CS 378 – Big Data Programming

Lecture 27

Partitioning Example,

Aggregation and Broadcast Variables

Review

- Assignment 12
  - Create user sessions
  - Order events by timestamp
  - Order sessions by user ID
  - Partition sessions by referring domain
  - Filter out large sessions (> 1000 events)

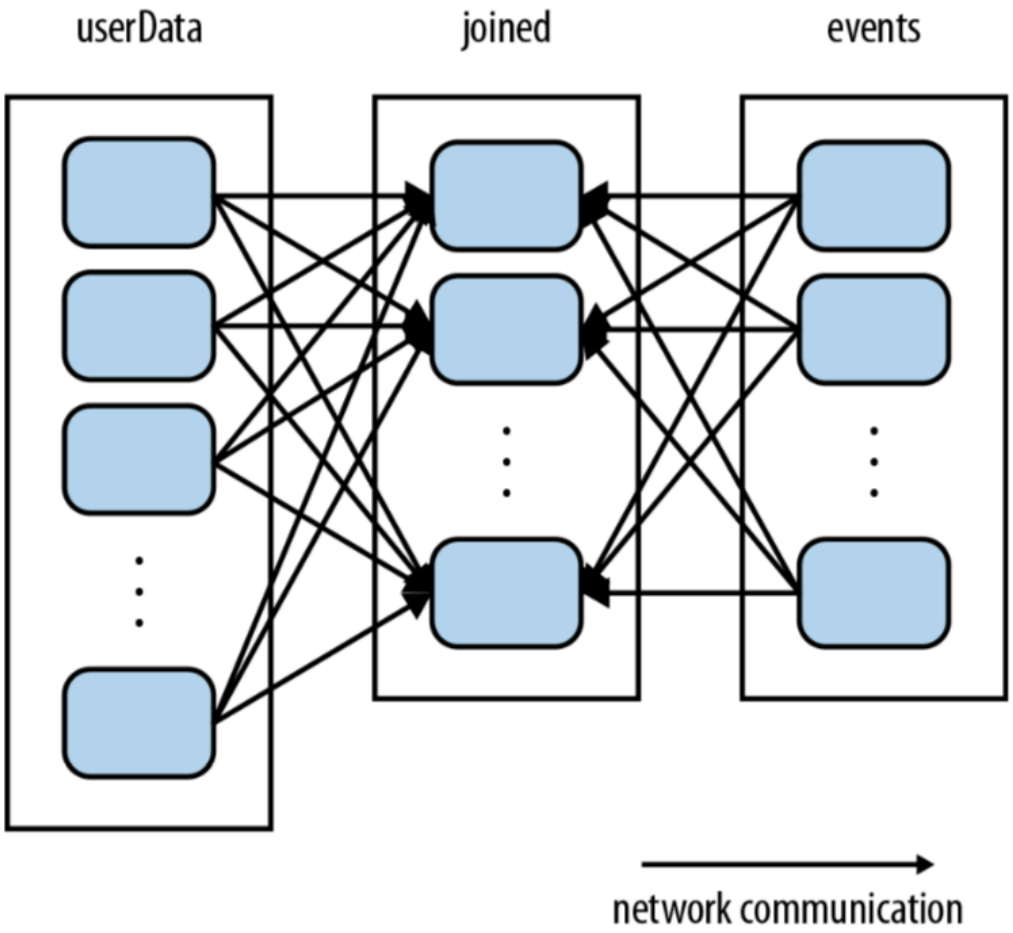
Partitioning - Review

- Prudent partitioning can greatly reduce the amount of communication (shuffle)

- If an RDD is scanned only once, no need
- If an RDD is reused multiple times in key-oriented operations
  - Partitioning can improve performance significantly

