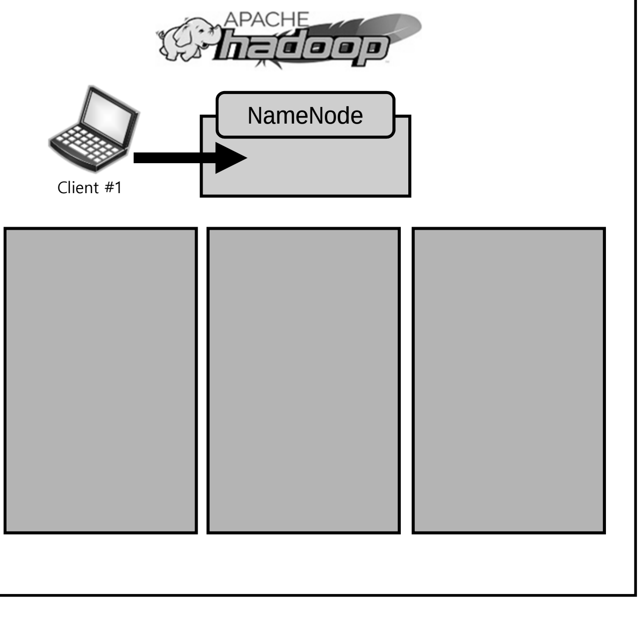
Big Data

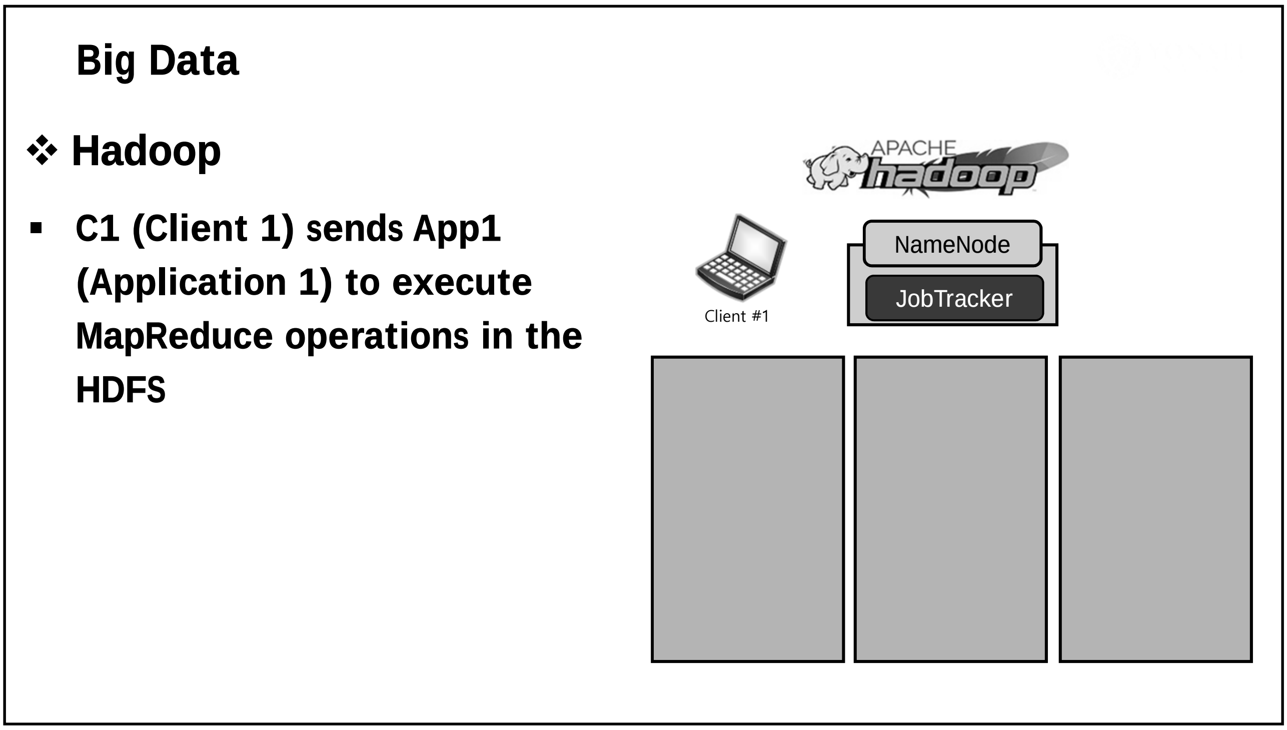
Hadoop vs. Hadoop YARN

Big Data

❖ Hadoop

- C1 (Client 1) sends App1 (Application 1) to execute MapReduce operations in the HDFS





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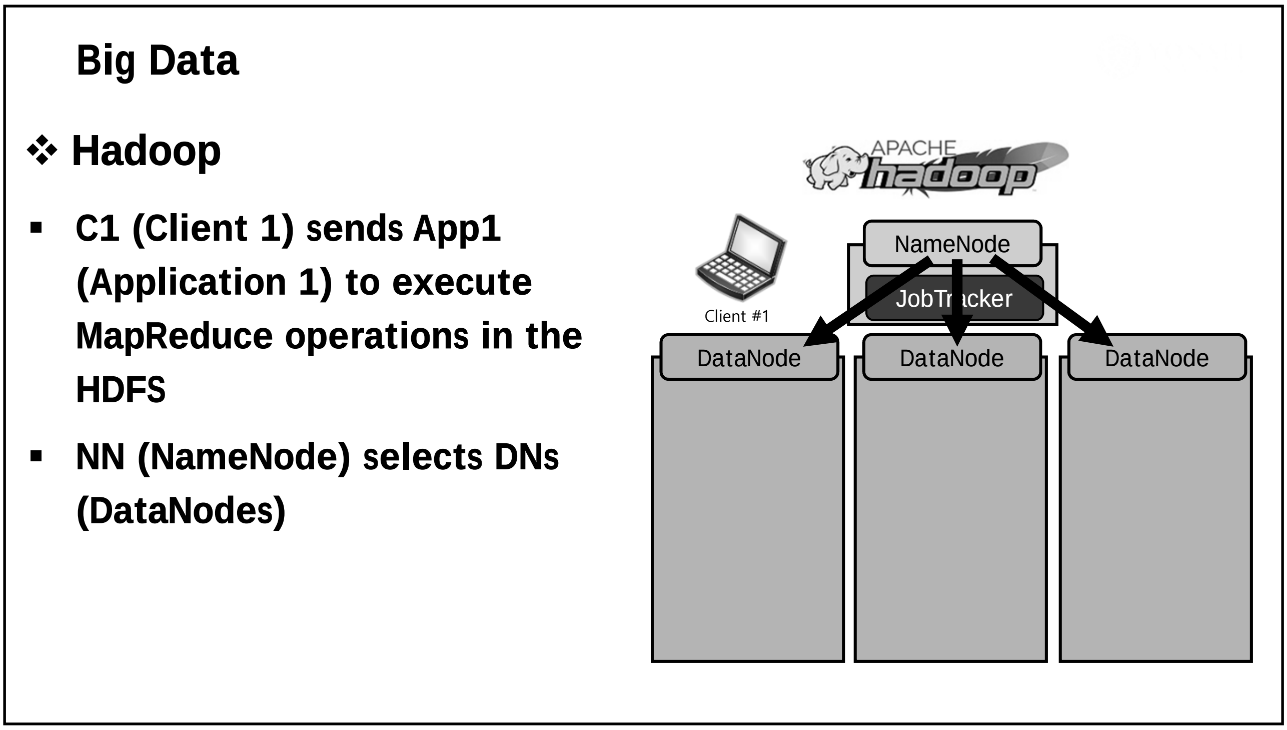
❖ Hadoop

- C1 (Client 1) sends App1 (Application 1) to execute MapReduce operations in the HDFS



