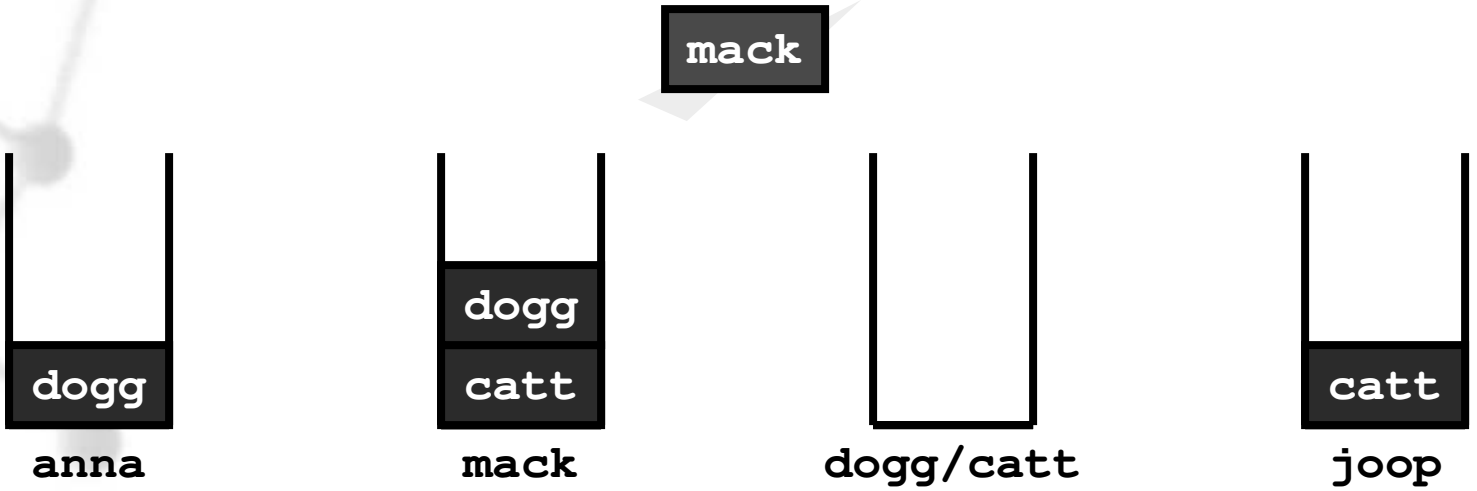

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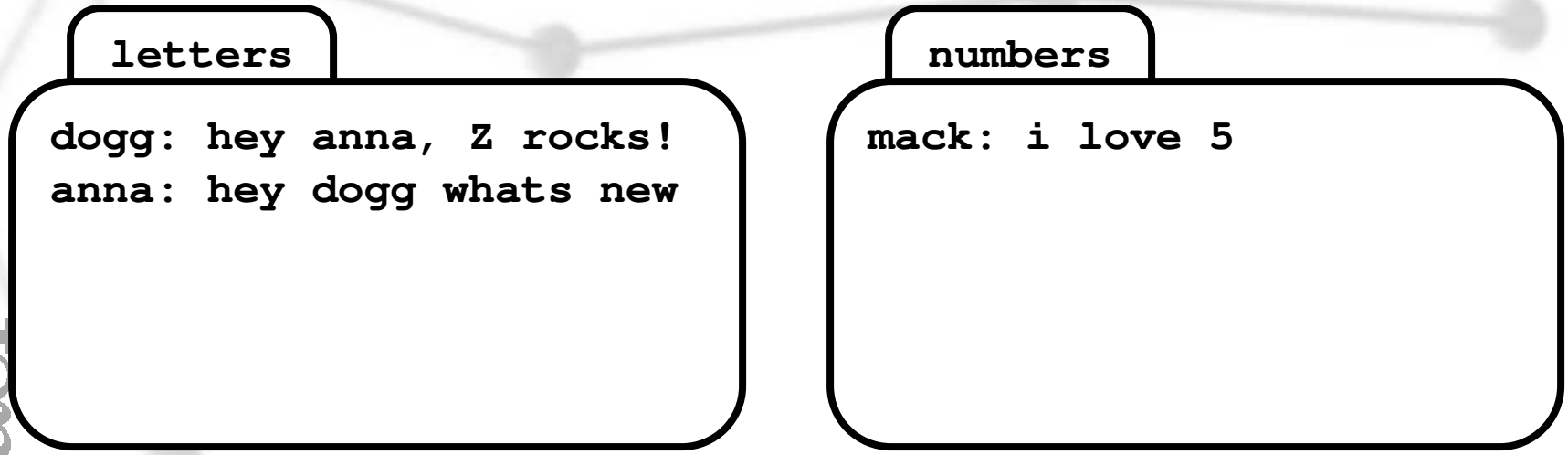
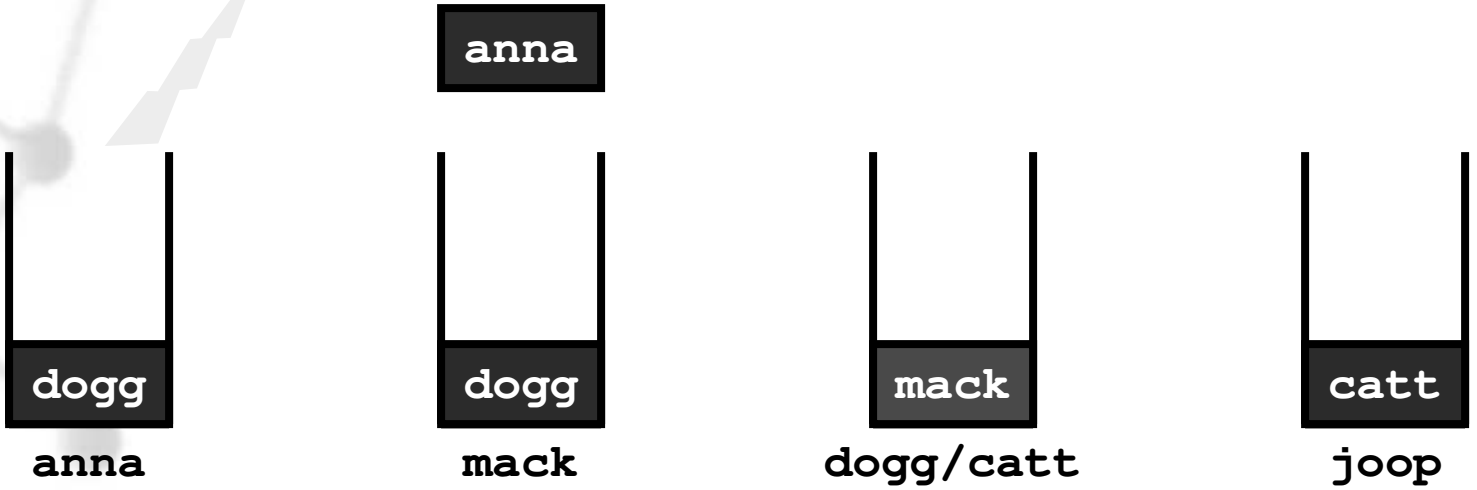
Multi-ID Users





