Map - Reduce

Distributed Systems: 15-440/640

Carnegie Mellon University

Purpose of this Session

- Crash-Course on Hadoop and Quick-Review of Concepts
- Quick-look at the Big-Components
- Checklist of the “must-haves” for this project
- Answer some FAQs asked during the TA office hours
- General expectations
- Question and Answers

Map-Reduce Overview - Hadoop

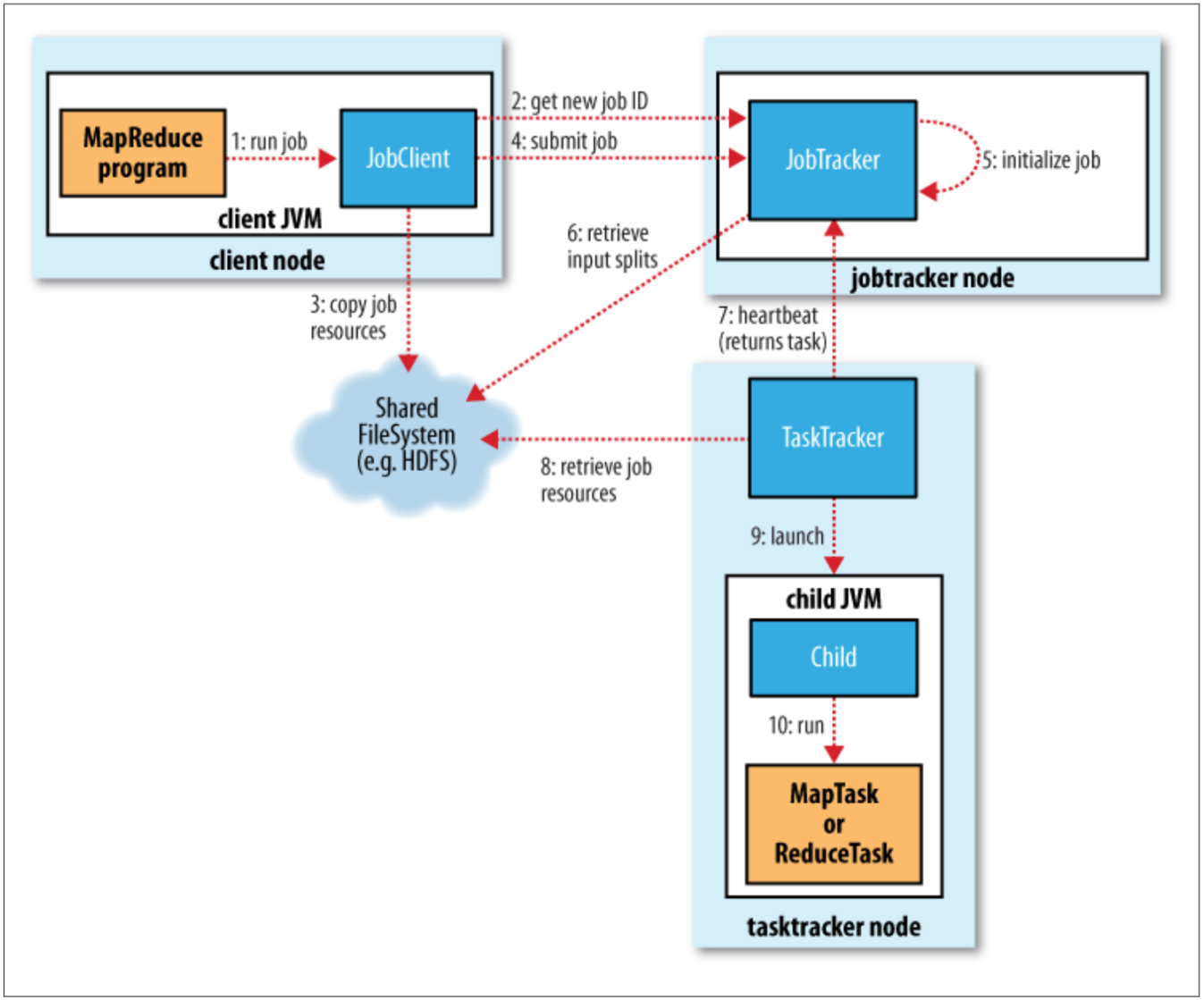
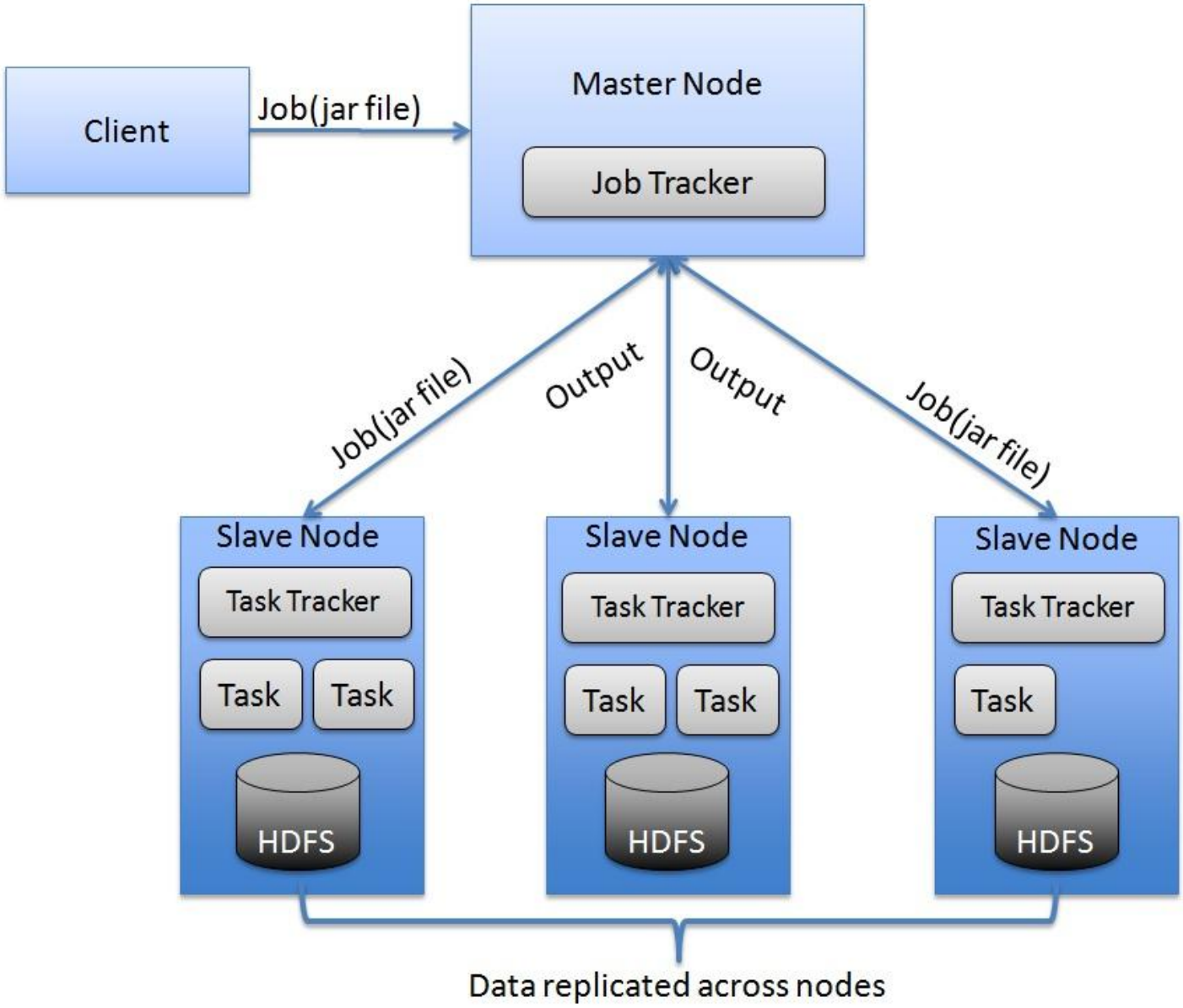
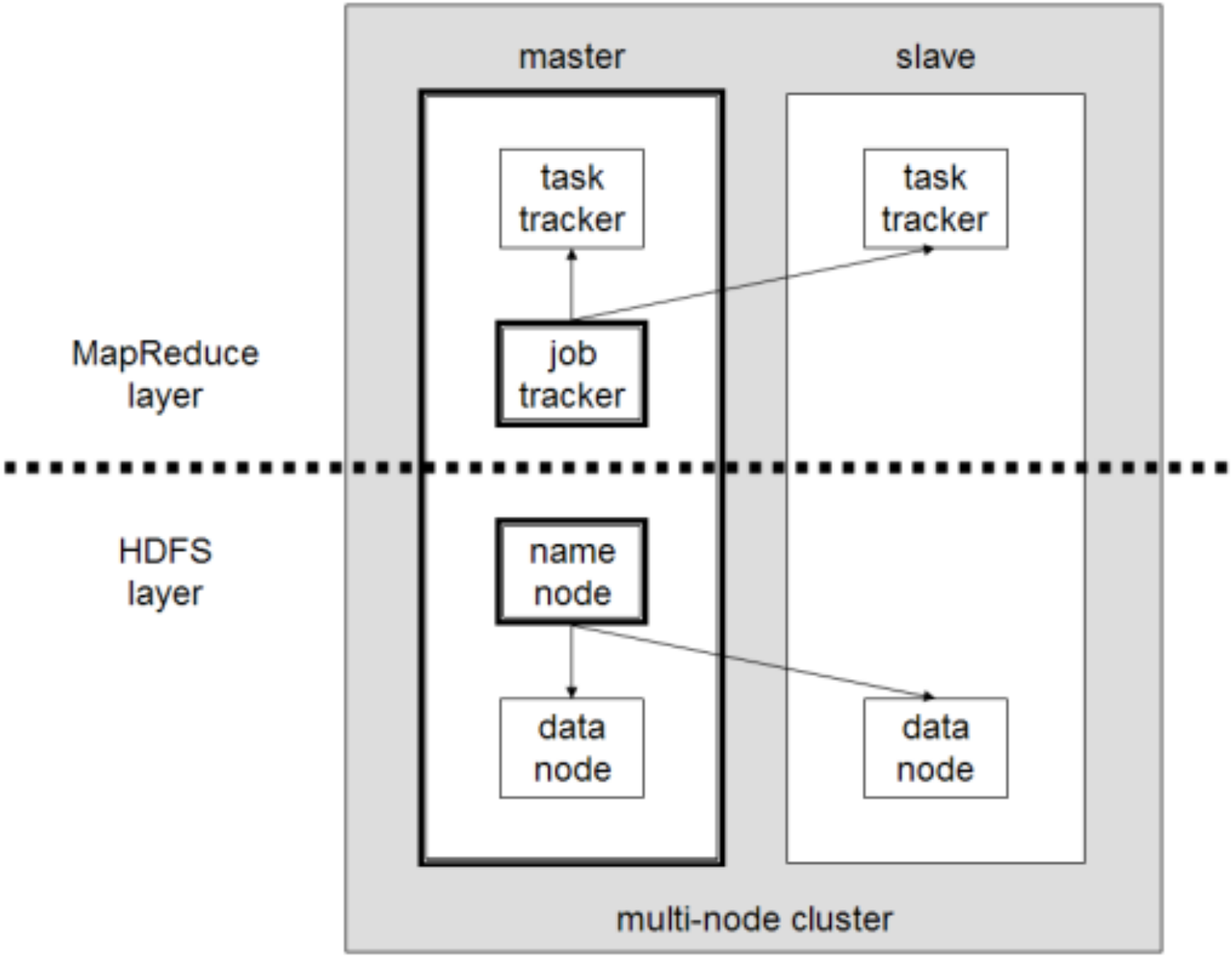


