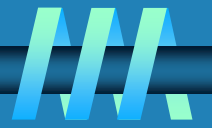
CS 395 – Analysis of Algorithms

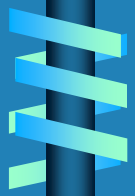
Chapter 1 – Introduction

- **Fundamental data structures**

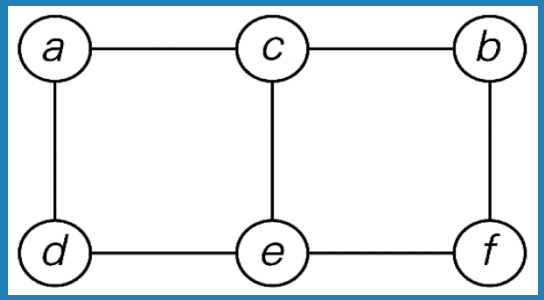
Fundamental data structures



- list
  - array
  - linked list
  - string
- stack
- queue
- priority queue
- graph
- tree
- set and dictionary



Graph representations



	a	b	c	d	e	f
a	0	0	1	1	0	0
b	0	0	1	0	0	1
c	1	1	0	0	1	0
d	1	0	0	0	1	0
e	0	0	1	1	0	1
f	0	1	0	0	1	0

(a)

a	→	c	→	d			
b	→	c	→	f			
c	→	a	→	b	→	e	
d	→	a	→	e			
e	→	c	→	d	→	f	
f	→	b	→	e			

FIGURE 1.7 (a) Adjacency matrix and

Note that the adjacency matrix of an undirected graph is always symmetric, i.e., A[i, j]= A[j, i] for every $0 \le i, j \le n - 1$ (why?).

Weighted Graphs

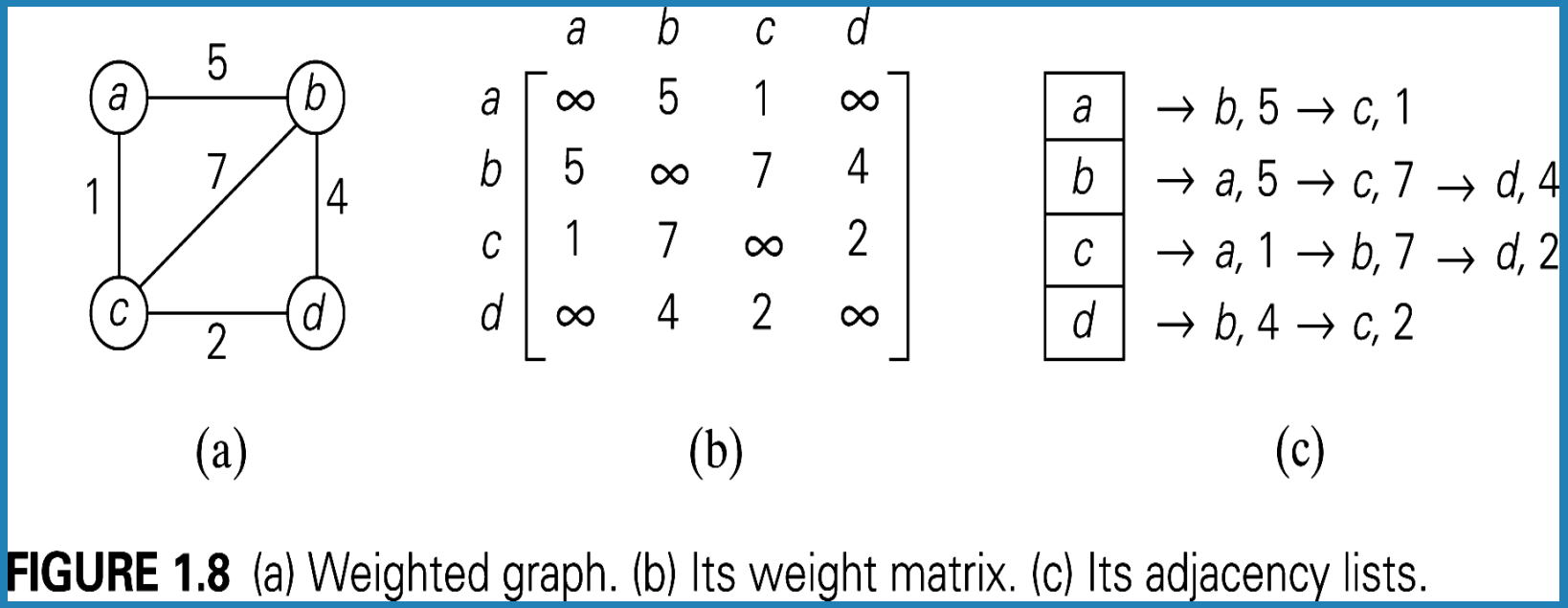


FIGURE 1.8 (a) Weighted graph. (b) Its weight matrix. (c) Its adjacency lists.