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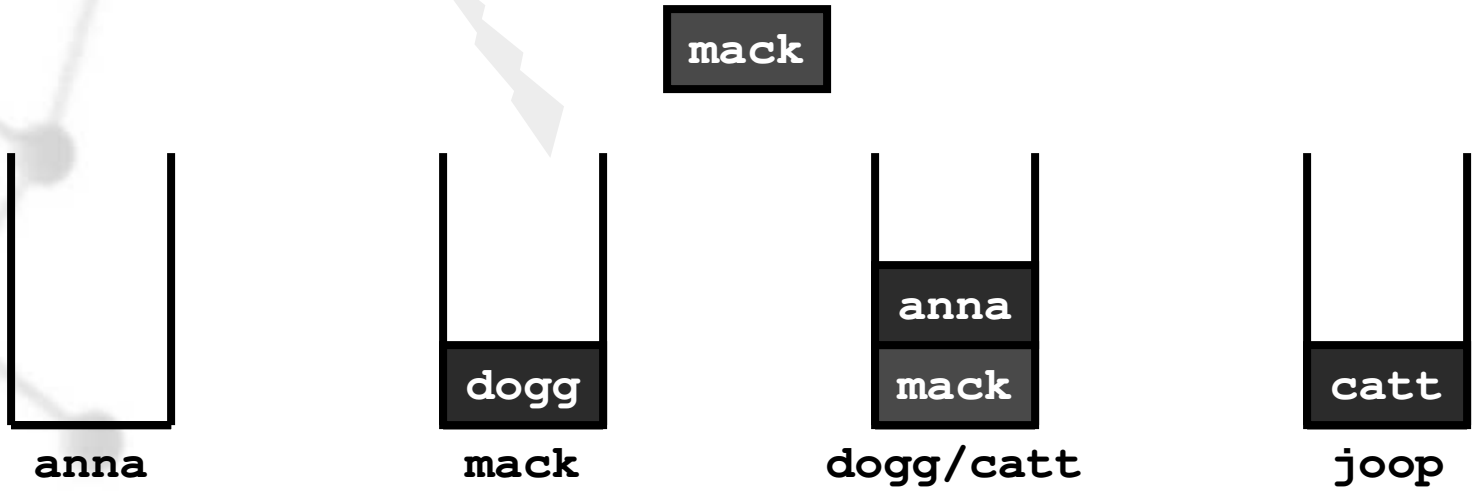

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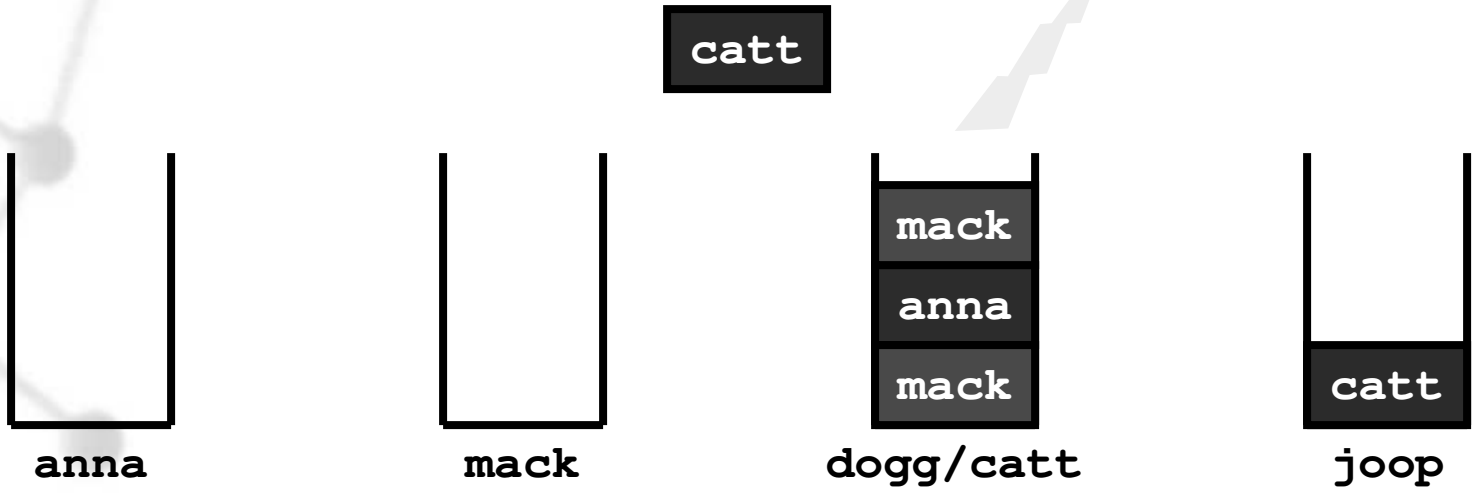

