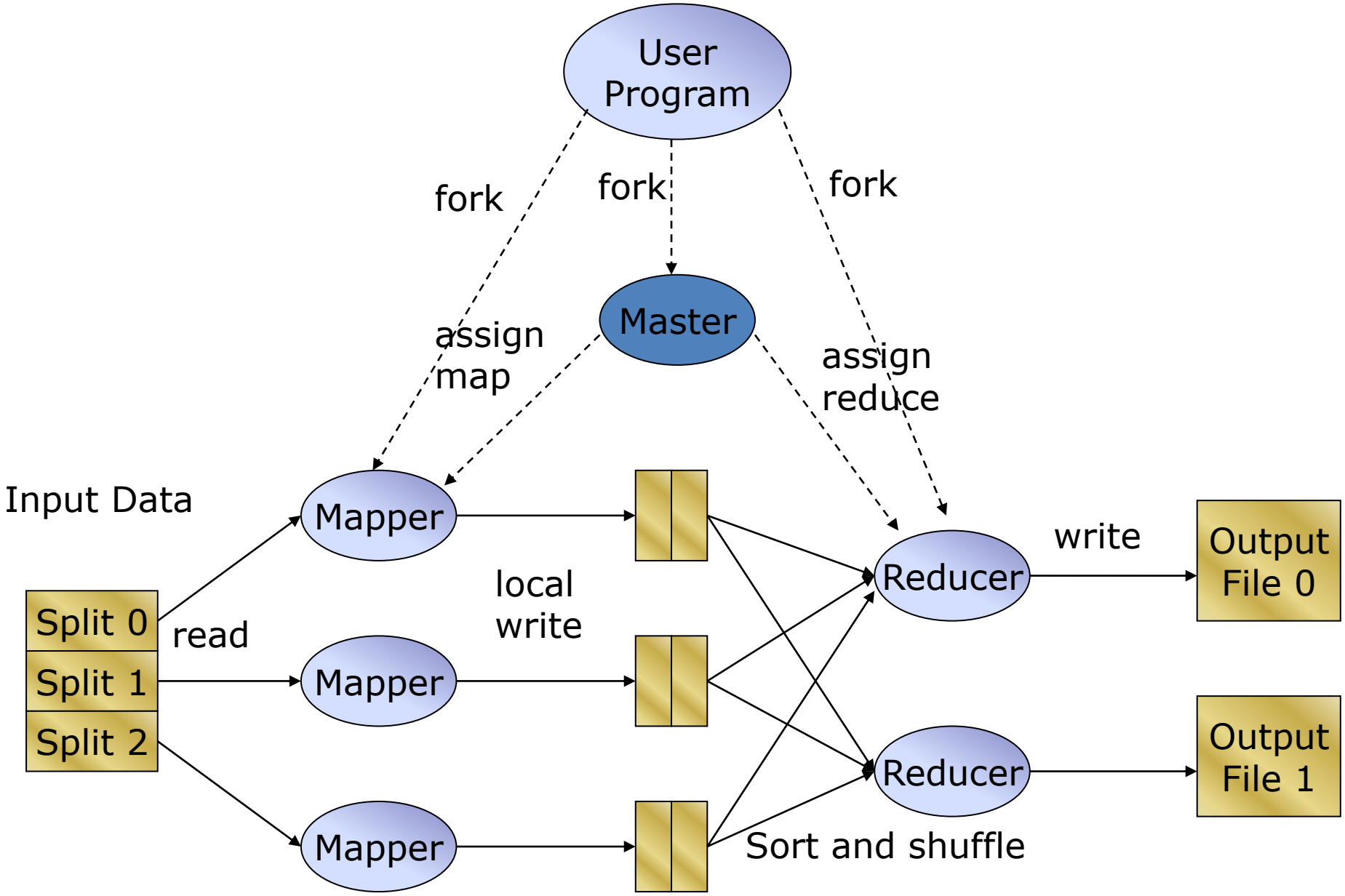
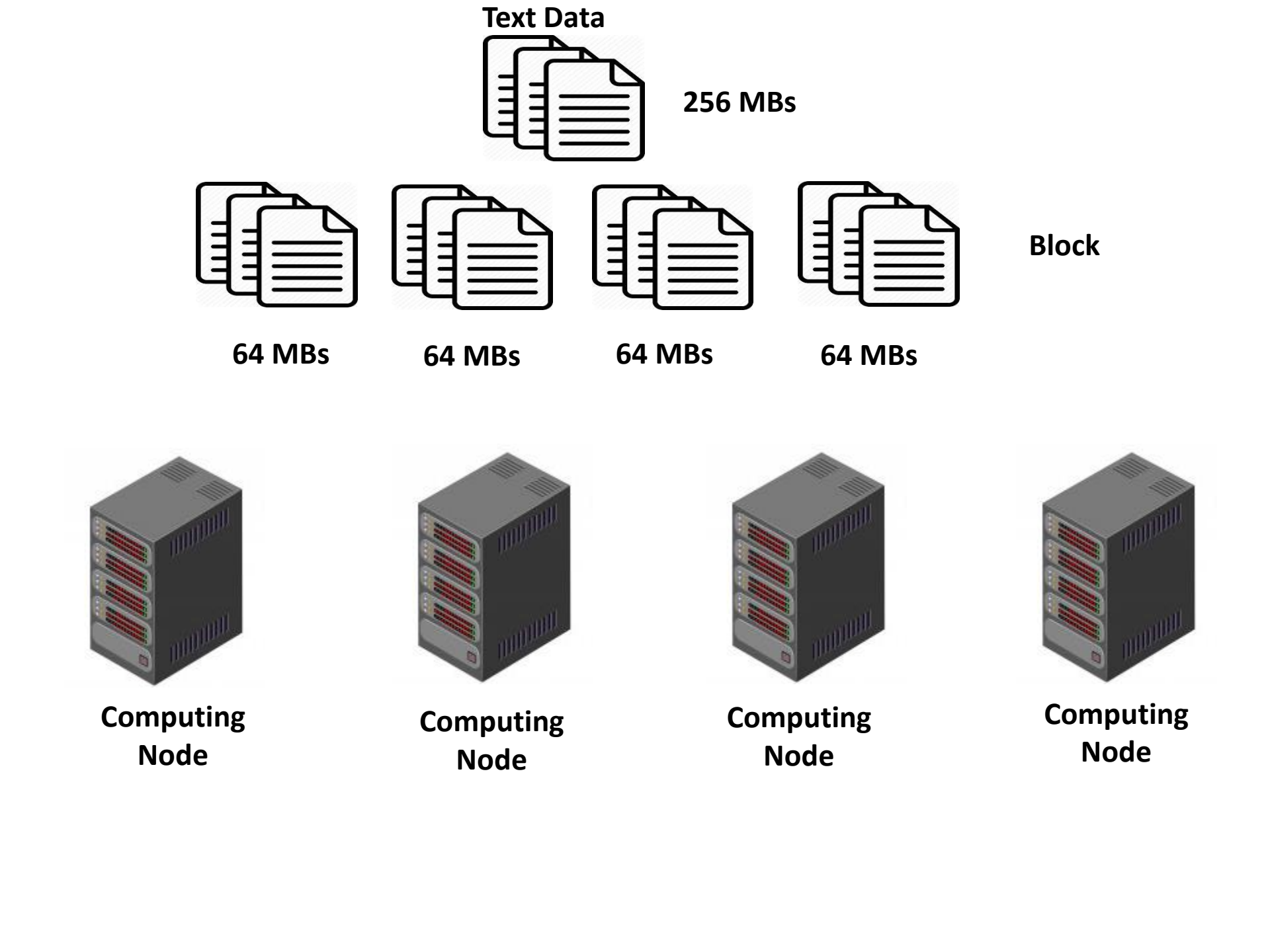
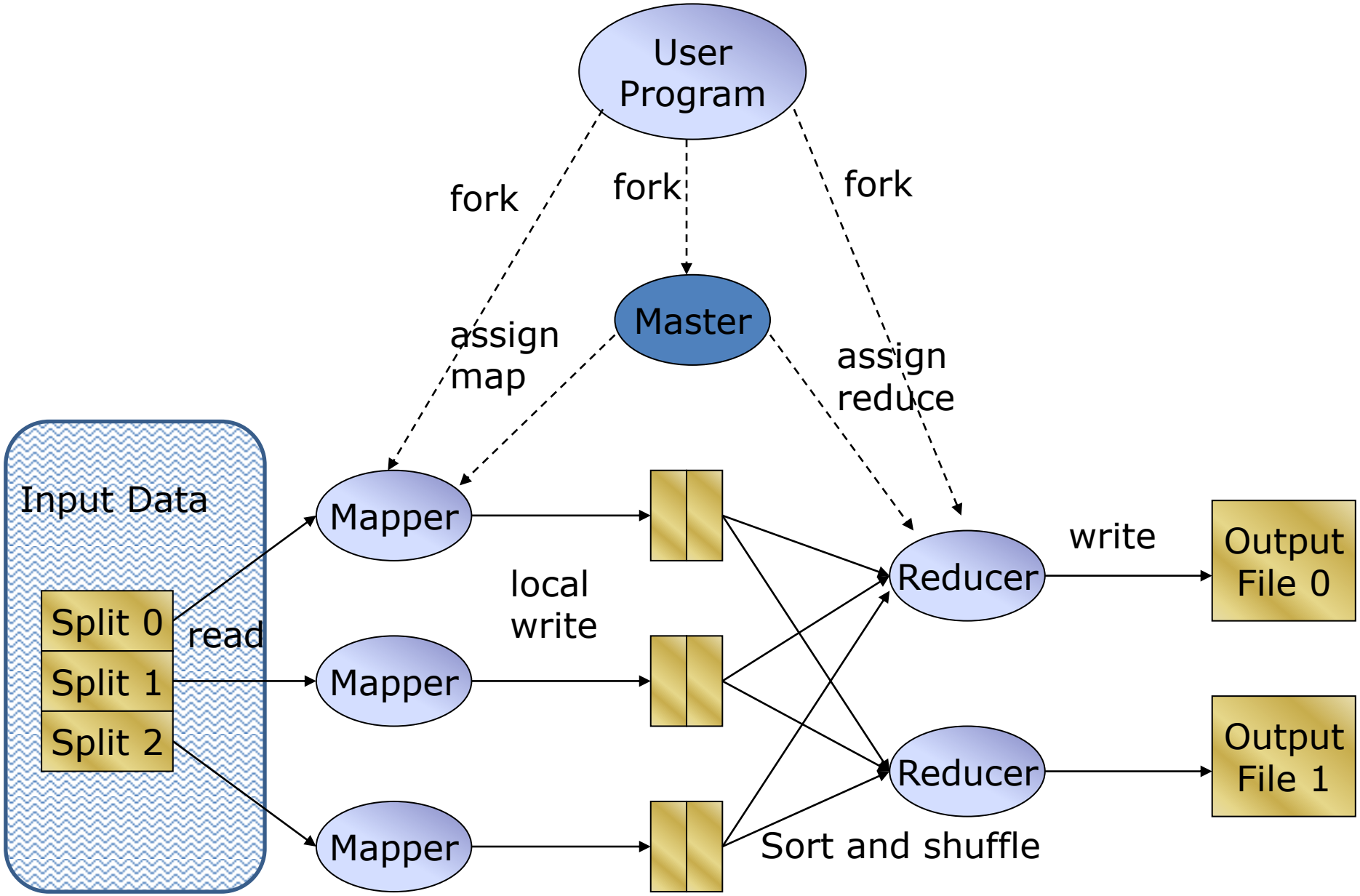
# MapReduce


User Program
