Pagerank in Apache Flink

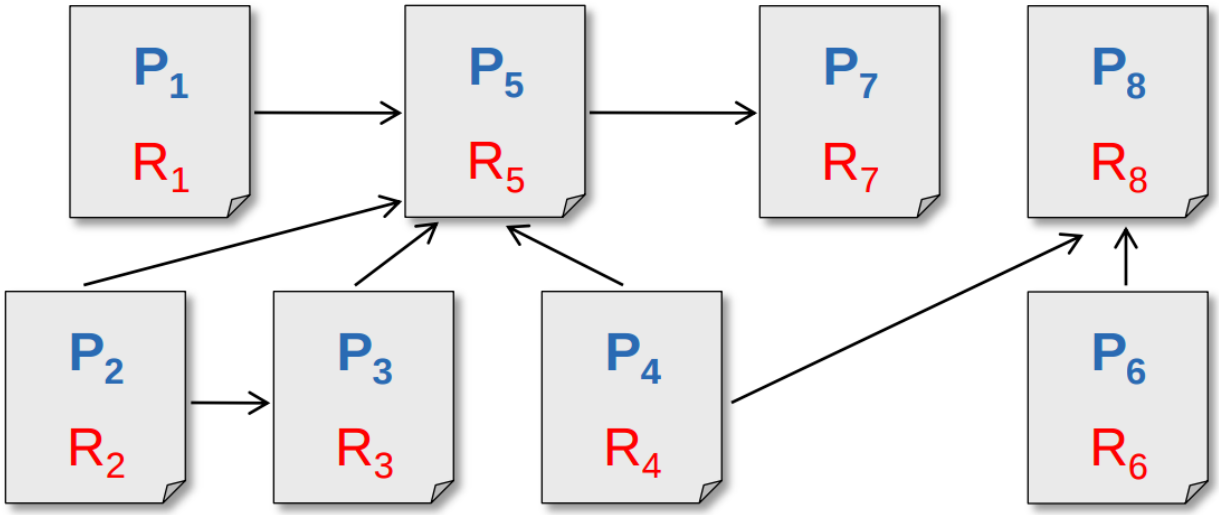
Author: Ward Schodts
Supervisor: Juan Soto

Datenbanksysteme und Informationsmanagement
Technische Universität Berlin

July 8, 2016

Agenda

Pagerank



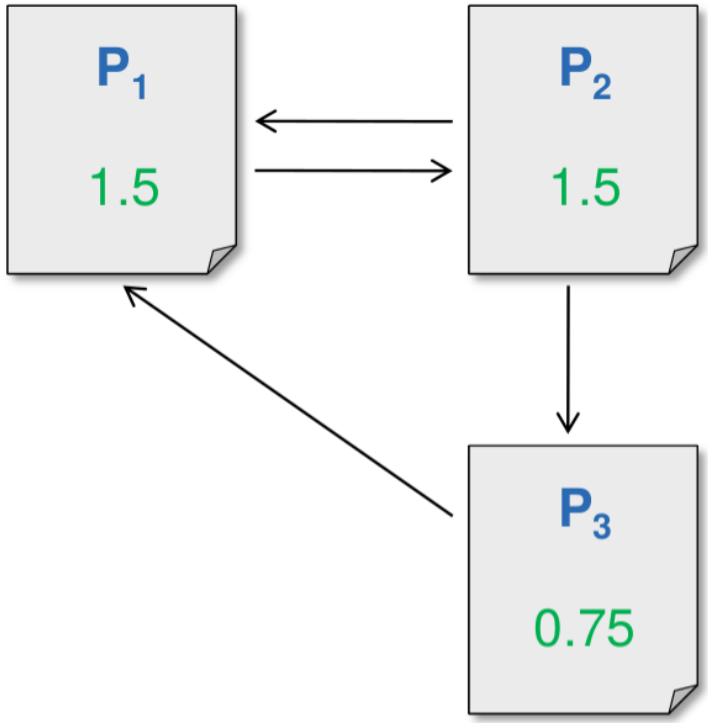
PageRank example 1 [6]

- A page has a high PageRank R if
  - there are many pages linking to it
  - or, if there are some pages with a high PageRank linking to it

Pagerank

$$R(P_i) = \sum_{P_j \in B_i} \frac{R(P_j)}{L_j}$$

- where
  - B_i is the set of pages that link to page P_i
  - L_j is the number of outgoing links for page P_j linking to it



