Data Structures

Project Part 2: Sparse Matrix

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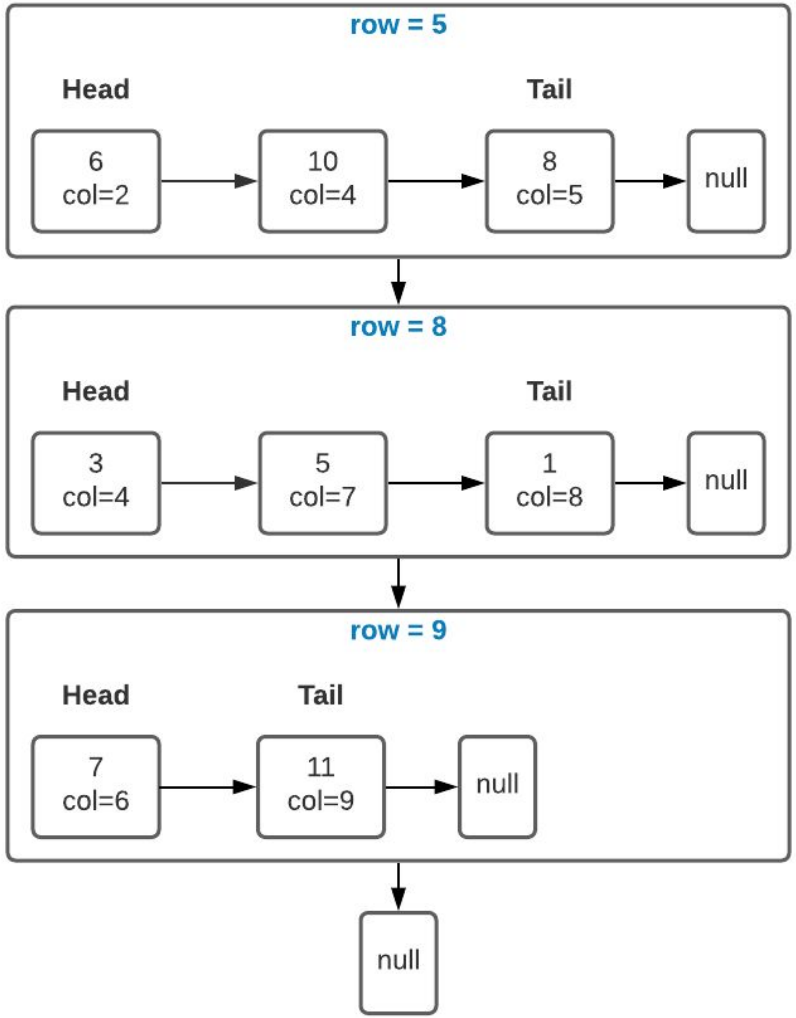
Problem #2: Sparse Matrix (2D Array)

- A more common case is a sparse matrix where most of values are zeros in a 2D structure or (rows x cols)
- Similarly, we will implement SparseMatrix to act like a 2D array
- Design wise:
  - Each row in the sparse matrix, is what we actually implemented in the 1D case
  - So we can think of our sparse matrix as being **a linked list of linked lists**
    - First: the 1D array linked list
    - Second: linked list, where the **data** of each node is a **1D linked list**
    - Again use a doubly linked list
    - Tip: try to reuse the first linked list as much as possible

Problem #2: Sparse Matrix

- Assume we have a 20x20 matrix
- However we have only the following cells
  - Arr[5][2] = 6, Arr[5][4] = 10, Arr[5][5] = 8
  - Arr[8][4] = 3, Arr[8][7] = 5, Arr[8][8] = 1
  - Arr[9][6] = 7, Arr[9][9] = 11
- We better create a list of 3 connected rows
  - Each row has the values at specific columns
- The figure on the right shows a parent linked list of three nodes
  - Inside each node is a linked list of its columns
  - To simplify the drawing, it's represented by a SLL



Problem #2: Sparse Matrix: 7x7 example

```
mat = SparseMatrix(7, 7)
# (row, col, value) order
mat.set_value(2, 5, 900)
mat.set_value(2, 5, 8)
mat.set_value(1, 6, -3)
mat.set_value(6, 6, -8)
mat.set_value(3, 0, 9)
mat.set_value(3, 3, 7)
mat.set_value(3, 5, 4)
mat.set_value(5, 5, 1)
mat.set_value(5, 2, 6)
```

```
print(mat)
"""
Row 1: -3@6
Row 2: 8@5
Row 3: 9@0, 7@3, 4@5
Row 5: 6@2, 1@5
Row 6: -8@6
"""
mat.print_as_2darray()
"""
0 0 0 0 0 0 0
0 0 0 0 0 0 -3
0 0 0 0 0 8 0
9 0 0 7 0 4 0
0 0 0 0 0 0 0
0 0 6 0 0 1 0
0 0 0 0 0 0 -8
"""
```

Problem #2: Sparse Matrix

```
mat2 = SparseMatrix(7, 7)
mat2.set_value(1, 6, 8)
mat2.set_value(3, 1, 4)

mat.add(mat2)

mat.print_as_2darray()
```

```
0 0 0 0 0 0 0
0 0 0 0 0 0 -3
0 0 0 0 0 8 0
9 0 0 7 0 4 0
0 0 0 0 0 0 0
0 0 6 0 0 1 0
0 0 0 0 0 0 -8

0 0 0 0 0 0 0
0 0 0 0 0 0 5
0 0 0 0 0 8 0
9 4 0 7 0 4 0
0 0 0 0 0 0 0
0 0 6 0 0 1 0
0 0 0 0 0 0 -8
```

"Acquire knowledge and impart it to the people."

"Seek knowledge from the Cradle to the Grave."