fork
fork
fork
Master
assign map
assign reduce
Input Data
Mapper
Split 0
Split 1
Split 2
read
Mapper
Mapper
local write
Reducer
Reducer
write
Output File 0
Output File 1
Sort and shuffle


Text Data
256 MBs
Block
64 MBs
64 MBs
64 MBs
64 MBs
Computing Node
Computing Node
Computing Node
Computing Node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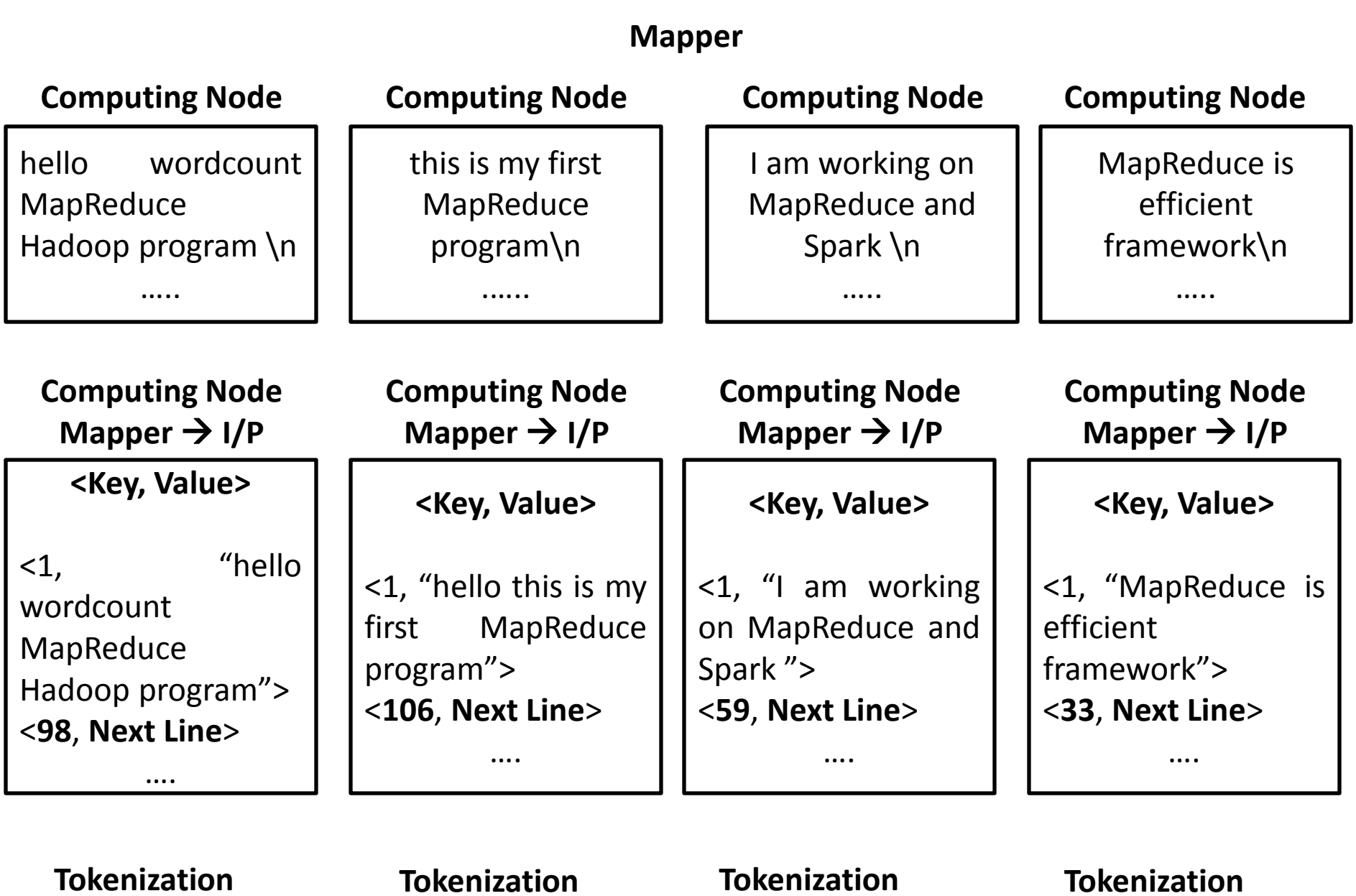
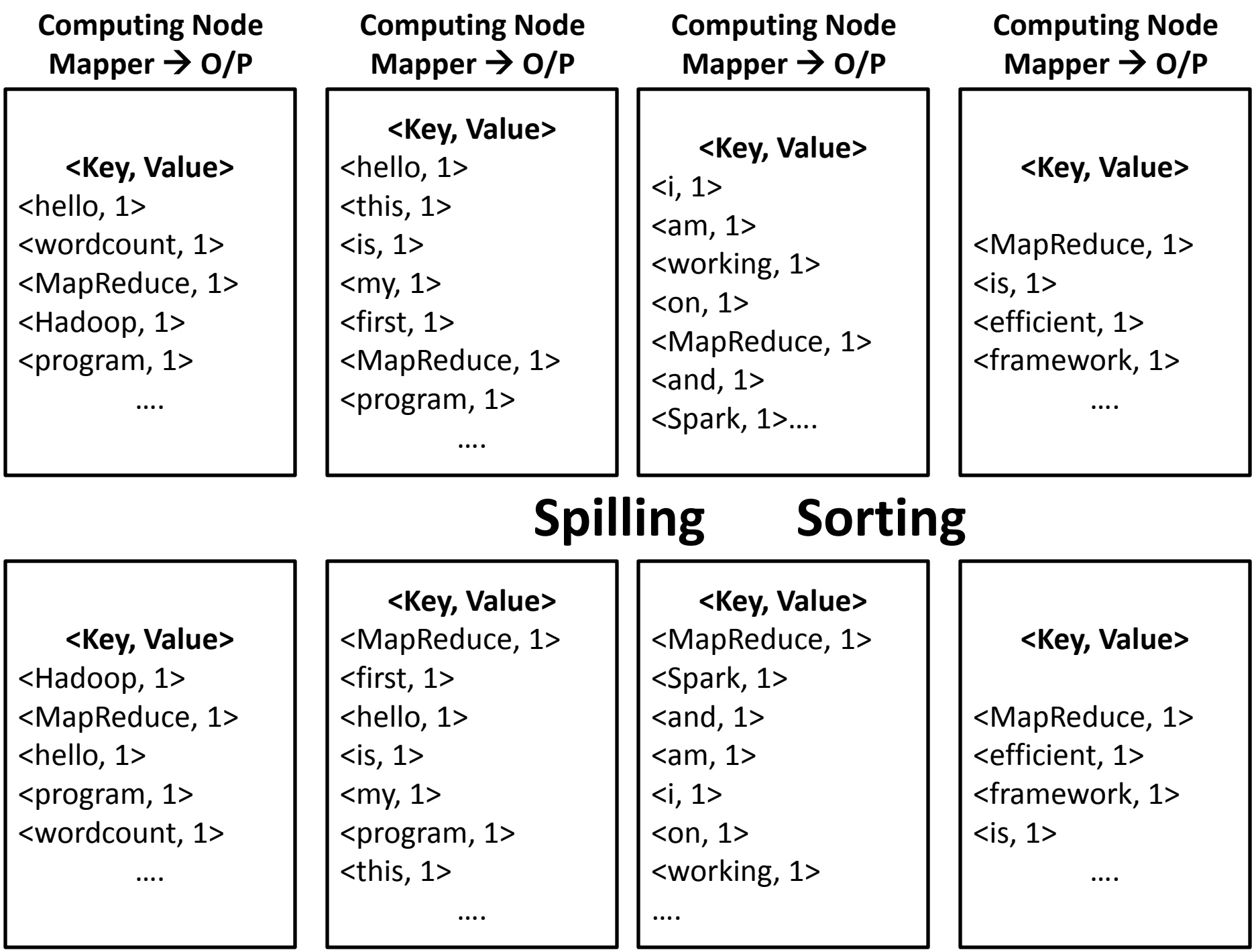