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❖ Hadoop

- C1 (Client 1) sends App1 (Application 1) to execute MapReduce operations in the HDFS
- NN (NameNode) selects DNs (DataNodes)

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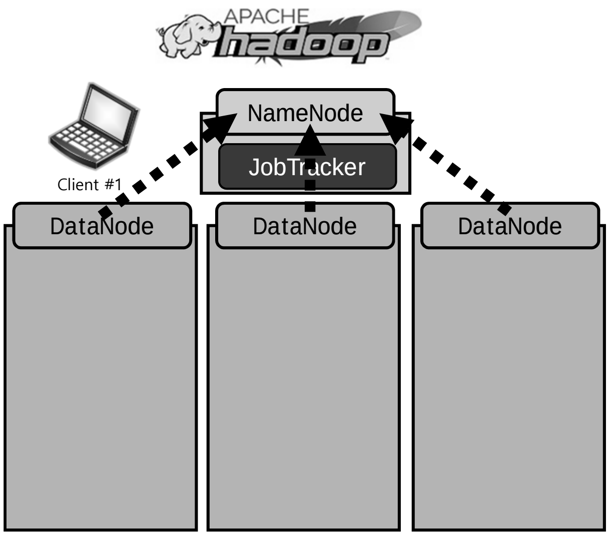
❖ Hadoop

- C1 (Client 1) sends App1 (Application 1) to execute MapReduce operations in the HDFS
- NN (NameNode) selects DNs (DataNodes)
- DNs send Heartbeat signals to the NN every 3 seconds



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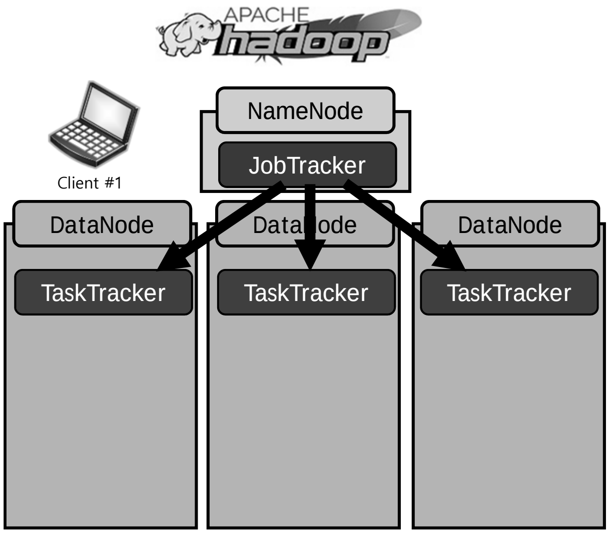
❖ Hadoop

- JT (JobTracker) (brain, master) sets up TTs (TaskTrackers) (workhorse, slave)



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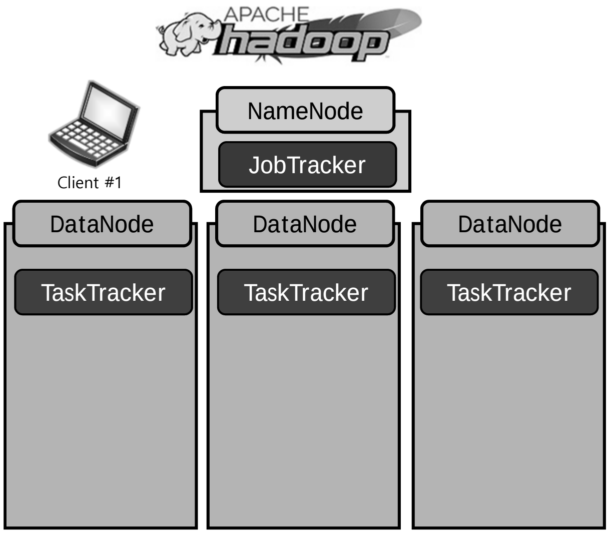
❖ Hadoop

- JT (JobTracker) (brain, master) sets up TTs (TaskTrackers) (workhorse, slave)
- Each TT assigns Slots to be either a Map slot or Reduce slot



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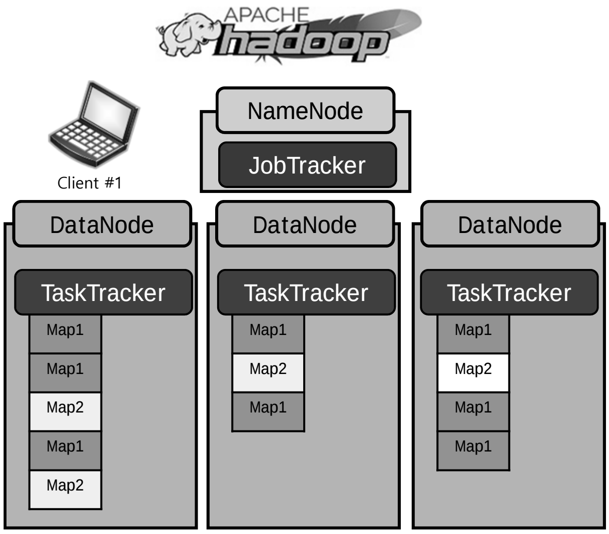
❖ Hadoop

- JT (JobTracker) (brain, master) sets up TTs (TaskTrackers) (workhorse, slave)
- Each TT assigns Slots to be either a Map slot or Reduce slot
- Map Slots are assigned Map functions (JVMs)



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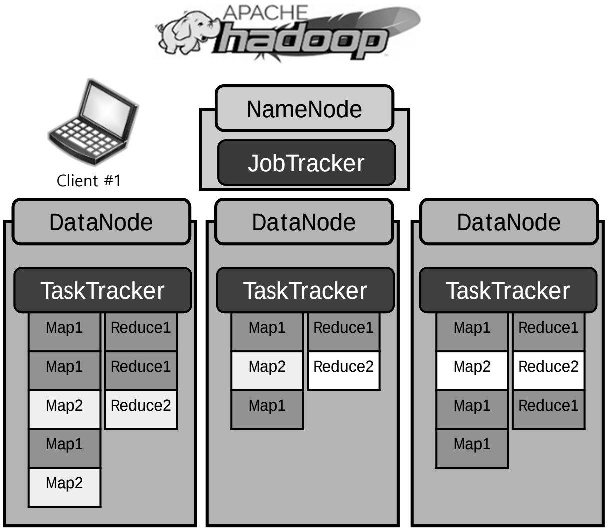
❖ Hadoop

- Reduce Slots are assigned Reduce functions (JVMs)
- Parallel processing is operated based on simultaneously controlling multiple Process IDs