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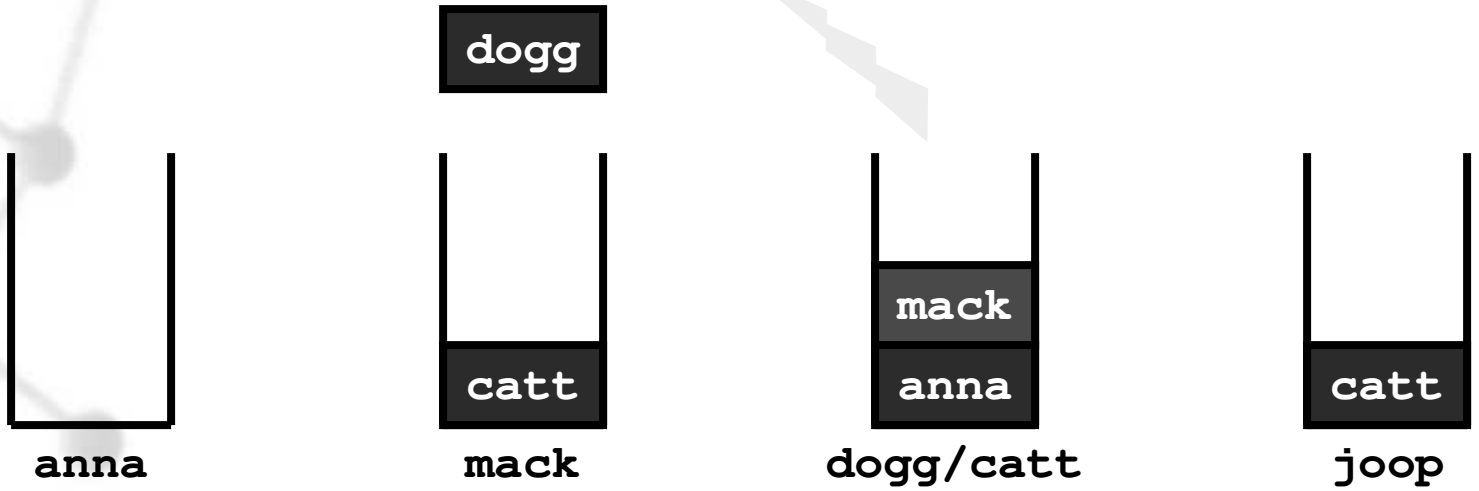

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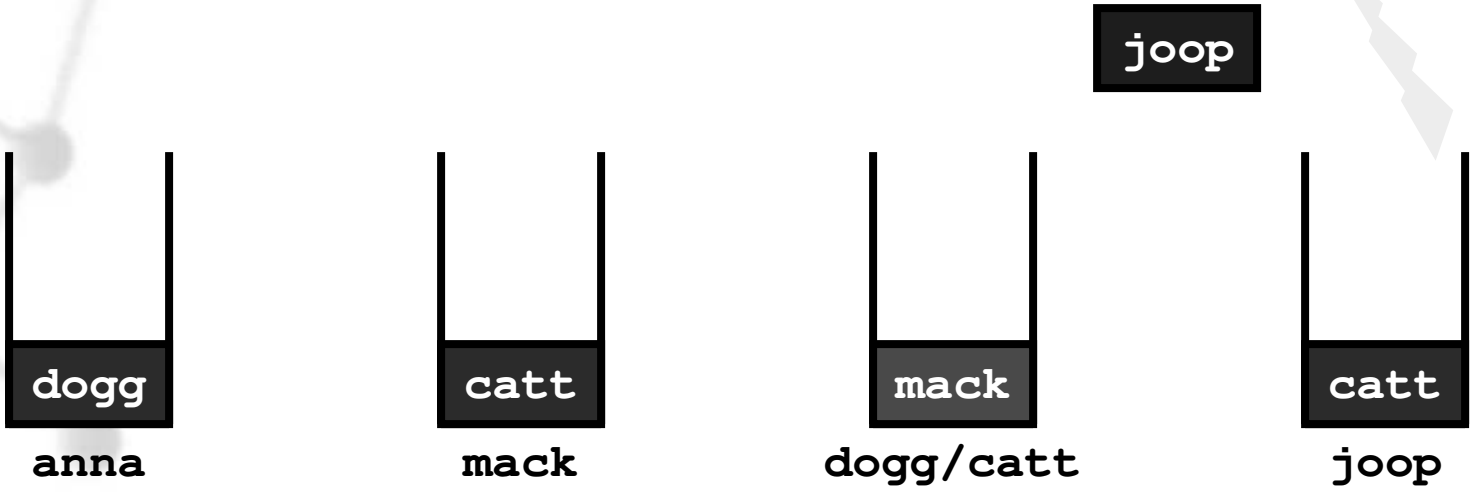

Rensselaer

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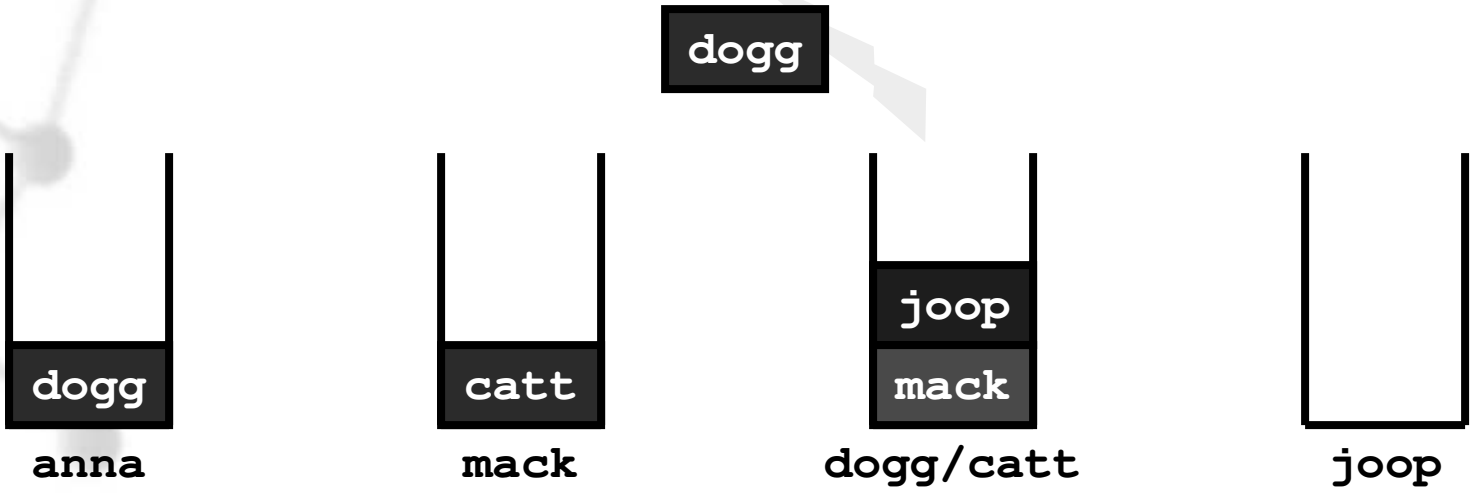