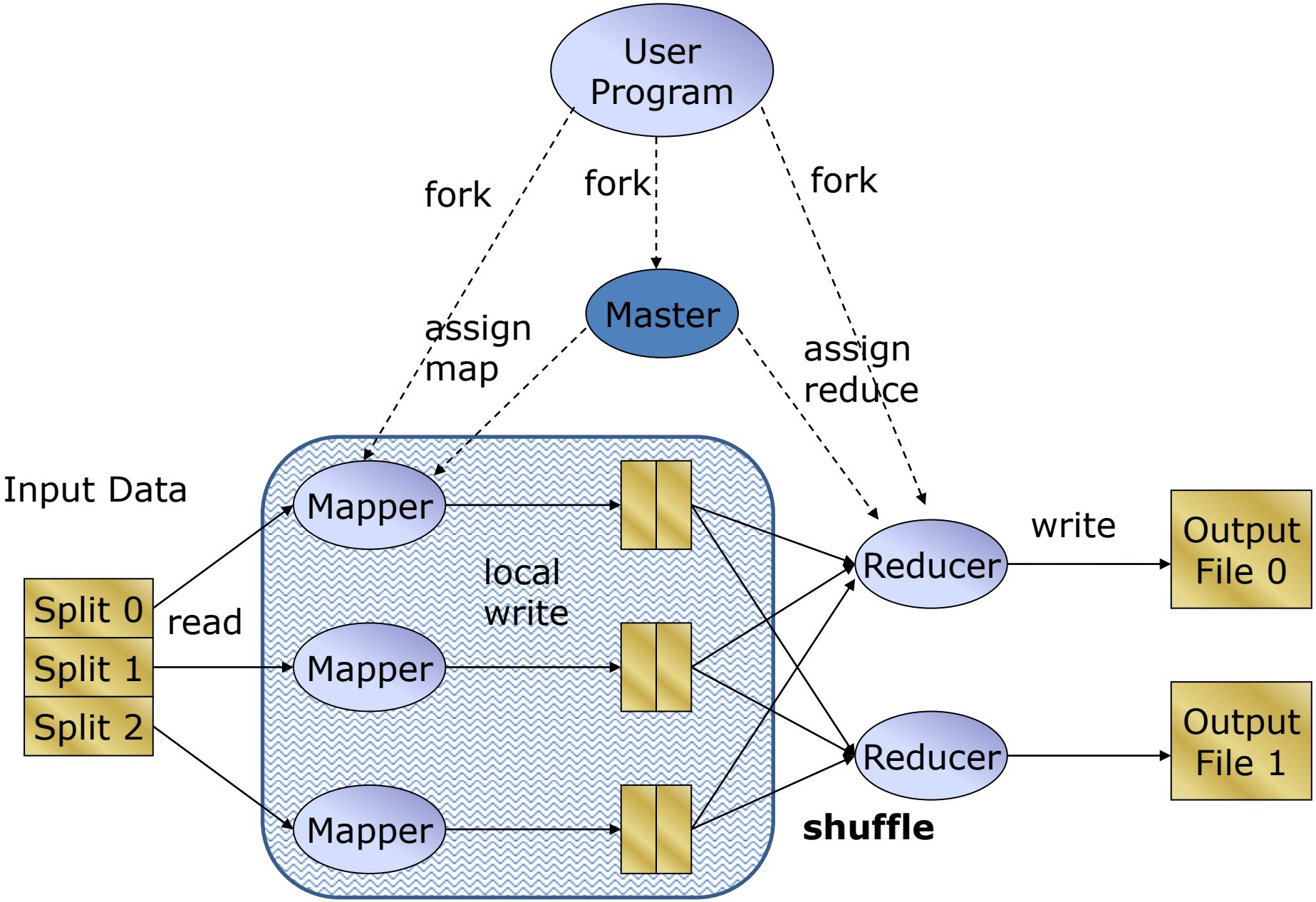

Mapper
Computing Node
Computing Node
Computing Node
Computing Node
hello wordcount MapReduce Hadoop program \n .....
