Brookshear-*Computer Science: An Overview,* 9th edition

Test Bank—Chapter Eight (Data Abstractions)

Multiple Choice Questions

1. Which of the following is a LIFO structure?

      A. ArrayB. Stack   C. Queue   D. Tree

ANSWER: B

2. Which of the following is a FIFO structure?

      A. ArrayB. Stack   C. Queue   D. Tree

ANSWER: C

3. Which of the following is static in the sense that it does not change size or shape as information is stored and retrieved?

      A. ArrayB. Stack   C. Queue   D. Tree

ANSWER: A

4. Suppose you were going to retrieve items of data that you would later need to process in the opposite order from that in which they were retrieved. Which of the following would be the best structure in which to store the items?

      A. Traditional linked list   B. Stack   C. Queue   D. Tree

ANSWER: B

5. Suppose a binary tree contained the nodes W, X, Y, and Z. If W and X were children of Y, and Z had no children, which node would be the root?

      A. W   B. X   C. Y   D. Z

ANSWER: C

6. Suppose a binary tree contained the nodes W, X, Y, and Z, and each node had at most one child. How many terminal nodes would be in the tree?

      A. One   B. Two   C. ThreeD. Undetermined

ANSWER: A

7. If the two-dimensional array X were stored in row-major order, then in the block of main memory containing X, which of the following would be true?

      A. The entry X[1,2] would appear before X[2,1].
      B. The entry X[1,2] would appear after X[2,1].
      C. The entry X[1,2] would be in the same location as X[2,1].
      D. None of the above

ANSWER: A

8. Which of the following is not used when determining the location of an entry in a two-dimensional homogeneous array stored in row-major order?

    A. Indices   B. Number of rows in the array
    C. Address polynomial   D. Number of columns in the array

ANSWER: B

9. Which of the following is not a means of locating an entry in a linked storage structure?

    A. Head pointer   B. Child pointer   C. Root pointer   D. NIL pointer

ANSWER: D

10. If a stack contained the entries w, x, y, z (from top to bottom), which of the following would be the contents after two entries were removed and the entry r was inserted?

    A. w, x, r B. y, z, r C. r, y, z D. r, w, x

ANSWER: C

11. If a queue contained the entries w, x, y, z (from head to tail), which of the following would be the contents after two entries were removed and the entry r was inserted?

    A. w, x, r B. y, z, r C. r, y, z D. r, w, x

ANSWER: B

12. If the number of nodes in a binary tree is 2^n (where n is a positive integer), then the entire tree would contain at least

    A. 2^{n+1} nodes   B. 2^{2n} nodes   C. $2^{n+1} - 1$ nodes   D. 2^{n+2} nodes

ANSWER: C

13. If the longest path in a binary tree contained exactly four nodes, what is the maximum number of nodes that could be in the entire tree?
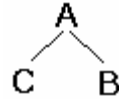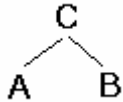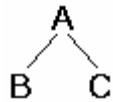
    A. 4   B. 7   C. 15   D. 31

ANSWER: C

14. The nodes in which of the trees below will be printed in alphabetical order by the following recursive procedure?

```
procedure printTree (Tree)
if (Tree is not empty)
   then (print the root node;
         apply the procedure printTree to the right subtree of Tree;
         apply the procedure printTree to the left subtree of Tree)
```

    A.   B.   C.

A.
```
    A
   / \
  B   C
```

B.
```
    C
   / \
  A   B
```
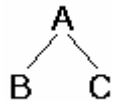
C.
```
    A
   / \
  C   B
```

ANSWER: C

15. The nodes in which of the trees below will be printed in alphabetical order by the following recursive procedure?
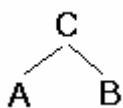
```
procedure printTree (Tree)
if (Tree is not empty)
   then (apply the procedure printTree to the left subtree of Tree;
         apply the procedure printTree to the right subtree of Tree;
         print the root node)
```
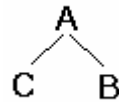
A.
```
    A
   / \
  B   C
```

B.
```
    C
   / \
  A   B
```

C.
```
    A
   / \
  C   B
```
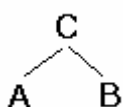
ANSWER: B

16. The table below represents a portion of a computer's main memory containing a binary tree. Each node consists of three cells, the first being data, the second being a pointer to the node's left child, and the third being a pointer to the node's right child. If the nil pointer is represented by 00 and the tree's root pointer contains 50, which of the following is a picture of the tree?

