

Aspect	Namenode	Datanode
Role	Acts as the master server in HDFS, managing metadata and coordinating access to data	Serves as the worker node ; stores actual data blocks of files across the cluster
Functionality	Manages the namespace of the file system, mapping file names to their data blocks	Stores and retrieves data blocks as directed by the Namenode; does not store metadata
Metadata Storage	Stores metadata for all files and directories, including block locations, replication info	Does not store metadata ; simply stores the data blocks assigned to it
Fault Tolerance	High priority for fault tolerance; if the Namenode fails, the HDFS is inaccessible	Datanodes are expendable; if a Datanode fails, data is re-replicated from other Datanodes
Communication	Communicates with client applications and Datanodes, coordinates read/write requests	Regularly sends heartbeats and block reports to the Namenode to confirm health and status
Replication Control	Controls and monitors replication to ensure data availability and fault tolerance	Stores replicas as per the Namenode's instructions and can delete or replicate data blocks as needed
Data Storage	Does not store actual data ; only stores metadata and system information about data block storage	Stores the actual data blocks as directed by the Namenode
Memory Requirements	Requires high memory and processing power to manage metadata for the entire file system	Lower memory requirement; primarily requires storage capacity for data blocks
Scalability	Limited scalability due to metadata constraints; only one primary Namenode is active at a time	Highly scalable; more Datanodes can be added to expand storage capacity
Fault Recovery	If the Namenode fails, a Secondary or Standby Namenode can help with recovery (in HA setup)	If a Datanode fails, the Namenode re-replicates blocks to other Datanodes to maintain replication

Examples of Data Stored	File names, directory structure, permissions, block mapping, replication info	Raw data blocks of files as directed by Namenode
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