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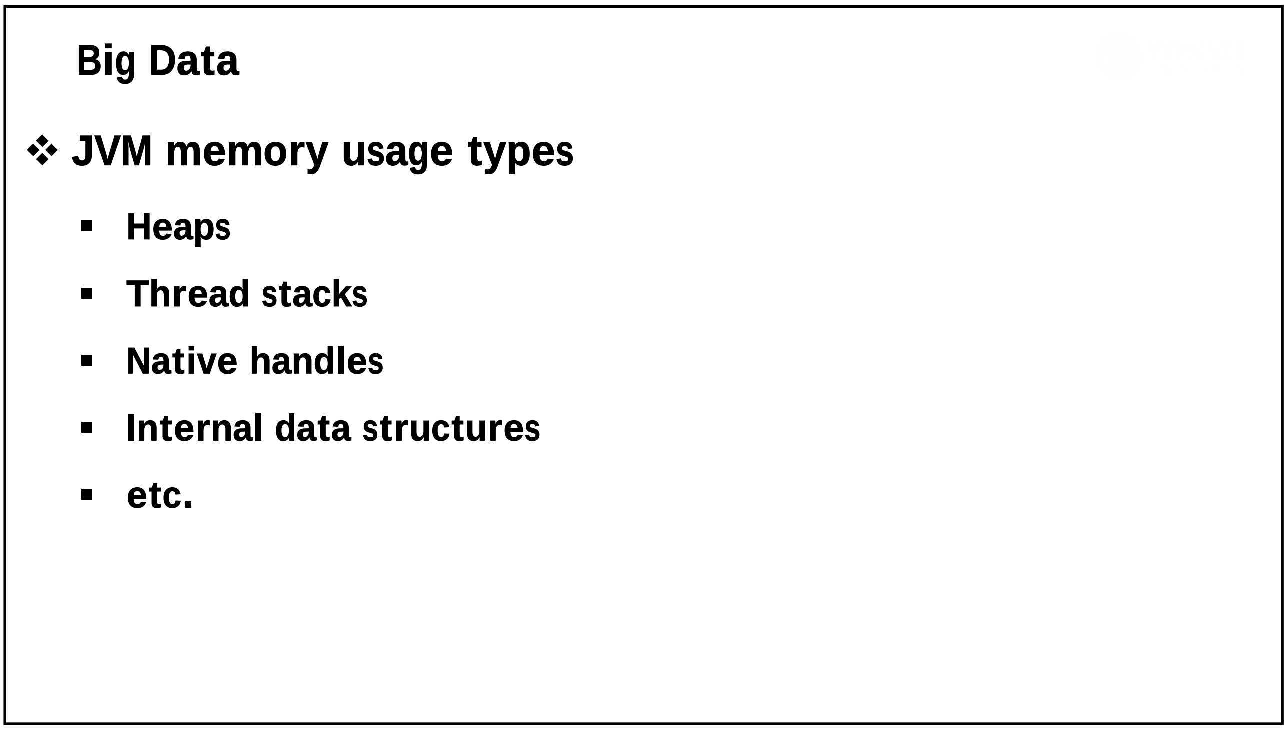
❖ Java

- Trademark is owned by Oracle
- JVM (Java Virtual Machine)
  - Virtual (abstract) computing system on a computer used to execute Java programs
- JRE (Java Runtime Environment)
  - Software package that contains a JVM called HotSpot and JCL (Java Class Library)



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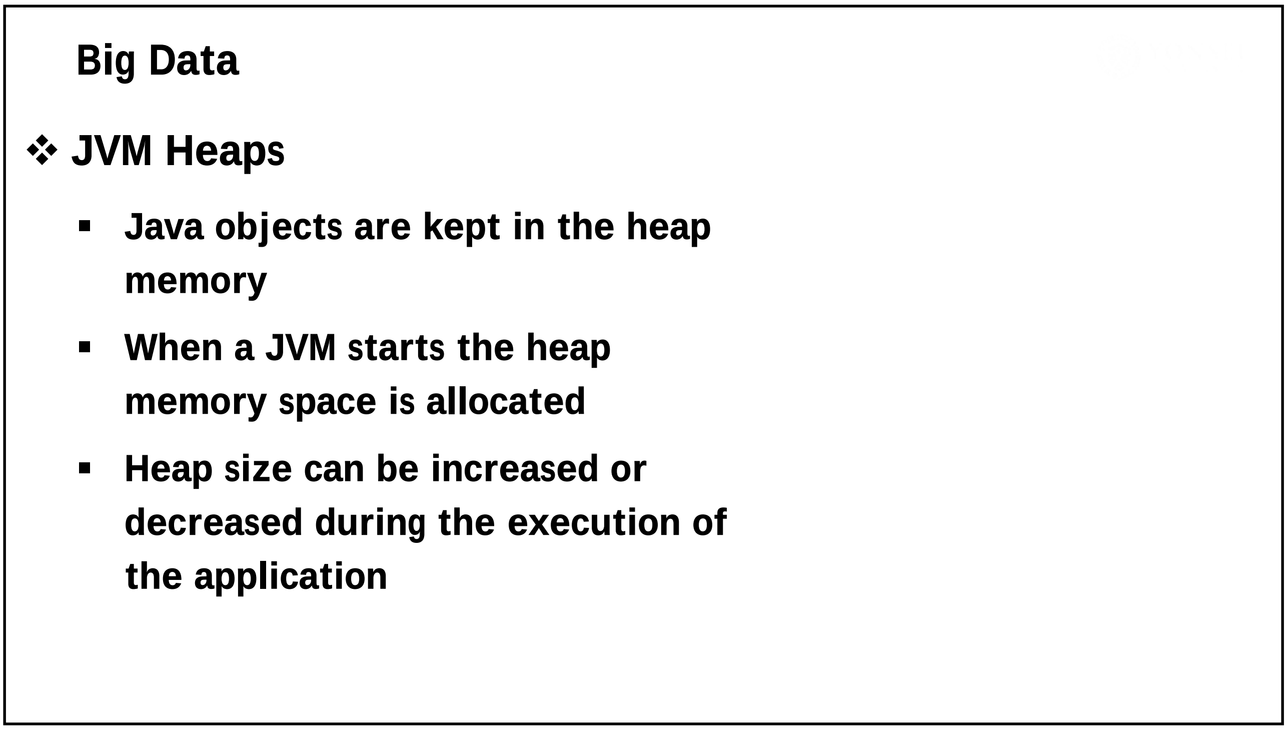
❖ JVM memory usage types

- Heaps
- Thread stacks
- Native handles
- Internal data structures
- etc.



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❖ JVM Heaps

- Java objects are kept in the heap memory
- When a JVM starts the heap memory space is allocated
- Heap size can be increased or decreased during the execution of the application

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❖ JVM Heaps

- Heap memory is allocated by the JVM using the OS (Operating System)
- JVM conducts heap management of the Java application

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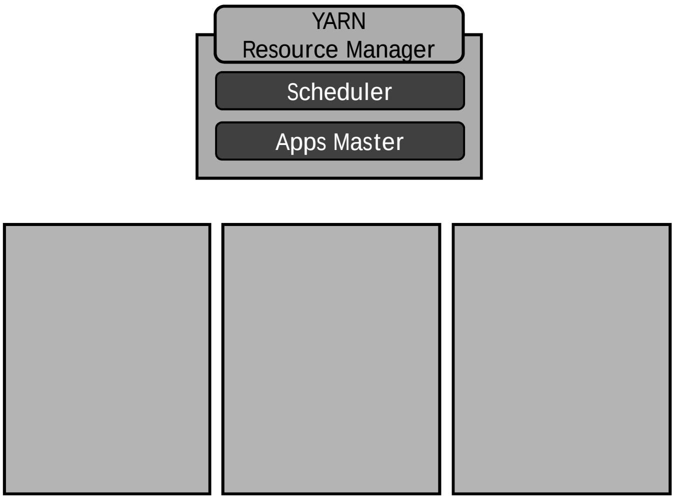
❖ Hadoop with YARN Example

- RM (Resource Manager) has a Scheduler and AM (Apps Master) inside



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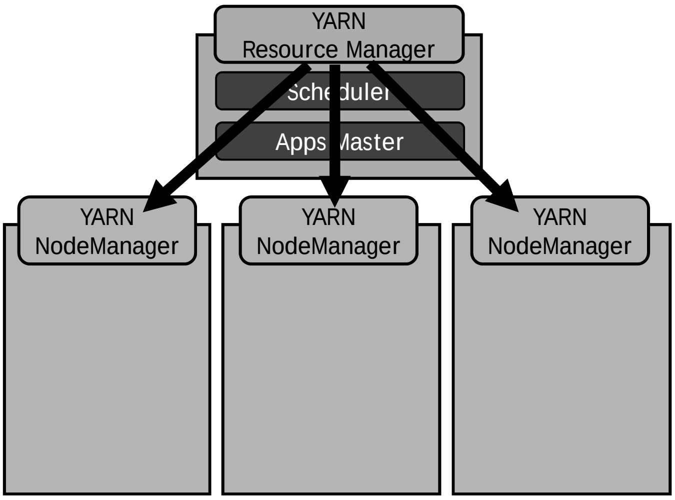
❖ Hadoop with YARN Example