Address	Contents
50	A
51	56
52	53
53	B
54	00
55	00
56	C
57	00
58	00

A.
```
    A
   / \
  B   C
```

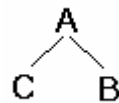B.
```
    C
   / \
  A   B
```

C.
```
    A
   / \
  C   B
```
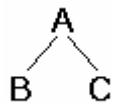
ANSWER: C

17. Suppose a binary tree is implemented as a linked structure in which each node contains both a left child pointer and a right child pointer. Which of the following statements is false?

A. The number of nodes in the tree is always at least the number of nodes on the longest path in the tree.

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B. The number of NIL pointers in the tree is always greater than the number of nodes in the tree.

C. Each terminal node in the tree is always at the end of a path that is as least as long as any other path in the tree.

D. Both the left child and right child pointers of every terminal node are NIL.

ANSWER: C

18. The table below represents a portion of a computer's main memory containing a binary tree stored row by row in a contiguous block as described in the chapter. What is the left child of the node V?

Address	Contents
50	T
51	U
52	V
53	W
54	X
55	Y
56	Z

A. W   B. X   C. Y   D. Z

ANSWER: C

19. The table below represents a portion of a computer's main memory containing a binary tree stored row by row in a contiguous block as described in the chapter. What is the parent of the node Z?

Address	Contents
50	T
51	U
52	V
53	W
54	X
55	Y
56	Z

A. T   B. U   C. V   D. Y

ANSWER: C

20. In a machine language, the technique in which the data to be manipulated by an instruction is included within the instruction itself is called

A. Immediate addressing   B. Direct addressing   C. Indirect addressing

ANSWER: A

21. In a machine language, the technique in which an instruction contains the location of a pointer to the data to be manipulated is called

A. Immediate addressing   B. Direct addressing   C. Indirect addressing

ANSWER: C

Fill-in-the-blank/Short-answer Questions

1. Answer the following questions in terms of the tree below.
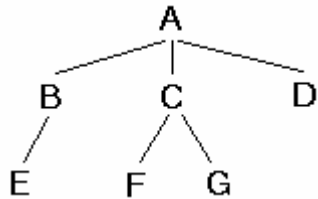
        A. The root node is _____ .

        B. Three nodes that are siblings are _____ , _____, and _____ .

        C. The terminal nodes are _____ .

        D. The node with only one child is _____ .

ANSWER: A. A   B. B, C, and D   C. E, F, G, and D   D. B

2. Two special forms of lists are the LIFO structures known as _____ , in which entries are

inserted and removed from the _____ , and FIFO structures known as _____ ,

in which entries are removed from the _____ and inserted at the _____ .

ANSWER: stacks, top, queues, head, tail

3. Suppose the expression X[1, 1] referred to the first-row, first-column entry in a two-dimensional array
with 5 rows and 7 columns. If the array is stored in row-major order beginning at memory address x and
each entry in the array requires n memory cells, what address polynomial would be used to compute the
address of the beginning of the entry X[I, J]?

        _____

ANSWER: $x + n(7(I - 1) + J - 1)$

4. Suppose the expression X[0, 0] referred to the first-row, first-column entry in a two-dimensional array
with 5 rows and 7 columns. If the array is stored in column-major order beginning at memory address x
and each entry in the array requires n memory cells, what address polynomial would be used to compute
the address of the beginning of the entry X[I, J]?

        _____

ANSWER: $x + n(5J + I)$

5. If a queue contained the entries B, C, D (from head to tail), what would be the contents of the queue
(again from head to tail) after one entry was removed and the entry A was inserted?

ANSWER: C, D, A

6. Suppose a queue contained the entries A, B, C, D (from head to tail) and suppose that the entries were removed and pushed on a stack one at a time until the queue was empty. What would be the contents of the queue (again from head to tail) if the entries were then popped from the stack and inserted back in the queue one at a time.

_____

ANSWER: D, C, B, A

7. In which direction does an unchecked queue crawl through memory (in the direction of its head or in the direction of its tail)?

_____

ANSWER: In the direction of its tail

8. The table below represents a portion of a computer's main memory containing a linked list. Each list entry consists of two cells, the first being data and the second being a pointer to the next list entry. If the nil pointer is represented by 00 and the list's head pointer contains 56, what are the data entries in the list? (List the entries in the order they occur in the list.)