Figure 6-1. How Hadoop runs a MapReduce job

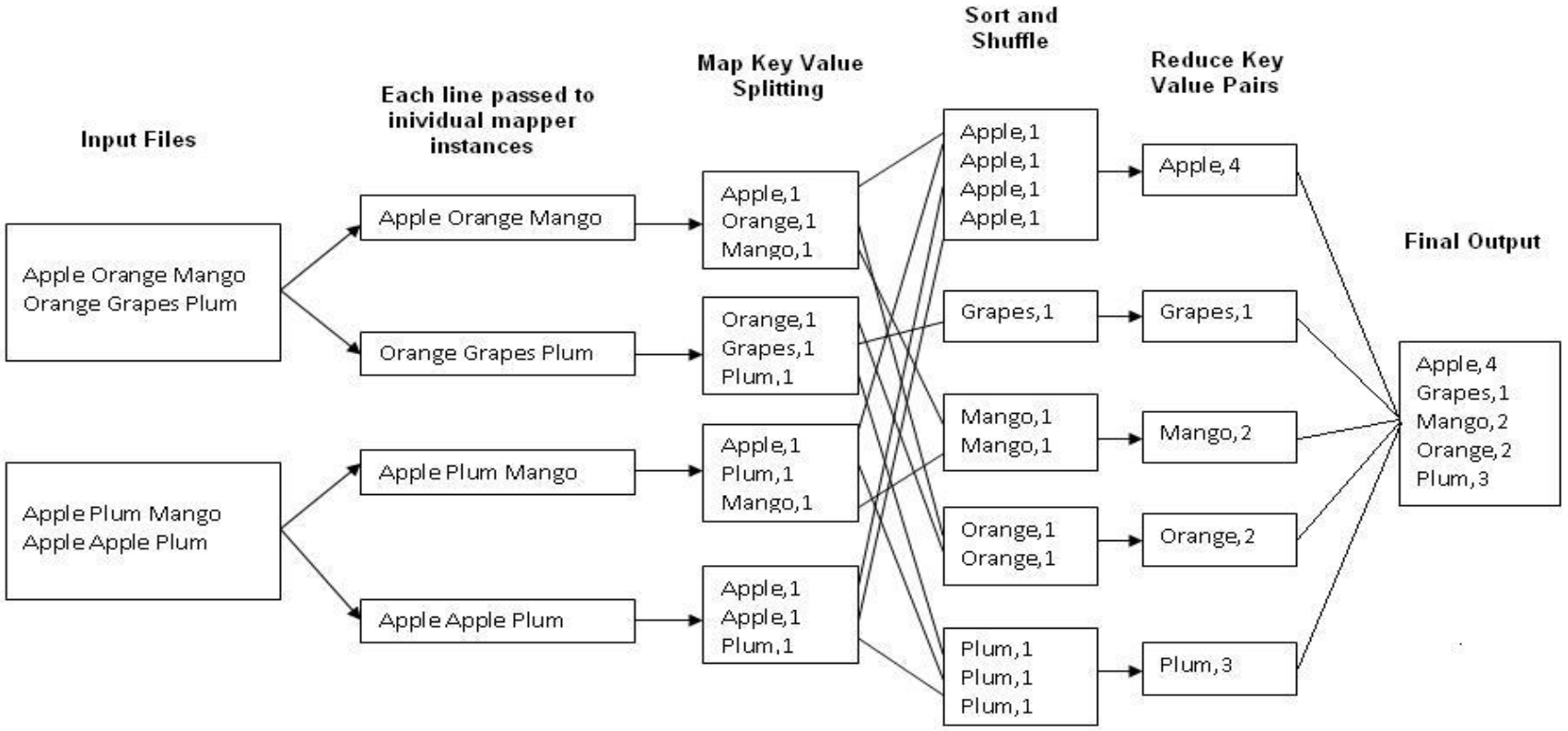
DFS Overview - HDFS



DFS Overview - HDFS



Map-Reduce Operational Overview



Note: You may have more than one output file (corresponding to each reducer)

