CSE231: Data Structures

Lecture 02

by

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Abstract Data Types (ADT)

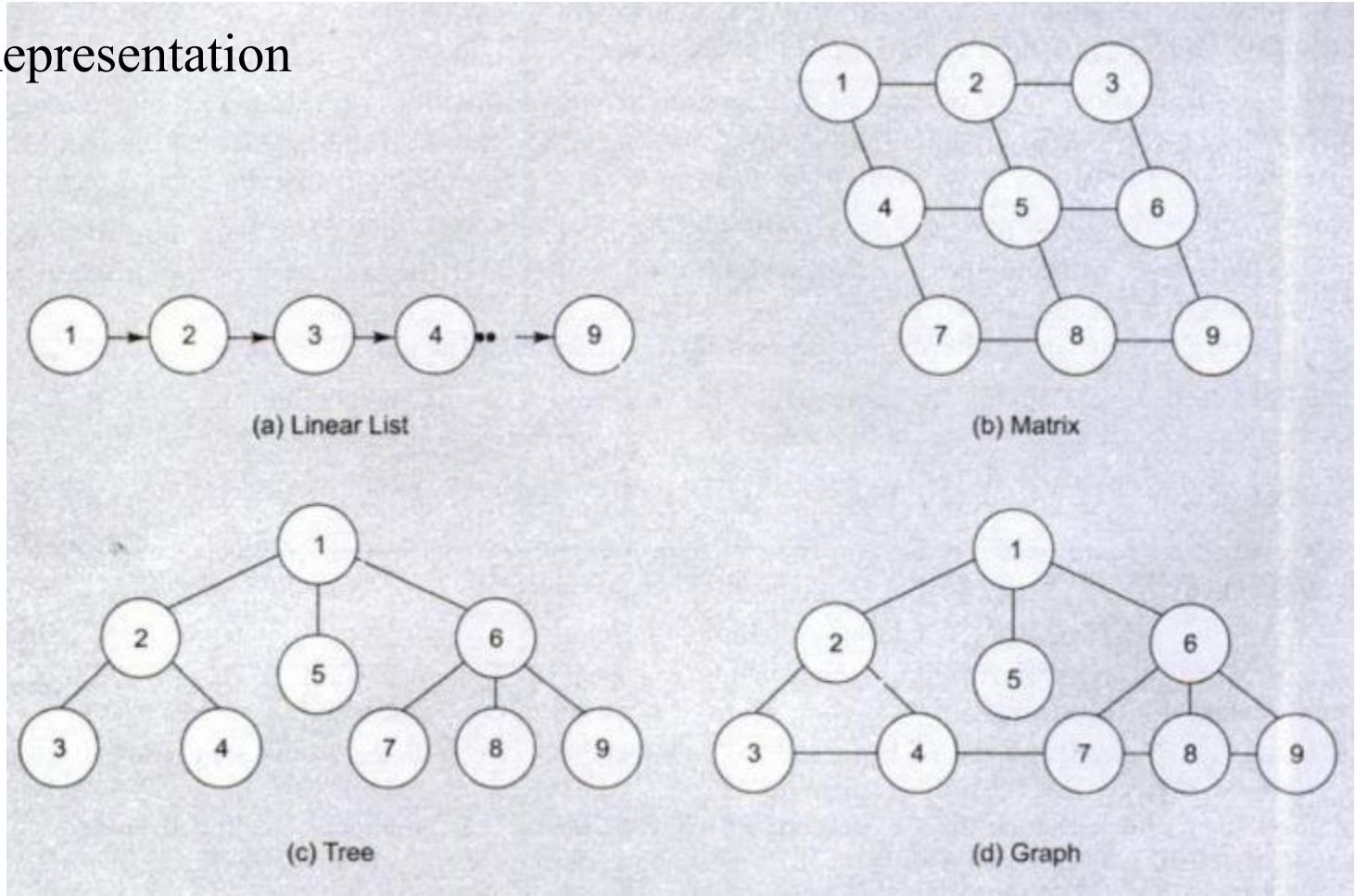
- An abstract data type (ADT) refers to a set of data values and associated operations that are specified accurately, independent of any particular implementation.
- ADT defines what a specific data type can do, but how it actually does it is hidden.
    - It consists of a set of definitions that allow us to use the functions while hiding the implementation details.

