MapReduce:

Simple Programming for Big Results

After this video you will be able to..

- Explain how MapReduce simplifies creating parallel programs

- Design a WordCount application using the MapReduce programming model

MapReduce = Programming Model for Hadoop Ecosystem

Parallel Programming = Requires Expertise

Semaphores

Threads

Monitors

Message Passing

Shared Memory

Locks

MapReduce = Only Map and Reduce!

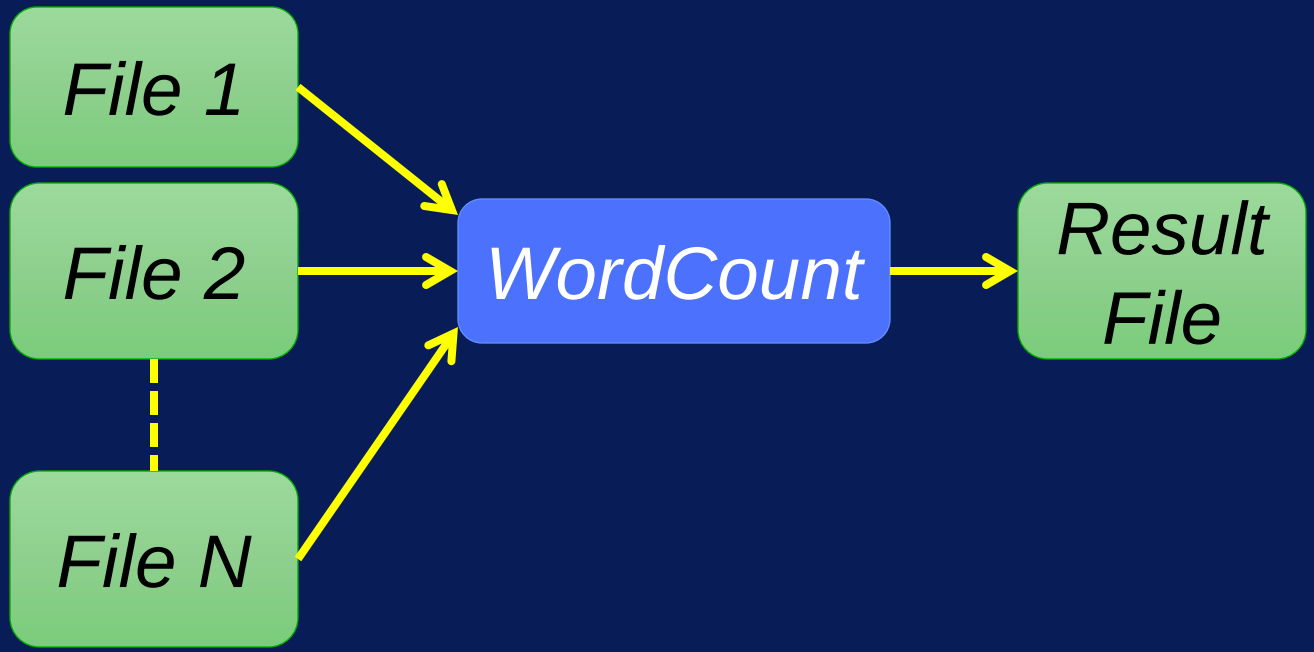
Based on Functional Programming

Map = apply operation to all elements

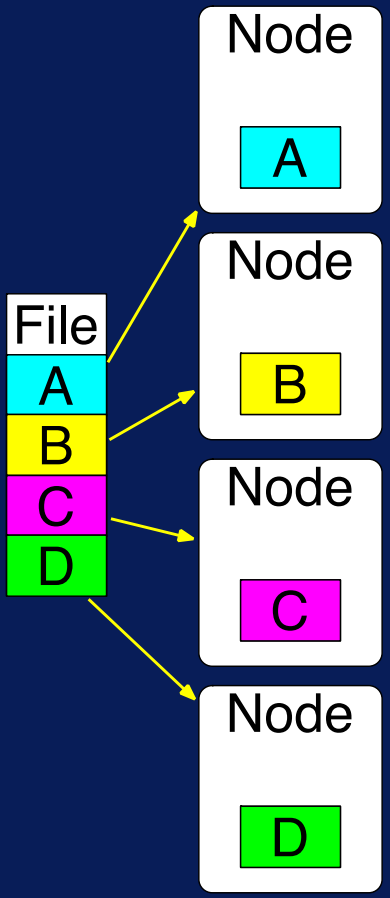
Reduce = summarize operation on elements

