Lecture 16.3
Spark Lineage and Checkpoints

EN 600.320/420

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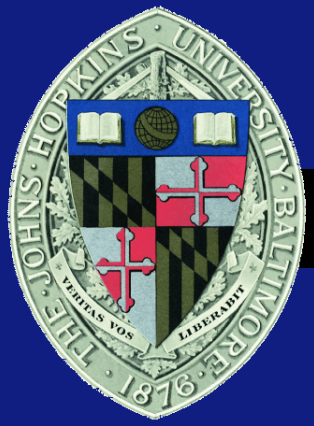

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Lineage and Recoverability

- Spark in the presence of failures:
  - Identify partitions of data (in an RDD) that have failed
  - Recompute the failed partitions using lineage
  - Parallelize recomputation (using Spark)
  - Easy because all RDDs are immutable
- Does not require *checkpoint/restart* or *rollback*
  - *Checkpoint* = save required memory (application state) to persistent storage sufficient to restart the computation
  - *Restart* = restart computation from a checkpoint
  - *Rollback* = Undo changes made to memory associated with computations that have failed or did not complete
  - All concepts related to managing a writeable memory related to computational progress in the presence of failures

Checkpointing versus Lineage

- It is desirable to checkpoint when:
  - Lineages become long (in dependencies)
  - Dependencies become wide
- Spark's default is to use the initial data load as the only checkpoint and restart from that checkpoint
  - But that depends on ability to localize recomputation to partitions
  - And on the length of the lineage

Example 2: PageRank

- Long lineage
  - Need to recompute entire on failure
- Checkpoint (save ranks)
  - Limit restart work

```
val links = spark.textFile(...).map(...).persist()
var ranks = // RDD of (URL, rank) pairs
for (i <- 1 to ITERATIONS) {
  // Build an RDD of (targetURL, float) pairs
  // with the contributions sent by each page
  val contribs = links.join(ranks).flatMap {
    (url, (links, rank)) =>
      links.map(dest => (dest, rank/links.size))
  }
  // Sum contributions by URL and get new ranks
  ranks = contribs.reduceByKey((x,y) => x+y)
               .mapValues(sum => a/N + (1-a)*sum)
}
```

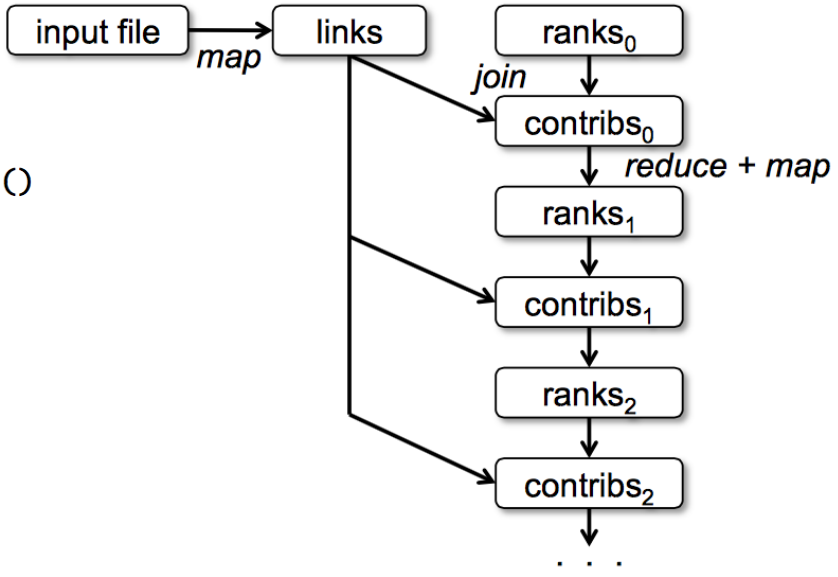

Figure 3: Lineage graph for datasets in PageRank.

Wide Dependencies

- Join, cross product, cogroup
  - Removes partition locality
- Checkpoint before or after wide dependency, because the entire RDD would need to be rebuilt