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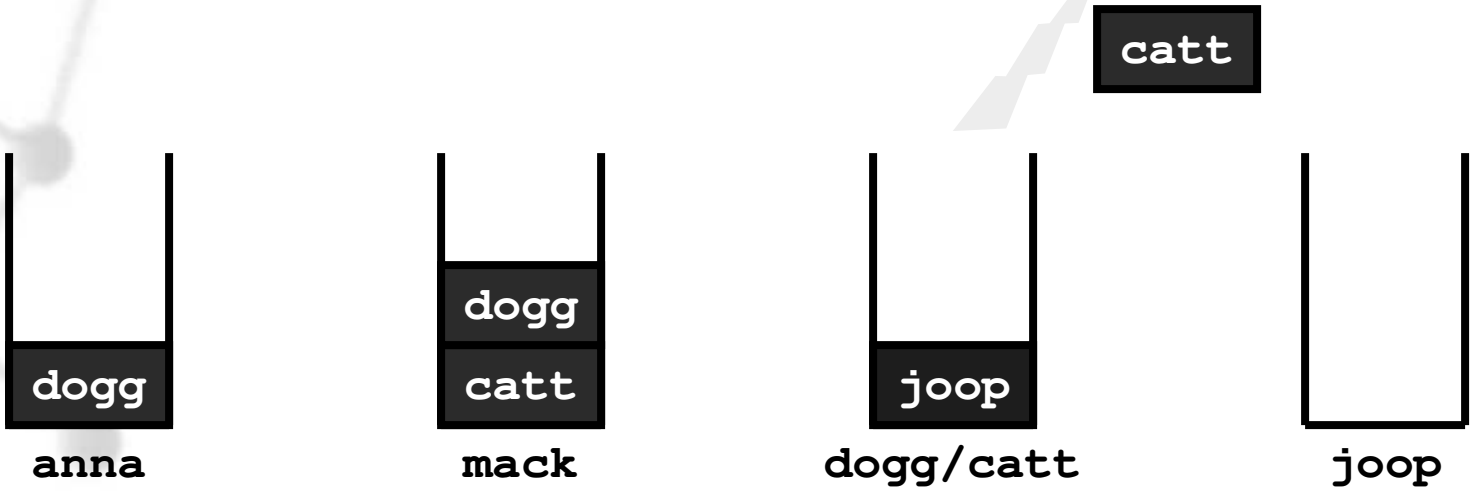

Rensselaer

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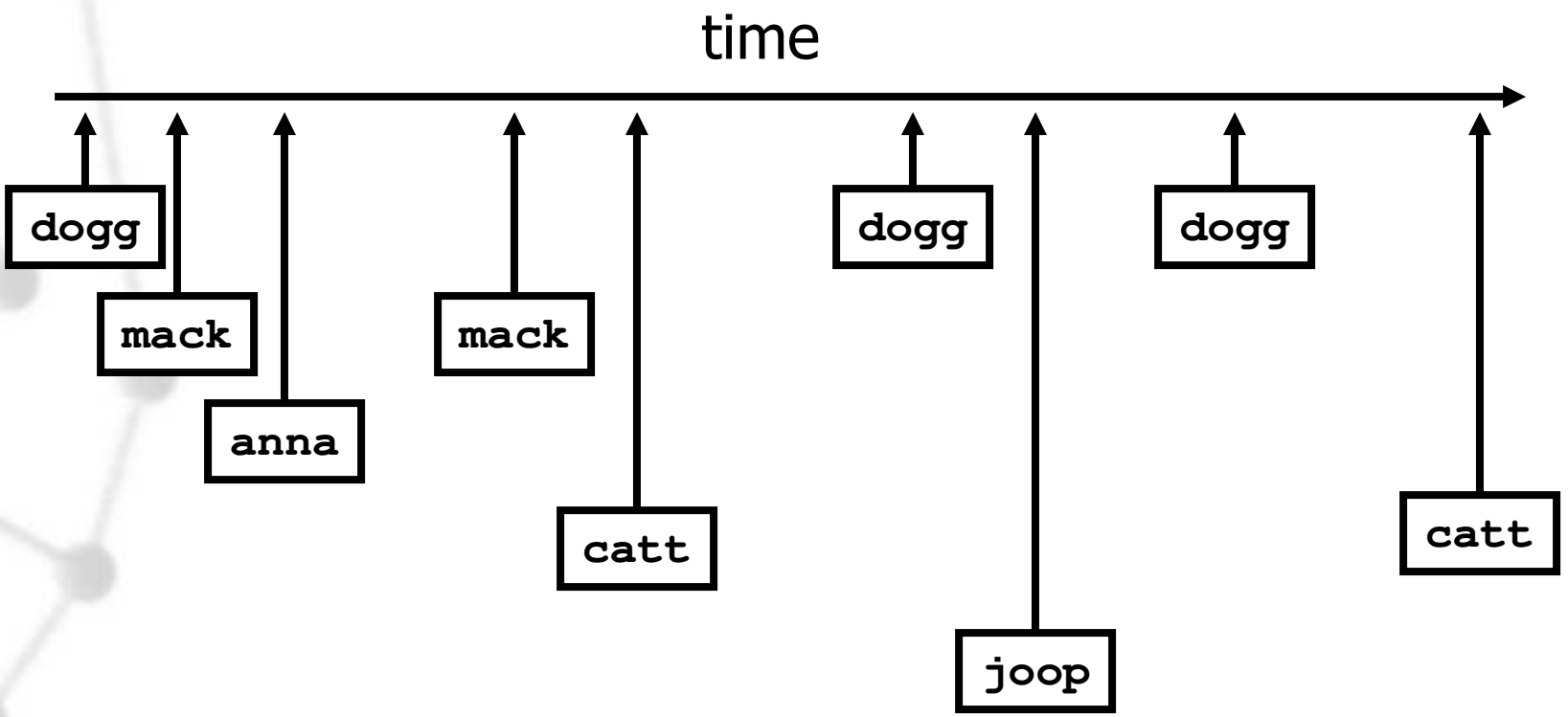
First Algorithm