f (x) = y

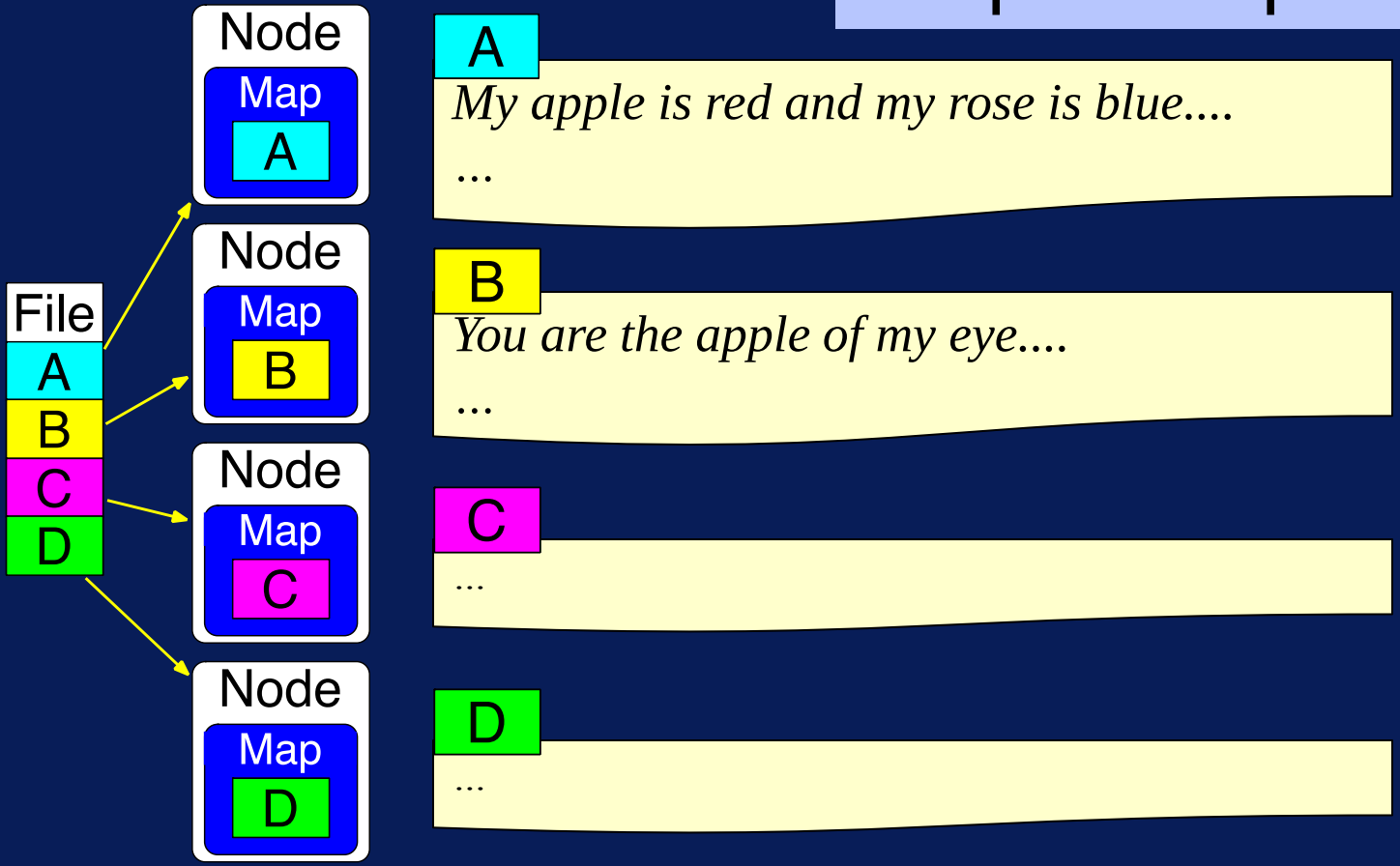
Example MapReduce Application: WordCount