List ADT

- Implementation:
  - Array Based
  - Linked List Based

- Operations:
  - Insert
  - Delete
  - Retrieve

List Representation



Abstract Data Type Model

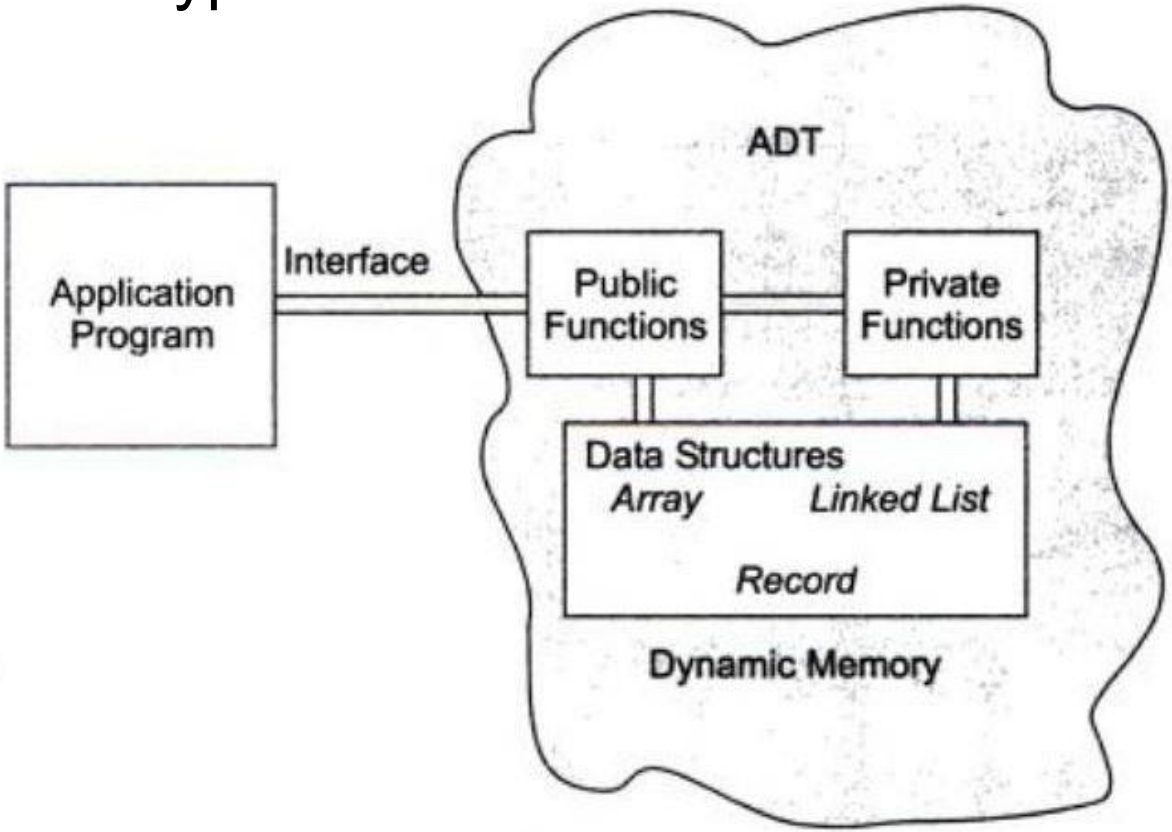


Fig. 1.13 ADT Model

Abstract Data Type Model

- Data are entered, accessed, modified, and deleted through the external application programming interface
- Two different parts of the ADT model: Functions and Data Structures
  - For each ADT operation, there is an algorithm that perform its specific task. The operation name and parameters are available to the application.
  - Data structures are available to all of the ADTs functions as required

Algorithms: Complexity, Time-Space Tradeoff

- An algorithm is a well-defined set of steps for solving a particular problem.
- Time and space an algorithm uses are two major measures of the efficiency calculation.
- The complexity of an algorithm is the function which gives the running time and/or space in terms of input size.
- Choice of data structure involves a time-space tradeoff.

Search Algorithms

- Linear Search

  It is defined as a sequential search algorithm that starts at one end and goes through each element of a list until the desired element is found, otherwise the search continues till the end of the data set.

5	**10**	**6**	**8**	**2**	**4**	**15**	**20**	**12**	**1**

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Time Complexity (Worst-case): O(N)

Space Complexity: O(1)

Search Algorithms

- Binary Search

  Binary search is a search algorithm that finds the position of a target value within a sorted array. Binary search compares the target value to the middle element of the array.