1. Collect information $\{\langle time_i, ID_i \rangle\}$
2. Compute minimum time delay minD for every pair of IDs
3. Cluster the delays using k-means into two groups.
   - Call pairs with larger center suspected to be the same actor (red)
   - Call pairs with smaller center suspected to different (blue)
4. Connected components using red edges are ID groups representing one actor

1. Collect information



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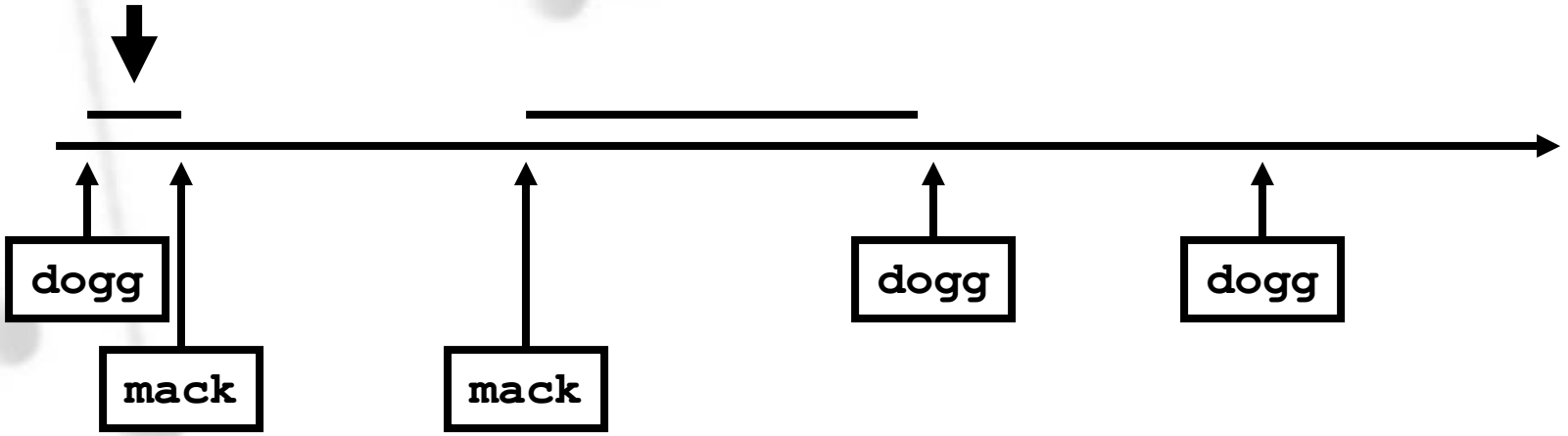
2. minD(dogg, mack)



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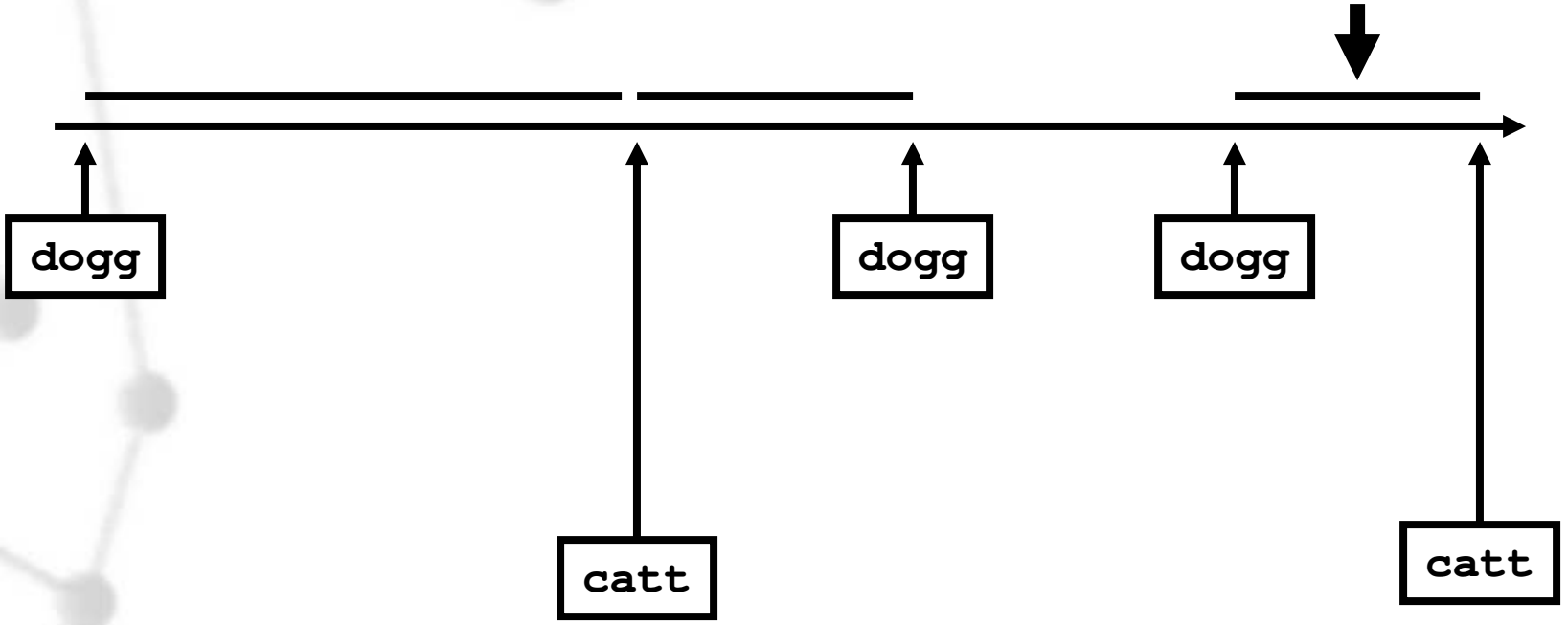
2. minD(dogg, catt)