Not-connected Graphs

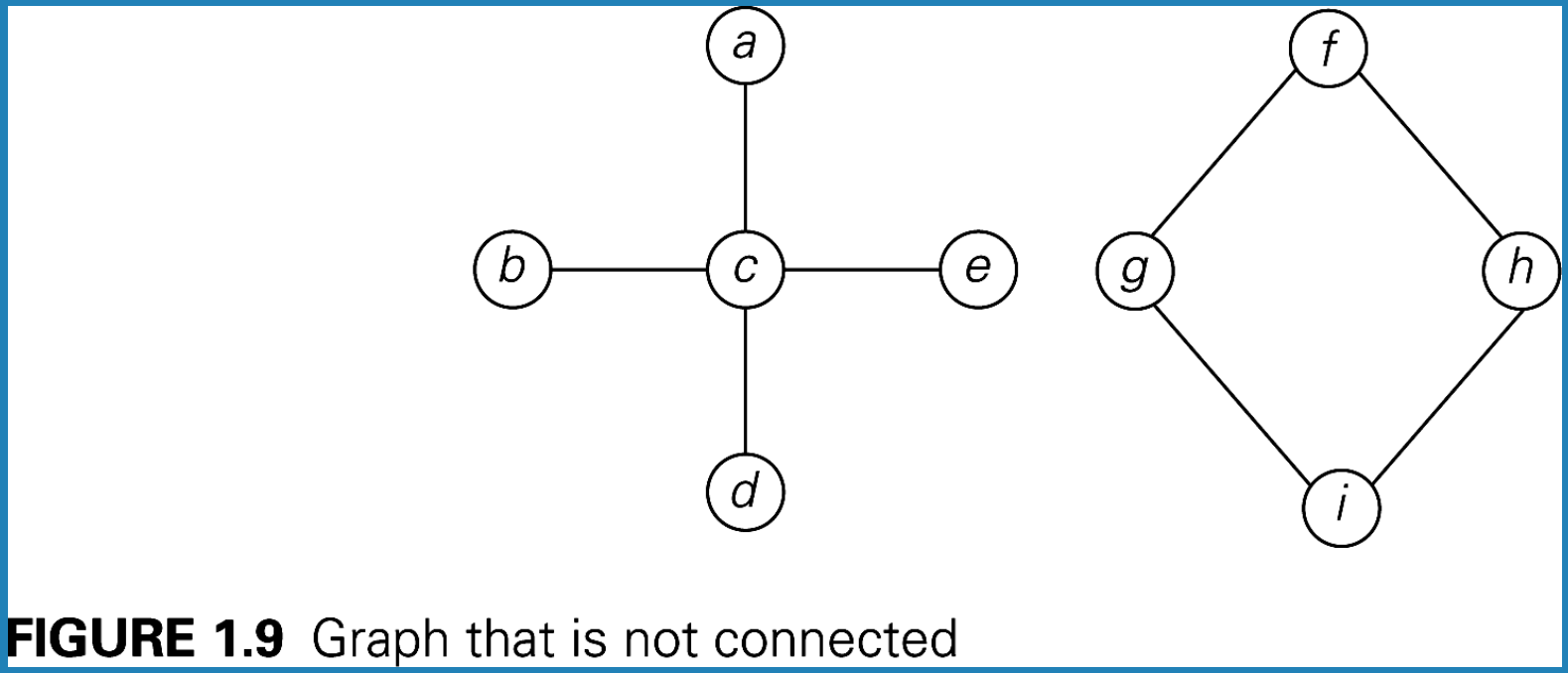


FIGURE 1.9 Graph that is not connected

Trees

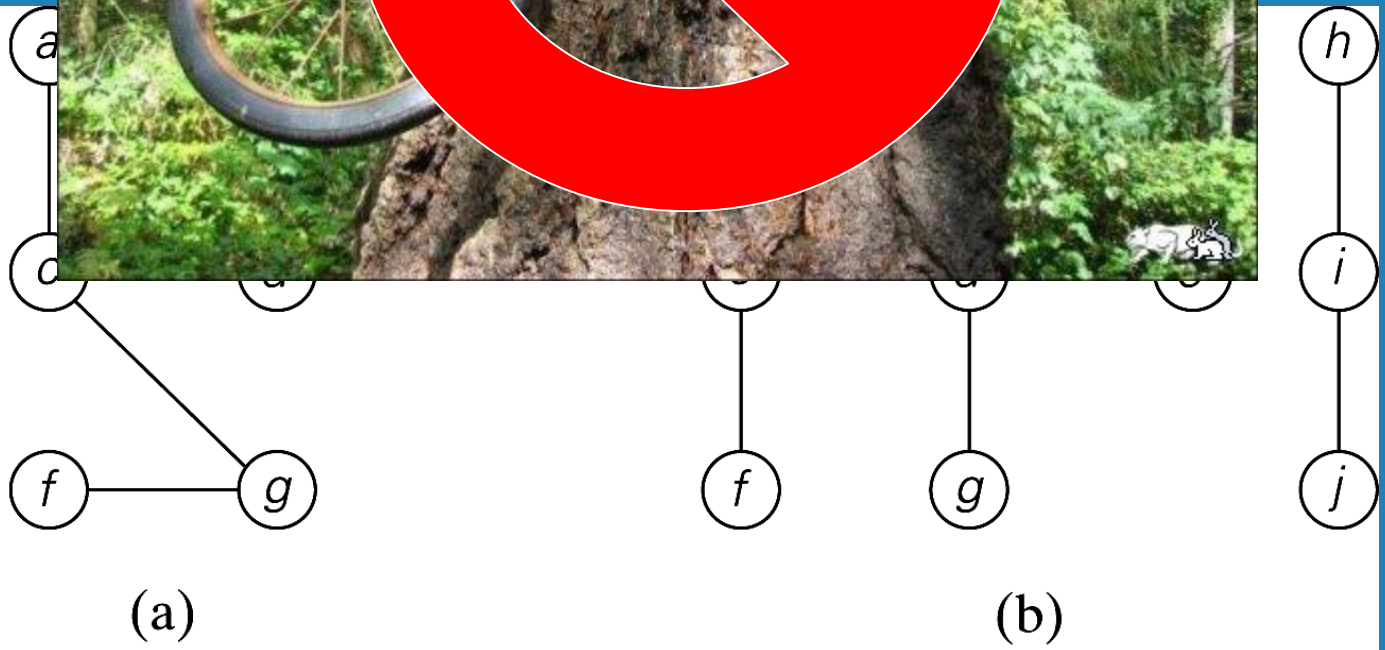


FIGURE 1.10 (a) Tree. (b) Forest.