- RM (Resource Manager) has a Scheduler and AM (Apps Master) inside
- RM prepares NMs (Node Managers) on multiple nodes in the cluster



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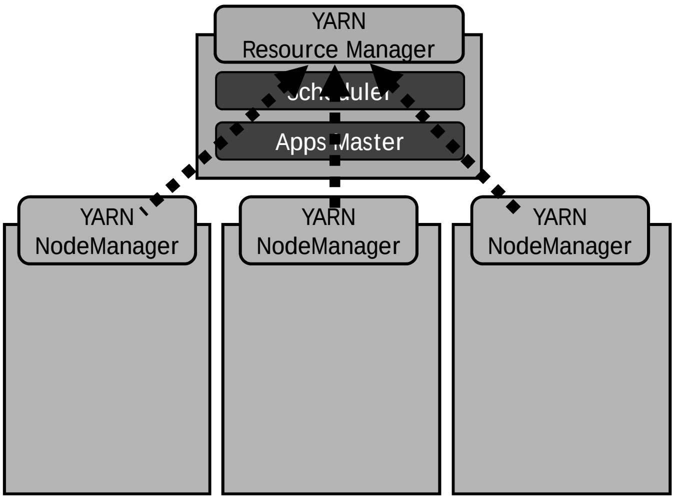
❖ Hadoop with YARN Example

- RM (Resource Manager) has a Scheduler and AM (Apps Master) inside
- RM prepares NMs (Node Managers) on multiple nodes in the cluster
- NMs send Heartbeats to the RM



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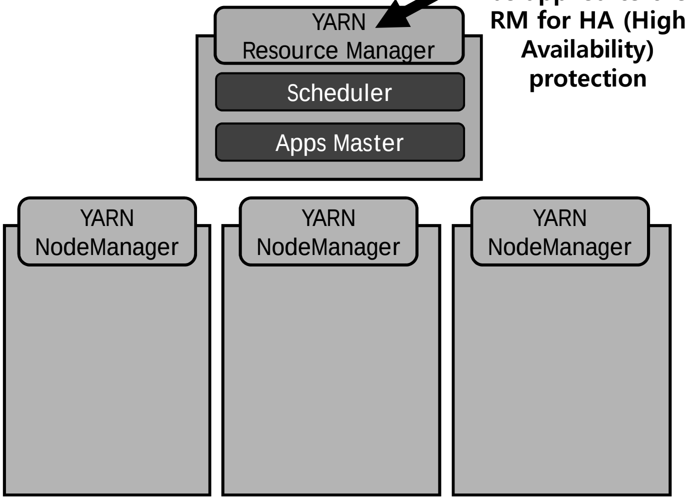
❖ Hadoop with YARN Example

- RM (Resource Manager) has a Scheduler and AM (Apps Master) inside
- RM prepares NMs (Node Managers) on multiple nodes in the cluster
- RM and NMs exchange Heartbeats



ZooKeeper can be applied to the RM for HA (High Availability) protection

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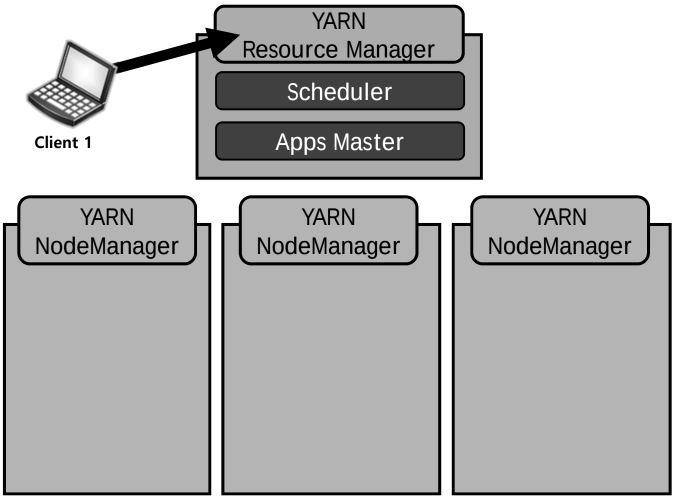
❖ Client 1 setup

1. Client 1 submits App1 (Application 1) to the RM



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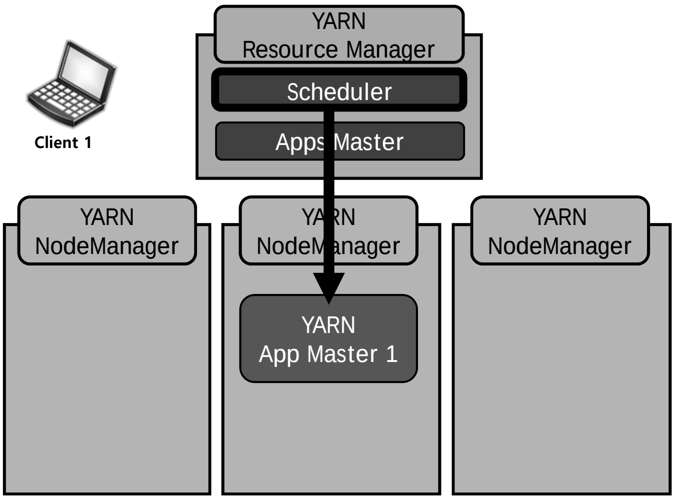
❖ Client 1 setup

1. Client 1 submits App1 (Application 1) to the RM
2. Scheduler selects a node with sufficient resources to setup AM1 (App Master 1)



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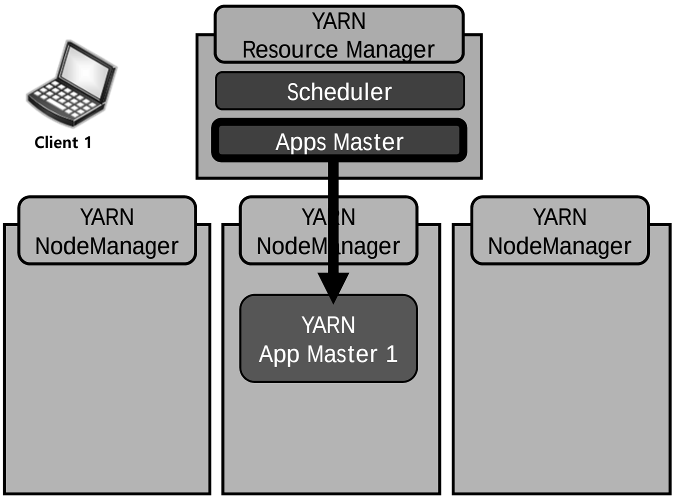
❖ Client 1 setup

1. Client 1 submits App1 (Application 1) to the RM
2. Scheduler selects a node with sufficient resources to setup AM1 (App Master 1)
3. AM (Apps Master) starts to monitor AM1 (to check if a failure occurs)



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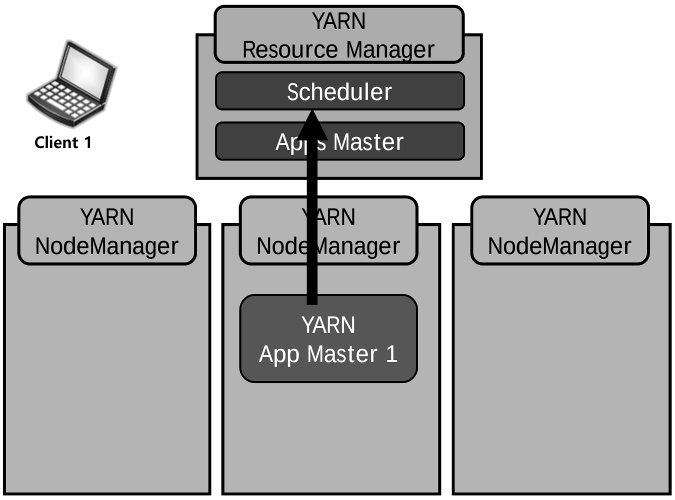
❖ Client 1 setup