Address	Contents
50	AA
51	00
52	BB
53	58
54	CC
55	50
56	DD
57	54
58	EE
59	00

_____

ANSWER: DD, CC, AA
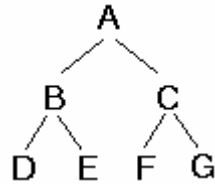
9. What sequence of nodes from the tree
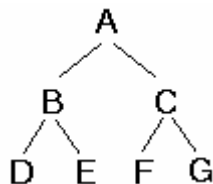
would be printed if the following recursive procedure were applied to it?

```
procedure printTree (Tree)
if (Tree is not empty)
  then (print the root of Tree;
        apply the procedure printTree to the right subtree of Tree)
```

_____

ANSWER: A, C, G

10. What sequence of nodes from the tree

would be printed if the following recursive procedure were applied to it? (The procedure uses a global stack called Stack that is assumed to begin empty.)

```
procedure printTree (Tree)
if (Tree is not empty)
   then (push the current node on Stack;
           apply the procedure printTree to the right subtree of Tree)
if (Stack is not empty)
   then (pop an entry from Stack and print that node)
```

_____

ANSWER: G, C, A

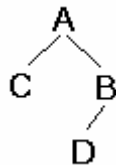11. What sequence of nodes from the tree

would be printed if the following recursive procedure were applied to it? (The procedure uses a global stack called Stack that is assumed to begin empty.)

```
procedure printTree (Tree)
push the left child of the root node on Stack;
if (right branch of Tree is not empty)
   then (apply the procedure printTree to the right subtree of Tree)
pop an entry from Stack and print that node.
```

_____

ANSWER: D, C

12. The table below represents a portion of a computer's main memory containing a binary tree. Each node consists of three cells, the first being data, the second being a pointer to the node's left child, and the third being a pointer to the node's right child. If the nil pointer is represented by 00 and the tree's root pointer contains 56, what data is in the left child of the root node?

Address	Contents
50	AA
51	53

52	00
53	BB
54	00
55	00
56	CC
57	50
58	00

_____

ANSWER: AA

13. The table below represents a portion of a computer's main memory containing a binary tree. Each node consists of three cells, the first being data, the second being a pointer to the node's left child, and the third being a pointer to the node's right child. If the nil pointer is represented by 00 and the tree's root pointer contains 53, how many terminal nodes are in the tree?

Address	Contents
50	AA
51	00
52	00
53	BB
54	00
55	56
56	CC
57	00
58	00

_____

ANSWER: One

14. The table below represents a portion of a computer's main memory containing a binary tree. Each node consists of three cells, the first being data, the second being a pointer to the node's left child, and the third being a pointer to the node's right child. If the nil pointer is represented by 00 and the tree's root pointer contains 53, how many nodes are on the longest path in the tree?

Address	Contents
50	AA
51	56
52	00
53	BB
54	00
55	50
56	CC
57	00
58	00

_____

ANSWER: Three

15. The table below represents a portion of a computer's main memory containing a binary tree stored row by row in a contiguous block as described in the chapter. What are the children of the node B?

```
Address    Contents
  50          A
  51          B
  52          C
  53          D
  54          E
  55          F
  56          G
```

ANSWER: D and E

16. If the longest path in a binary tree contains five nodes, what is the maximum number of terminal nodes that could be in the tree?

_____

ANSWER: 16

17. If the variable named `Box` had the user-defined type `RectangleType` defined by

```
Define type RectangleType to be
{real    length;
 real    width;
 real    height
}
```

What expression would be used to reference the length of Box?

_____

ANSWER: `Box.length`

18. If the type `BananaSplit` was defined by a statement such as

```
define type BananaSplit to be
{int    Banana;
 int    IceCream;
 int    Chocolate;
 int    WhippedCream;
 int    Nuts;
 int    Cherry
}
```

what statement would probably be used to declare the variable `Desert` to be an instance of that type?

_____

ANSWER: `BananaSplit Desert;`
(The declaration of Desert would use the same syntax as the declarations using the primitive type int.)

19. Suppose the abstract data type `StackType` was defined as follows:

```
define type StackType to be
{int StackEntries[20];
 int StackPointer = 0;
 procedure push(Value)
```

```
      {StackEntries[StackPointer] ← Value;
       StackPointer ← StackPointer + 1;
      }
    }
```

A. What would be the value of the variable `StackPointer` associated with `Stack` after executing the statement

```
    StackType Stack;
```

_____

B. Then, what would be the value of `StackPointer` associated with `Stack` after executing the statement

```
    Stack.push(5);
```

_____

ANSWER: A. 0   B. 1

20. Suppose the abstract data type `StackType` was defined as follows:

```
    define type StackType to be
    {int StackEntries[20];
     int StackPointer = 0;
     procedure push(Value)
     {StackEntries[StackPointer] ← Value;
       StackPointer ← StackPointer + 1;
     }
    }
```

A. What would be the value of the variable `StackPointer` associated with `Stack2` after executing the statements

```
    StackType Stack1, Stack2;
    Stack1.push(5);
    Stack2.push(6);
    Stack2.push(7);
```

_____

B. What would be the value of `StackEntries[0]` associated with `Stack1` after executing the statements in part A?

_____

C. What would be the value of `StackEntries[0]` associated with `Stack2` after executing the statements in part A?

_____

ANSWER: A. 2   B. 5   C. 6

21. The following represents a portion of a computer's main memory.

Address	Contents
50	51
51	56
52	53
53	57
54	58
55	50
56	57
57	52
58	53

A. What would be stored at address 50 after executing the instruction "Copy the contents of the memory cell at address 54 to address 50"?