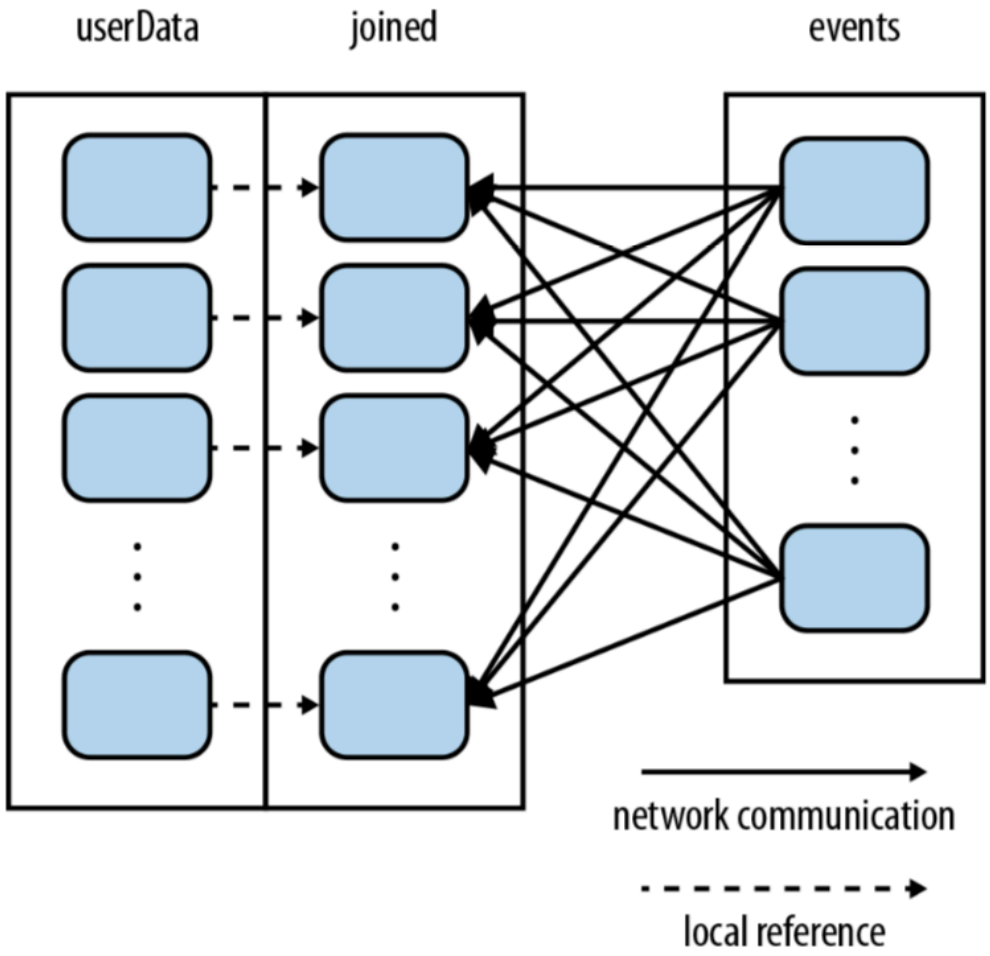
Partitioning

Figure 4-4, from Learning Spark



Partitioning

Figure 4-5, from Learning Spark



Example - Page Rank

- Walk through page rank algorithm for Spark
- See a more complex algorithm using Spark
  - Iterative
- Show benefits of partitioning, persistence

What is Page Rank?

Algorithm for weighting linked documents

Part of Google's ranking algorithm – lots of other stuff included

Basic idea

Rank++ for inbound links

Rank++ for high rank links

In this image:

Size proportional to # inbound links

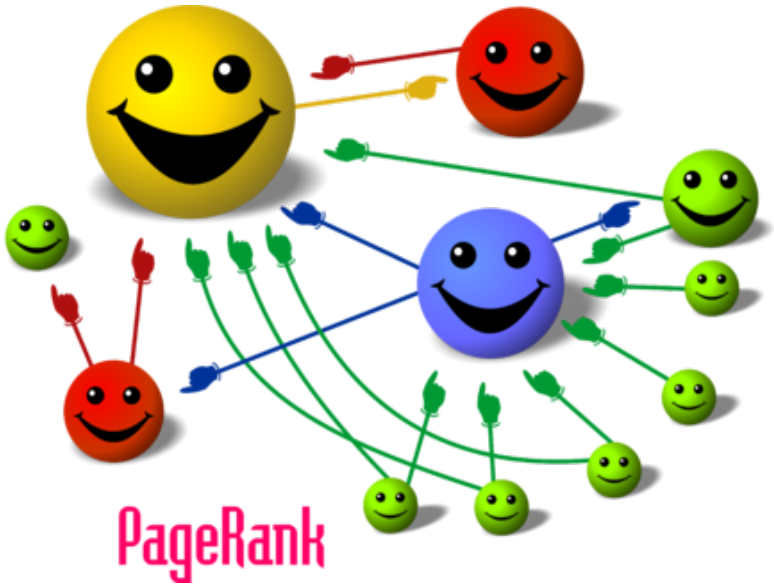


Image: en.wikipedia.org/wiki/File:PageRank-hi-res.png

Basic Page Rank Algorithm

From Learning Spark, pp. 66-67

- Give each page an initial rank of 1
- On each iteration, have page `p` send a contribution of `rank(p)/numNeighbors(p)` to its neighbors
- Set each page's rank to

```
0.15 + 0.85 * contributionsReceived
```