Rooted Trees

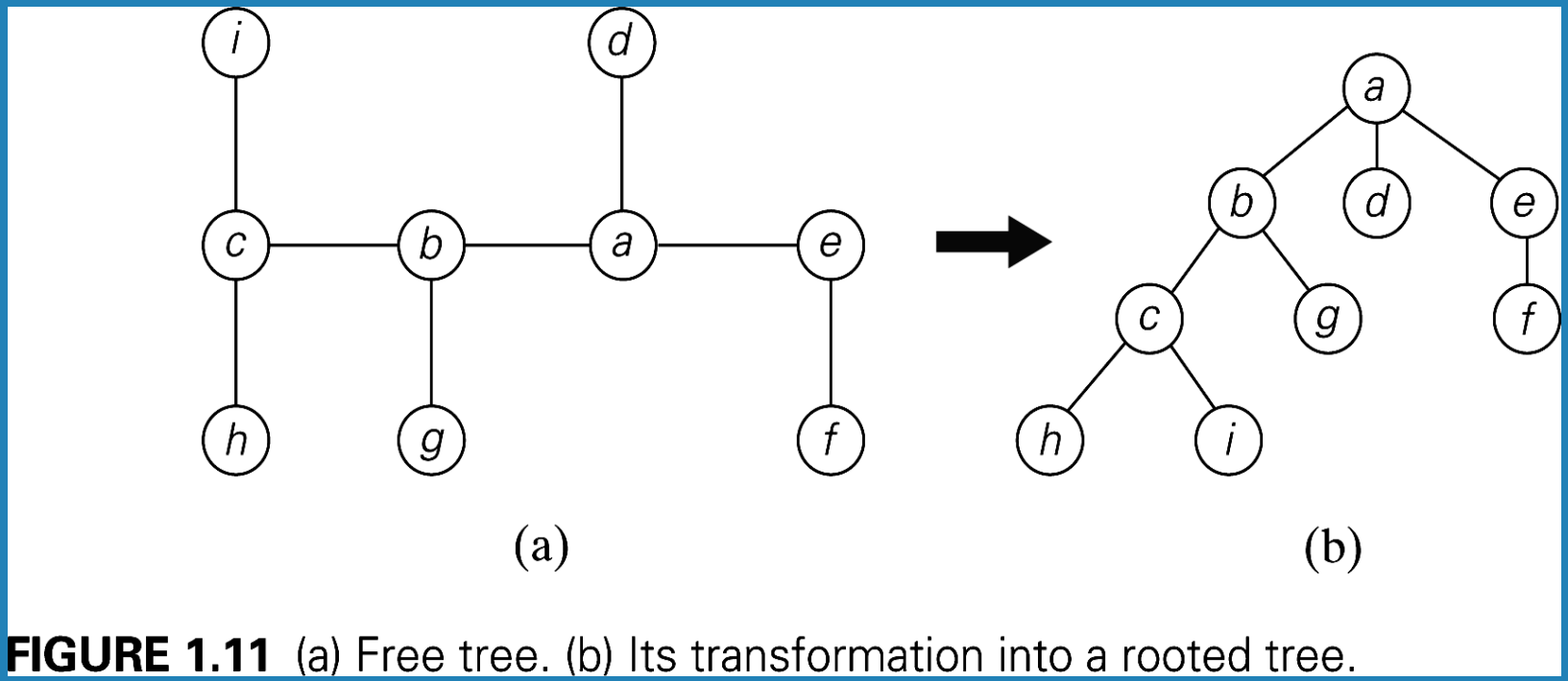


FIGURE 1.11 (a) Free tree. (b) Its transformation into a rooted tree.