4. AM1 communicates with the Scheduler requesting for Containers to be set on the nodes



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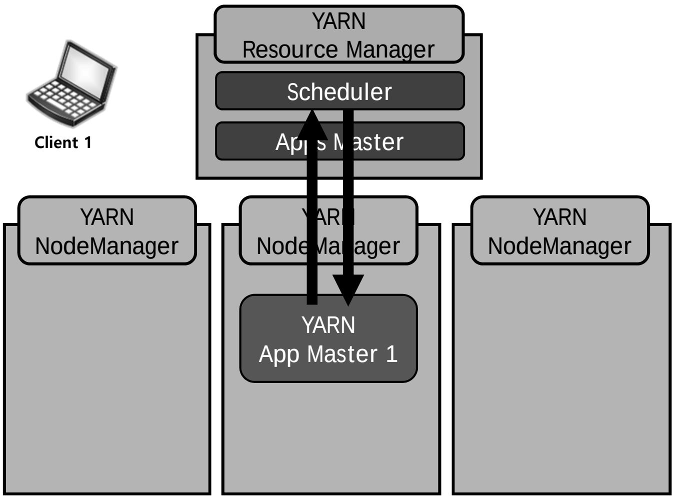
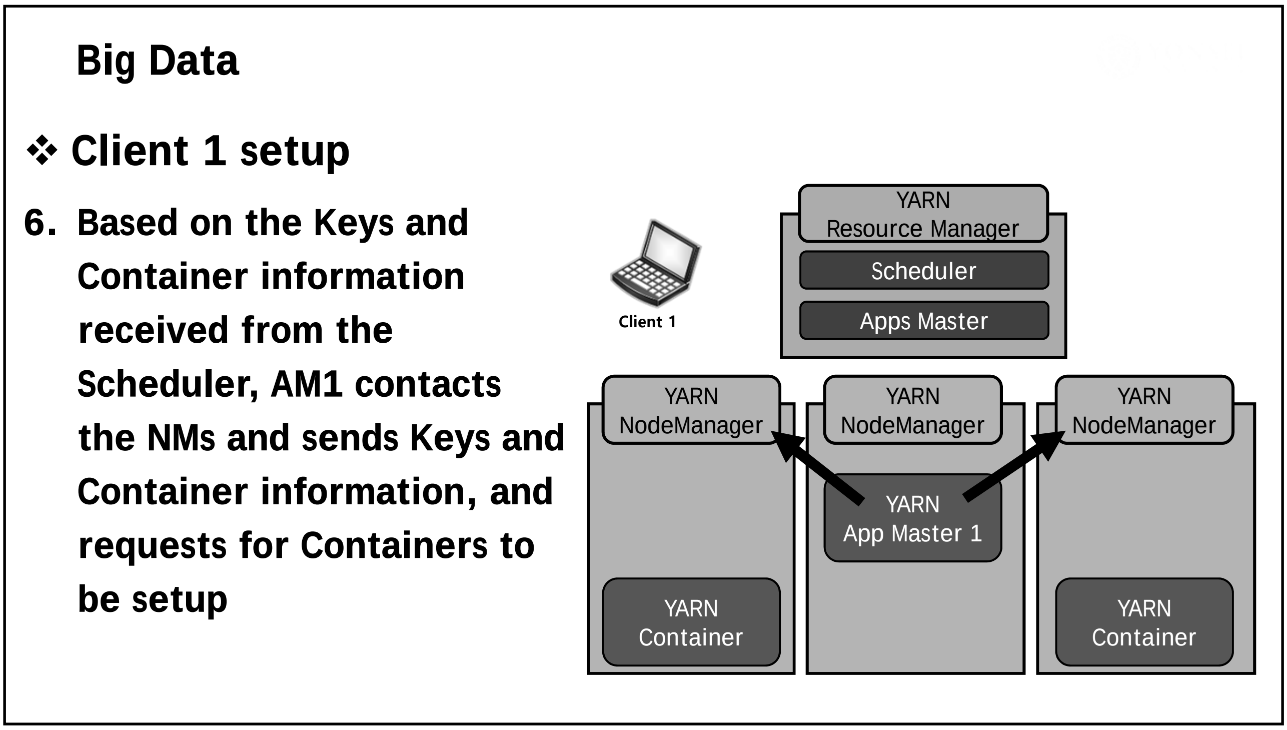
❖ Client 1 setup

4. AM1 communicates with the Scheduler requesting for Containers to be set on the nodes
5. Scheduler sends Keys and Container information to AM1 for the Containers to be setup





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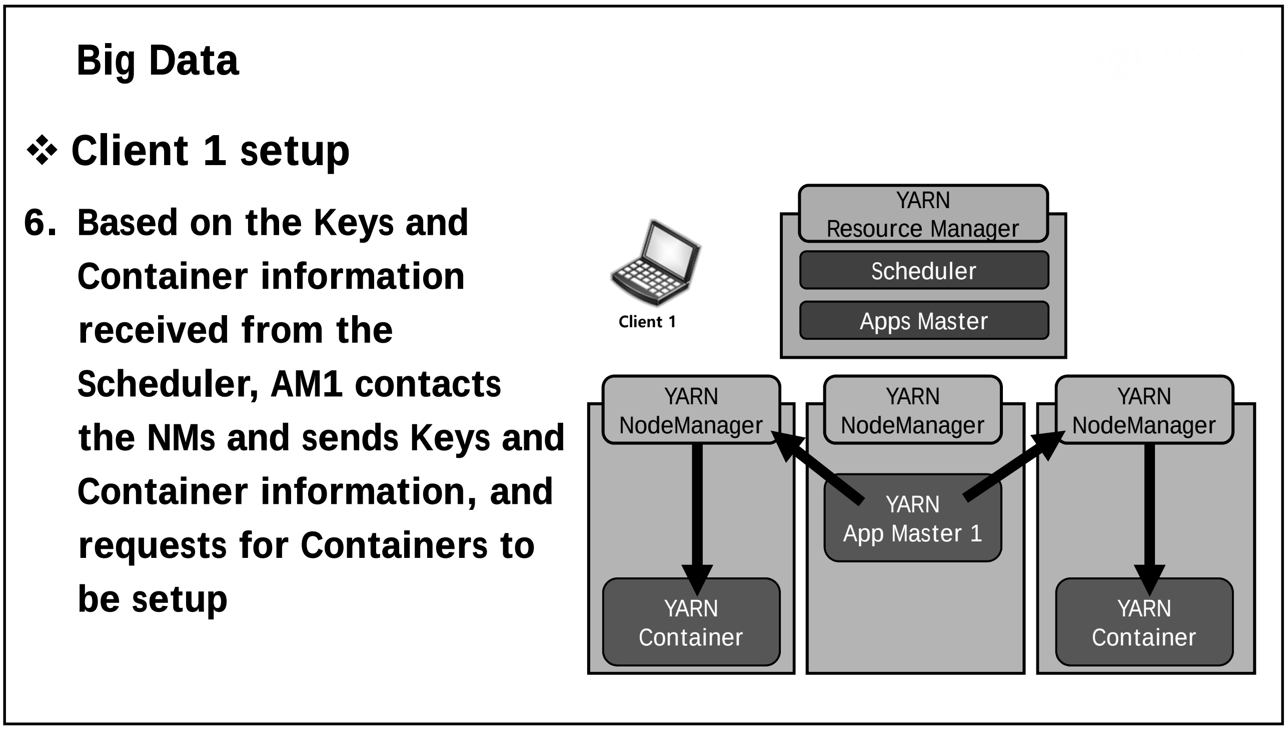
❖ Client 1 setup