Page Rank - Example

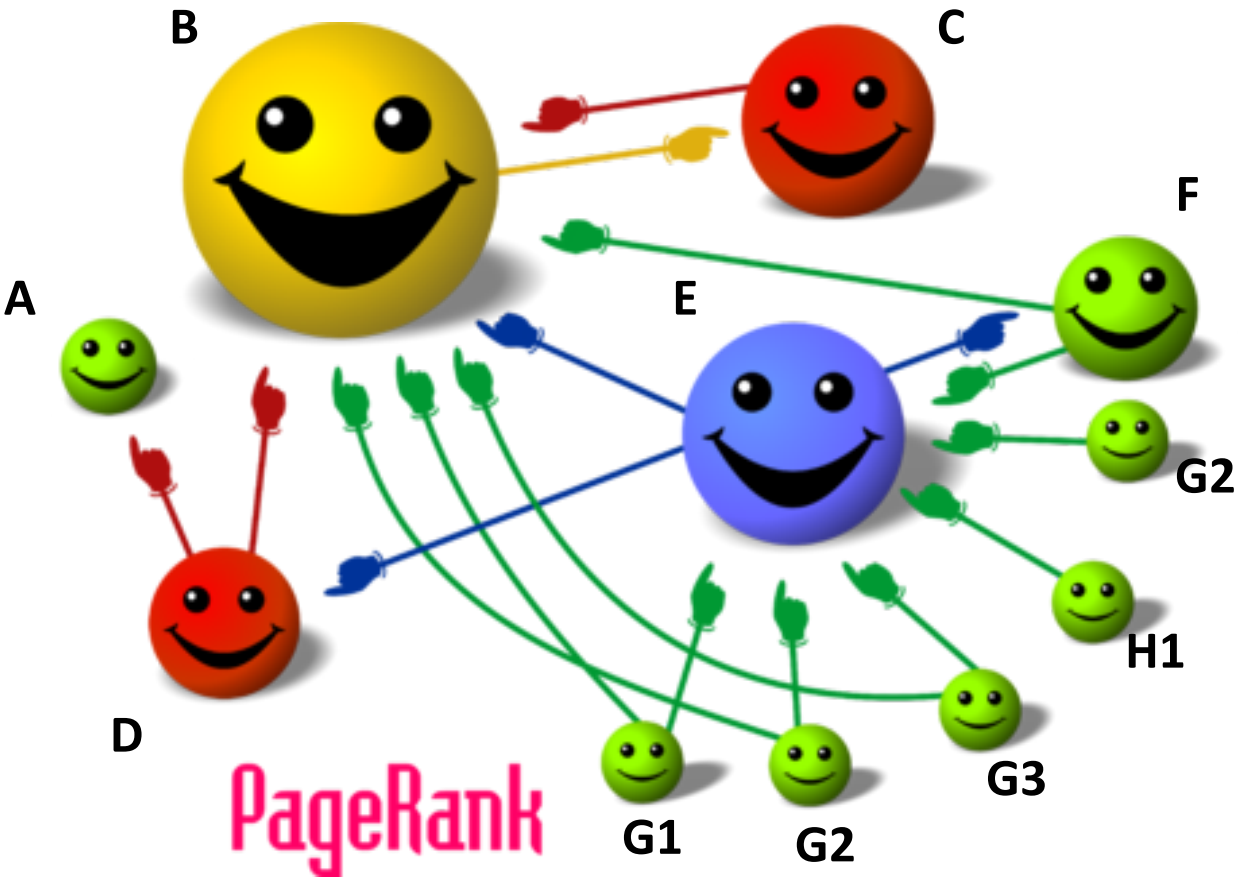


Image from: en.wikipedia.org/wiki/File:PageRank-hi-res.png

Accumulators

- In our session generator app,
- Suppose we wanted to count the number of sessions that are filtered due to size (> 1000)

- How would we do this?

- How did we do this using Hadoop map-reduce?

Accumulators

- An accumulator provides a means for aggregating values from worker nodes back to the driver node.

- Create an accumulator from the context

- Increment the accumulator in functions passed to worker nodes

Accumulators

- For failures or re-evaluation, what happens?
- Actions:
  - Each task's update applied only once
- Transformations:
  - No guarantee that task updates applied only once
  - Re-evaluation will update accumulator each time

Broadcast Variables

- If you want to access a read-only data structure from multiple transformations
  - It will be wrapped into each closure
  - Wasteful if the data is large
- A broadcast variable addresses this issue
  - Sent to each worker node only once
  - Accessible from closures sent to the workers
  - Data must be serializable