

## 清華大學資訊系統與應用研究所 2011 年秋博士班資格考－資料結構

1. (9%) What are stacks and queues? Give at least three applications for stacks and queues.

2. Given set  $S = \{a, b, c, d, e, f, g, h, i, j, k, l\}$  and the following equivalence pairs

$$a \equiv e, g \equiv k, d \equiv b, j \equiv i, h \equiv e, g \equiv i, d \equiv f, c \equiv l, l \equiv a, g \equiv h$$

Find the corresponding equivalence classes. (8%)

3. Given an infix expression  $(a + b) / d * e * (f + a * b) - c$ .

(a) What is its corresponding prefix expression? (8%)

(b) What is its corresponding postfix expression? (8%)

4. (8%) Please write a recursive function to print the postorder representation of a binary expression tree.

5. (16%) Below please find some descriptions of an **undirected graph**:

$$\text{EmployeeGraph} = (V, E)$$

$$V(\text{EmployeeGraph}) = \{\text{Susan, Darlene, Mike, Fred, John, Sander, Lance, Jean, Brent, Fran}\}$$

$$E(\text{EmployeeGraph}) = \{(\text{Susan, Darlene}), (\text{Fred, Brent}), (\text{Sander, Susan}), (\text{Lance, Fran}), (\text{Sander, Fran}), (\text{Fran, John}), (\text{Lance, Jean}), (\text{Jean, Susan}), (\text{Mike, Darlene}), (\text{Brent, Lance}), (\text{Susan, John})\}$$

a. Please draw *EmployeeGraph*, implemented as an adjacency matrix. Store the vertex values in alphabetical order. (5%)

b. Using the adjacency matrix for *EmployeeGraph*, describe the path from **Susan** to **Lance** (1) using a breadth-first strategy ; (2) using a depth-first strategy. (6%)

c. Which one of the following phrases best describes the relationship represented by the edges between the vertices in *EmployeeGraph*? (5%)

(1) “works for” ; (2) “is the supervisor of” ; (3) “is senior to” ; (4) “works with”

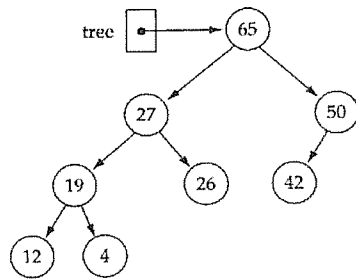
6. (9%)

a. Which of the following trees are *complete*?

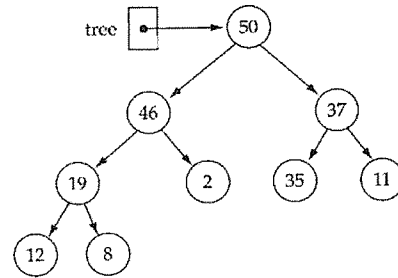
b. Which of the following trees are *full*?

c. Which of the following trees are *heaps*?

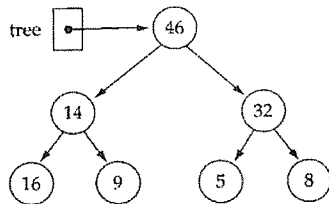
(a)



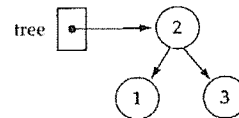
(d)



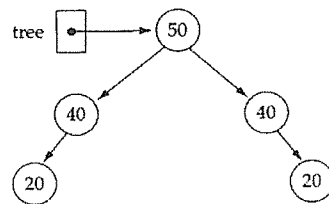
(b)



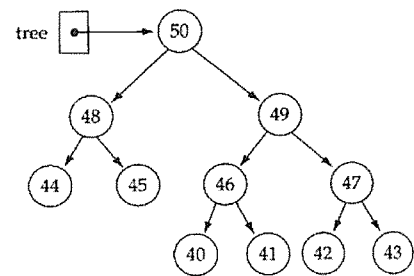
(e)



(c)



(f)



7. (12%) What is quick sort? Please write the quick sort algorithm.

8. (12%) What is the worst case and best case time complexity for quick sort?

9. (10%) According to your algorithm, please give examples for the worst case and the best case time complexity of quick sort. Please show that your examples are correct.