An introduction to Lecture-3

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Lecturer (Senior Scale)

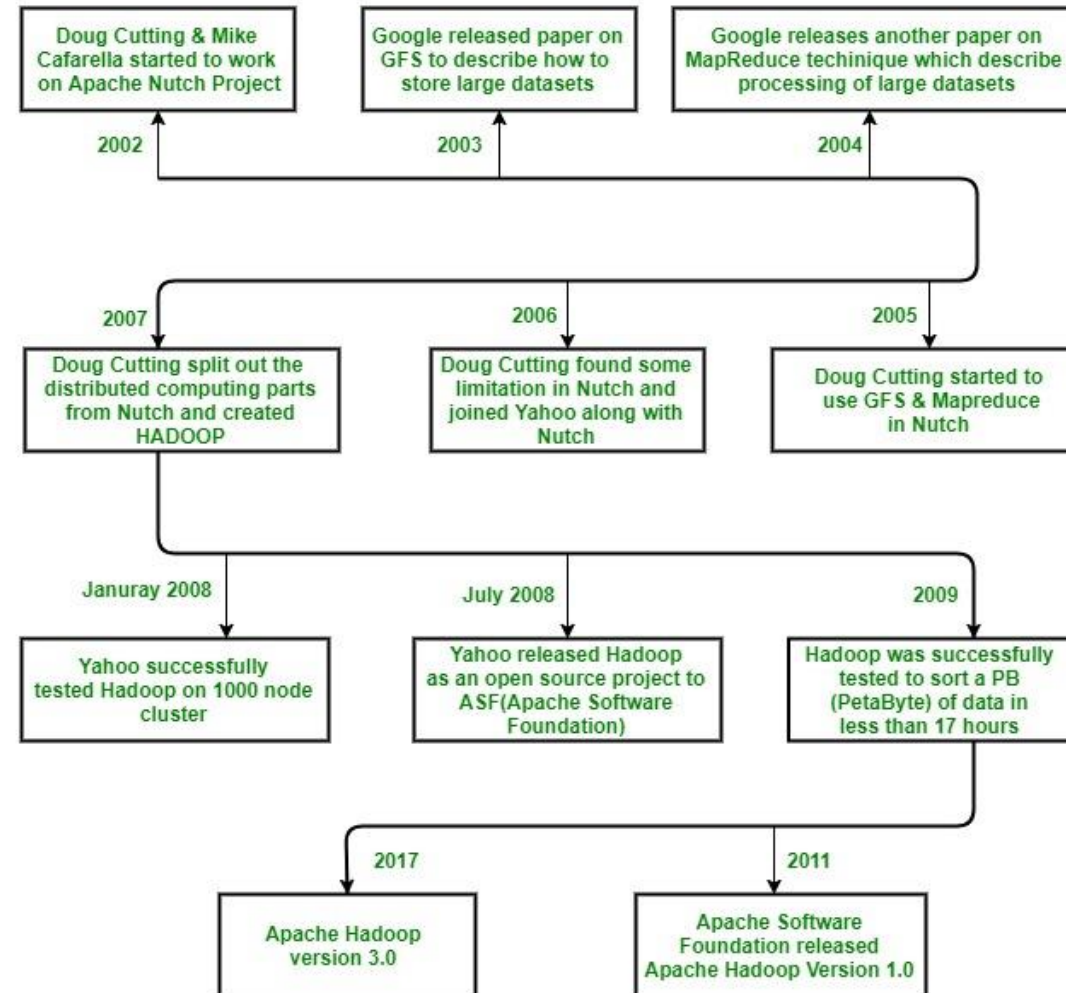Department of Computer Science and Engineering

What is Hadoop

Hadoop is an open project overseen by the Apache Software Foundation

Originally based on papers published by Google in 2003 and 2004

Hadoop committers work at several different organizations – Including Cloudera, Yahoo!, Facebook, LinkedIn

Hadoop takes a radical new approach to the problem of distributed computing – distribute the data as it's initially stored in the system and individual nodes work on data local to the nodes.

