Data Structures

Logical and physical View

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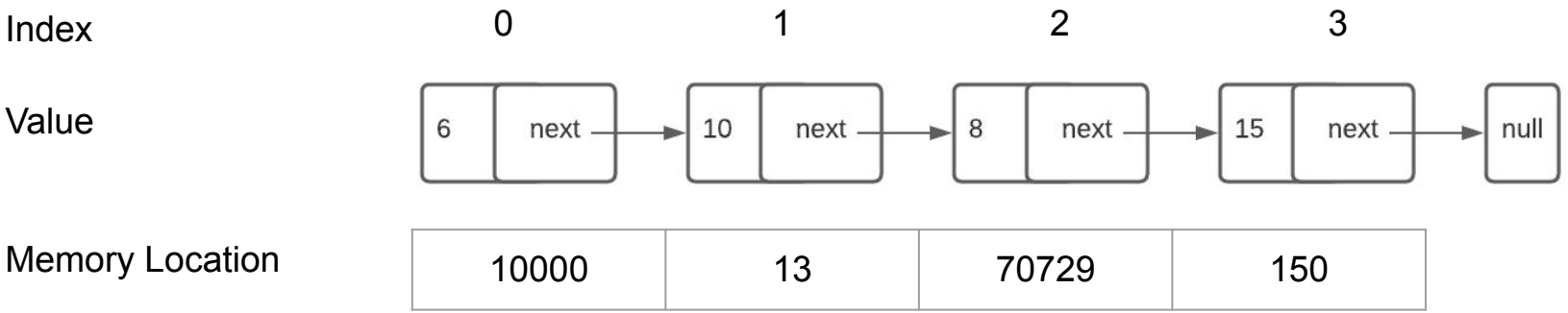
Recall: Arrays

- **Consecutive memory block**
  - Array of 4 integers = **consecutive** 4 * 32 = 128 bits
  - We can work out the location of the **i-th integer** with a simple formula
    - If array[0] starts in the memory at location 10000
    - Thus, the 4th cell, array[3], is at location:: 10000 + 3 * 32 = 10096
    - Hence, it's O(1) to find an element

Index	0	1	2	3
Value	6	10	8	15
Memory Location	10000	10032	10064	10096

Linked Lists

- **Scattered memory cells**
  - A linked list of four integers will have four cells scattered at different locations in the memory (each containing the data and a 'next' node)
  - We have to follow the links to find the ith integer
  - Hence, it's O(n) to find an element



A Physical Data Structure

- The word physical, *as in English*, refers to the actual storage/memory
- There are ONLY 2 ways to arrange data in memory
  - **Blocks as in** the array
  - **Scattered**, such as linked lists, with connections (e.g. 'next') to link them together in memory
- Any **other** data structure must end at some **low level** using these ways to create/access memory
- Linked-list and Arrays are known as physical data structures
- A **physical data structure** refers to the **actual organization** of data on a storage device.

A Logical Data Structure

- Starting from the next section, we will study **Logical** Data Structures
  - They provide **functionalities and data-arrangement** to achieve specific purposes
  - However, at the low-level, they will eventually either utilize a block in memory (think of the array), or be scattered in memory (think about the linked list)
- A common example is the restaurant queue. We need a means of representing a queue of people and this MUST correspond to the chronological order in which they have entered the establishment, or ordered food, etc...
  - We introduce the queue data structure, which can be implemented either using arrays or linked lists
- We think ADT wise. We need a data structure that supports X, Y, Z, etc
  - What first. How later.
- Don’t worry about this slide. It will make sense by the end of the course

"Acquire knowledge and impart it to the people."

"Seek knowledge from the Cradle to the Grave."