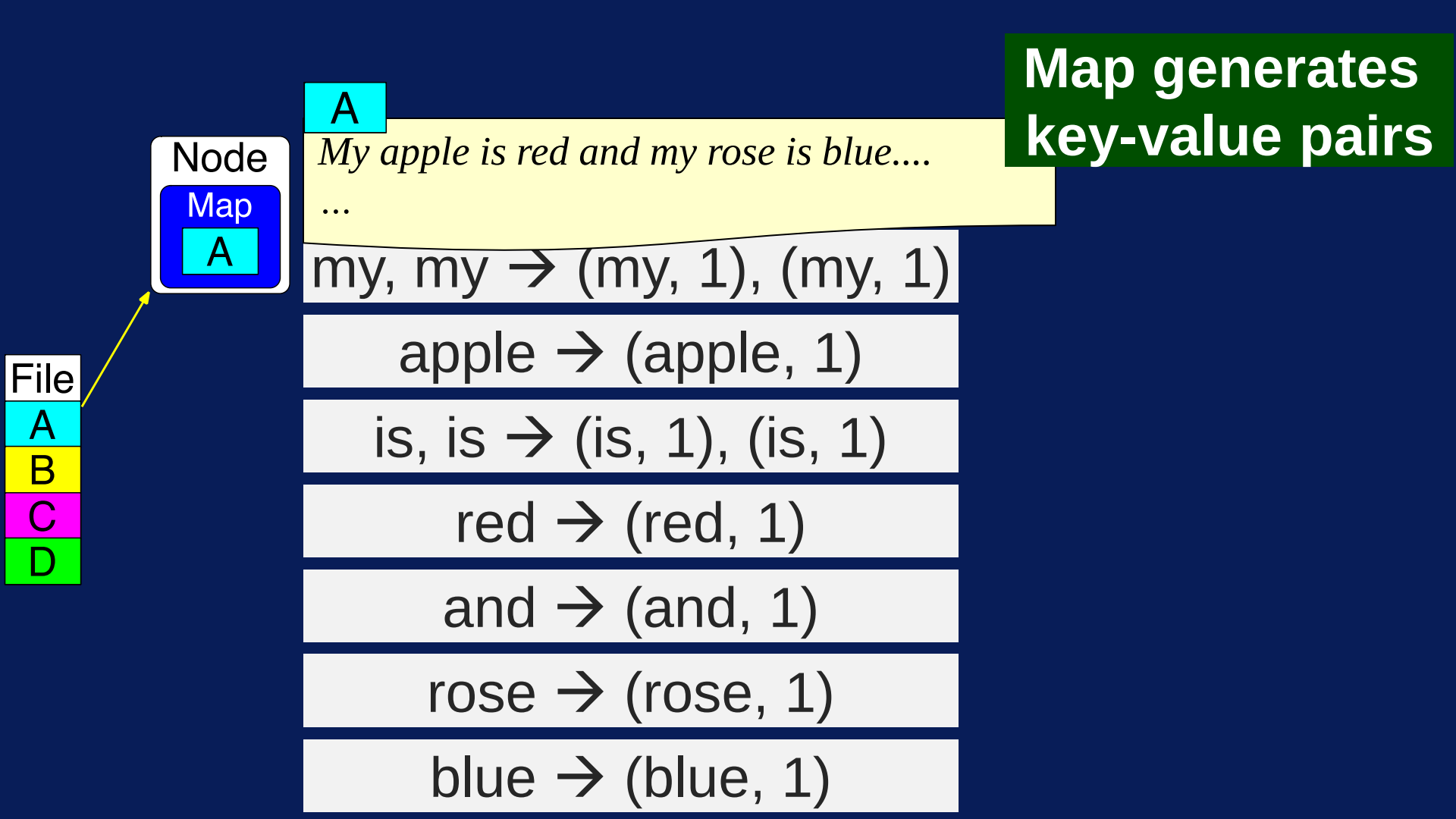


Step 0: File is stored in HDFS

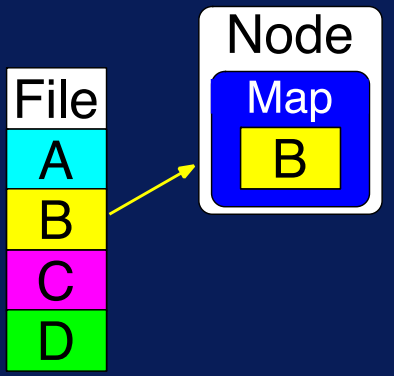


Step 1: Map on each node




Map generates key-value pairs
Node
Map
A
File
A
B
C
D
A
My apple is red and my rose is blue....
...
my, my → (my, 1), (my, 1)
apple → (apple, 1)
is, is → (is, 1), (is, 1)
red → (red, 1)
and → (and, 1)
rose → (rose, 1)
blue → (blue, 1)

Map generates key-value pairs



B

You are the apple of my eye....

...

You → (You, 1)

are → (are, 1)

the → (the, 1)

apple → (apple, 1)

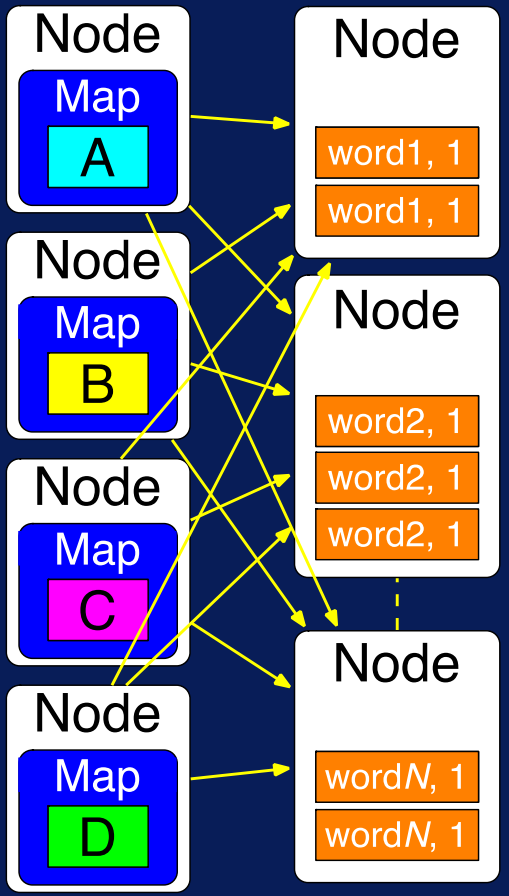
of → (of, 1)

my → (my, 1)

eye → (eye, 1)

