

Map Reduce Examples

Jay Urbain, Phd

Example: Word length histogram

Abridged Declaration of Independence

A Declaration By the Representatives of the United States of America, in General Congress Assembled.

When in the course of human events it becomes necessary for a people to advance from that subordination in which they have hitherto remained, and to assume among powers of the earth the equal and independent station to which the laws of nature and of nature's god entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the change.

We hold these truths to be self-evident; that all men are created equal and independent; that from that equal creation they derive rights inherent and inalienable, among which are the preservation of life, and liberty, and the pursuit of happiness; that to secure these ends, governments are instituted among men, deriving their just power from the consent of the governed; that whenever any form of government shall become destructive of these ends, it is the right of the people to alter or to abolish it, and to institute new government, laying its foundation on such principles and organizing its power in such form, as to them shall seem most likely to effect their safety and happiness. Prudence indeed will dictate that governments long established should not be changed for light and transient causes: and accordingly all experience hath shewn that mankind are more disposed to suffer while evils are sufferable, than to right themselves by abolishing the forms to which they are accustomed. But when a long train of abuses and usurpations, begun at a distinguished period, and pursuing invariably the same object, evinces a design to reduce them to arbitrary power, it is their right, it is their duty, to throw off such government and to provide new guards for future security. Such has been the patient sufferings of the colonies; and such is now the necessity which constrains them to expunge their former systems of government. the history of his present majesty is a history of unremitting injuries and usurpations, among which no one fact stands single or solitary to contradict the uniform tenor of the rest, all of which have in direct object the establishment of an absolute tyranny over these states. To prove this, let facts be submitted to a candid world, for the truth of which we pledge a faith yet unsullied by falsehood.

How many “big”, “medium”, and “small” words are used?

Example: Word Length Histogram

Big = Yellow = 10+ letters

Medium = Red = 5..9 letters

Small = Blue = 2..4 letters

Tiny = Pink = 1 letter

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Split the document into chunks and process each chunk on a different computer

Chunk 1

Chunk 2

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Map Task 1
(204 words)

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(key, value)

(yellow, 17)
(red, 77)
(blue, 107)
(pink, 3)

Map Task 2
(190 words)

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(yellow, 20)
(red, 71)
(blue, 93)
(pink, 6)

Example: Word Length Histogram

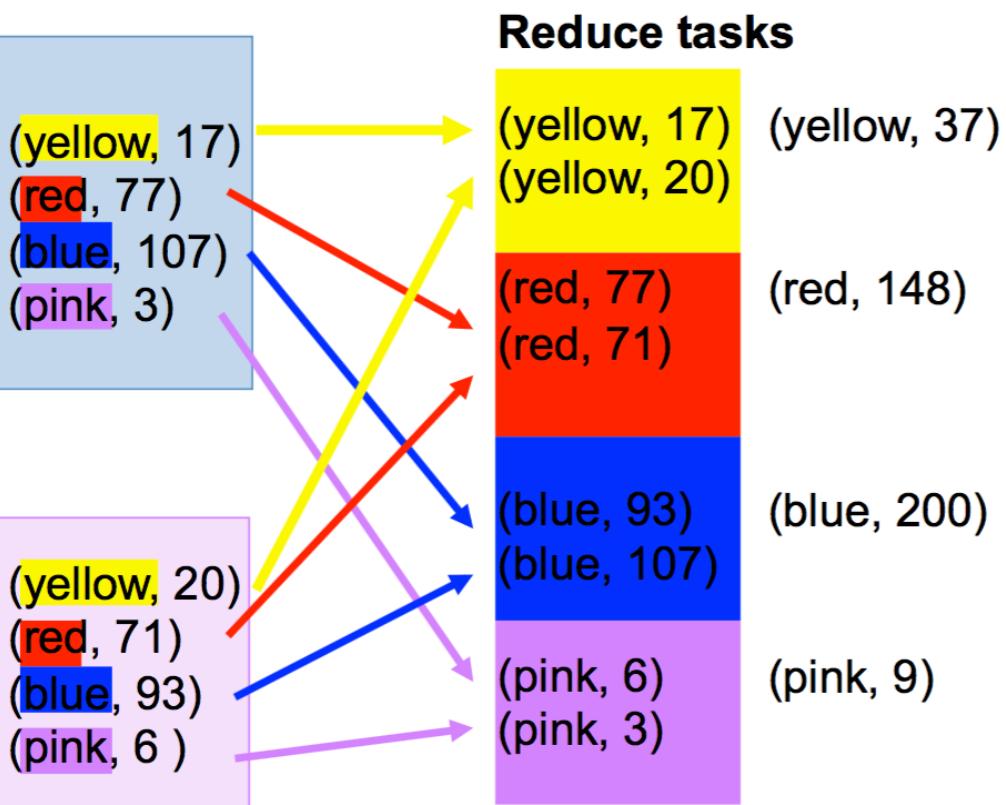
Map task 1

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Map task 2

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“Shuffle step”