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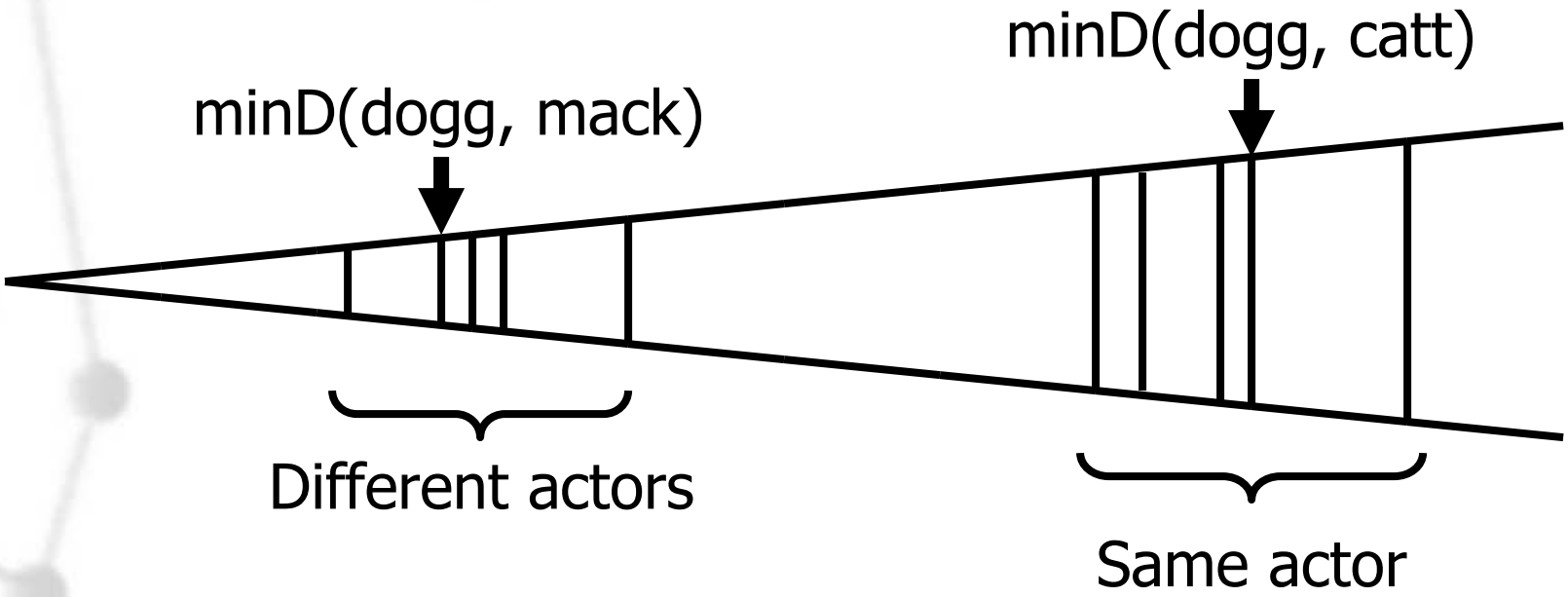
3. Cluster minD values



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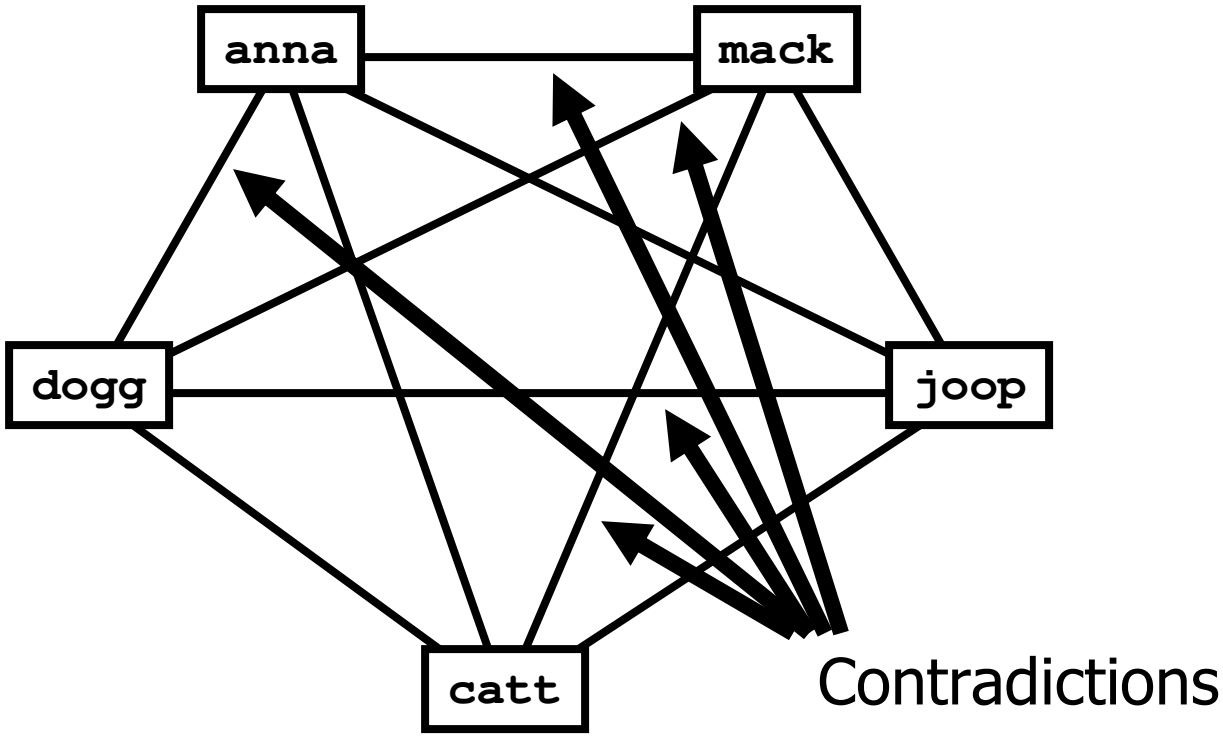
3. Resulting Alias Graph