6. Based on the Keys and Container information received from the Scheduler, AM1 contacts the NMs and sends Keys and Container information, and requests for Containers to be setup



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❖ Client 1 setup

6. Based on the Keys and Container information received from the Scheduler, AM1 contacts the NMs and sends Keys and Container information, and requests for Containers to be setup

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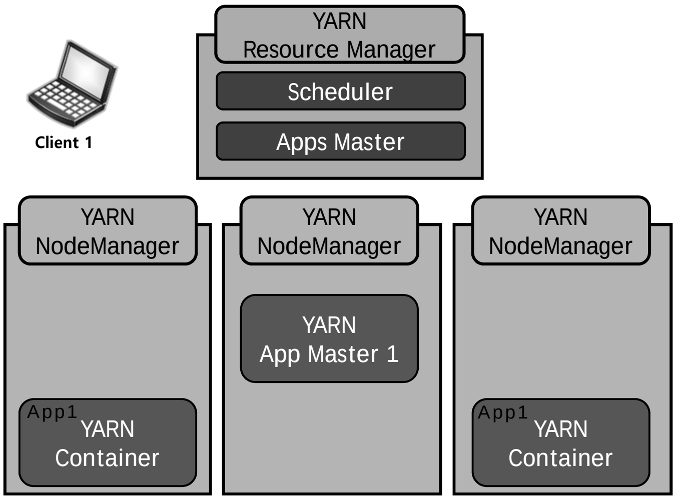
❖ Client 1 setup

7. Each NM contacted by AM1 will setup a Container to run App1 on their node



Client 1

YARN Resource Manager

Scheduler

Apps Master

YARN NodeManager

App1 YARN Container

YARN NodeManager

YARN App Master 1

YARN NodeManager

App1 YARN Container

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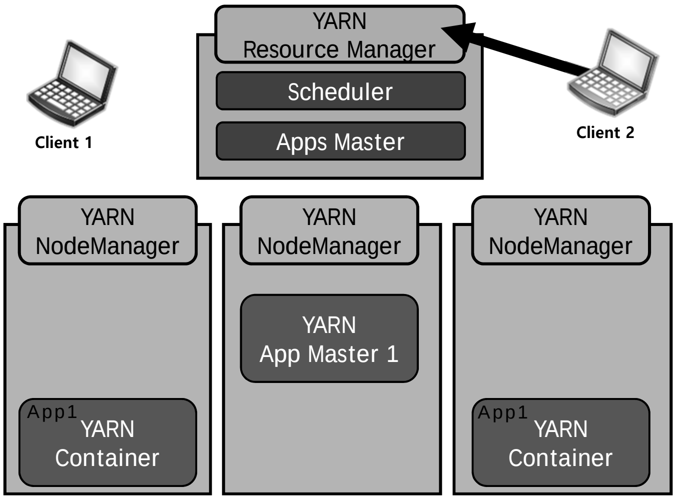
❖ Client 2 setup

8. Client 2 submits App2 (Application 2) to the RM



Client 1

YARN Resource Manager

Scheduler

Apps Master

Client 2

YARN NodeManager

App1 YARN Container

YARN NodeManager

YARN App Master 1

YARN NodeManager

App1 YARN Container

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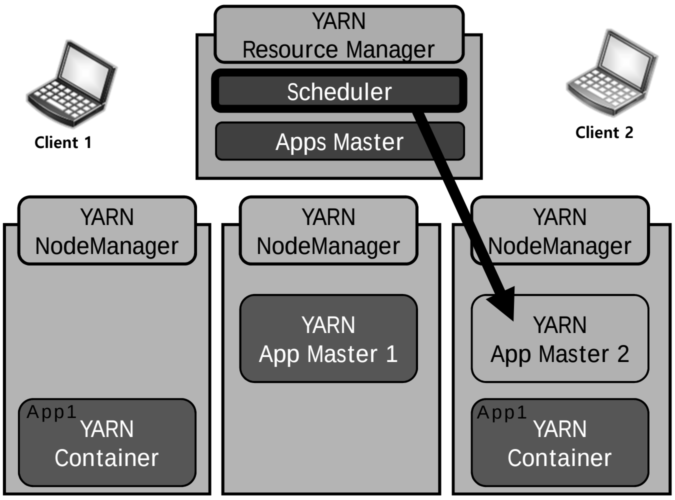
❖ Client 2 setup

8. Client 2 submits App2 (Application 2) to the RM
9. Scheduler selects a node to setup AM2 (App Master 2)



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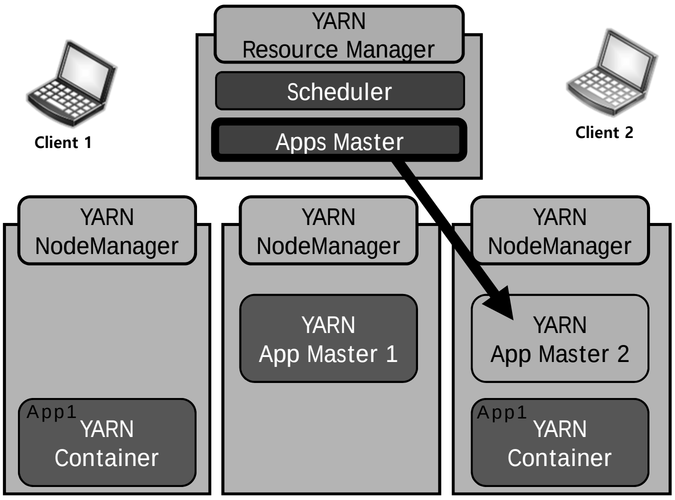
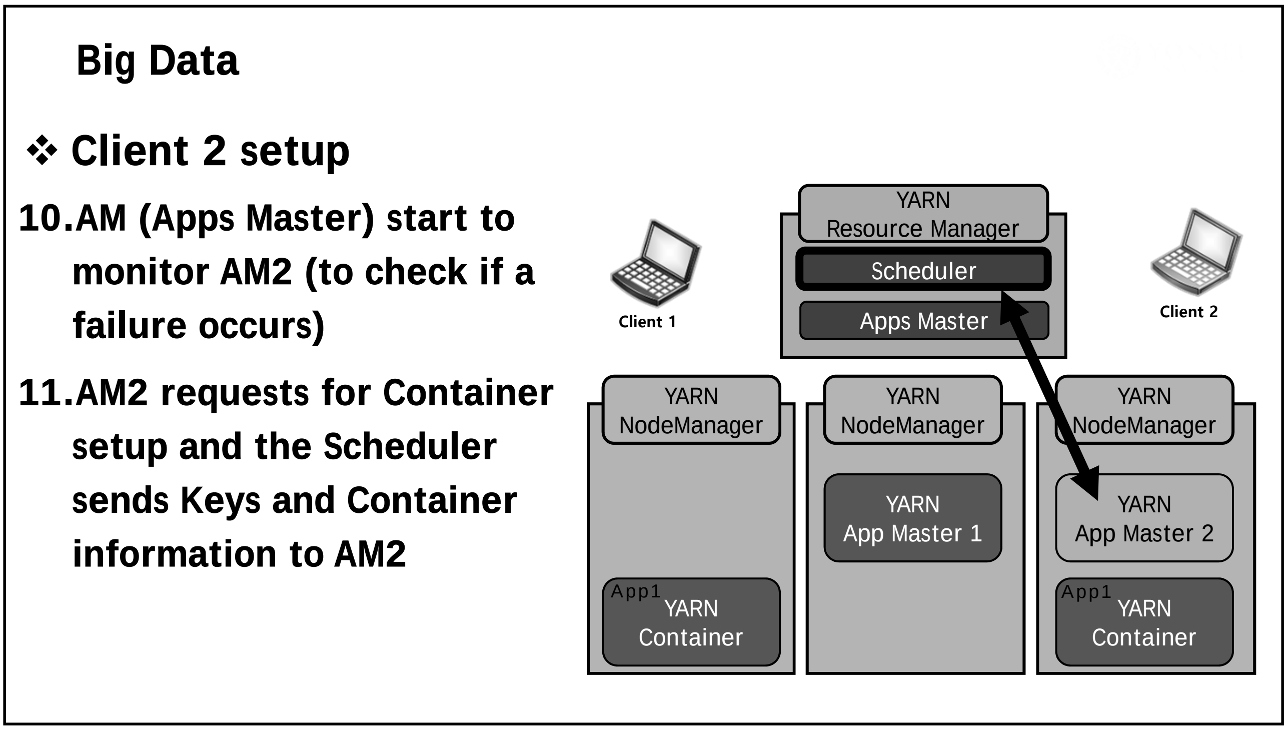
❖ Client 2 setup