Example: Build an Inverted Index

Input:

tweet1, (“I love pancakes for breakfast”)
tweet2, (“I dislike pancakes”)
tweet3, (“What should I eat for breakfast?”)
tweet4, (“I love to eat”)

Desired output:

“pancakes”, (tweet1, tweet2)
“breakfast”, (tweet1, tweet3)
“eat”, (tweet3, tweet4)
“love”, (tweet1, tweet4)
...

Example: Relational Join

Employee

Name	SSN
Sue	999999999
Tony	777777777

Assigned Departments

EmpSSN	DepName
999999999	Accounts
777777777	Sales
777777777	Marketing

Employee ⋈ Assigned Departments

Name	SSN	EmpSSN	DepName
Sue	999999999	999999999	Accounts
Tony	777777777	777777777	Sales
Tony	777777777	777777777	Marketing

Relational Join in MapReduce: *Before Map Phase*

Employee

Name	SSN
Sue	999999999
Tony	777777777

Assigned Departments

EmpSSN	DepName
999999999	Accounts
777777777	Sales
777777777	Marketing

Key idea: Lump all the tuples together into one dataset



Employee, Sue, 999999999
Employee, Tony, 777777777
Department, 999999999, Accounts
Department, 777777777, Sales
Department, 777777777, Marketing

What is this for?

Relational Join: Map Phase

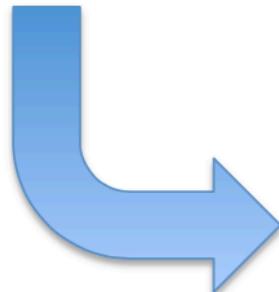
Employee, Sue, 999999999

Employee, Tony, 777777777

Department, 999999999, Accounts

Department, 777777777, Sales

Department, 777777777, Marketing



key=999999999, value=(Employee, Sue, 999999999)
key=777777777, value=(Employee, Tony, 777777777)
key=999999999, value=(Department, 999999999, Accounts)
key=777777777, value=(Department, 777777777, Sales)
key=777777777, value=(Department, 777777777, Marketing)

why do we use this as the key?

Relational Join: Reduce Phase

key=999999999, values=[(Employee, Sue, 999999999),
(Department, 999999999, Accounts)]



Sue, 999999999, 999999999, Accounts

key=777777777, values=[(Employee, Tony, 777777777),
(Department, 777777777, Sales),
(Department, 777777777, Marketing)]



Tony, 777777777, 777777777, Sales
Tony, 777777777, 777777777, Marketing

Relational Join in MapReduce, again

Order(orderid, account, date)

1, aaa, d1
2, aaa, d2
3, bbb, d3

Map

Order

1, aaa, d1	→ 1 : "Order", (1,aaa,d1)
2, aaa, d2	→ 2 : "Order", (2,aaa,d2)
3, bbb, d3	→ 3 : "Order", (3,bbb,d3)

Line

1, 10, 1	→ 1 : "Line", (1, 10, 1)
1, 20, 3	→ 1 : "Line", (1, 20, 3)
2, 10, 5	→ 2 : "Line", (2, 10, 5)
2, 50, 100	→ 2 : "Line", (2, 50, 100)
3, 20, 1	→ 3 : "Line", (3, 20, 1)

tagged with
relation name

Lineltem(orderid, itemid, qty)

1, 10, 1
1, 20, 3
2, 10, 5
2, 50, 100
3, 20, 1

Reducer for key 1

"Order", (1,aaa,d1)
"Line", (1, 10, 1)
"Line", (1, 20, 3)



(1, aaa, d1, 1, 10, 1)
(1, aaa, d1, 1, 20, 3)

Simple Social Network Analysis: Count Friends

Input

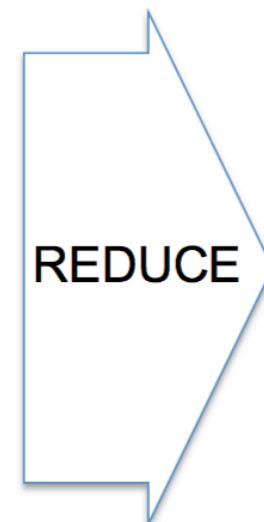
Jim, Sue
Sue, Jim
Lin, Joe
Joe, Lin
Jim, Kai
Kai, Jim
Jim, Lin
Lin, Jim