History

Doug Cutting & Mike Cafarella started to work on Apache Nutch Project
— 2002

Google released paper on GFS to describe how to store large datasets
— 2003

Google releases another paper on MapReduce techinique which describe processing of large datasets
— 2004

Doug Cutting split out the distributed computing parts from Nutch and created HADOOP
— 2007

Doug Cutting found some limitation in Nutch and joined Yahoo along with Nutch
— 2006

Doug Cutting started to use GFS & Mapreduce in Nutch
— 2005

Yahoo successfully tested Hadoop on 1000 node cluster
— Januray 2008

Yahoo released Hadoop as an open source project to ASF(Apache Software Foundation)
— July 2008

Hadoop was successfully tested to sort a PB (PetaByte) of data in less than 17 hours
— 2009

Apache Hadoop version 3.0
— 2017

Apache Software Foundation released Apache Hadoop Version 1.0
— 2011

Who Uses Hadoop?

Hadoop Components
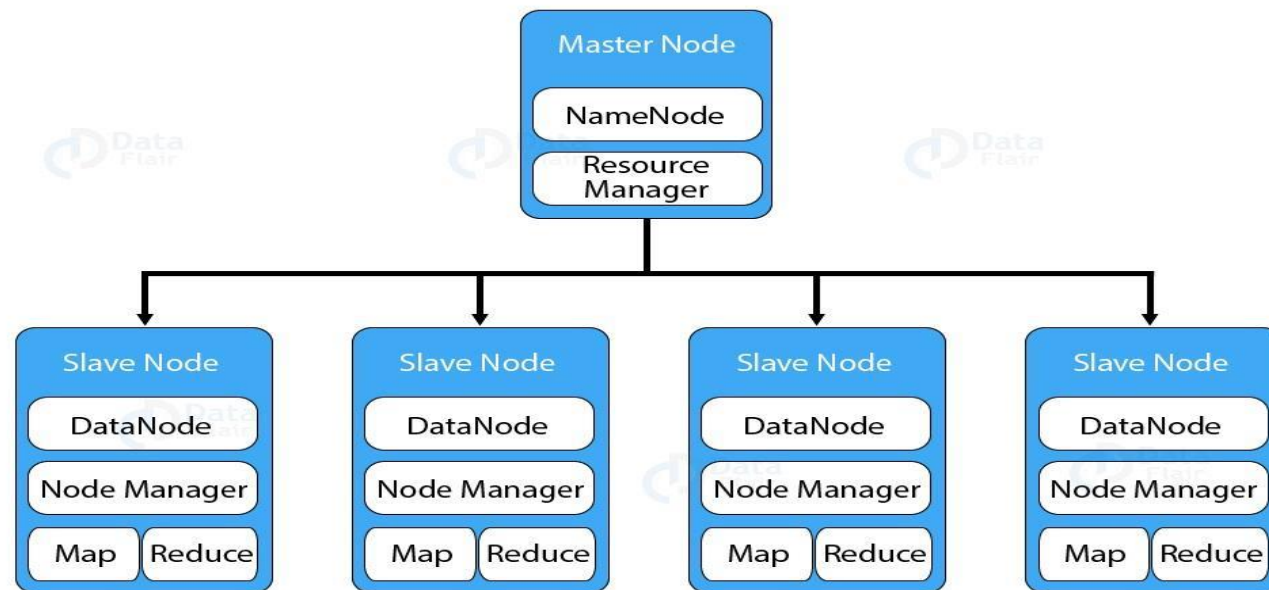
HDFS

HDFS stands for **Hadoop Distributed File System**. It provides for data storage of Hadoop. HDFS splits the data unit into smaller units called blocks and stores them in a distributed manner.
It has got two daemons running.
- Master node – NameNode
- Slave nodes – DataNode.

Master Nodes

- **NameNode**
  - **Only 1 per cluster**
  - **A single NameNode stores all metadata**
  - **Filenames, locations on DataNodes of each block, owner, group, etc.**
  - **All information maintained in RAM for fast lookup**
 - **File system metadata size is limited to the amount of available RAM on the NameNode**

Slave Nodes

- **DataNode**
  - **1-4000 per cluster**
  - **Store file contents**
  - **Stores as opaque 'blocks' on the underlying file system**
  - **Different blocks of the same file will be stored on different DataNodes**
 - **Same blocks is stored on three (or more) DataNode for redundancy**

Self-healing

- **DataNodes send heartbeats to the NameNode**
  - After a period without any heartbeats, a DataNode is assumed to be lost
  - NameNode determines which blocks were on the lost node
  - NameNode finds other DataNodes with copies of these blocks
  - These DataNodes are instructed to copy the blocks to other nodes
  - Replication is actively maintained

