

# Questions 11 and 13 Only

10. Are these system specifications consistent? "Whenever the system software is being upgraded, users cannot access the file system. If users can access the file system, then they can save new files. If users cannot save new files, then the system software is not being upgraded."
11. Are these system specifications consistent? "The router can send packets to the edge system only if it supports the new address space. For the router to support the new address space it is necessary that the latest software release be installed. The router can send packets to the edge system if the latest software release is installed, The router does not support the new address space."
12. Are these system specifications consistent? "If the file system is not locked, then new messages will be queued. If the file system is not locked, then the system is functioning normally, and conversely. If new messages are not queued, then they will be sent to the message buffer. If the file system is not locked, then new messages will be sent to the message buffer. New messages will not be sent to the message buffer."
13. What Boolean search would you use to look for Web pages about beaches in New Jersey? What if you wanted to find Web pages about beaches on the isle of Jersey (in the English Channel)?
14. What Boolean search would you use to look for Web pages about hiking in West Virginia? What if you wanted to find Web pages about hiking in Virginia, but not in West Virginia?
- \*15. Each inhabitant of a remote village always tells the truth or always lies. A villager will give only a "Yes" or a "No" response to a question a tourist asks. Suppose you are a tourist visiting this area and come to a fork in the road. One branch leads to the ruins you want to visit; the other branch leads deep into the jungle. A villager is standing at the fork in the road. What one question can you ask the villager to determine which branch to take?
16. An explorer is captured by a group of cannibals. There are two types of cannibals—those who always tell the truth and those who always lie. The cannibals will barbecue the explorer unless he can determine whether a particular cannibal always lies or always tells the truth. He is allowed to ask the cannibal exactly one question.
  - a) Explain why the question "Are you a liar?" does not work.
  - b) Find a question that the explorer can use to determine whether the cannibal always lies or always tells the truth.
17. When three professors are seated in a restaurant, the hostess asks them: "Does everyone want coffee?" The first professor says: "I do not know." The second professor then says: "I do not know." Finally, the third professor says: "No, not everyone wants coffee." The hostess comes back and gives coffee to the professors who want it. How did she figure out who wanted coffee?
18. When planning a party you want to know whom to invite. Among the people you would like to invite are three touchy friends. You know that if Jasmine attends, she will

become unhappy if Samir is there, Samir will attend only if Kanti will be there, and Kanti will not attend unless Jasmine also does. Which combinations of these three friends can you invite so as not to make someone unhappy?

Exercises 19–23 relate to inhabitants of the island of knights and knaves created by Smullyan, where knights always tell the truth and knaves always lie. You encounter two people, *A* and *B*. Determine, if possible, what *A* and *B* are if they address you in the ways described. If you cannot determine what these two people are, can you draw any conclusions?

19. *A* says "At least one of us is a knave" and *B* says nothing.
20. *A* says "The two of us are both knights" and *B* says "*A* is a knave."
21. *A* says "I am a knave or *B* is a knight" and *B* says nothing.
22. Both *A* and *B* say "I am a knight."
23. *A* says "We are both knaves" and *B* says nothing.

Exercises 24–31 relate to inhabitants of an island on which there are three kinds of people: knights who always tell the truth, knaves who always lie, and spies (called normals by Smullyan [Sm78]) who can either lie or tell the truth. You encounter three people, *A*, *B*, and *C*. You know one of these people is a knight, one is a knave, and one is a spy. Each of the three people knows the type of person each of the other two is. For each of these situations, if possible, determine whether there is a unique solution and determine who the knave, knight, and spy are. When there is no unique solution, list all possible solutions or state that there are no solutions.