Ordered Trees

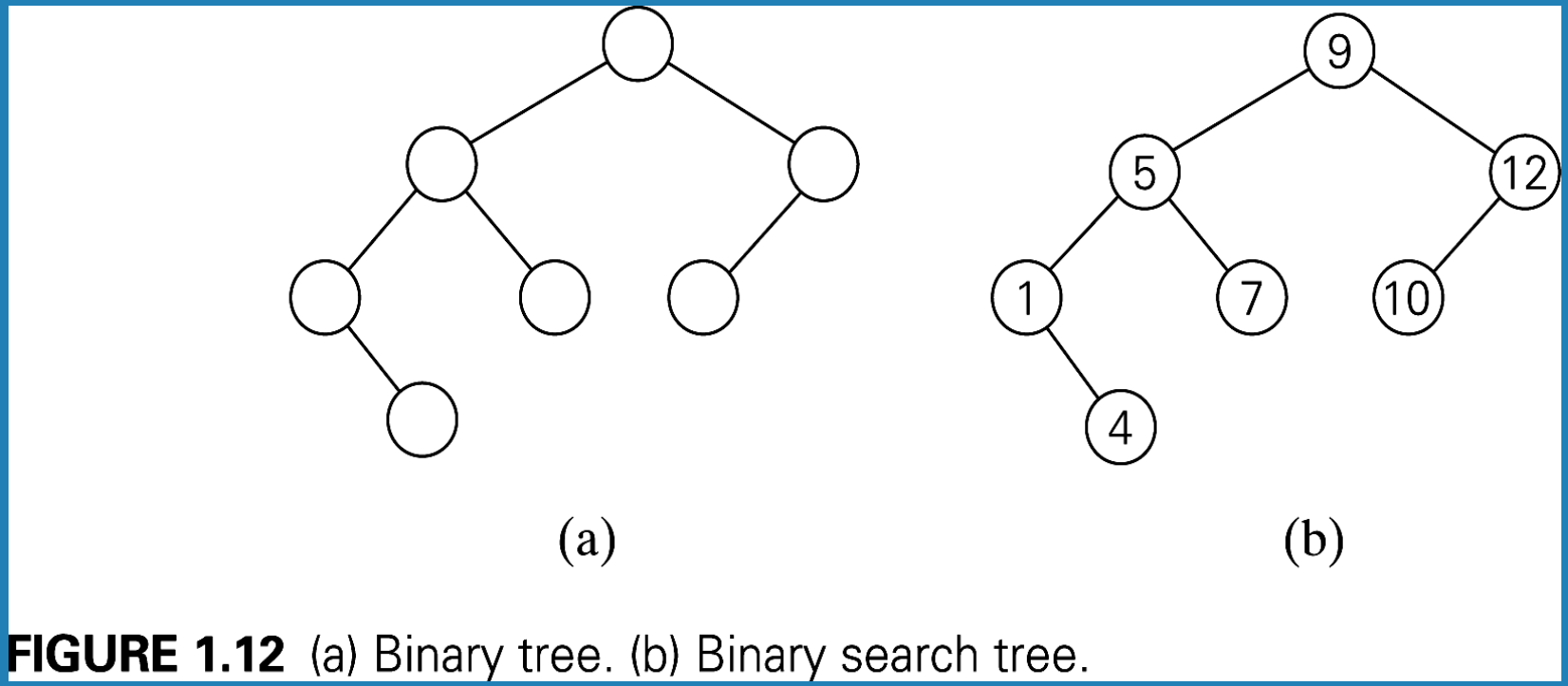
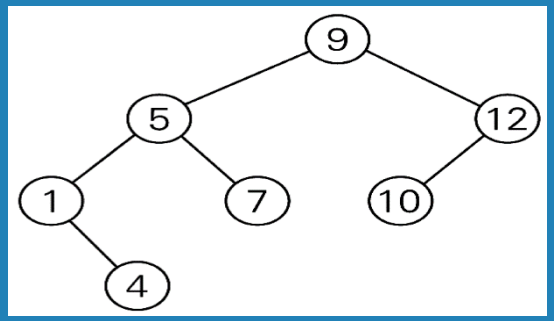


