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% homework-3/docs/writeup.tex

\documentclass{article}

\usepackage{listings} % for code listings
\usepackage{graphicx} % for including images

\begin{document}

\title{Homework 3 Writeup}
\author{Your Name}
\date{\today}

\maketitle

\section{Discussion on Compressed Sparse Row (CSR) Format}

\subsection{Representation of SparseMatrixCSR}

The SparseMatrixCSR structure represents a sparse matrix using three arrays:

\begin{itemize}
    \item \textbf{Value Array (\_nzval)}: Contains the nonzero values of the matrix.
    \item \textbf{Column Index Array (\_col\_index)}: Contains the column indices corresponding to the nonzero values.
    \item \textbf{Row Index Array (\_row\_index)}: Contains the starting index of each row in the value and column index arrays.
\end{itemize}

\subsection{Efficiency of CSR for Matrix-Vector Multiplication}

CSR is typically more efficient for matrix-vector multiplication compared to CSC. This is because matrix-vector multiplication involves iterating over the rows of the matrix, and CSR format allows for efficient access to the nonzero elements of each row.

\subsection{Storage Arrays for Given Matrix}

The storage arrays for the given matrix should be:

Value: [8,3,7,1,5,8,6,1,9]

Column Index: [0,1,0,2,3,0,2,2,3]

Row Index: [0,2,4,7,7,9]
```

\section{Compilation}

To compile the project, I ran it from Xcode, so I just pressed start in the application.

\section{Implementation}

To implement the iteration, the following Vector arithmetic operations were used:

\begin{itemize}
    \item Vector addition
    \item Scalar-vector multiplication
    \item Norm calculation
\end{itemize}

\section{Verification and Timing}

\subsection{Dense Matrix}

For the dense matrix representation:

\begin{itemize}
    \item Iterations: 18342
    \item Final norm(r): 0.000999652
    \item Time per iteration: 92 microseconds
\end{itemize}

\subsection{Sparse Matrix}

For the sparse matrix representation:

\begin{itemize}
    \item Iterations: 1
    \item Final norm(r): 0.000999168
    \item Time per iteration: 20 microseconds
\end{itemize}

\end{document}