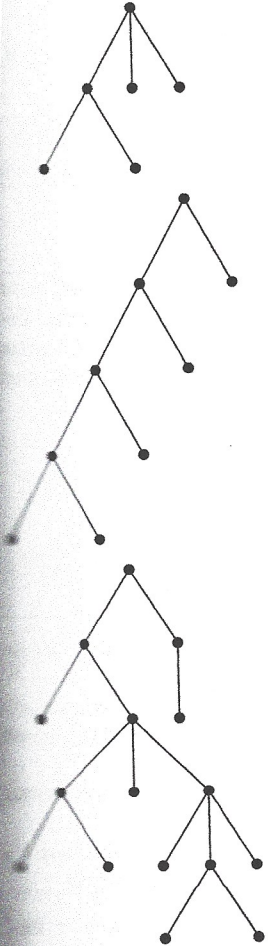
24. *A* says "*C* is the knave," *B* says, "*A* is the knight," and *C* says "I am the spy."
25. *A* says "I am the knight," *B* says "I am the knave," and *C* says "*B* is the knight."
26. *A* says "I am the knave," *B* says "I am the knave," and *C* says "I am the knave."
27. *A* says "I am the knight," *B* says "*A* is telling the truth," and *C* says "I am the spy."
28. *A* says "I am the knight," *B* says, "*A* is not the knave," and *C* says "*B* is not the knave."
29. *A* says "I am the knight," *B* says "I am the knight," and *C* says "I am the knight."
30. *A* says "I am not the spy," *B* says "I am not the spy," and *C* says "*A* is the spy."
31. *A* says "I am not the spy," *B* says "I am not the spy," and *C* says "I am not the spy."

Exercises 32–38 are puzzles that can be solved by translating statements into logical expressions and reasoning from these expressions using truth tables.

32. The police have three suspects for the murder of Mr. Cooper: Mr. Smith, Mr. Jones, and Mr. Williams. Smith, Jones, and Williams each declare that they did not kill Cooper. Smith also states that Cooper was a friend of Jones and that Williams disliked him. Jones also states that he did not know Cooper and that he was out of town the day Cooper was killed. Williams also states that he

Exercises

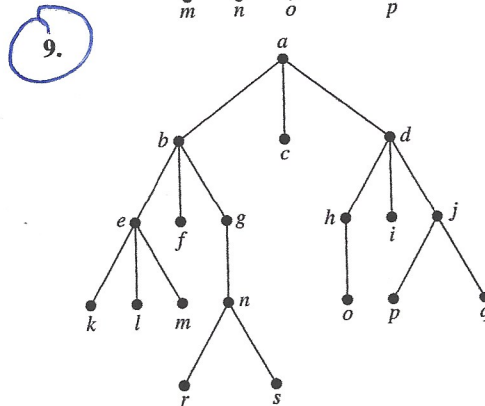
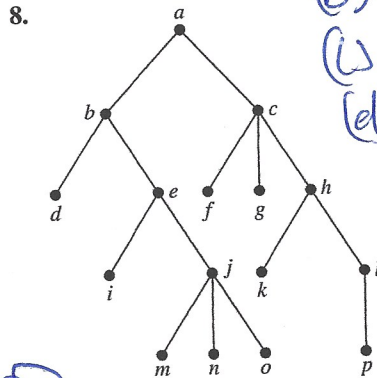
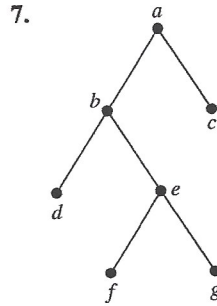
Exercises 1–3 construct the universal address system for the ordered rooted tree. Then use this to order its vertices in the lexicographic order of their labels.



- Suppose that the address of the vertex  $v$  in the ordered rooted tree  $T$  is 3.4.5.2.4.
- At what level is  $v$ ?
  - What is the address of the parent of  $v$ ?
  - What is the least number of siblings  $v$  can have?
  - What is the smallest possible number of vertices in  $T$  if  $v$  has this address?
  - Find the other addresses that must occur.
- Suppose that the vertex with the largest address in an ordered rooted tree  $T$  has address 2.3.4.3.1. Is it possible to determine the number of vertices in  $T$ ?
- Can the leaves of an ordered rooted tree have the following list of universal addresses? If so, construct such an ordered rooted tree.
- 1.1.1, 1.1.2, 1.2, 2.1.1.1, 2.1.2, 2.1.3, 2.2, 3.1.1, 3.1.2.1, 3.1.2.2, 3.2

- 1.1, 1.2.1, 1.2.2, 1.2.3, 2.1, 2.2.1, 2.3.1, 2.3.2, 2.4.2.1, 2.4.2.2, 3.1, 3.2.1, 3.2.2
- 1.1, 1.2.1, 1.2.2, 1.2.2.1, 1.3, 1.4, 2, 3.1, 3.2, 4.1.1.1

In Exercises 7–9 determine the order in which a preorder traversal visits the vertices of the given ordered rooted tree.



