BIG DATA MANAGEMENT

CZ/CE4123

Tutorial 5:
Column Stores

QUESTION1

Given column store table T as follow.

(1)Give the flow chart (the flow graph presented in the lecture slides) using "column at a time" for the query

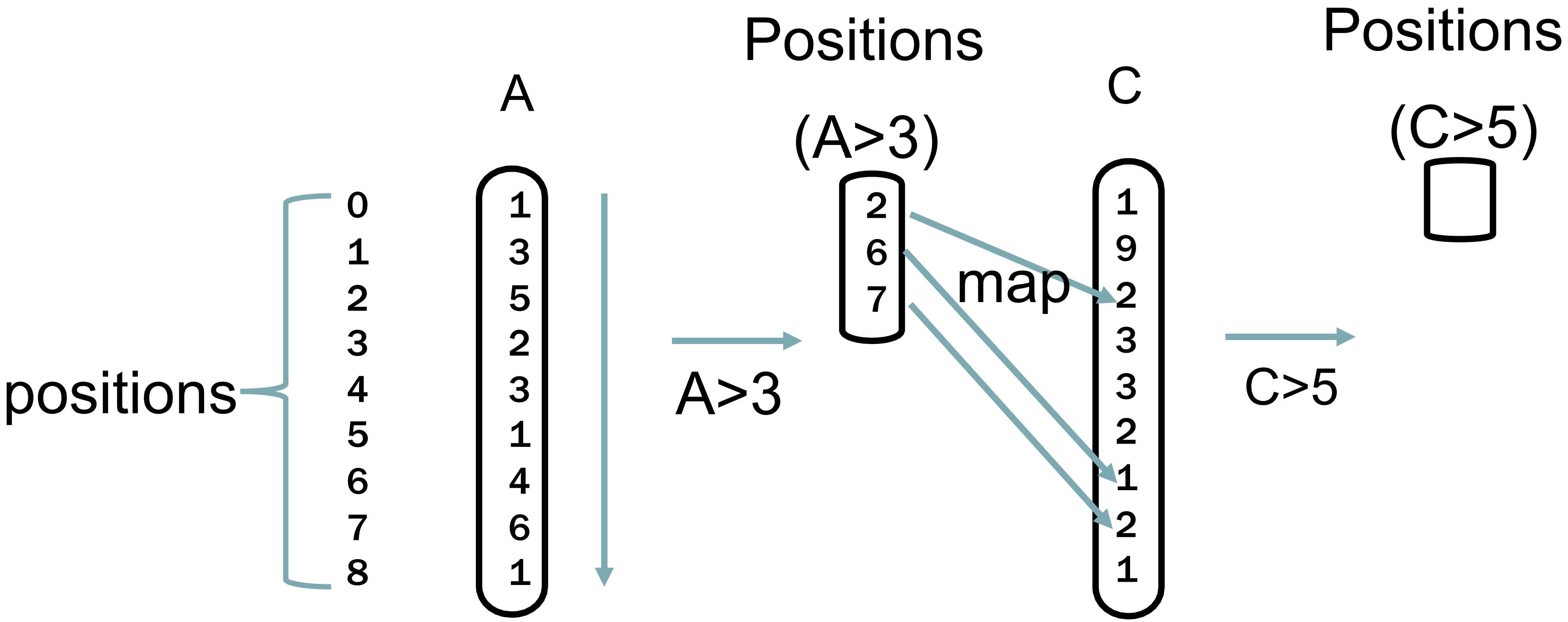
"***SELECT*** *min(B)* ***FROM*** *T* ***WHERE*** *A>3 and C>5*"

(2)Give the flow chart using "column at a time" for the query

"***SELECT*** *sum(C)* ***FROM*** *T* ***WHERE*** *A<10 and B>3*"

A	B	C
1	4	1
3	3	9
5	5	2
2	5	3
3	7	3
1	1	2
4	2	1
6	7	2
1	1	1

SOLUTION FOR (1)



positions

0	1	2	3	4	5	6	7	8

A

1	3	5	2	3	1	4	6	1

A>3

Positions (A>3)