Same block stored in different DataNodes
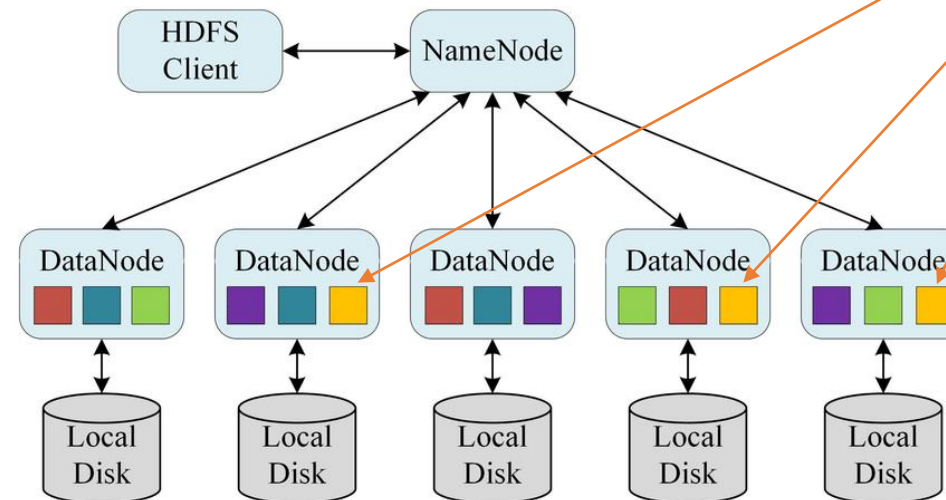
Block in HDFS

Block is nothing but the smallest unit of storage on a computer system. It is the smallest contiguous storage allocated to a file. In Hadoop, we have a default block size of 128MB or 256 MB.

Example.txt

518 MB

a	b	c	d	e
128 MB	128 MB	128 MB	128 MB	6 MB
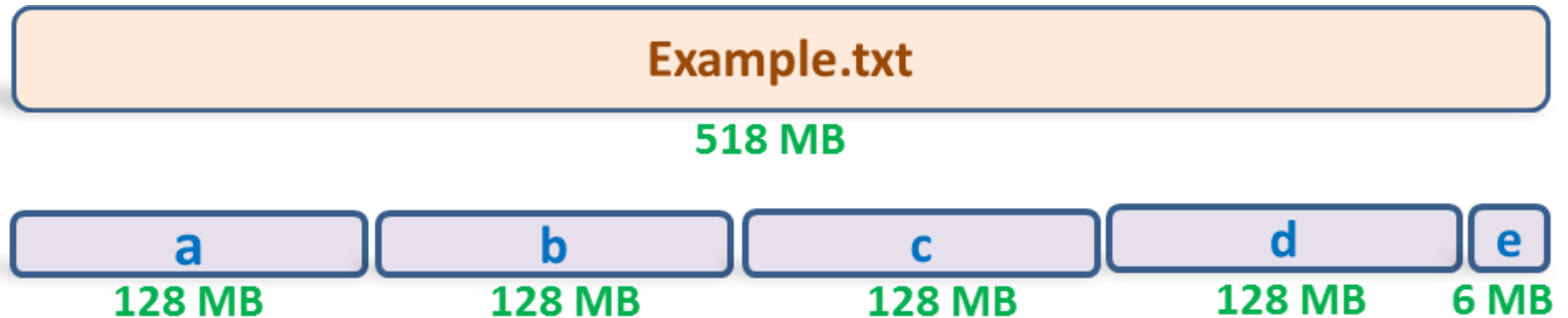
What is MapReduce

