DATA STRUCTURES AND ITS APPLICATIONS

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Multilist Representation

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Sparse Matrix

Matrix ??

Two Dimensional data 1 1 3 0 4
1 3 5 1 0
9 0 5 1 0

Sparse Matrix??

More zero elements than non zero elements
0 0 3 0 0
0 0 5 1 0
0 0 0 0 0

Sparse Matrix Representation

- 2D Matrix

  results in lot of memory wastage as non zero elements are also stored
- Triple Notation

  Array representation
- Multilist Representation

  Linked representation hence size can be changed dynamically

Sparse Matrix Representation: Triple Notation

In triple notation sparse matrix is represented as an array of tuple values.

Each tuple consists of

<rowno columnno Value>

The first block in array block holds information regarding

<total no of rows, total no of columns ,value>

$$\begin{pmatrix} 2 & 0 & 0 & 0 \\ 4 & 0 & 0 & 3 \\ 0 & 0 & 0 & 0 \\ 8 & 0 & 6 & 1 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

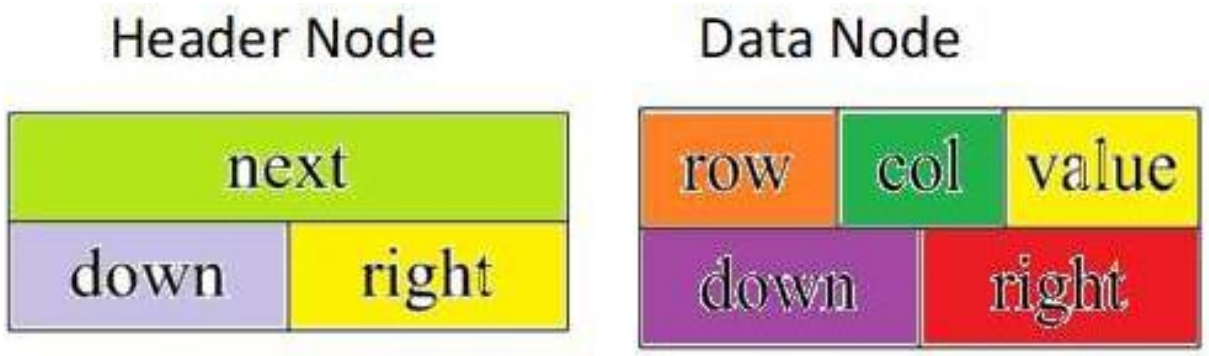
Triple Notation

Row No	Column No	Value
5	4	6
0	0	2
1	0	4
1	3	3
3	0	8
3	3	1
4	2	6

Sparse Matrix Representation: Linked representation

Node Structure

Two types of nodes are used



Sparse Matrix Representation: Linked representation

Node Structure Definition

```
#define MAX_SIZE 50 /* size of
largest
matrix */
typedef enum {head, entry} tagfield;
typedef struct matrixNode *
matrixPointer; typedef struct entryNode {
int row;
int col;
int value; };
```

```
typedef struct matrixNode {
    matrixPointer down;
    matrixPointer right;
    tagfield tag;
    union
    {
    matrixPointer
    next; entryNode
    entry;
};  } u;
```

Sparse Matrix Representation: Linked representation

Example

$$\begin{pmatrix} 2 & 0 & 0 & 0 \\ 4 & 0 & 0 & 3 \\ 0 & 0 & 0 & 0 \\ 8 & 0 & 6 & 1 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