Motivations for Map-Reduce

- Big-Data processing
- Increased utilization of commodity infrastructure
- Similar things can be done in parallel :)
- Scaled-Out, Distributed
- Fault-Tolerant, Replicated
- Hip and Cool !!! Really

Elements of Concern - Architecture

Communication	Information	Interaction (User Experience)	Computation/ Processing	Failure Management
Central Master a. k.a Job Tracker Local Master a.k.a Task Tracker	Information about the chunks/splits of the file Information about the nodes	Ability to submit a job	Common structure to take mapper and reducer code of the application programmer	Auto-replicate of file chunk if the node fails to maintain the RF
Status and Health Checking of i. Nodes and ii. Map Tasks ii. Reduce Tasks	Global State: i. Status of Map Tasks ii. Status of Reduce Tasks iii. Status of Job	Ability to pull print about the job	Automatically send the his source-code across the nodes where file-chunks are available	Re-start the map/reduce task if one fails Threshold on re-attempts
Scheduling the tasks appropriately Splitting the input file into chunks (Data actually needs to be sent and replicated)	Local State: i. Status of the Mapper ii. Status of Reducer iii. Intermediate files and I/O handling	Put yourself in the system admin's shoes who is managing this cluster	Data-Locality knowledge for the master Schedule some work as soon as something slot is free How many slots?	Status reporting if a job failure Capturing and providing as much as relevant information to application programmer

Required Deliverables

- Distributed File System
- Map reduce framework
- Administration/Bootstrapping tool or instructions
- 2 Examples to showcase your framework
- Detailed Report

Distributed File System

- Don’t complicate things!
- Think of a way to:
  - Split large files into chunks
  - Transfer the chunks to different hosts
  - Track where chunks exist.
  - Maintaining a replication factor for fault tolerance

Distributed File System (Cont.)

Important:

- Use of afs after initial bootstrapping for your framework is **not** allowed!
- For all purposes think of it as each node having their own local storage communicating through your dfs framework.

Map-Reduce Framework

- Hadoops Map-Reduce Architecture - a good starting point.
- Refer the Word Count Example
- The Same map reduce code works on all file chunks on same/different hosts
- Maximize efficiency by running jobs on locally available files

Map-Reduce Framework (Cont.)

Important:

- Fault Tolerance is Expected.
  What happens
  - if mapper fails?
  - if reducer fails?

- Config file should contain all the parameter your framework can support.
  - Some essential parameters like Input format, output format, input path, output path, mapper class and reducer class are expected

What you don't need to do

- You do *not* need to exactly emulate Hadoop or HDFS.
- No need for consistency, conflict resolution etc in your DFS.

Report checklist

“Extremely important part of the project”. Much more important than you think!

- Things we are looking for here:
  - Overall design and implementation of the MapReduce framework
  - Design and implementation of the distributed framework
  - Programmer API
  - Replica creation
  - Interaction between MapReduce and distributed file system
  - Work conservation and data location awareness
  - Launching and relaunching of Mappers and Reducers
  - Various Tradeoffs in your design.
  - **Build instructions**. If these are missing, we can’t do much. Please do not give us just jars, we need to be able to build your project while testing. Also, do not give us just jars of your example. We need the source code for those too.

    “The Submitted code must work on afs. Please test it in afs before submitting”

Common Questions

- Do we need to merge output of reducers?
  - No, 1 output per reducer.
- Do we need to build a distributed file system? If yes, how much?
  - Refer previous decks
- Hey hadoop does it this way, is that what we are supposed to do?
  - No, You are welcome to use your own design.
- Fixed records - what does that mean?
  - Simplest case - Line of string.
- Do I need a shell on each node?
  - No, its up to your design

References

Map reduce by Google http://static.googleusercontent.com/media/research.google.com/en/us/archive/mapreduce-osdi04.pdf