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Quiz 2: Matrix Multiplication (10 points), **15 minutes**

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$$A = \begin{bmatrix} 2 & 0 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} B = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$$

Consider multiplying the above matrices (to produce matrix C = AB) using the one-phase MapReduce approach. Suppose that matrices are stored in text files in the sparse format as shown in class. For example, A[1,1] = 2 is stored as 1,1,2. Note that zero entries are NOT stored.

a. [3 points] Write the logic of map function for the mapper processing matrix A. What key-value pairs does it output?

Mapper_A(line-offset, line) [1.5 points]
split the line into i , k and A[i][k]
output => ((i,c), ('A', k, A[i,k]), where $1 \le c \le$ n , n -> no of column of B
[1.5 points]

((1,1),('A',1,2)) , ((1,2),('A',1,2)), ((2,1),('A',1,1)) , ((2,2),('A',1,1)),

((3,1),('A',2,1)) , ((3,2),('A',2,1))

b. [3 points] Write the logic of map function for the mapper processing matrix B. What key-value pairs does it output?

Mapper_B(line-offset,Text) [1.5 points]
split the line into k , j and B[k][j]
output => ((r,j), ('B', k, B[k,j]), where $1 \le r \le$ m , m -> no of rows of A
[1.5 points]

((1,1),('B',1,1)) , ((2,1),('B',1,1)) , ((3,1),('B',1,1)) ,

((1,1),('B',2,1)) , ((2,1),('B',2,1)) , ((3,1),('B',2,1)) ,

((1,2),('B',2,1)) , ((2,2),('B',2,1)) , ((3,2),('B',2,1))

c. [4 points] Write the logic of reduce function. For each call to the reduce function, state its input and output.

[2 points]

input would be key (i,j) value [('A', 1, A[i, 1]), …, ('A', p, A[i, p]),
('B', 1, B[1, j]), …, ('B', p, B[p, j])]

output - ((i,j), A[i, 1] * B[1, j] + … + A[i, p] * B[p, j])

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[2 points]

(1,1),[('A',1,2),('B',1,1)] => ((1,1),2)

(1,2),[('A',1,2),('B',2,1)] => No Output

(2,1),[('A',1,1),('B',1,1),('B',2,1)] => ((2,1),1)

(2,2),[('A',1,1),('B',2,1)] => No Output

(3,1),[('A',2,1),('B',1,1),('B',2,1)] => ((3,1),1)

(3,2),[('A',2,1),('B',2,1)] => ((3,2),1)