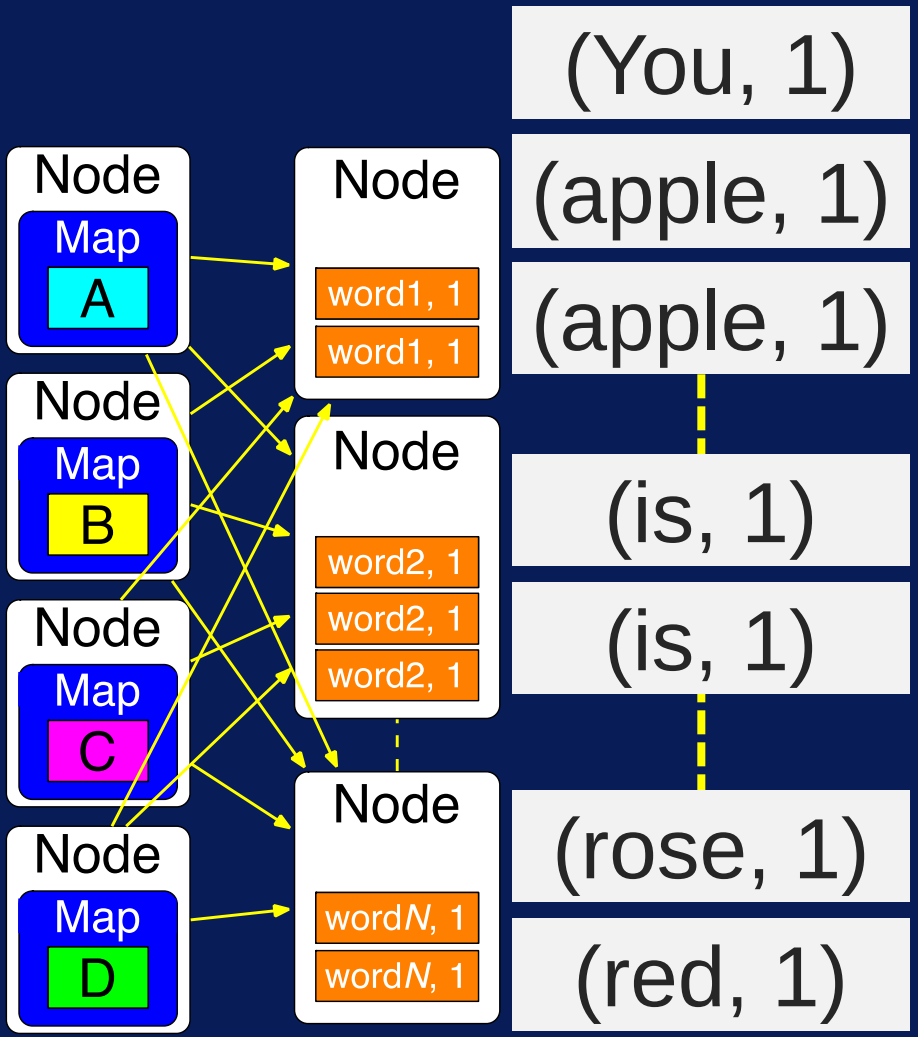
Step 2: Sort and Shuffle

Pairs with same key moved to same node



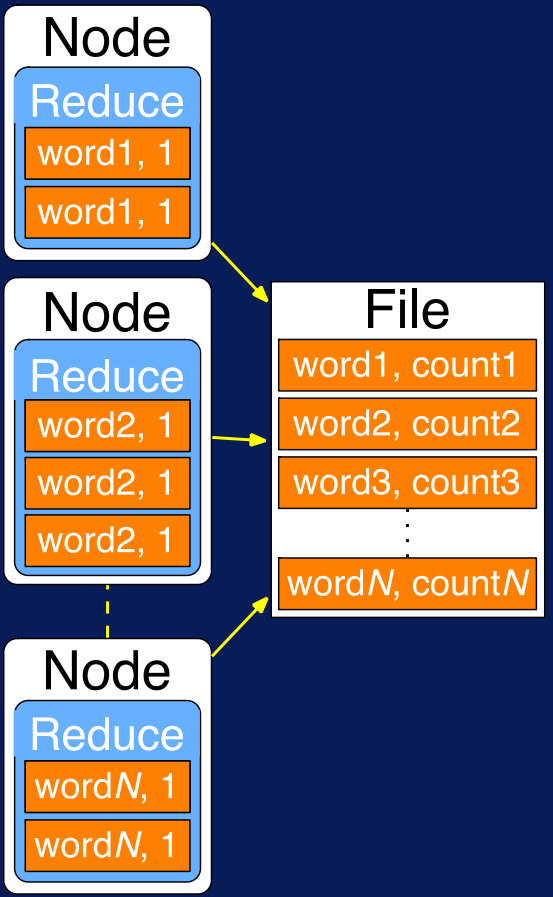
Step 2: Sort and Shuffle

Pairs with same key moved to same node



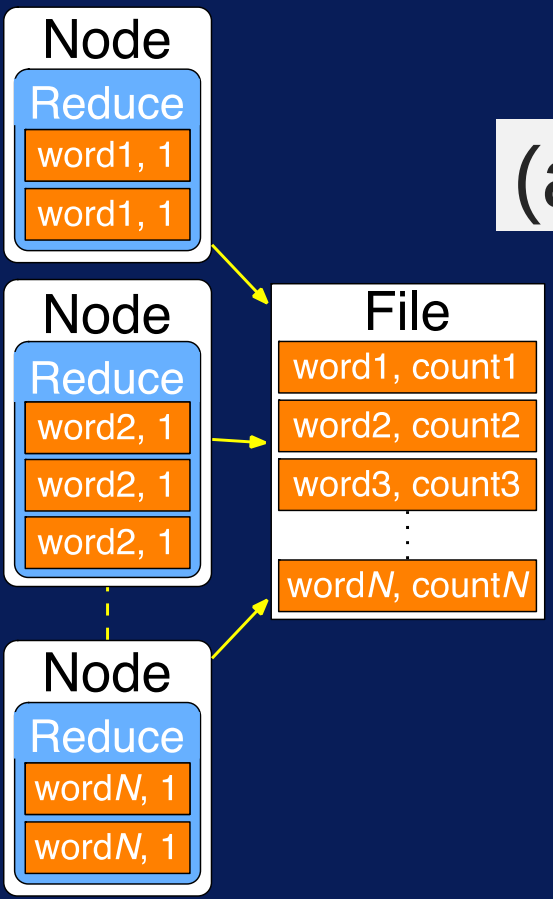
Step 3: Reduce