MapReduce is a method for distributing a task across multiple nodes
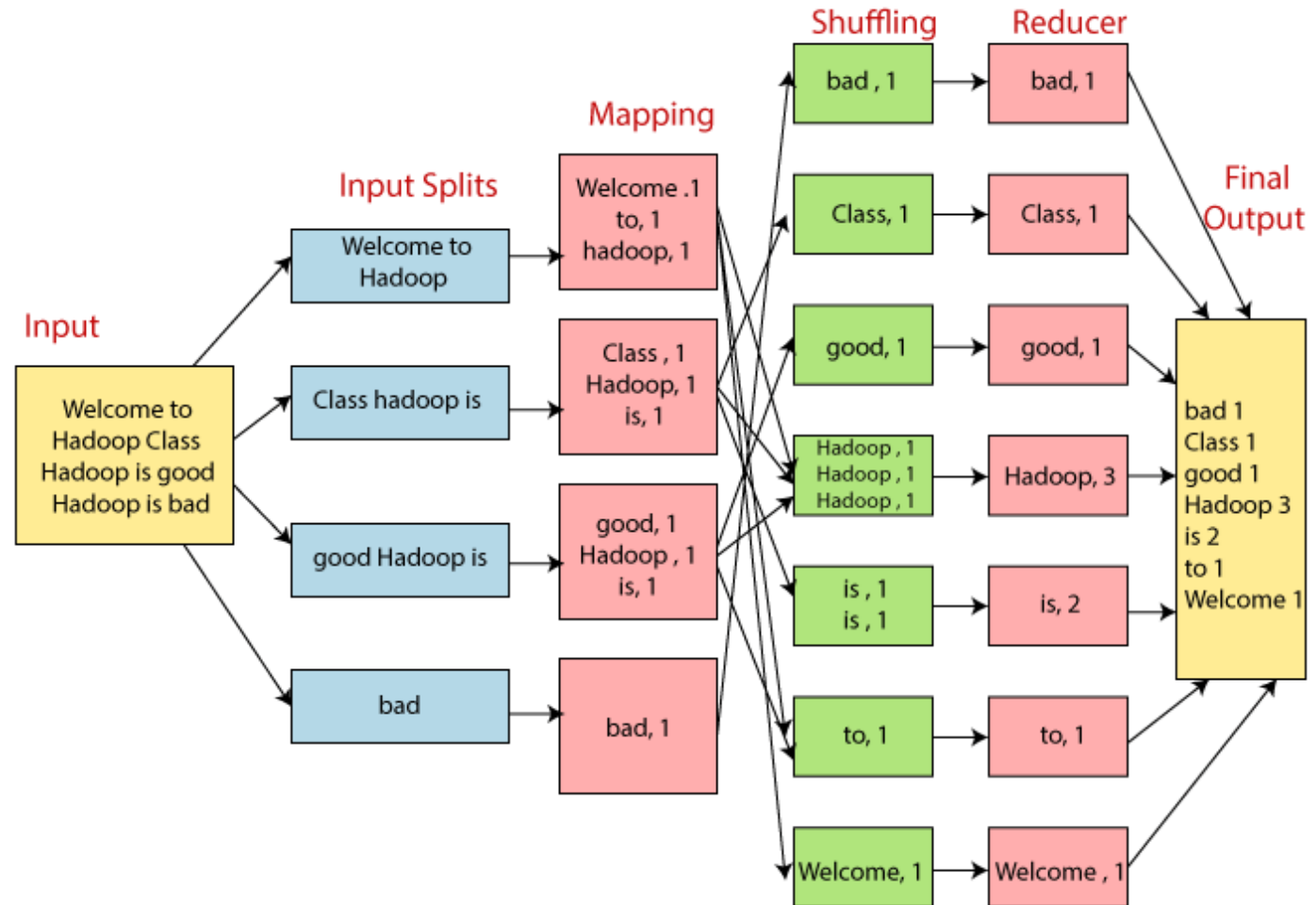
Each node processes data stored on that node
- Where possible

Consists of two phases:
- Map
- Reduce

MapReduce

- Map Task
  - **RecordReader**
  - **Map**
  - **Combiner**
  - **Partitioner**

- Reduce Task
 - **Shuffle and Sort**
  - **Reduce**
  - **OutputFormat**

YARN

YARN or Yet Another Resource Negotiator is the resource management layer of Hadoop.

❏ separate resource management and job scheduling/monitoring function into separate daemons
❏ one global ResourceManager and per-application ApplicationMaster
❏ Application can be a single job or a DAG of jobs

Inside the YARN framework, we have two daemons
- ResourceManager
  - resources among all the competing applications in the system

- NodeManager
  - monitor the resource usage by the container and report the same to ResourceManger