2	6	7

map

C

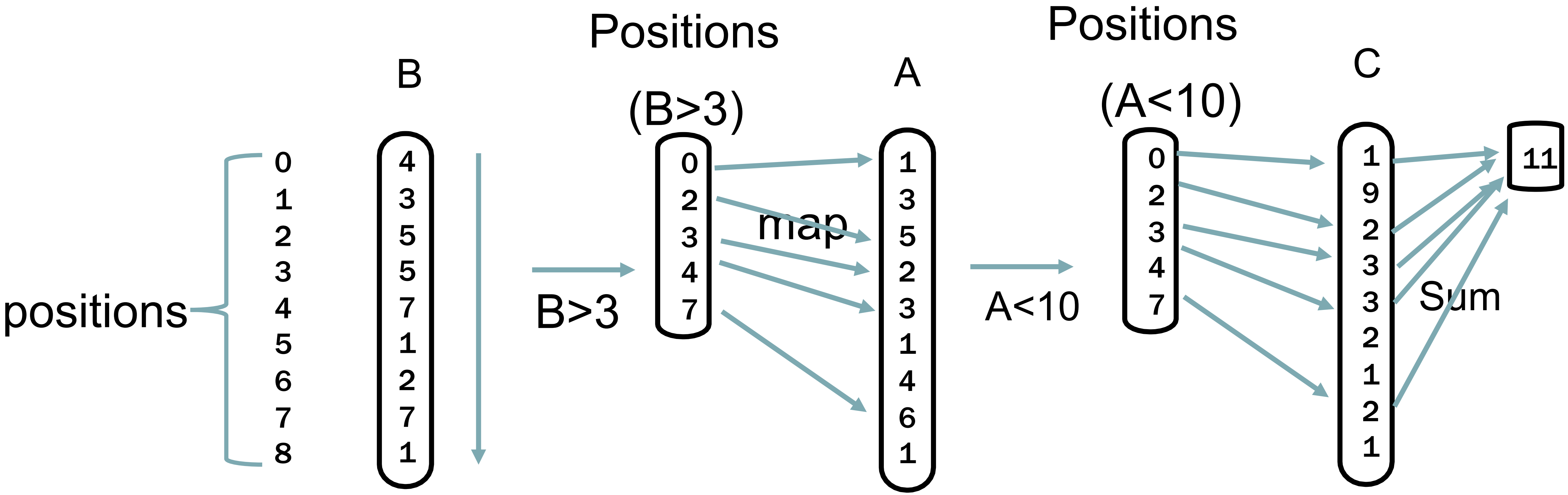
1	9	2	3	3	2	1	2	1

C>5

Positions (C>5)