10. AM (Apps Master) start to monitor AM2 (to check if a failure occurs)





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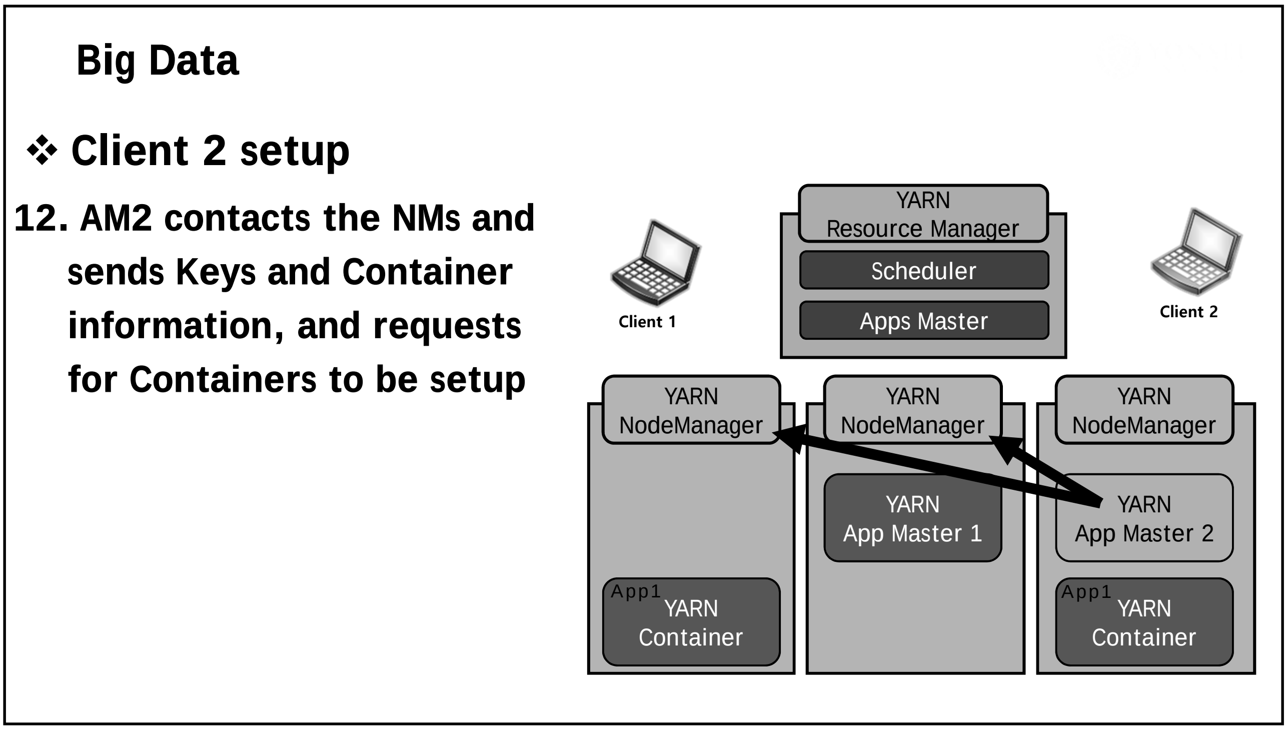
❖ Client 2 setup

10. AM (Apps Master) start to monitor AM2 (to check if a failure occurs)

11. AM2 requests for Container setup and the Scheduler sends Keys and Container information to AM2



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❖ Client 2 setup

12. AM2 contacts the NMs and sends Keys and Container information, and requests for Containers to be setup

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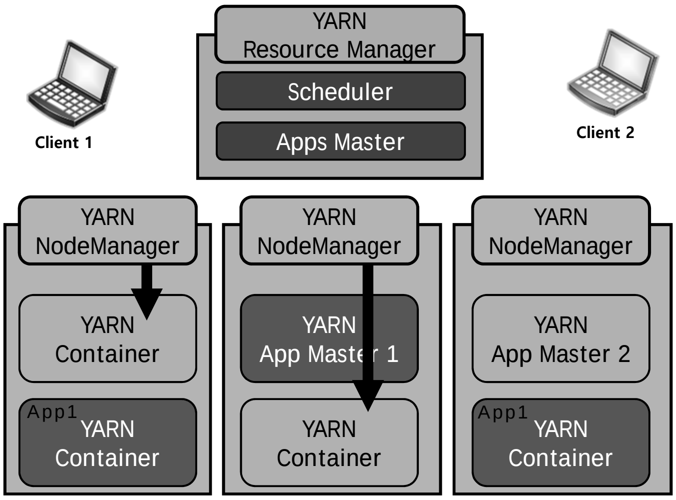
❖ Client 2 setup

12. AM2 contacts the NMs and sends Keys and Container information, and requests for Containers to be setup
13. Each NM contacted by AM2 will setup a Container to run App2 on their node



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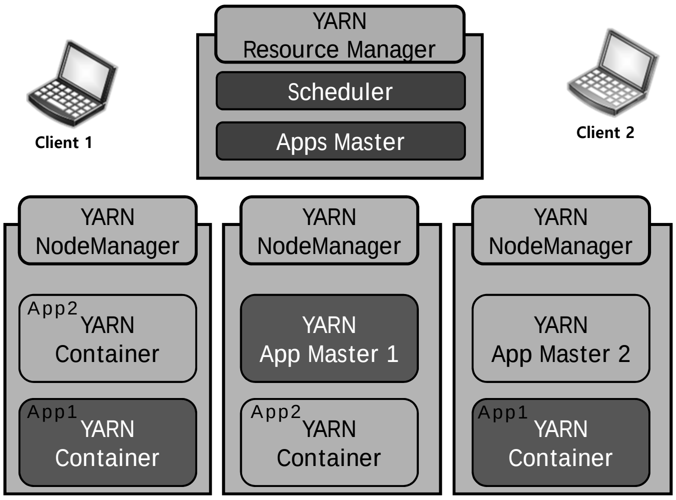
❖ Client 2 setup

12. AM2 contacts the NMs and sends Keys and Container information, and requests for Containers to be setup
13. Each NM contacted by AM2 will setup a Container to run App2 on their node
14. App2 will run on the new Containers



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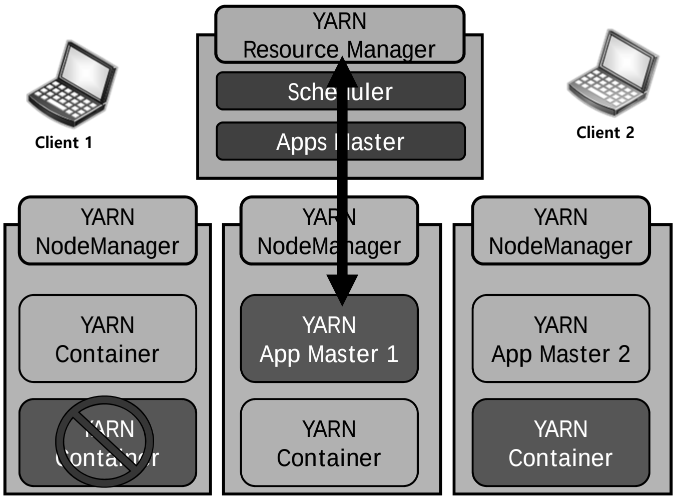
❖ Fault Tolerance in YARN