YARN
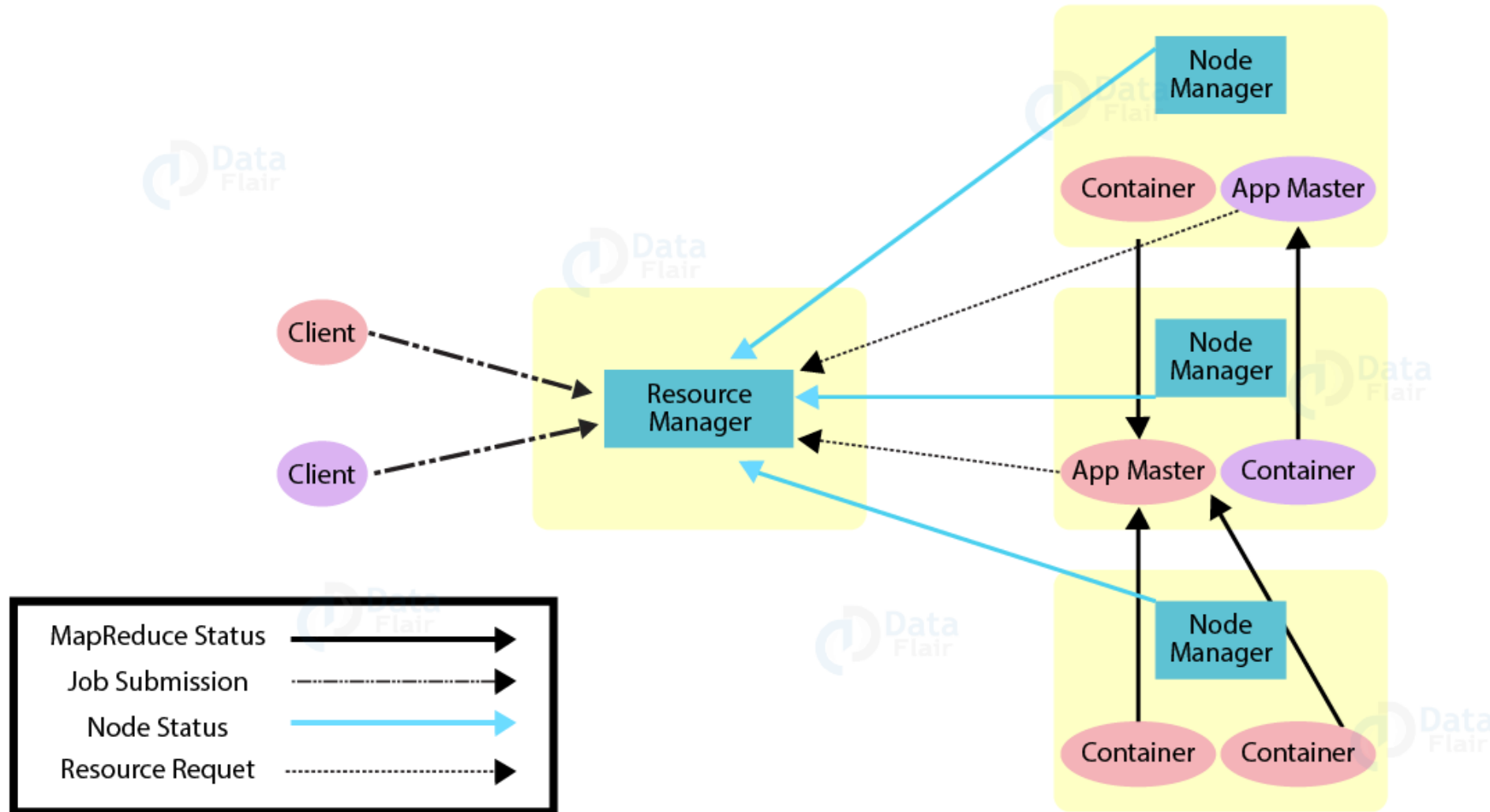
ResourceManger

The ResourceManger has two important components
- Scheduler
- ApplicationManager

Scheduler
- Scheduler is responsible for allocating resources to various applications. This is a pure scheduler as it does not perform tracking of status for the application. It also does not reschedule the tasks which fail due to software or hardware errors. The scheduler allocates the resources based on the requirements of the applications.

Application Manager
- Accepts job submission.
- Negotiates the first container for executing ApplicationMaster. A container incorporates elements such as CPU, memory, disk, and network.
- Restarts the ApplicationMaster container on failure.
- Negotiates resource container from Scheduler.
- Tracks the resource container status.
- Monitors progress of the application.

Features of Yarn

- Multi-tenancy
- Cluster Utilization
- Scalability
- Compatibility

Reference

➤ https://data-flair.training/blogs/hadoop-tutorial/Cluster Utilization
➤ https://www.geeksforgeeks.org/hadoop-introduction/Compatibility

Thank You