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Exercise 1

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Problem 1. (*Matrix Vector Multiplication by Map-Reduce*)

Let $\mathbf{A} \in \mathbb{R}^{n \times m}$ be a matrix with large dimensions n and m .

- a) Let $\mathbf{v} \in \mathbb{R}^m$ be a vector. Explain a way to execute the multiplication of \mathbf{A} and \mathbf{v} using MapReduce.
- b) Let $\mathbf{B} \in \mathbb{R}^{m \times k}$ be a matrix. Explain a way to execute the multiplication of \mathbf{A} and \mathbf{B} using MapReduce.

Problem 2. (*Sparse Vectors with Map-Reduce*)

Let $\mathbf{v} \in \mathbb{R}^n$ be a sparse vector with large dimension n .

- a) Let $\mathbf{w} \in \mathbb{R}^n$ be a sparse vector. Explain a way to execute the sum of \mathbf{v} and \mathbf{w} using MapReduce.
- b) Explain a way to execute the average squared value $\frac{1}{n} \sum_{i=1}^n (v_i)^2$ using MapReduce.