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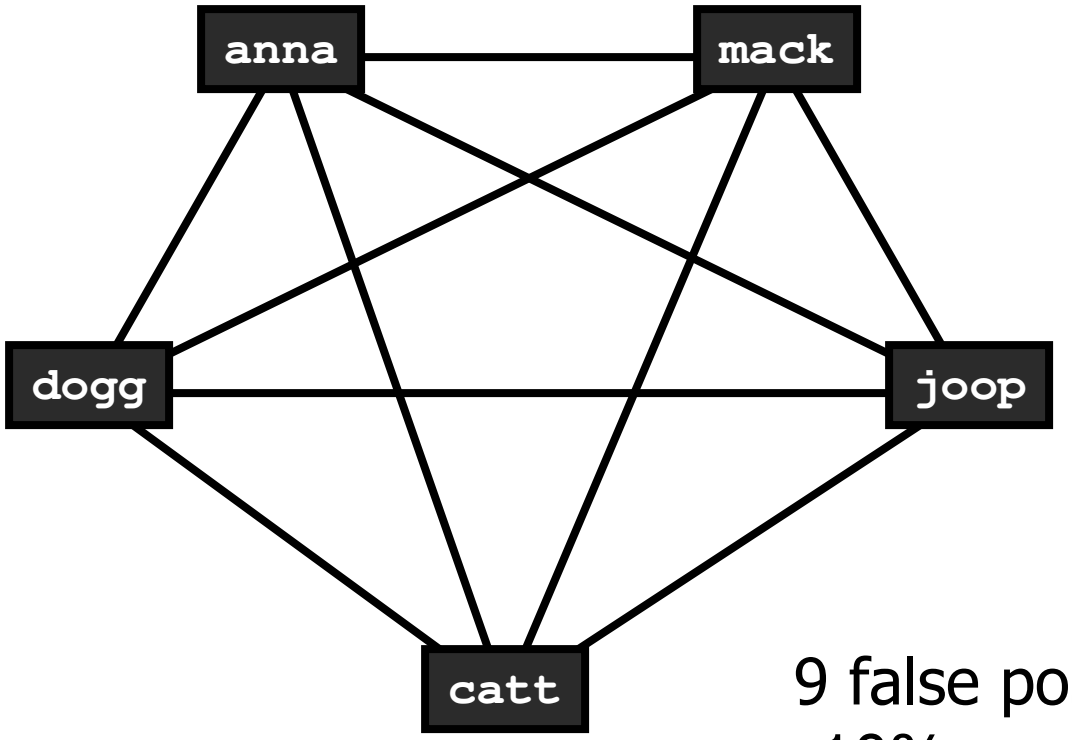
4. One Red Component

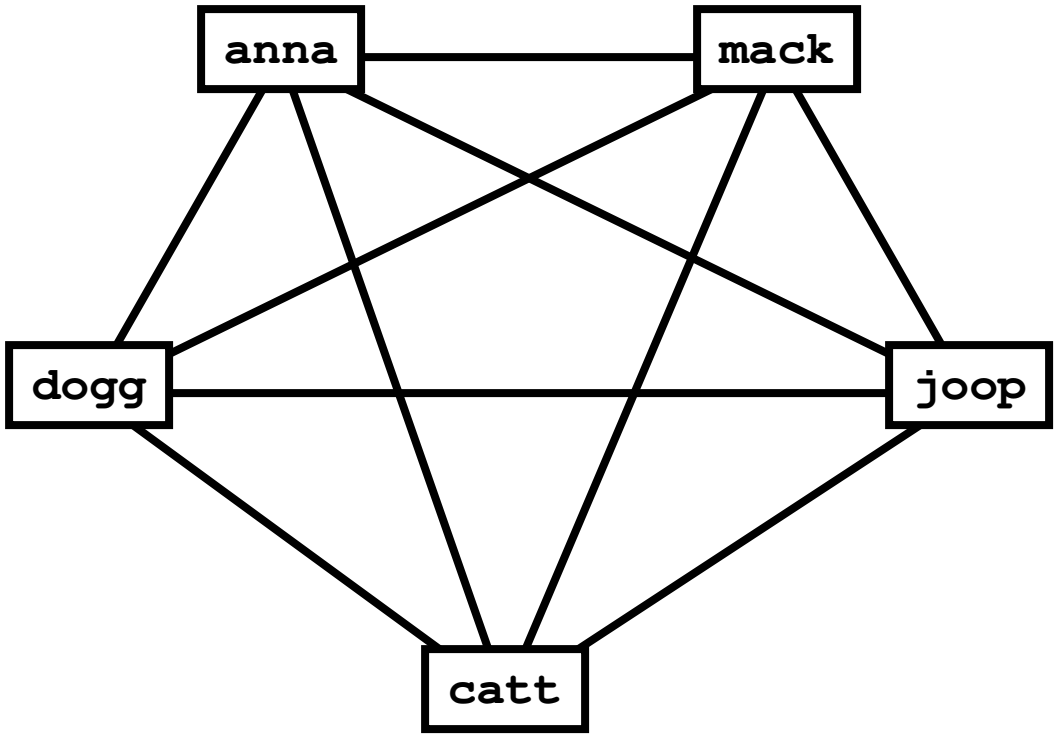


9 false positives
10% accuracy

Refinement Algorithm

1.
2. } Follow original algorithm
3.
4. Find groups connected with red edges
5. Color IDs into smaller ID groups using blue edges