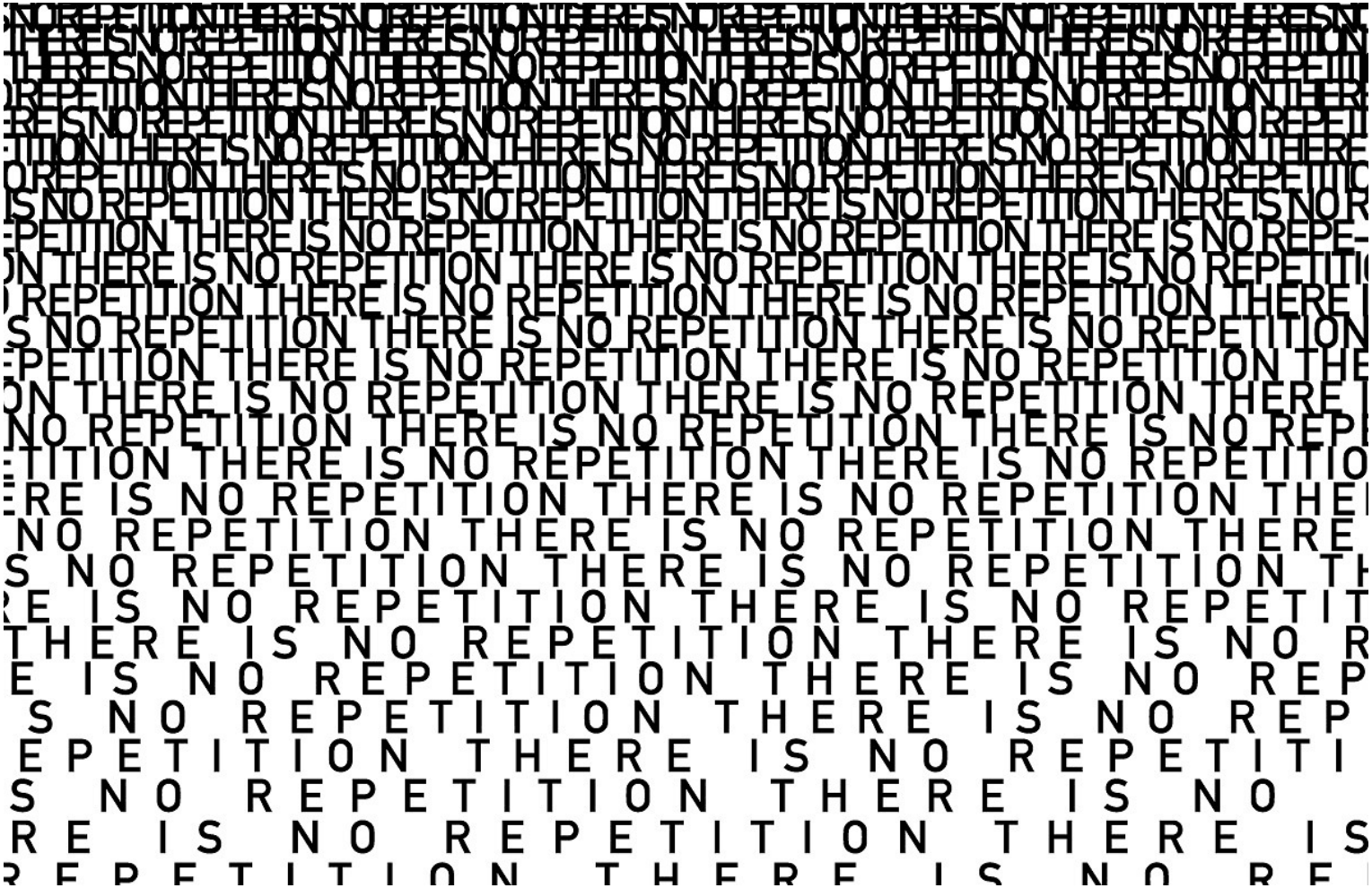
PageRank example 2 [6]

[3]

Apache Flink

- Open source framework for distributed Big Data Analytics
- Exploits:
  - data streaming
  - in-memory processing
  - iteration operators

  to improve performance
- Formerly Stratosphere (Flink means agile)
- Developped here at TUB

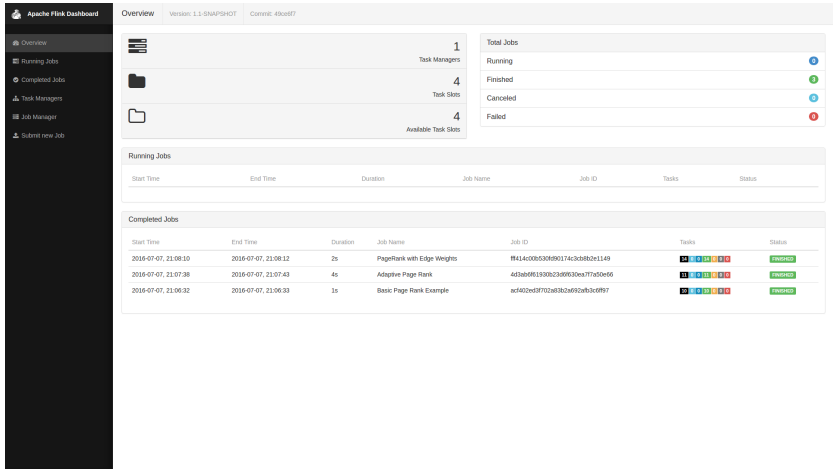


[7]