Add values for same keys



Step 3: Reduce

Add values for same keys



(You, 1) → (You, 1)

(apple, 1), (apple, 1) → (apple, 2)

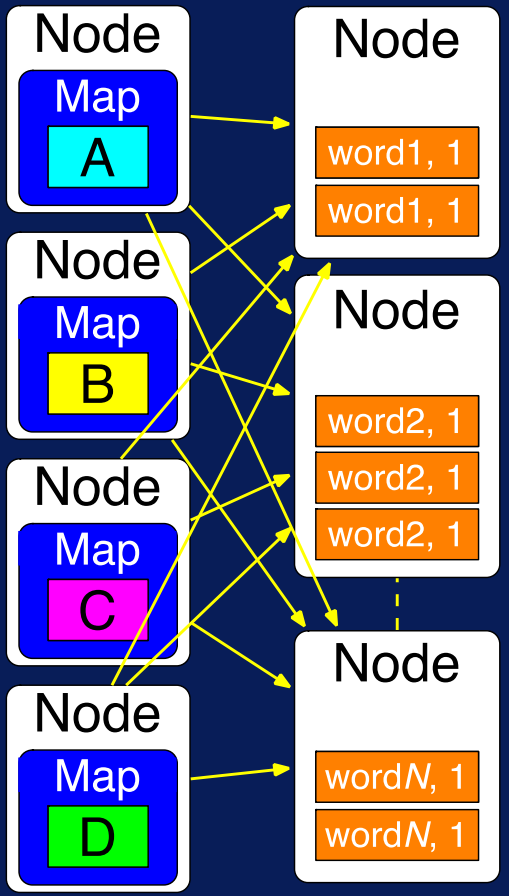
(my, 1), (my, 1), (my, 1) → (my, 3)

(red, 1) → (red, 1)

(rose, 1) → (rose, 1)

Represents a large number of applications.