Jim, 1
Sue, 1
Lin, 1
Joe, 1
Jim, 1
Kai, 1
Jim, 1
Lin, 1



Jim, (1, 1, 1)
Lin, (1, 1)
Sue, (1)
Kai, (1)
Joe, (1)

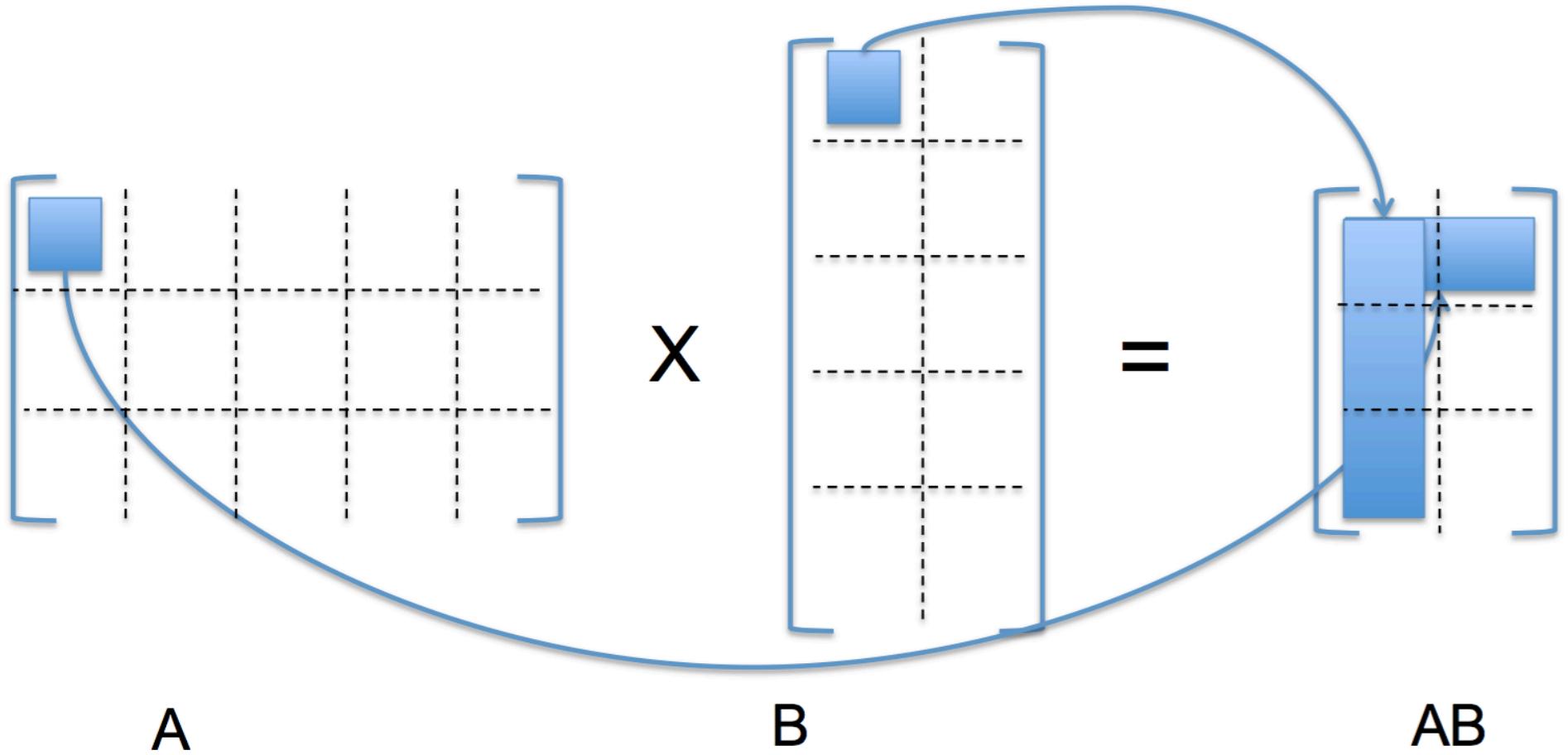


Desired Output

Jim, 3
Lin, 2
Sue, 1
Kai, 1
Joe, 1

Matrix Multiply

- $C = A \times B$
- In the map phase:
 - for each element (i,j) of A , emit $((i,k), A[i,j])$ for k in $1..N$
 - for each element (j,k) of B , emit $((i,k), B[j,k])$ for i in $1..L$
- In the reduce phase:
 - $\text{Sum}(A[i,j]*B[j,k])$



- One reducer per output cell
- Each reducer computes $\sum_j (A[i,j] * B[j,k])$