Apache Flink: 2 possible setups

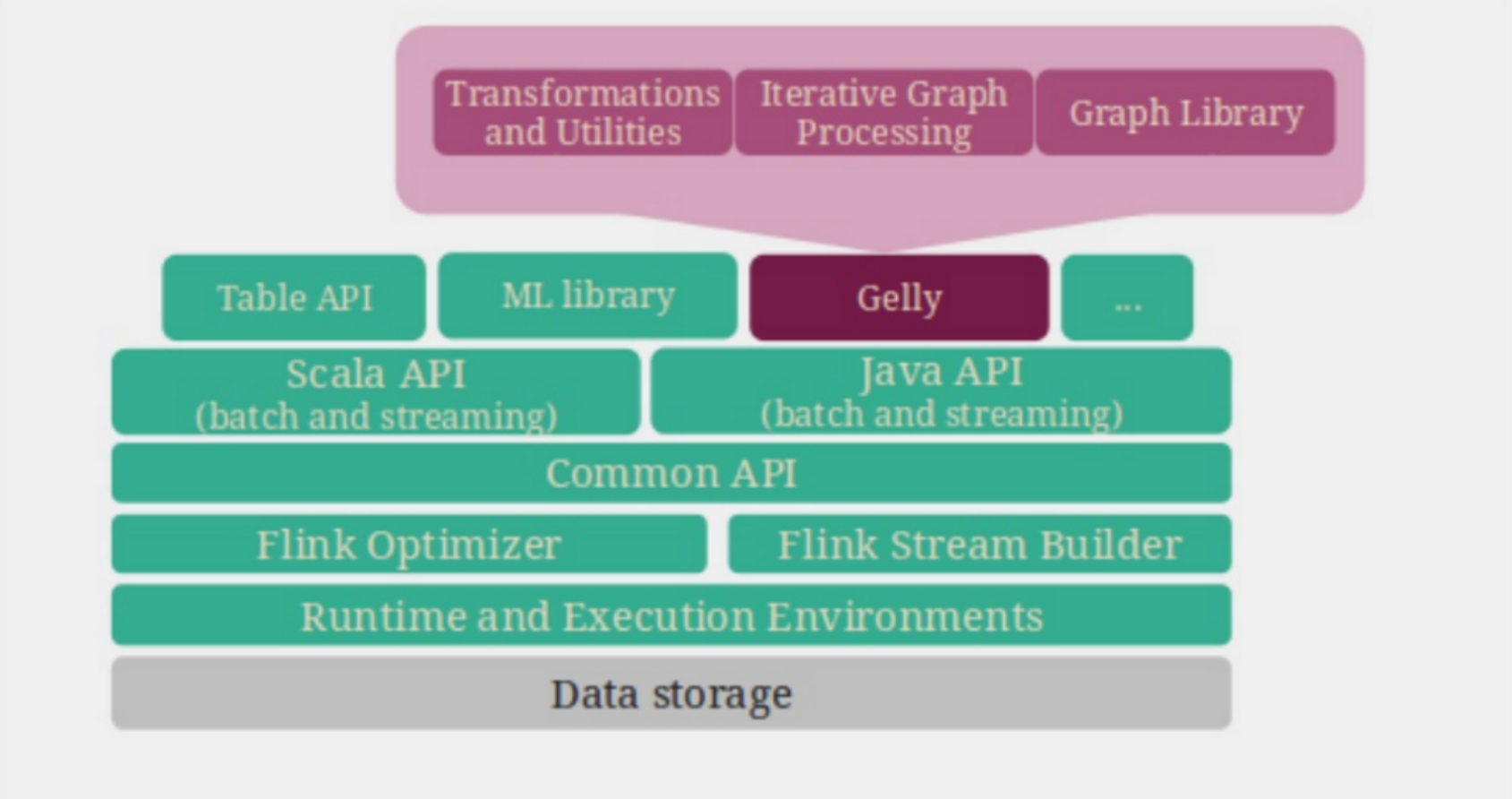
```xml
<dependencies>

    <dependency>
        <groupId>org.apache.flink</groupId>
        <artifactId>flink-java</artifactId>
        <version>${flink.version}</version>
    </dependency>


    <dependency>
        <groupId>org.apache.flink</groupId>
        <artifactId>flink-streaming-java_2.10</artifactId>
        <version>${flink.version}</version>
    </dependency>


    <dependency>
        <groupId>org.apache.flink</groupId>
        <artifactId>flink-gelly_2.10</artifactId>
        <version>${flink.version}</version>
    </dependency>

    <dependency>
        <groupId>org.apache.flink</groupId>
        <artifactId>flink-table_2.10</artifactId>
        <version>${flink.version}</version>
    </dependency>
```

Maven



Binary version (self compiled)

Apache Flink: Gelly



Gelly

Apache Flink: Gelly

- Large-scale graph processing API
- On top of Flink's Java API
- Off-the shelf library methods (e.g. pagerank)
- Iterative algorithms

Agenda

General experiment setup

Experiment 1:

1. Data file with graph (and pagerank solution)

   ⇓

2. Use Flink and Graphlab implemention to compute pagerank

   ⇓

3. Compare with solution

General experiment setup

Experiment 1:

1. Data file with graph (and pagerank solution)

   ⇓

2. Use Flink and Graphlab implemention to compute pagerank

   ⇓

3. Compare with solution

Experiment 2:

1. Data file with huge graph (no solution yet)

   ⇓

2. Use Flink and Graphlab implemention to compute pagerank

   ⇓

3. Compare with each other

Experiment 1 data

Data from a former Hadoop toolkit (Cloud9, now Bespin):

Name	# vertices	# edges
Small	93	195
Medium	316	430
Large	1458	3545

Experiment 2 data

Webgraph from `snap.stanford.edu/data/`

Name	# vertices	# edges
web-Google	875713	5105039

Agenda

Flink algorithm 1

dataArtisians logo, [1]

- An exercise from dataArtisians
- Uses the standard Gelly implementation
- # input nodes = # output nodes

Flink algorithm 2

dataArtisans

- A case study implementation from dataArtisians
- A custom implementation
- # input nodes = # output nodes

Flink algorithm 3

- An example from the Apache Flink repository
- A custom implementation
- # input nodes != # output nodes → filters

Turi pagerank algorithm

Turi logo, [8]