5	10	11	12	13	14	15	20	30	50

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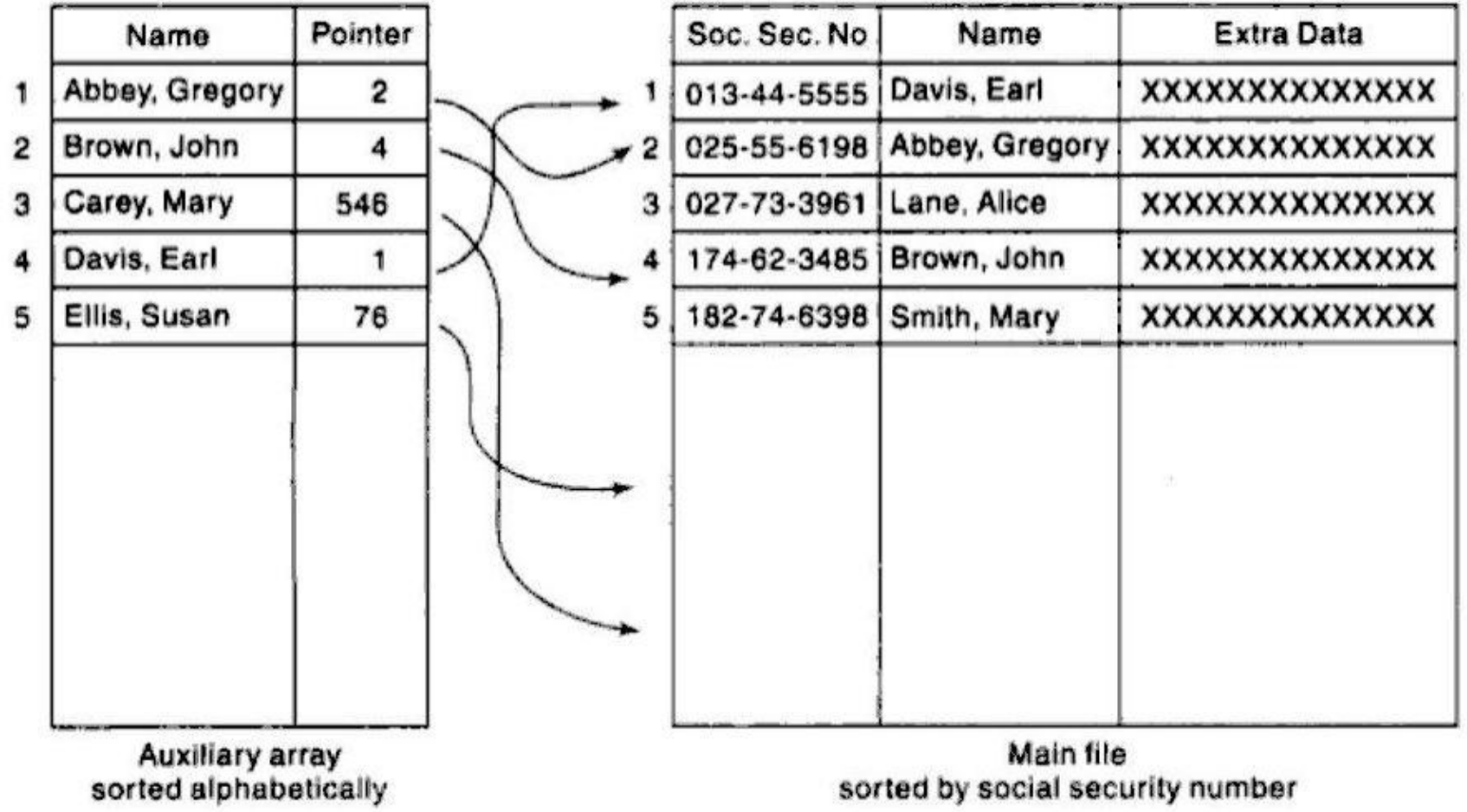
Time Complexity (Worst-case): O(logN)

Space Complexity: O(1)

Time-Space Tradeoff

- Suppose a file of records contains name, social security number, and much additional information among its fields.
- Sorting the file alphabetically and running binary search is efficient way to find the record for a given name.
- What if we are only given the social security number of the person? We have to perform linear search. (Time-consuming)
- Solution: Have another file which is sorted numerically according to social security number. (Space-consuming)

Time-Space Tradeoff



Thank You!