4. One Red Component



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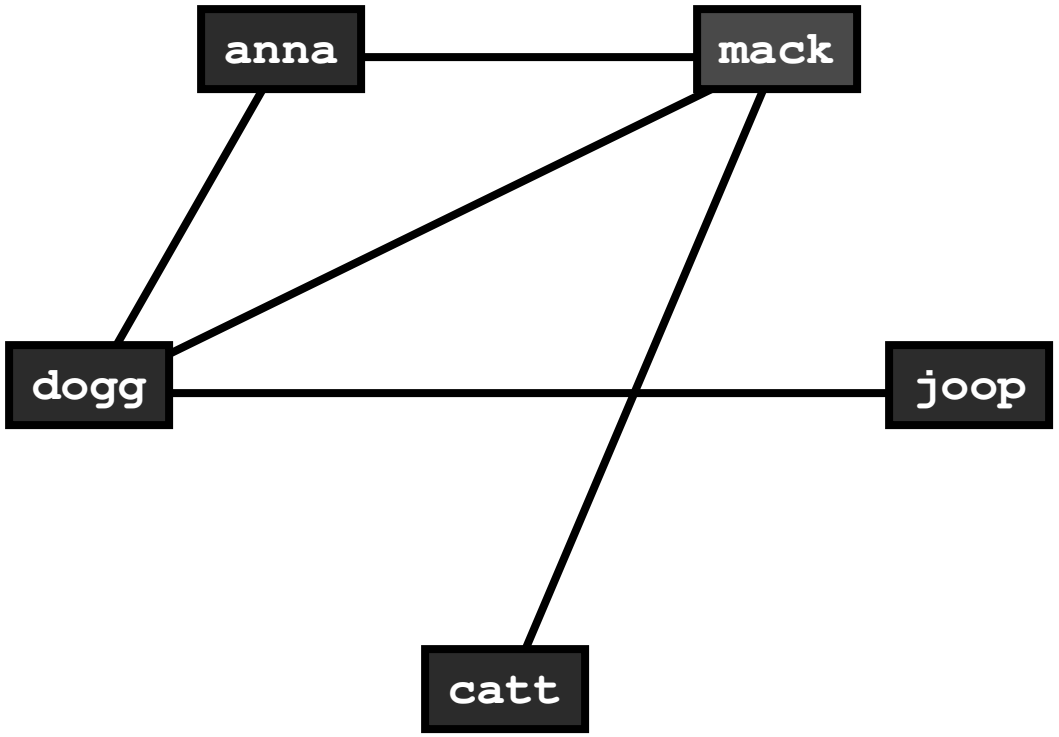
5. Color Blue Graph



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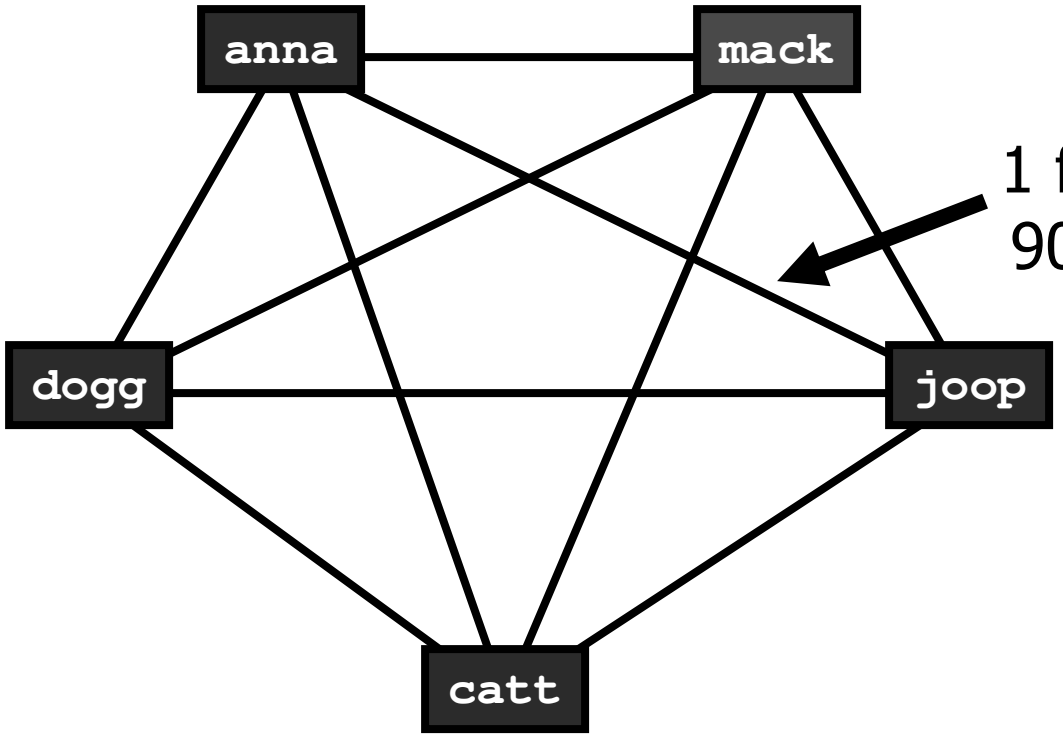
5. Color Blue Graph



1 false positive
90% accuracy

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Overview

- A model of a public forum
- Two efficient statistics-based algorithms for identification of multi-ID users
- Simulation results

Simulation results

The average number of messages per pair	Accuracy without coloring (%)	Accuracy with coloring (%)
0.513	70.2797	70.9765
8.274	97.3140	97.3473
87.68	99.7762	99.7826
880.4	99.9995	99.9998

The dependence of Accuracy on the number of messages

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Future Work

- Real-life testing
- More sophisticated model
  - Different types of users
  - Short and overlapping online appearances
  - Length of posts
- Algorithm improvements
  - Statistical evaluation of the new models
  - Lexical and semantic analysis