- Used the standard implementation
- Builds a graph out of the edges dataset

Agenda

Results

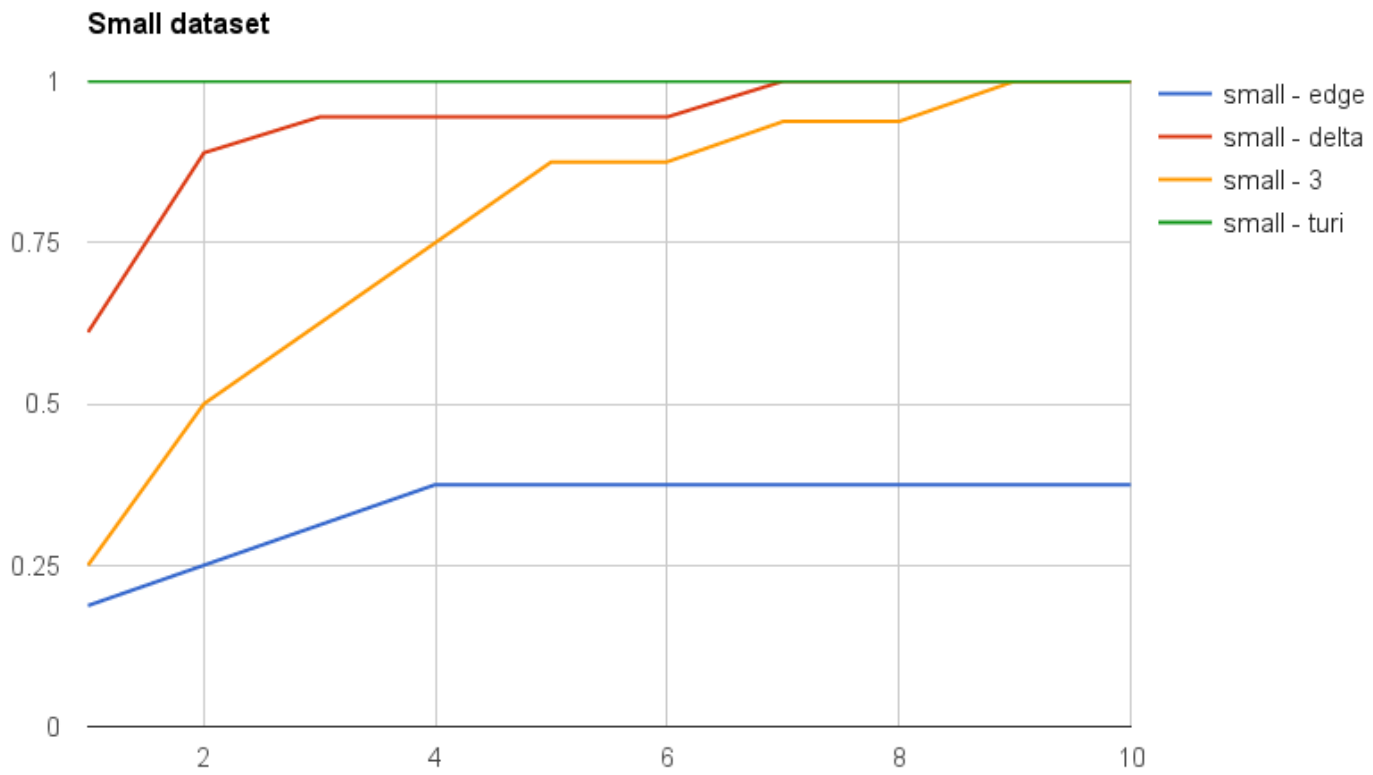
To compare I implemented a comparer that:

- could handle list of diffrence sizes,
- took care of equal pagerank values (they maybe sorted in different way),
- had a modifyable window to compare with.