- In which order are the vertices of the ordered rooted tree in Exercise 7 visited using an inorder traversal?
- In which order are the vertices of the ordered rooted tree in Exercise 8 visited using an inorder traversal?
- In which order are the vertices of the ordered rooted tree in Exercise 9 visited using an inorder traversal?
- In which order are the vertices of the ordered rooted tree in Exercise 7 visited using a postorder traversal?
- In which order are the vertices of the ordered rooted tree in Exercise 8 visited using a postorder traversal?
- In which order are the vertices of the ordered rooted tree in Exercise 9 visited using a postorder traversal?

17(a) Represent the expressions  $(x+xy) + (x/y)$  and  $x + ((2y) + x)/y$  using binary trees. Write these expressions in (b) prefix notation, (c) postfix notation, (d) infix notation.

## Questions 11.2.

(D) Build a binary search tree for the words banana, peach, apple, pear, coconut, mango, and papaya using alphabetical order.

39. How many comparisons are needed to locate or to add each of the words in the search tree for Exercise 2, starting fresh each time.

(a) pear (c) kumquat.

## Question 13.1

List all the steps used to search for 9 in the sequence 1, 3, 4, 5, 6, 8, 9, 11 using:

(a) a linear search. (b) a binary search.

35) Use the bubble sort to sort 3, 1, 5, 7, 4. Showing the lists obtained at each step.

39) Use the ~~insertion~~ insertion sort to sort the list in exercise 35, showing the lists obtained at each step.

41) (a) Sort these lists using the selection sort. (a) 3, 5, 4, 1, 2

## Question 27.

Draw Venn diagrams for each of these combinations of the sets A, B, and C.

(a)  $A \cap (B - C)$  (b)  $(A \cap B) \cup (A \cap C)$

(c)  $(A \cap \bar{B}) \cup (A \cap \bar{C})$

Section 1.1

Question 9.

Let  $P$  and  $Q$  be the propositions "Swimming at the New Jersey Shore is allowed" and "sharks have been spotted near the shore," respectively. Express each of these compound propositions as an English sentence.

(9b)  $P \wedge Q$  (d)  $P \rightarrow \neg Q$  (g)  $P \leftrightarrow \neg Q$

(31) d.  $(P \vee Q) \rightarrow (P \wedge Q)$ . Construct a truth table for each of these compound propositions.

33 (b)  $(P \oplus Q) \rightarrow (P \wedge Q)$

35 (c)  $(P \rightarrow Q) \vee (\neg P \rightarrow Q)$

37 (a)  $P \rightarrow (\neg Q \vee R)$

Section 1.2

You cannot edit a protected Wikipedia entry unless you are an administrator. Express your answer in terms of  $e$ : "you can edit a protected Wikipedia entry" and  $a$ : "you are an administrator."

Question 27. Draw a Venn diagram for each of these combinations of the sets  $A, B$ , and  $C$ .

(a)  $A \cap (B - C)$  (b)  $(A \cap B) \cup (A \cap C)$  (c)  $(A \cap B) \cup (A \cap C)$

(5) You are eligible to be president of the United States U.S.A. Only if you are at least 35 years old, were born in the U.S.A., at the time of your birth both of your parents were citizens, and you have lived at least 14 years in the country. Express your answer in terms of  $e$ : "you are eligible to be president of the U.S.A.,"  $a$ : "you are at least 35 years old,"  $b$ : "you were born in the U.S.A.,"  $p$ : "At the time of your birth, both of your parents were citizens," and  $r$ : "you have lived at least 14 years in the U.S.A."

(9) Are these system specifications consistent? "The system is in multiuser state if and only if it is operating normally. If the system is operating normally, the kernel is functioning. The kernel is not functioning or the system is in interrupt mode. If the system is not in multiuser state then it is in interrupt mode. The system is not in interrupt mode."

Question 25. Let  $A = \{0, 2, 4, 6, 8, 10\}$ ,  $B = \{0, 1, 2, 3, 4, 5, 6\}$ , and  $C = \{4, 5, 6, 7, 8, 9, 10\}$ . Find: (a)  $A \cap B \cap C$ . (b)  $A \cup B \cup C$ . (c)  $(A \cup B) \cap C$ . (d)  $(A \cap B) \cup C$ .