this is my first MapReduce program\n .....
I am working on MapReduce and Spark \n .....
MapReduce is efficient framework\n .....
Computing Node Mapper → I/P
Computing Node Mapper → I/P
Computing Node Mapper → I/P
Computing Node Mapper → I/P
<Key, Value>
<1, "hello wordcount MapReduce Hadoop program">
<98, Next Line>
....
<Key, Value>
<1, "hello this is my first MapReduce program">
<106, Next Line>
....
<Key, Value>
<1, "I am working on MapReduce and Spark ">
<59, Next Line>
....
<Key, Value>
<1, "MapReduce is efficient framework">
<33, Next Line>
....
Tokenization
Tokenization
Tokenization
Tokenization


Computing Node
Mapper → O/P
<Key, Value>
<hello, 1>
<wordcount, 1>
<MapReduce, 1>
<Hadoop, 1>
<program, 1>
….
Computing Node
Mapper → O/P
<Key, Value>
<hello, 1>
<this, 1>
<is, 1>
<my, 1>
<first, 1>
<MapReduce, 1>
<program, 1>
….
Computing Node
Mapper → O/P
<Key, Value>
<i, 1>
<am, 1>
<working, 1>
<on, 1>
<MapReduce, 1>
<and, 1>
<Spark, 1>….
Computing Node
Mapper → O/P
<Key, Value>
<MapReduce, 1>
<is, 1>
<efficient, 1>
<framework, 1>
….
Spilling
Sorting
<Key, Value>
<Hadoop, 1>
<MapReduce, 1>
<hello, 1>
<program, 1>
<wordcount, 1>
….
<Key, Value>
<MapReduce, 1>
<first, 1>
<hello, 1>
<is, 1>
<my, 1>
<program, 1>
