Arrays and Structures:

The Sparse Matrix Data Type

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Outline

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1. **The Sparse Matrix ADT**

2. Matrix Transpose

3. Matrix Multiplication

An $m \times n$ Matrix

- An $m \times n$ matrix with m rows and n columns.

$$\begin{bmatrix} -27 & 3 & 4 \\ 6 & 82 & -2 \\ 109 & -64 & 11 \\ 12 & 8 & 9 \\ 48 & 27 & 47 \end{bmatrix}$$

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- Totally 15 elements with 15 nonzero entries.

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$$
\begin{bmatrix}
15 & 0 & 0 & 22 & 0 & \text{-15} \\
0 & 11 & 3 & 0 & 0 & 0 \\
0 & 0 & 0 & \text{-6} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
91 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 28 & 0 & 0 & 0
\end{bmatrix}
$$

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- Totally 36 elements with only 8 nonzero entries.

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- How to efficiently store this sparse matrix?

Remarks & The Idea

- The standard representation of a matrix is a two-dimensional array defined as a `[MAX_ROWS] [MAX_COLS]`.
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- Let's consider alternative forms of representation for the matrix.
  - Store only nonzero elements of the matrix.

The Sparse Matrix ADT

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	Row	Col	Value
A[0]	6	6	8
A[1]	0	0	15
A[2]	0	3	22
A[3]	0	5	-15
A[4]	1	1	11
A[5]	1	2	3
A[6]	2	3	-6
A[7]	4	0	-91
A[8]	5	2	-28

▷ | A[0] | 6 | 6 | 8 |

index, # rows, # cols, # nonzeros

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Discussions