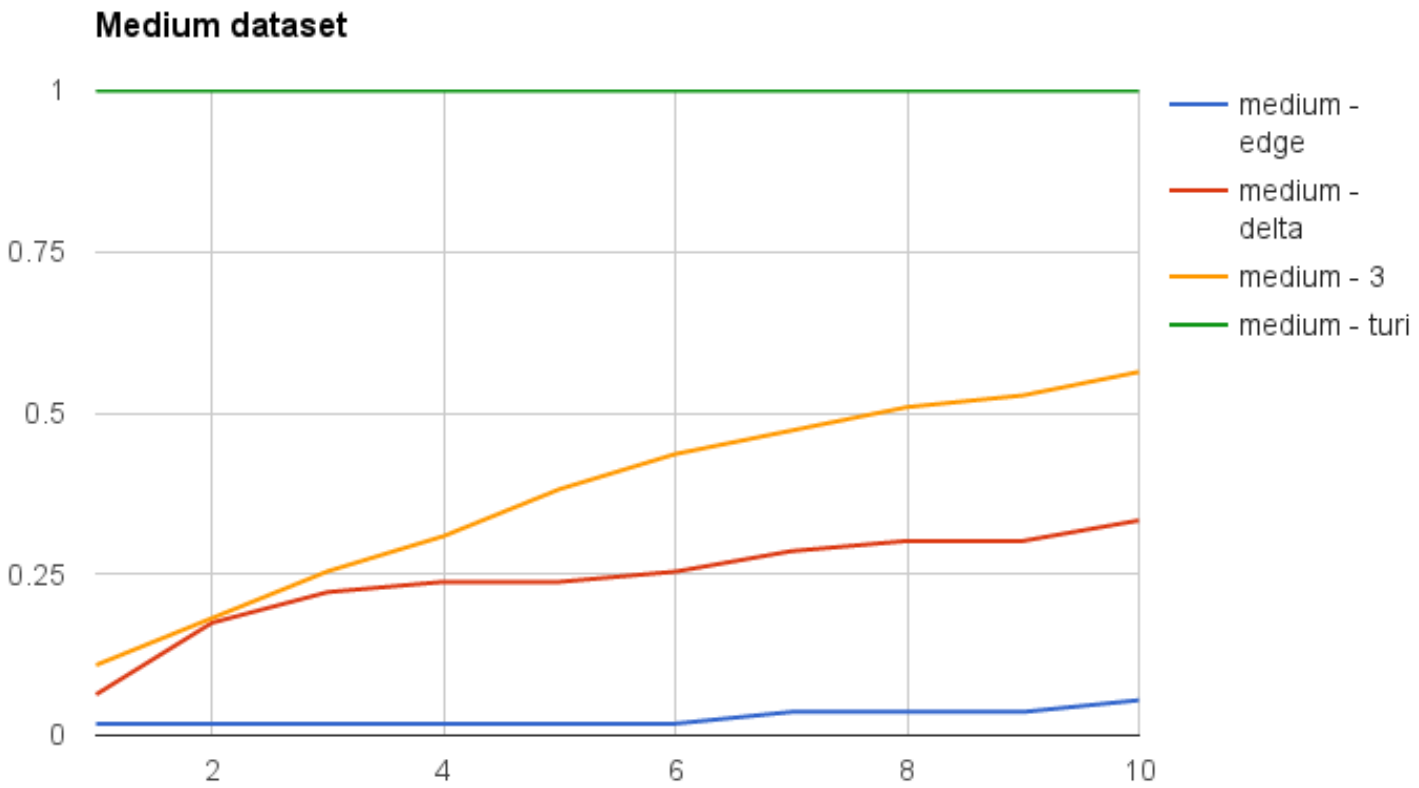
Results: experiment 1

Any expectations?