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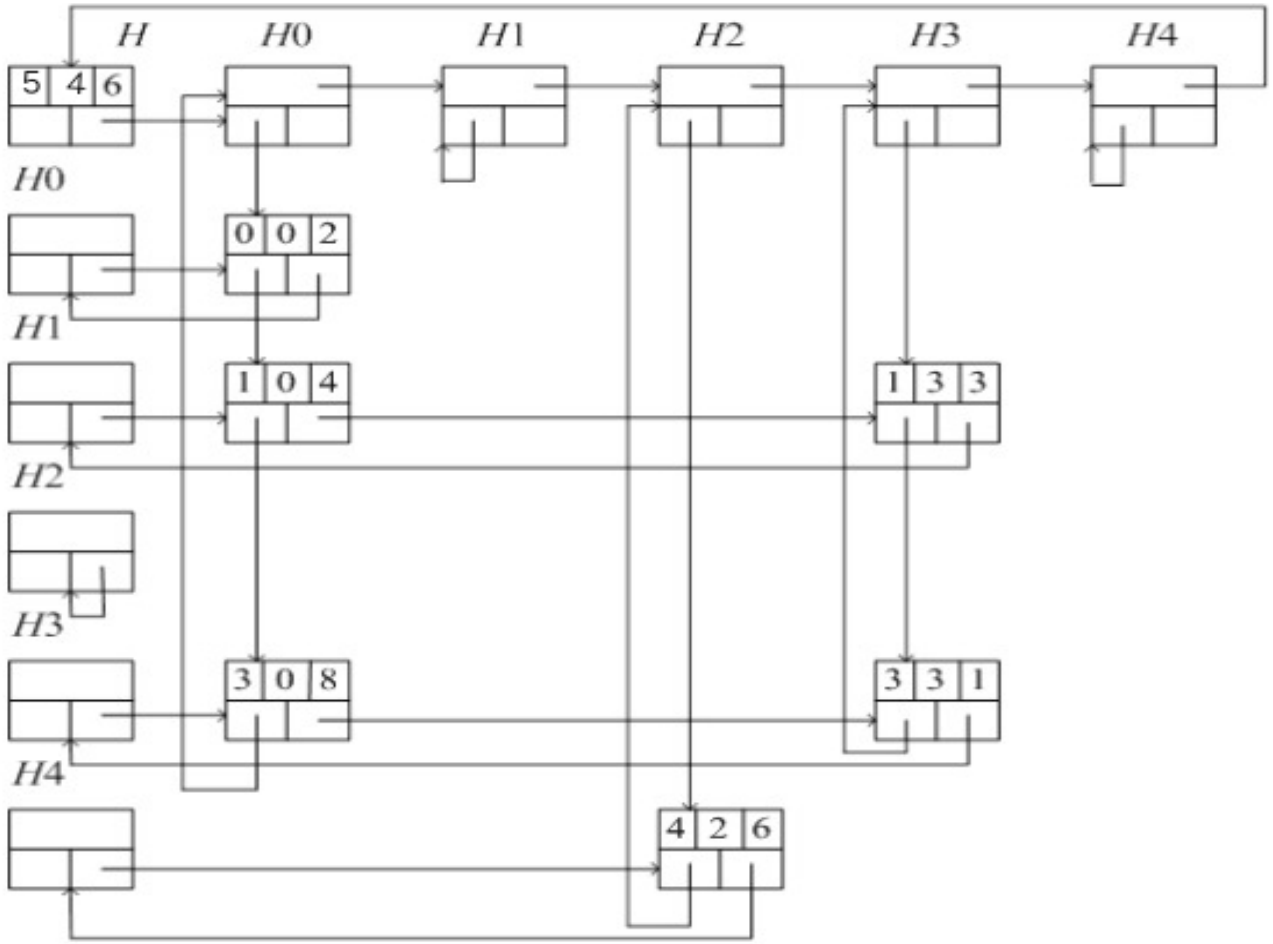
Sparse Matrix Representation: Linked representation



Courtesy: “Fundamentals of Data Structures” By Ellis Horowitz and Sartaj Sahni

DATA STRUCTURES AND ITS APPLICATIONS

Sparse Matrix Representation Summary

Sparse matrix representation

- Triple
- Linked Representation

Concepts can be applied to implement the following operations

- Create_SparseMatrix()
- Transpose_of_SparseMatrix()
- Add_SparseMatrices()
- Multiple_SparseMatrices()

1. Which of the following is a typical use-case of a multi-list data structure?

a) Representing a polynomial equation with multiple variables.

b) Maintaining a single linked list for multiple queues.

c) Storing data where each node is linked to multiple independent lists, such as adjacency lists in graphs.

d) Both (a) and (c).

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2. Which of the following is a primary advantage of sparse matrix representation?

a) It reduces the number of rows and columns.

b) It stores only non-zero elements, reducing memory usage.

c) It allows faster searching for zero elements.

d) It increases redundancy.

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3. For an m x n matrix with k non-zero elements, the 3-tuple representation requires how many rows in total?

a) k rows.

b) k + 1 rows.

c) k + 2 rows.

d) m + n + k rows.

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4. To convert a regular matrix into a sparse matrix (3-tuple form), which of the following is correct?

a) Traverse the matrix row-wise, and for each non-zero element, store (row, col, value) in the tuple.

b) Traverse the matrix column-wise, ignoring zero elements.

c) Only store diagonal elements.

d) Store all elements in row-major order.

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5. In a linked list representation of a sparse matrix, each non-zero element is typically stored as:

a) A node with (row, column, value) and pointers to the next non-zero element in the same row and column.

b) A node with only the value and a single next pointer.

c) A node with (row, column, value) but no pointers.

d) An array of nodes representing each row.

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