<this, 1>
….
<Key, Value>
<MapReduce, 1>
<Spark, 1>
<and, 1>
<am, 1>
<i, 1>
<on, 1>
<working, 1>
….
<Key, Value>
<MapReduce, 1>
<efficient, 1>
<framework, 1>
<is, 1>
….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Reducer
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write
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Output File 1
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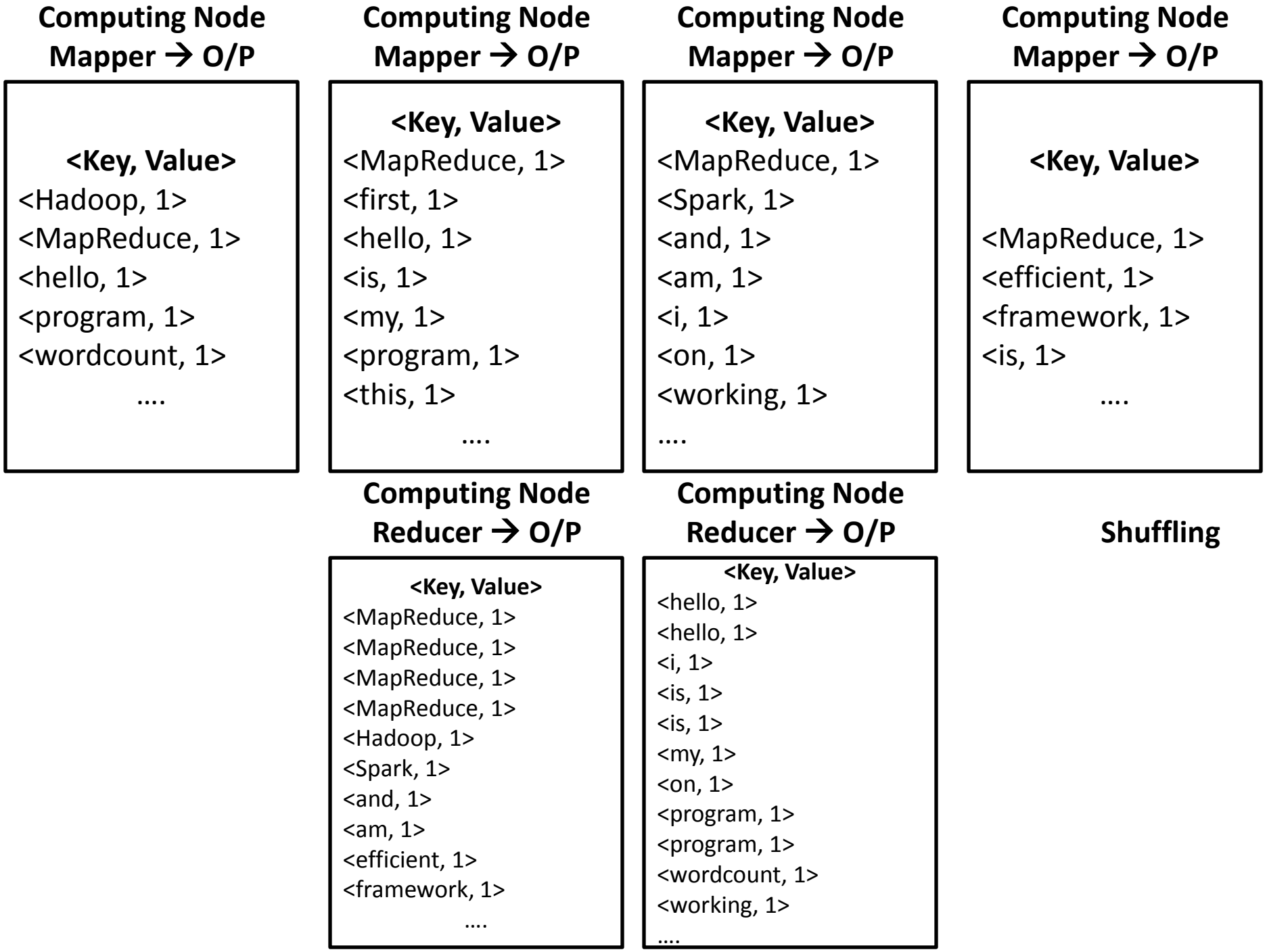

Computing Node
Mapper → O/P
<Key, Value>
<Hadoop, 1>
<MapReduce, 1>
<hello, 1>
<program, 1>
<wordcount, 1>
….
Computing Node
Mapper → O/P
<Key, Value>
<MapReduce, 1>
<first, 1>
<hello, 1>
<is, 1>
<my, 1>
<program, 1>
<this, 1>
….
Computing Node
Mapper → O/P
<Key, Value>
<MapReduce, 1>
<Spark, 1>
<and, 1>
<am, 1>
<i, 1>
<on, 1>
<working, 1>
….
Computing Node
Mapper → O/P
<Key, Value>
<MapReduce, 1>
<efficient, 1>
<framework, 1>
<is, 1>
….
Computing Node
Reducer → O/P
<Key, Value>
<MapReduce, 1>
<MapReduce, 1>
<MapReduce, 1>
<MapReduce, 1>
<Hadoop, 1>
<Spark, 1>
<and, 1>
<am, 1>
<efficient, 1>
<framework, 1>
….
Computing Node
Reducer → O/P
<Key, Value>
<hello, 1>
<hello, 1>
<i, 1>
<is, 1>
<is, 1>
<my, 1>
<on, 1>
<program, 1>
<program, 1>
<wordcount, 1>
<working, 1>
….