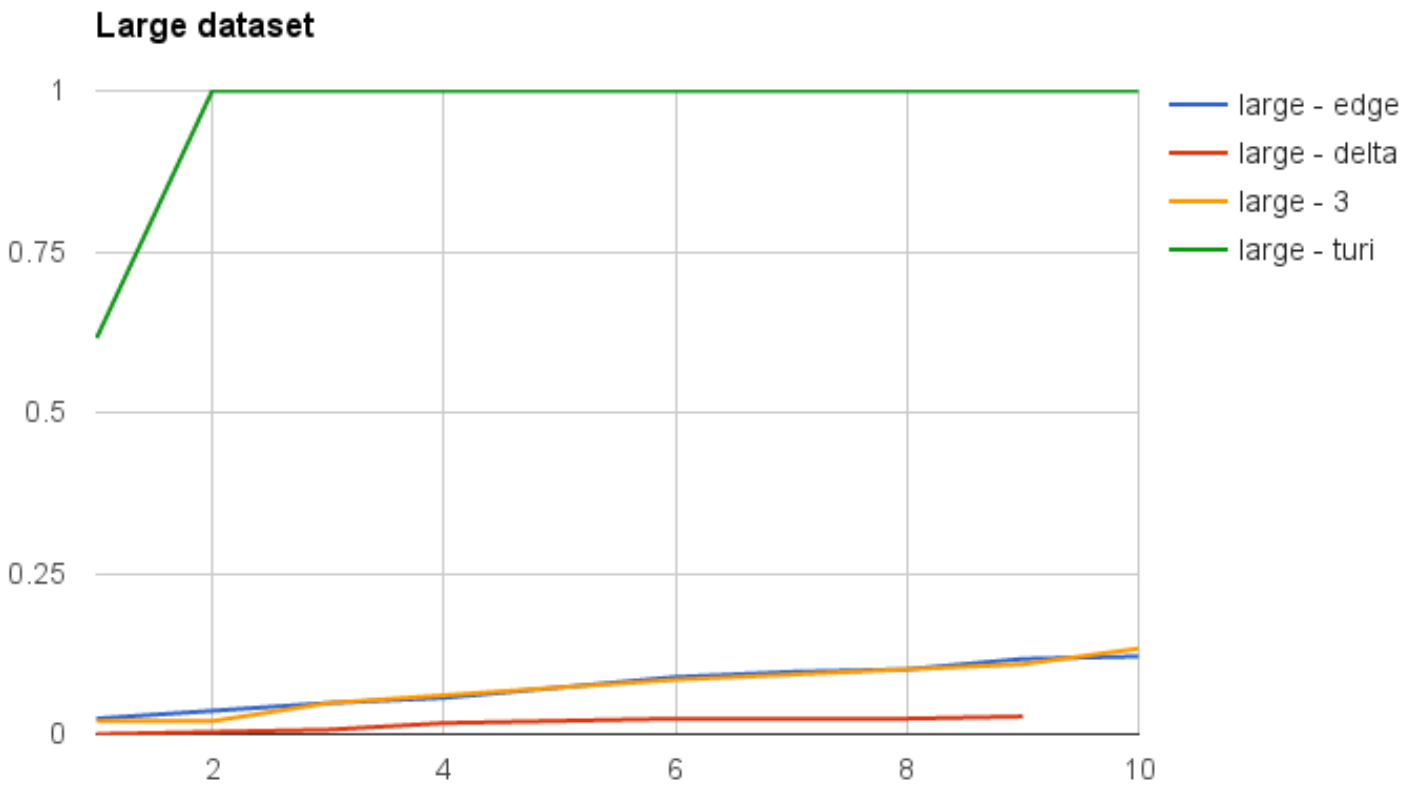
Results: experiment 1



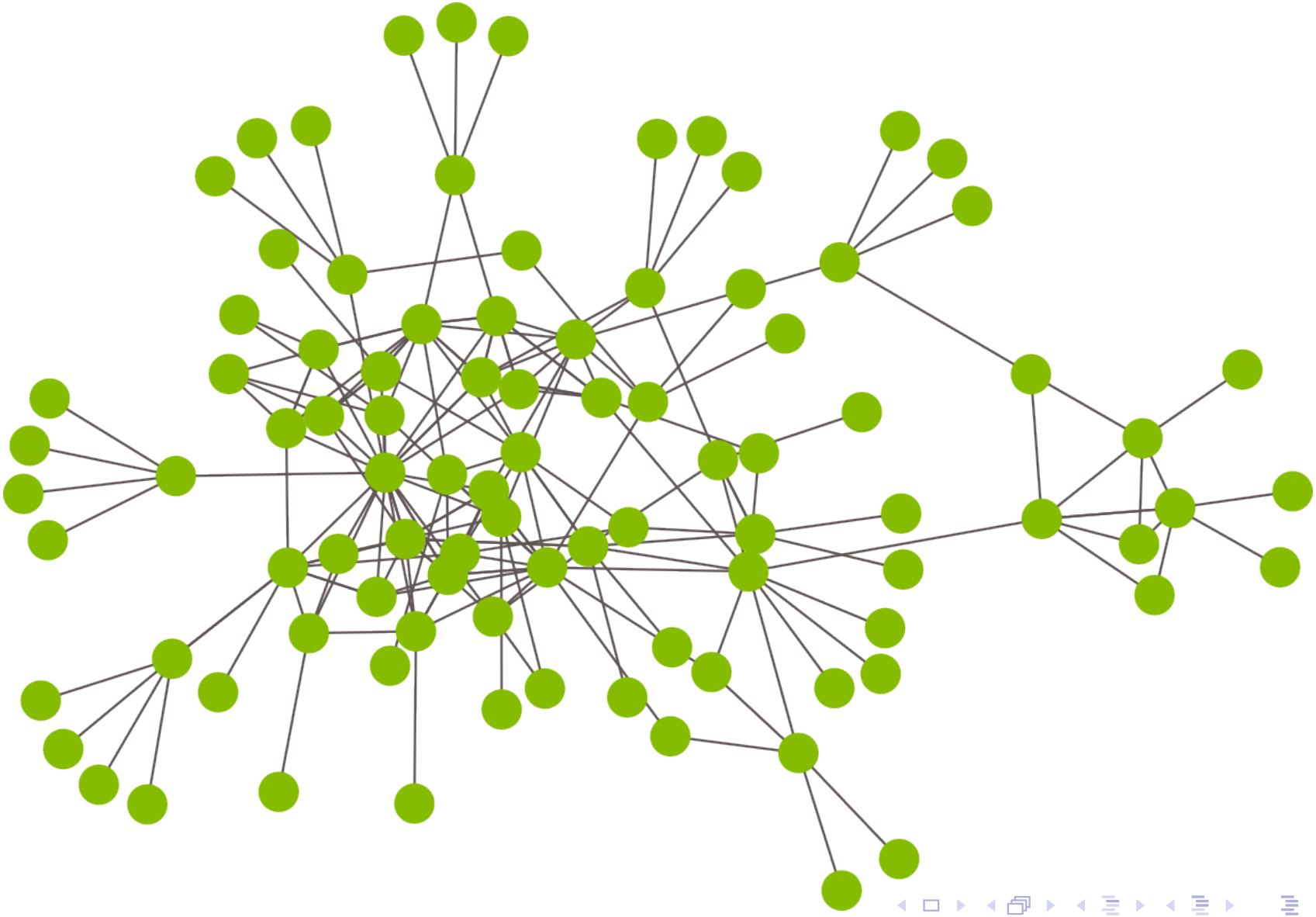
Results: experiment 1



Results: experiment 1