- If a Container crashes, AM1 will communicate with the RM and will setup a new Container to replace the crashed Container



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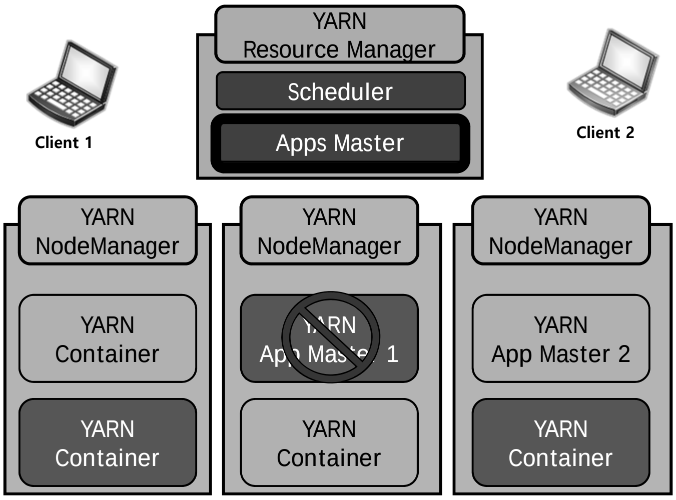
❖ Fault Tolerance in YARN

- If AM1 crashes, the AM in the RM will setup a new AM1 (on the same or on another node)



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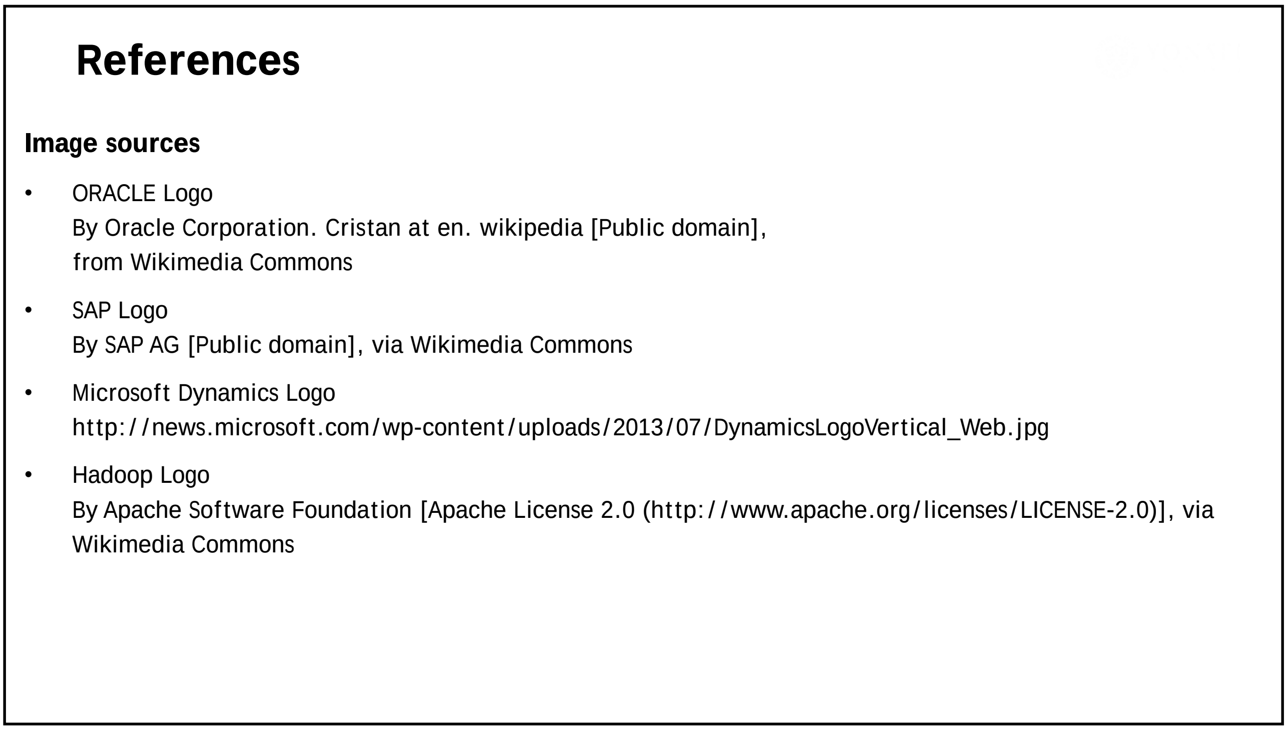

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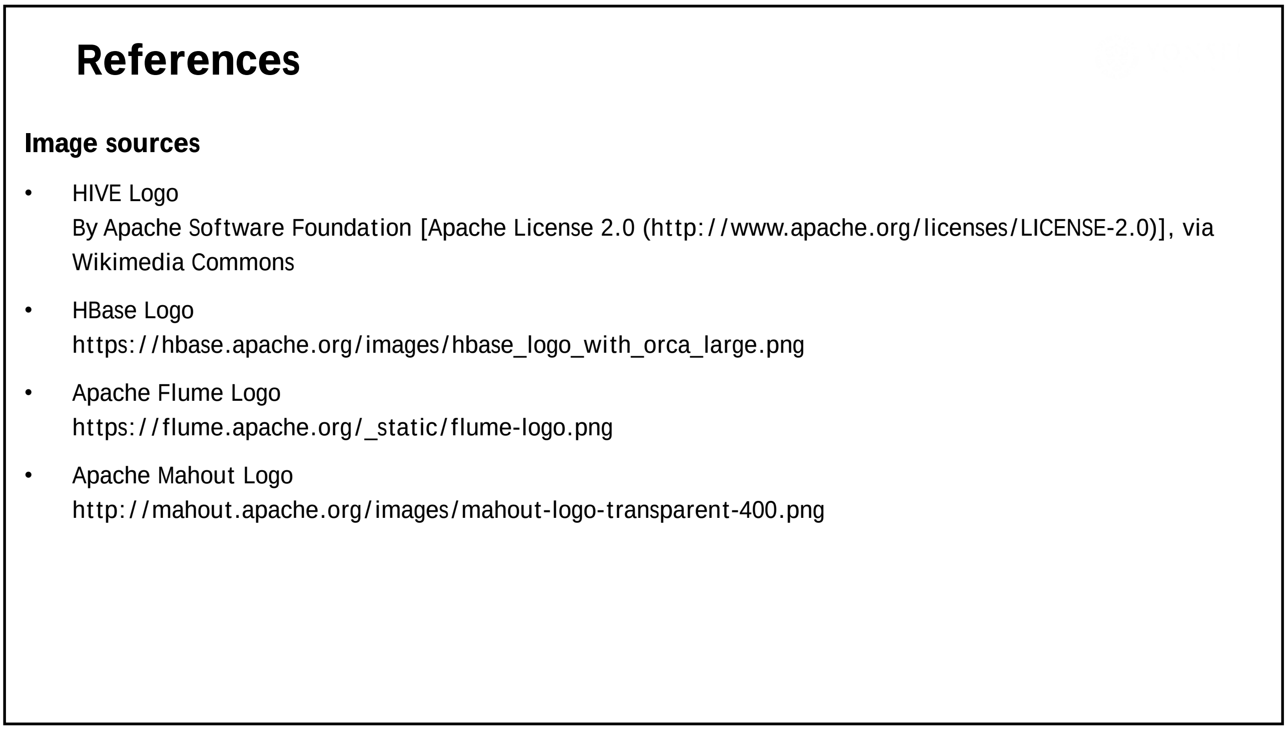

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