No tuples qualified

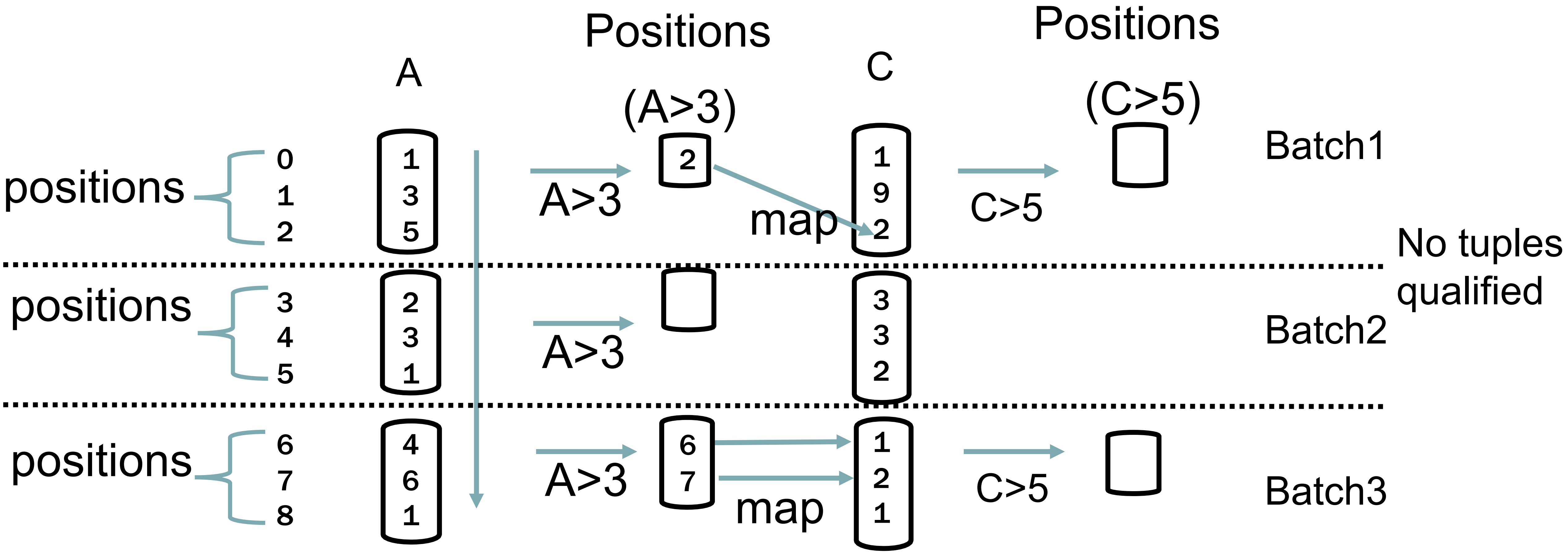
SOLUTION FOR (2)