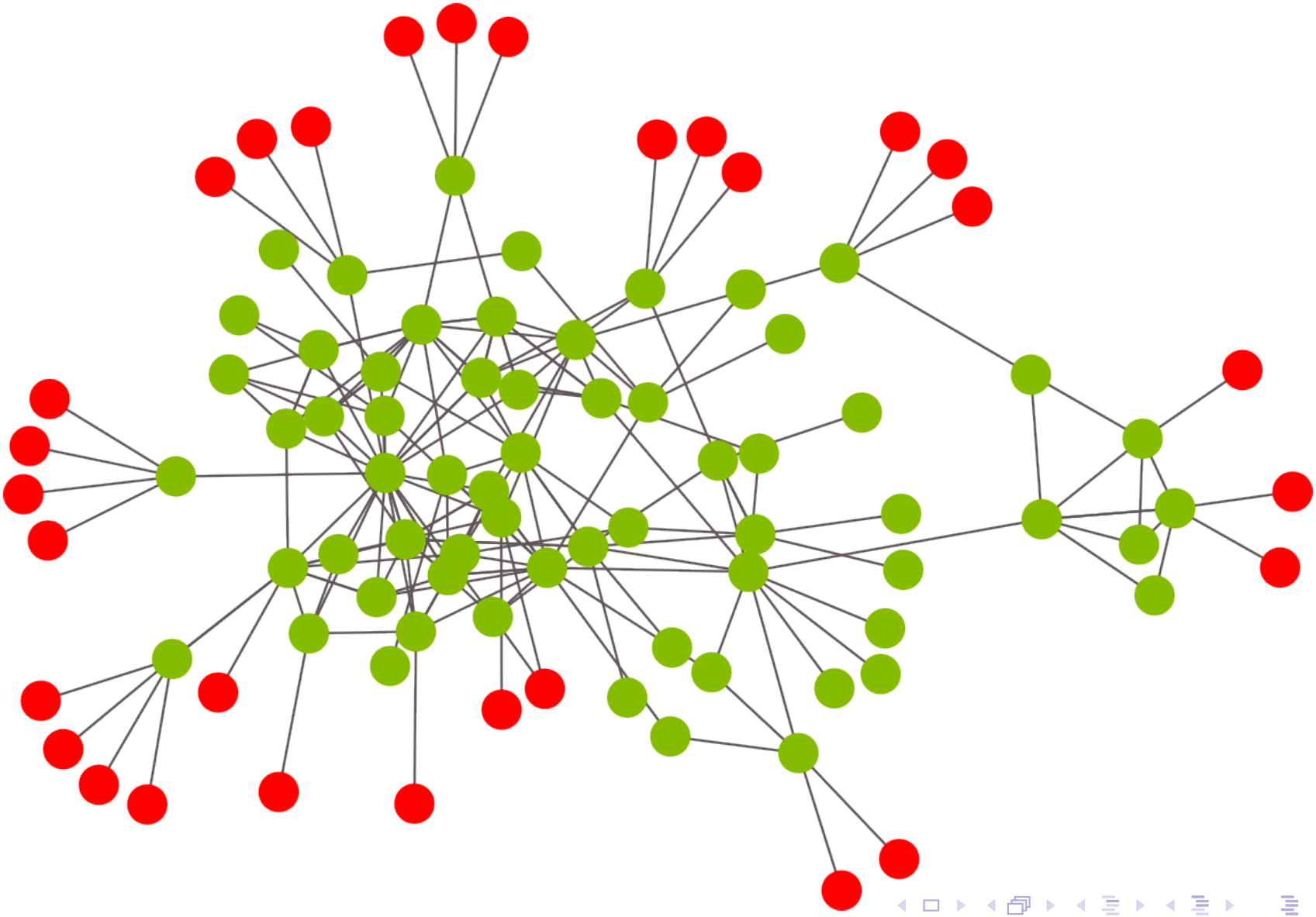


Why are the results so bad?

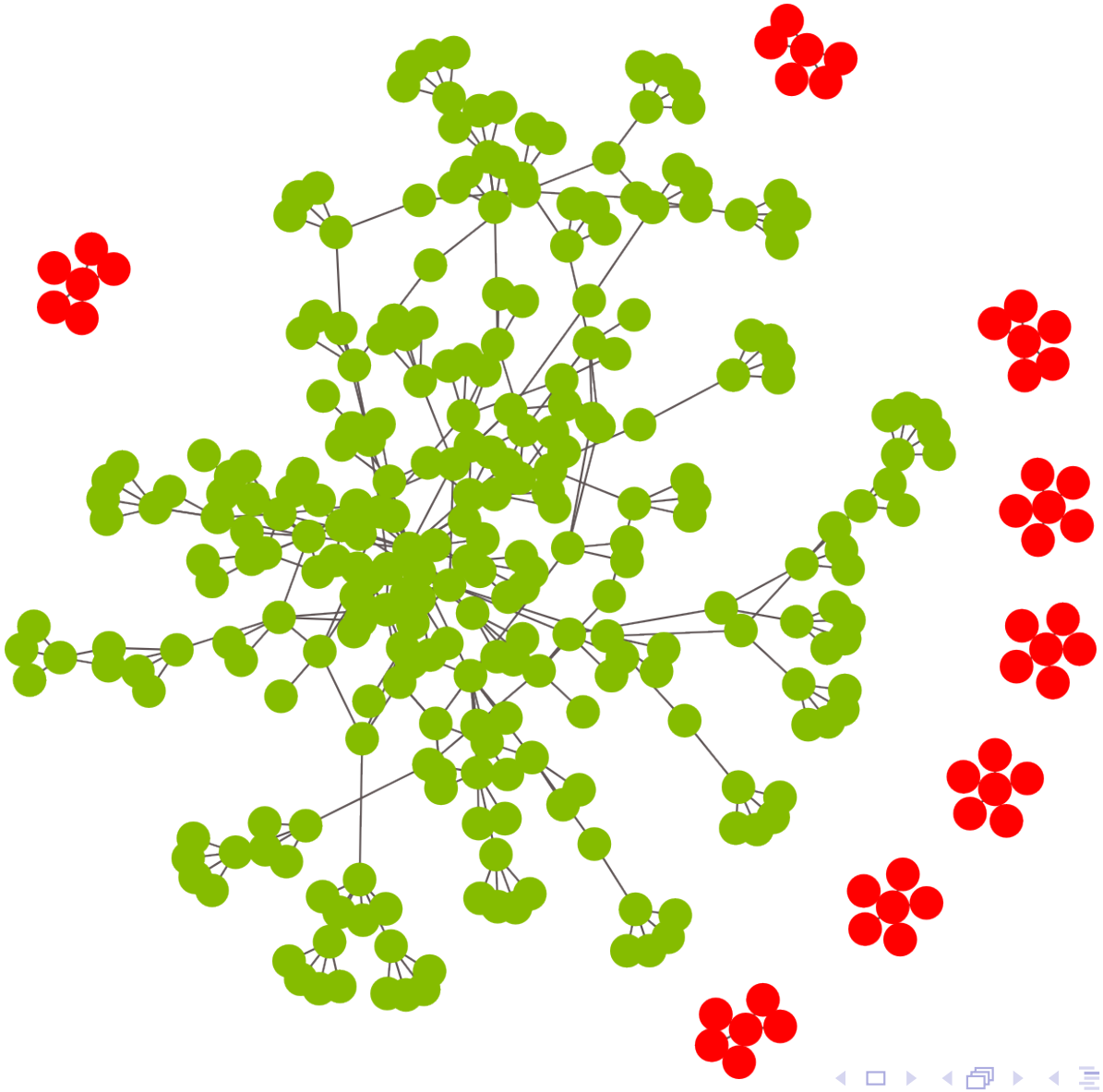


Why are the results so bad?