Sort and Shuffle



(You, http://you1.fake)

(apple, http://apple1.fake)

(apple, http://apple2.fake)

(is, http://apple2.fake)

(is, http://apple2.fake)

(rose, http://apple2.fake)

(red, http://apple2.fake)

Reduce Results for “apple”

(apple -> http://apple1.fake,
http://apple2.fake)

Reduce Results for “apple”

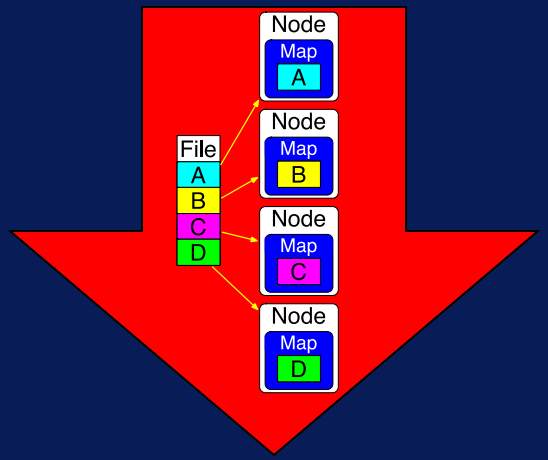
Key	Value
(apple	http://apple1.fake, http://apple2.fake)