_____

B. What would be stored at address 50 after executing the instruction "Copy the contents of the memory cell pointed to by the cell at address 54 to address 50"?

_____

ANSWER: A. 58   B. 53

Vocabulary (Matching) Questions

The following is a list of terms from the chapter along with descriptive phrases that can be used to produce questions (depending on the topics covered in your course) in which the students are ask to match phrases and terms. An example would be a question of the form, "In the blank next to each phrase, write the term from the following list that is best described by the phrase."

Term	Descriptive Phrase
pointer	Contains the address at which an entity is stored
address polynomial	Used to find entries in a homogeneous array
abstraction	The separation of internal implementation from external functionality
list	A general sequential storage structure
stack	A LIFO storage structure
queue	A FIFO storage structure
array	A "rectangular" storage structure that does not change in size or shape
tree	A storage structure that may contain siblings.
user-defined data type	A storage structure template built by combining primitive types
abstract data type	A custom-built data type including both data and operations
class	A "type" whose instances are objects
instance	An entity conforming to a type
linked structure	A data storage system in which items are connected via pointers
top	The "head" of a stack
root	The top node of a tree
NIL pointer	Indicates the end

General Format Questions

1. What condition indicates that a linked list is empty?

ANSWER: An empty linked list is indicated by a NIL head pointer.

2. The table below represents a portion of a computer's main memory containing a linked list. Each entry consists of two cells, the first being data, the second being a pointer to the next entry. If the nil pointer is represented by 00 and the list's head pointer contains 52, modify the memory cells so the data at address 50 replaces the second entry in the list.

Address	Contents
50	AA
51	00
52	BB
53	58
54	CC
55	00
56	DD
57	00
58	EE
59	54

ANSWER: Change the cell at address 51 to 54 and change the cell at address 53 to 50.

3. The table below represents a portion of a computer's main memory containing a linked list. Each entry consists of two cells, the first being data, the second being a pointer to the next entry. If the nil pointer is represented by 00 and the list's head pointer contains 52, modify the memory cells so the data at address 56 is inserted at the end of the list.

Address	Contents
50	AA
51	00
52	BB
53	58
54	CC
55	00
56	DD
57	00
58	EE
59	54

ANSWER: Change the cell at address 55 to 56.

4. The table below represents a portion of a computer's main memory containing a binary tree. Each node consists of three cells, the first being data, the second being a pointer to the node's left child, and the third being a pointer to the node's right child. If the nil pointer is represented by 00 and the tree's root pointer contains 53, draw a picture of the tree showing the data in each node?

Address	Contents
50	AA
51	56
52	00
53	BB
54	00

```
55        50
56        CC
57        00
58        00
```

ANSWER:


```
BB
  \
    AA
   /
 CC
```

5. Why is a queue normally implemented as a circular queue?

ANSWER: To keep it from crawling through memory unchecked.

6. What is the distinction between a user-defined data type and an abstract data type?

ANSWER: A user-defined data type is merely a "data storage template" whereas an abstract data type includes procedures for manipulating the data as well.

7. Define each of the following:

      A. Primitive data type   B. User-defined data type   C. Abstract data type

ANSWER: A. A data type provided as a predefined feature of a programming language.
       B. A data arrangement template defined in a program.
       C. An extension of a user-defined type that incorporates procedures for manipulating the data.

8. What is the distinction between a type and an instance of that type?

ANSWER: A type is a collection of characteristics. An instance of that type is an entity with those characteristics. (A type is a template from which an instance of that type is constructed.)

9. What is the distinction between direct addressing and indirect addressing?

ANSWER: When using direct addressing, the address of the data to be manipulated is included in the instruction. When using indirect addressing, the location of a pointer to the data to be manipulated is included in the instruction.

10. The table below represents a portion of a computer's main memory containing a binary tree stored row by row in a contiguous block as described in the chapter. Draw a picture of the tree.

Address	Contents
50	A
51	B
52	C
53	D
54	E
55	F
56	G
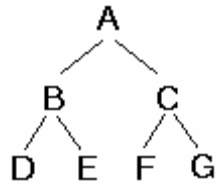
ANSWER:

11. In a machine language, what advantage does indirect addressing offer over immediate and direct addressing?

ANSWER: Indirect addressing allows the same instruction to be used to perform the same operation on different items of data merely by changing the value of the pointer referenced in the instruction.