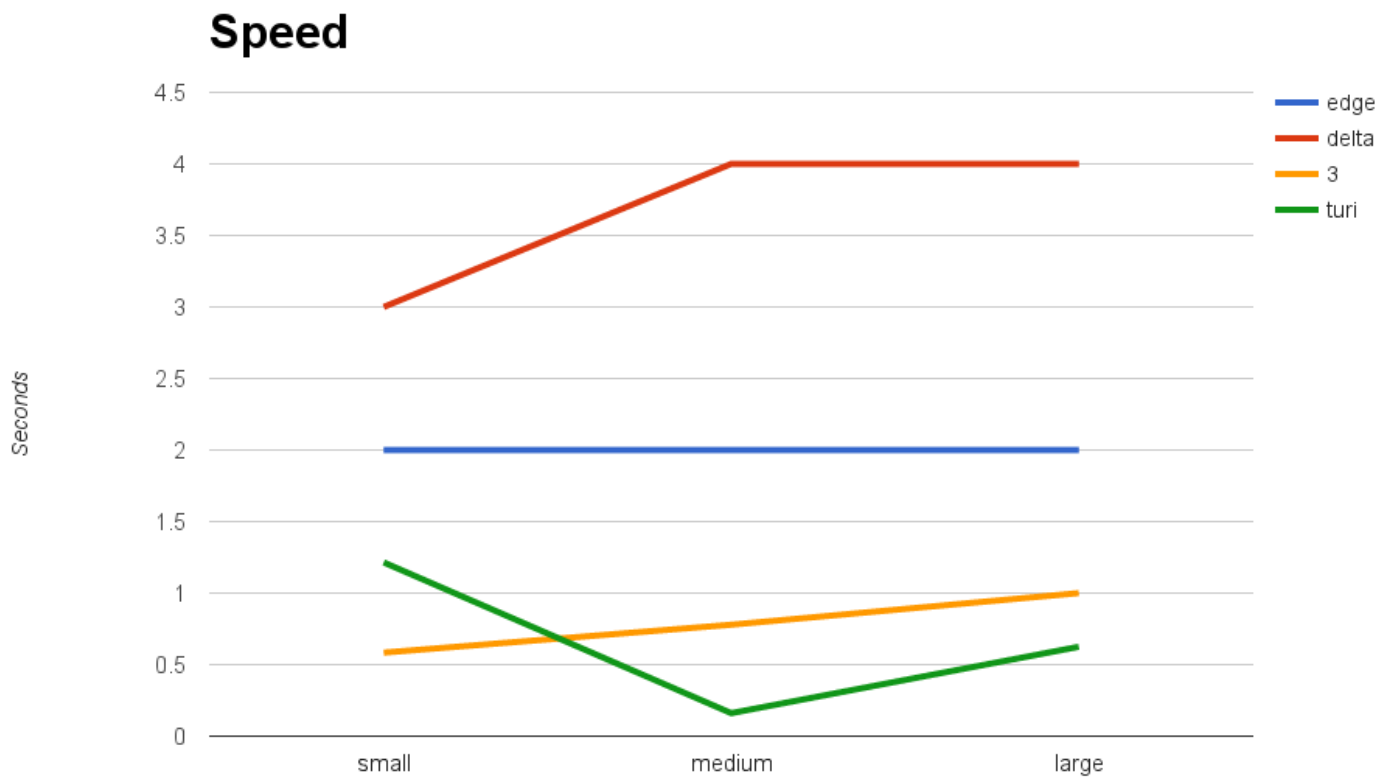
Why are the results so bad?



Why are the results so bad?



Speed


Speed
Seconds
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
small
medium
large
edge
delta
3
turi

Agenda

Conclusion

Thank you for your attention

Questions?

References I


Data Artisians. *Data Artisians logo*. URL: %5Curl%7Bhttps://www.mapr.com/sites/default/files/data_artisans_logo.png%7D.


Slim Baltagi. *Overview of Apache Flink: Next-Gen Big Data Analytics Framework*. 2015. URL: %5Curl%7Bhttp://www.slideshare.net/sbaltagi/overview-of-apacheflinkbyslimbaltagi?qid=5f0b5424-d187-4c79-a600-6cae794c686e&v=&b=&from_search=3%7D.


Apache Flink. *Apache Flink Squirrel*. URL: %5Curl%7Bhttps://flink.apache.org/img/logo/png/1000/flink_squirrel_1000.png%7D.

References II


Lawrence Page et al. “The PageRank citation ranking: bringing order to the web.” In: (1999).


Lawrence Page et al. “The PageRank citation ranking: bringing order to the web.” In: (1999).


Beat signer. *Google PageRank*. 2009. URL: %5Curl%7Bhttp://www.slideshare.net/signer/google-pagerank-presentation?qid=18af8836-30e7-41cd-9edb-956bd7ca324d&v=&b=&from_search=2%7D.

References III


Mathias Spahlinger. *There is no repetition*. URL: %5Curl%7Bhttps://www.google.com/search?q=repeat&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi4laH2tuLNAhVnB8AKHTPQCU4Q_AUICCgB&biw=1590&bih=765#tbm=isch&q=no+repetition&imgrc=h1qwLbEEezv8SM:%7D.


Inc Turi. *Turi*. URL: %5Curl%7Bhttps://www.google.com/search?q=repeat&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi4laH2tuLNAhVnB8AKHTPQCU4Q_AUICCgB&biw=1590&bih=765#tbm=isch&q=no+repetition&imgrc=h1qwLbEEezv8SM:%7D.