Map
Shuffle and Sort
Reduce

Map

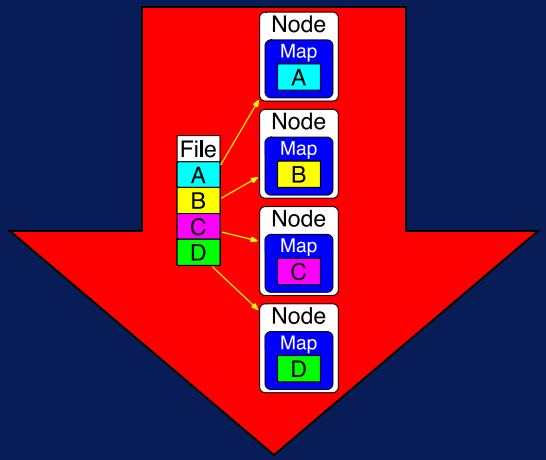
Shuffle and Sort

Reduce

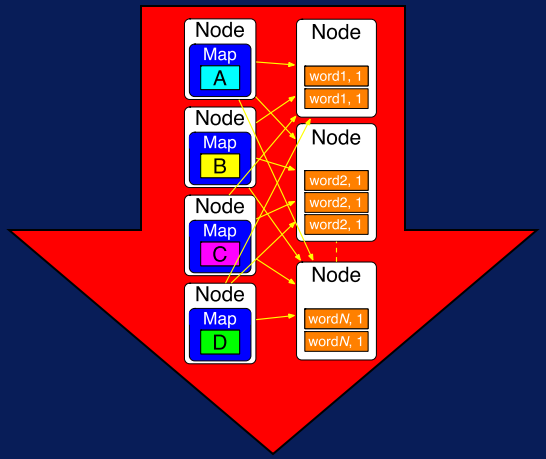


Parallelization over the input

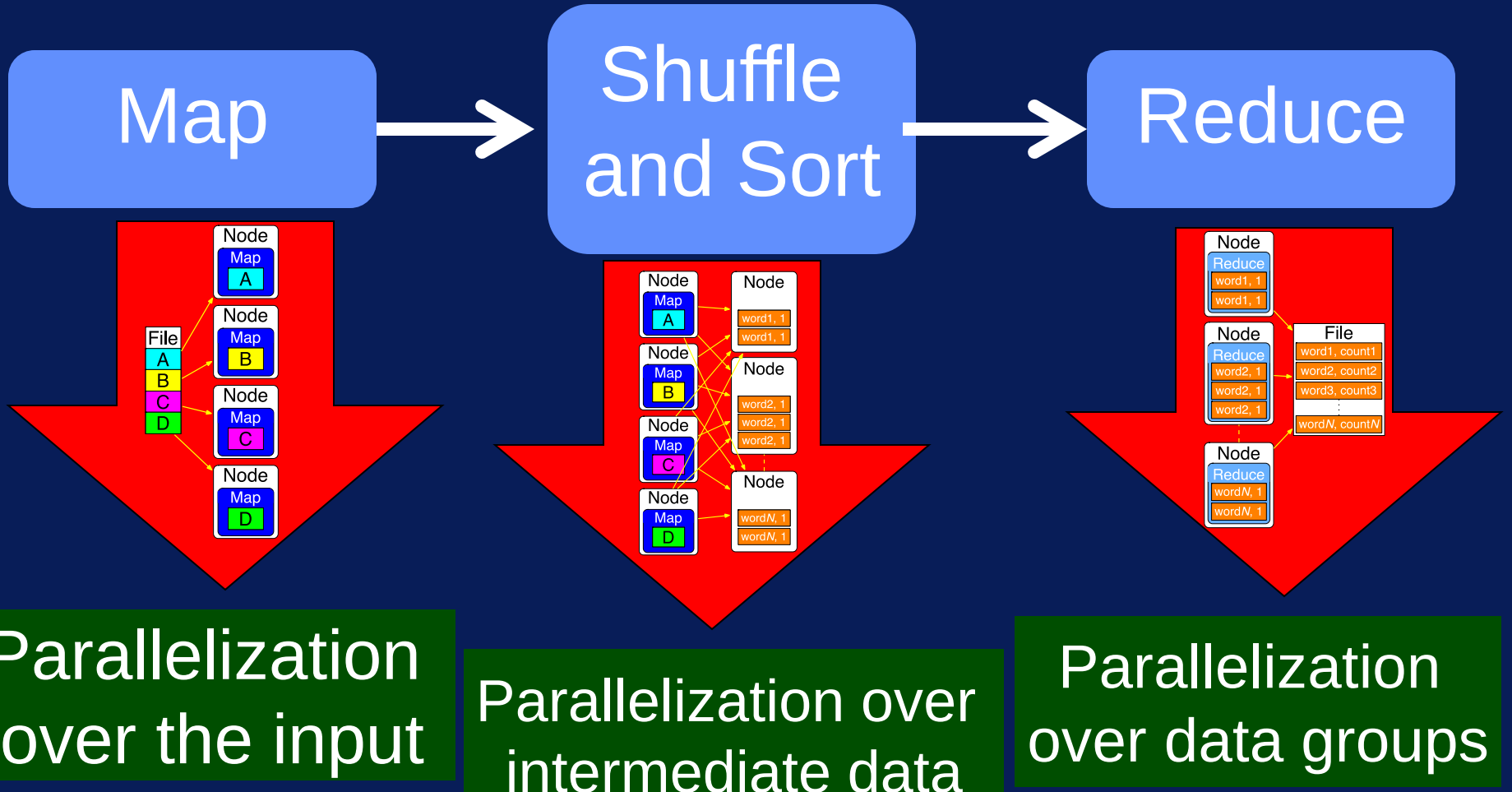
Map → Shuffle and Sort → Reduce



Parallelization over the input



Parallelization data sorting


Map
Shuffle and Sort
Reduce
File
A
B
C
D
Node
Map
A
Node
Map
B
Node
Map
C
Node
Map
D
Node
Map
A
Node
Map
B
Node
Map
C
Node
Map
D
Node
word1, 1
word1, 1
Node
word2, 1
word2, 1
word2, 1
Node
wordN, 1
wordN, 1
Node
Reduce
word1, 1
word1, 1
Node
Reduce
word2, 1
word2, 1
word2, 1
Node
Reduce
wordN, 1
wordN, 1
File
word1, count1
word2, count2
word3, count3
wordN, countN
Parallelization over the input
Parallelization over intermediate data
Parallelization over data groups

MapReduce is bad for:

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Frequently **changing** data

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Frequently **changing** data

Dependent tasks

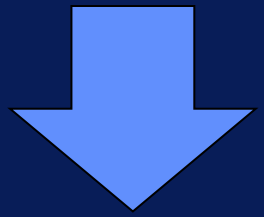
MapReduce is bad for:

Frequently **changing** data

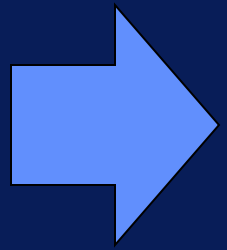
Dependent tasks

Interactive analysis

MapReduce



Simplified parallel programming



Applications with independent data-parallel tasks