Data Structures

Project: Sparse Array

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Problem #1: Sparse 1D Array

- In some applications, we might want to represent arrays of huge indices (e.g. 10^8); however, in many cases, most of the array is comprised of zeros (95%+)
- Creating such huge arrays is very time & memory harmful with no return
  - Complete: 0 0 20 0 40 50 0 70 0 0 … 0 0 0 0 … 0 0 0 0
  - Better: (50, 5), (20, 2), (70, 7), (40, 4) = (value, idx) list
- A better idea is to represent such arrays using a linked list
- Create a doubly linked list class named **SparseArray**
  - It represents a sparse array (only **non-empty** elements)
  - Functionalities: Set and Get positions, Print array and Add arrays
- *A useful application: Polynomial representation (e.g. $2X^{60} + 17X^{1500}$)*

Problem #1: Sparse 1D Array

```
array = SparseArray(15)
array.set_value(5, 50)  # idx, value
array.set_value(2, 20)
array.set_value(8, 80)
array.set_value(4, 4000)
array.set_value(4, 40)

print(array.get_value(8), array.get_value(9))
# 80 None

print(array)
# 20@2, 40@4, 50@5, 80@8

array.print_as_array()
# 0 0 20 0 40 50 0 0 80 0 0 0 0 0 0
```

Problem #1: Sparse 1D Array

- For the add functionality:
  - The 2 arrays must be of the same length
  - Feel free to code **simple but slow** approach for the Add functionality
- Develop **test cases** to compare results of str(array) with the expected results

```
array2 = SparseArray(15)
array2.set_value(5, 3)
array2.set_value(14, 100)

print(array2)
# 3@5, 100@14
array.add(array2)
print(array)
# 20@2, 40@4, 53@5, 80@8, 100@14
```

"Acquire knowledge and impart it to the people."

"Seek knowledge from the Cradle to the Grave."