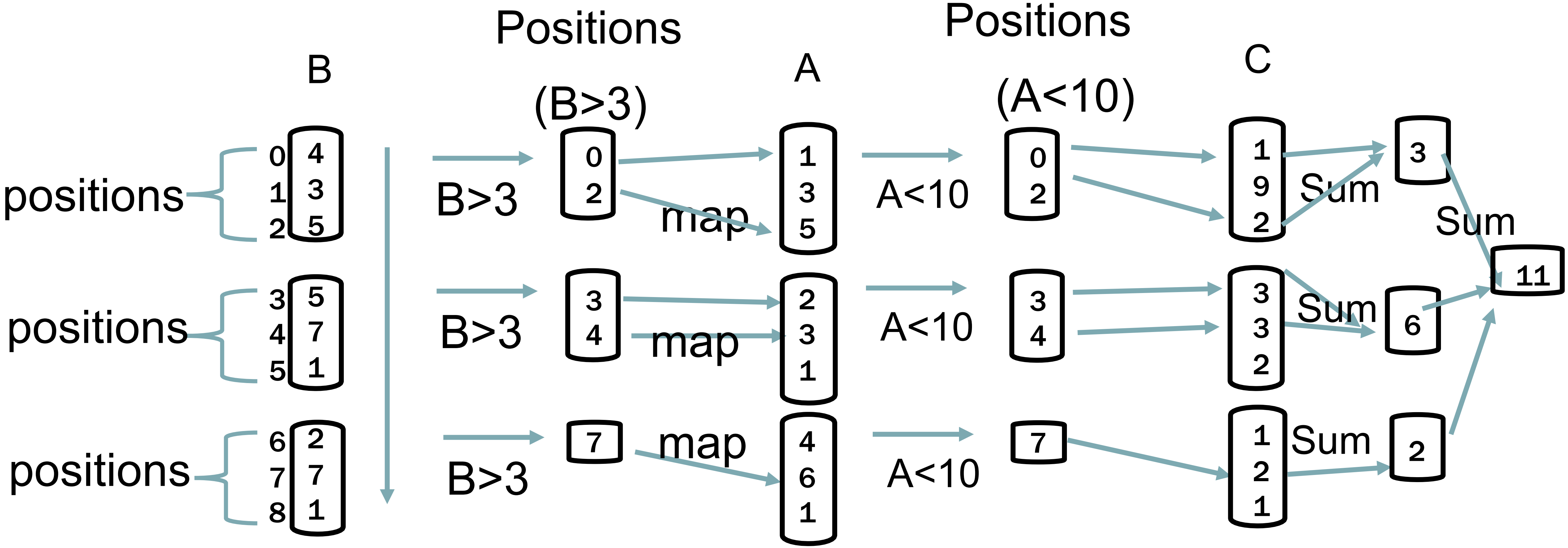
QUESTION 2

Redo Question 1 using “vector at a time”. Assume that the vector size is 3.

SOLUTION FOR (2)



SOLUTION FOR (2)



QUESTION 3

Suppose we are querying a **Student** information table with three columns **Name**, **Email**, **Age**. Given a query of the following form:

"***SELECT*** *Name* ***FROM*** *Student* ***WHERE*** *predicate (Email) and predicate (Age)*".

Here, a predicate applied on a column is a filtering function (e.g., **Email** ending with *ntu.edu.sg,* **Age**>19). We define the selectivity of a predicate by the percentage of the qualified results in the corresponding column. Assume that the selectivity of predicate(**Email**) is p and the selectivity of predicate(**Age**) is q, where $0<p<1$, and $0<q<1$. Let page size be P. We assume each column width is less than P and each value in a column is contained in a page. Consider two options in scanning columns: scanning **Email** first and scanning **Age** first.

(1) If the column widths are the same (denoted by w), please analyze which is better.

(2) If the width of **Email** is $2w$, and the widths for **Name** and **Age** are w, then which option is better?

RECAP

Cost for column store (number of page access):

$Zw/P+2\mathrm{result}(A)*4/P+\mathrm{result}(A)+2\mathrm{result}(AB)*4/P+\mathrm{result}(AB)$

$=Zw/P+\mathrm{result}(A)*(8/P+1)+\mathrm{result}(AB)*(8/P+1)$

$\boxed{\approx Zw/P+\mathrm{result}(A)+\mathrm{result}(AB)}$

SOLUTION TO (1)

Answer:

Use the formula we learnt in the lectures.

Let Email be *A*, and Age be *B*. Let *Z* be the length of a column

The cost of option 1 (Scanning Email first) is approximately

Zw/P+result(A)+result(AB)

The cost of option 2 (Scanning Age first) is approximately

Zw/P+result(B)+result(AB)

SOLUTION TO (1)

Answer:

Use the formula we learnt in the lectures.

Let Email be *A*, and Age be *B*. Let *Z* be the length of a column

The cost of option 1 (Scanning Email first) is approximately

Zw/P+result(A)+result(AB)

The cost of option 2 (Scanning Age first) is approximately

Zw/P+result(B)+result(AB)

Note that **result(A)=Zp, result(B)=Zq**

Then, if p<q, then scanning Email first is better; if p=q, equally good; if p>q, then scanning Age first is better.

SOLUTION TO (2)

Recap the formula we learnt in the lectures.

Zw/P+result(A)+result(AB)

Width of 1st accessed column

SOLUTION TO (2)

Answer:

Let Email be Column *A*, and Age be Column *B*. Let width of Email be 2*w*. Then the width of Age is *w*.

Revise the formula we learnt in the lectures.

The cost of option 1 (Scanning Email first) is approximately

2Zw/P+result(A)+result(AB)

The cost of option 2 (Scanning Age first) is approximately

Zw/P+result(B)+result(AB)

Note that **result(A)=Zp, result(B)=Zq**

SOLUTION TO (2)

Answer:

Then, option 1 is worse (or option 2 is better) when

2Zw/P+Zp+result(AB) > Zw/P+Zq+result(AB)

→ Zw/P+Zp > Zq

→ w/P+p>q

(Note: it is also okay to use more refined formulas, i.e., considering the cost of positions.)

FURTHER DISCUSSION

In practice, how do we know p and q?