FIGURE 1.12 (a) Binary tree. (b) Binary search tree.

Binary Search Tree implementation



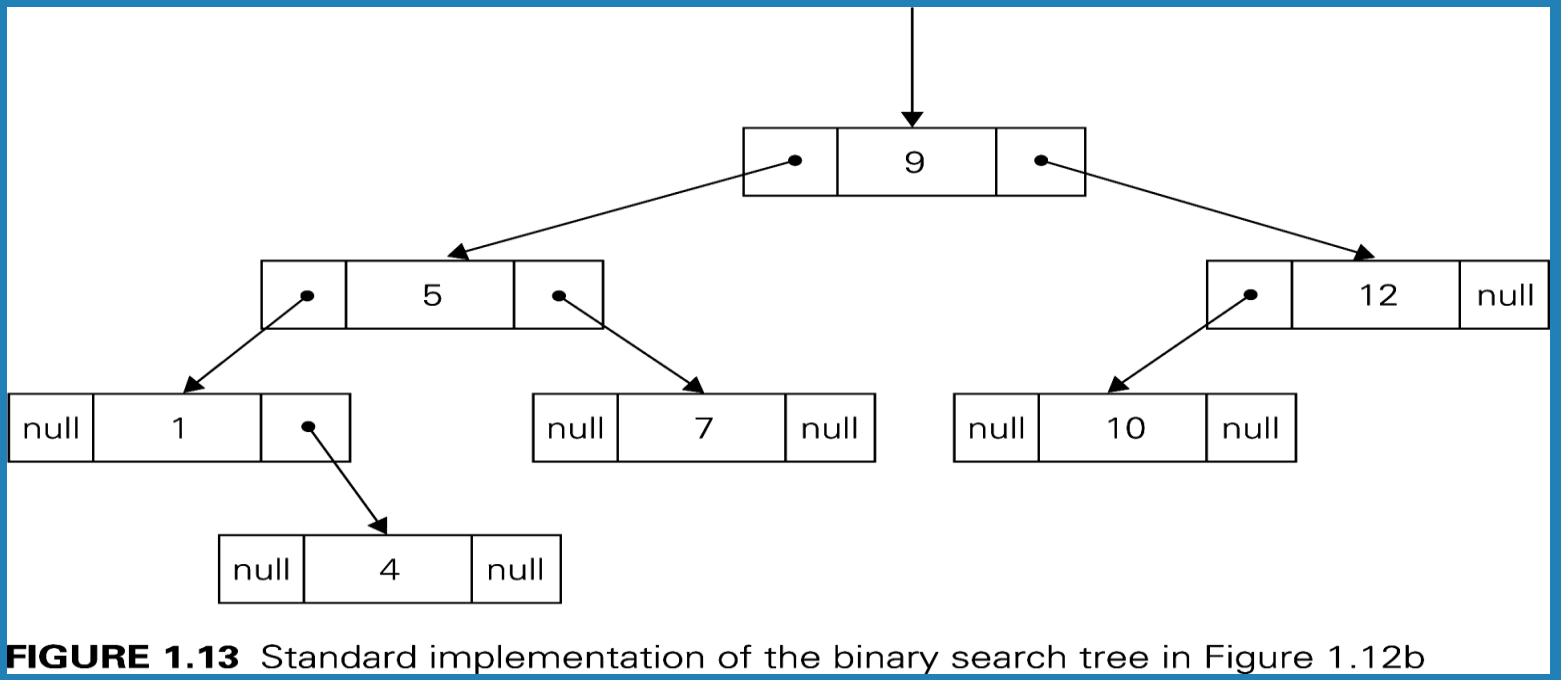


FIGURE 1.13 Standard implementation of the binary search tree in Figure 1.12b

First child-next sibling

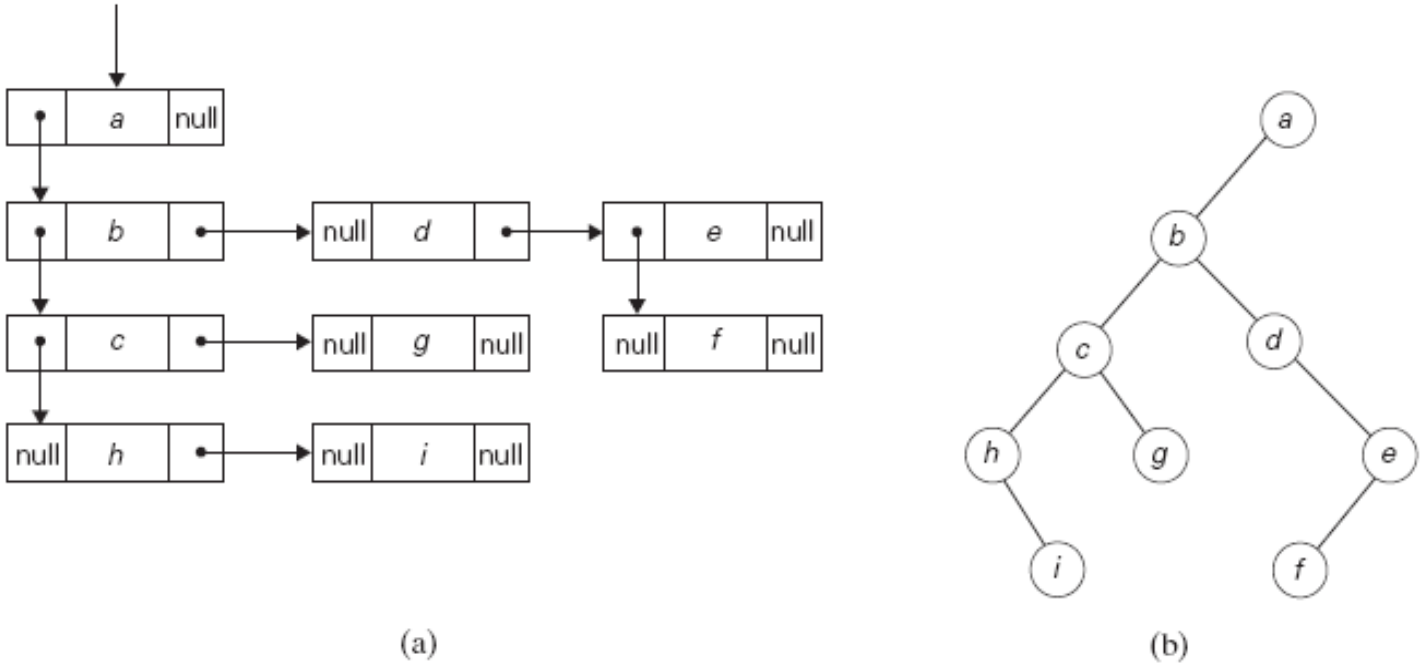
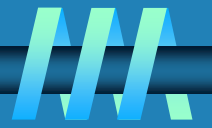


FIGURE 1.14 (a) First child–next sibling representation of the tree in Figure 1.11b. (b) Its binary tree representation.

Sets and Dictionaries



- **Set: unordered collection of distinct items called elements.**
  - **Represented as subset of Universal Set using bit vector**
  - **Or using Lists**
- **Multiset / Bag: Allows duplicate elements.**
- **Dictionary: data structure supporting operations on a set:**
  - **searching for a given item,**
  - **adding a new item, and**
  - **deleting an item**