Shuffling

**Computing Node**
**Reducer → O/P**

| **<Key, Value>** |
| --- |
| <MapReduce, 1> |
| <MapReduce, 1> |
| <MapReduce, 1> |
| <MapReduce, 1> |
| <Hadoop, 1> |
| <Spark, 1> |
| <and, 1> |
| <am, 1> |
| <efficient, 1> |
| <framework, 1> |
| …. |

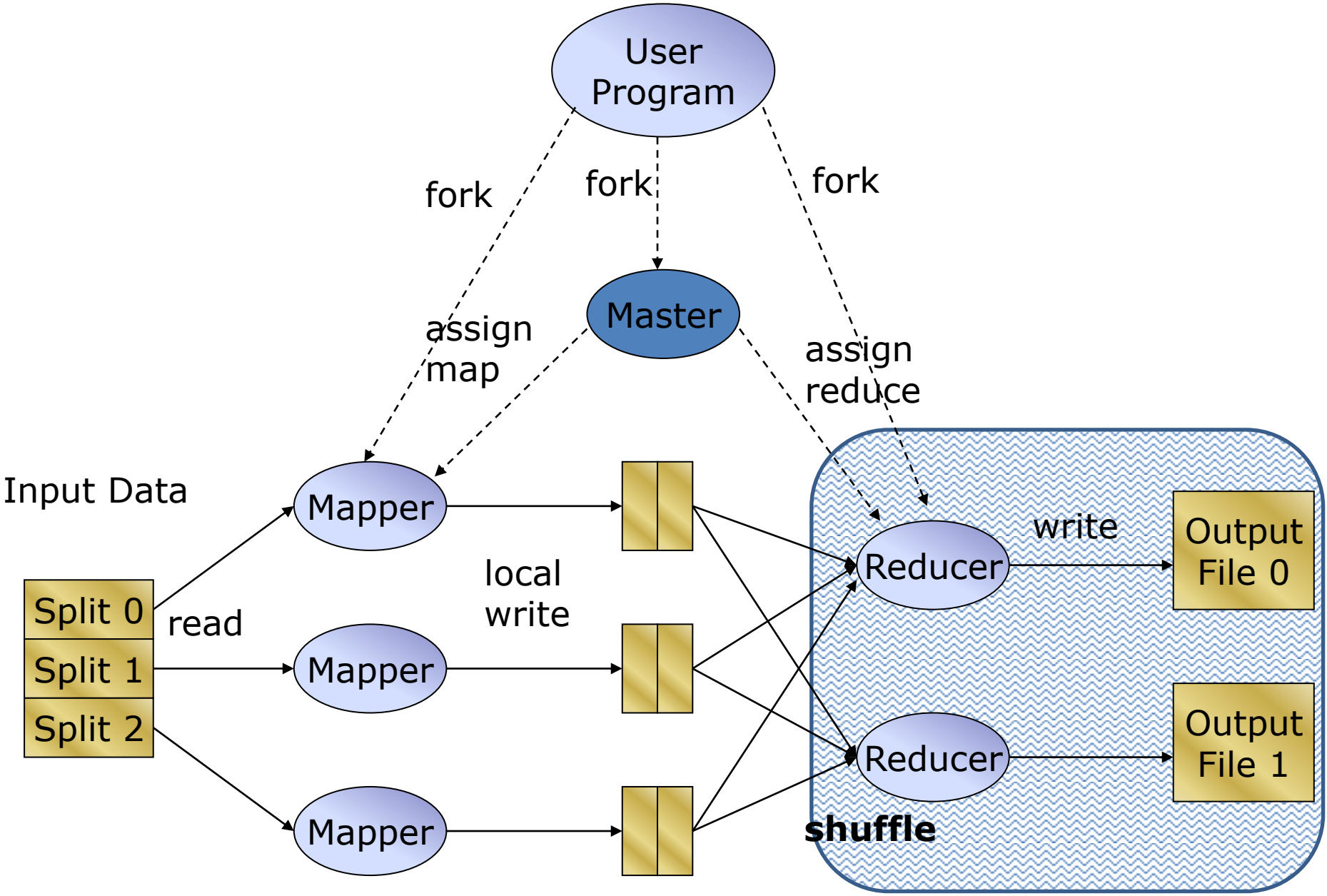
**Computing Node**
**Reducer → O/P**

| **<Key, Value>** |
| --- |
| <hello, 1> |
| <hello, 1> |
| <i, 1> |
| <is, 1> |
| <is, 1> |
| <my, 1> |
| <on, 1> |
| <program, 1> |
| <program, 1> |
| <wordcount, 1> |
| <working, 1> |
| …. |

| **<Key, Value>** |
| --- |
| <MapReduce, 4> |
| <Hadoop, 1> |
| <Spark, 1> |
| <and, 1> |
| <am, 1> |
| <efficient, 1> |
| <framework, 1> |
| …. |

| **<Key, Value>** |
| --- |
| <hello, 2> |
| <i, 1> |
| <is, 2> |
| <my, 1> |
| <on, 1> |
| <program, 2> |
| <wordcount, 1> |
| <working, 1> |
| …. |

**HDFS**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Reducer
write
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Output File 1
shuffle

- No of Mapper and Reducer
- Key Parameter in MapReduce Design
  - Key-Value pair
  - Load Balance b/t Mapper and Reducer