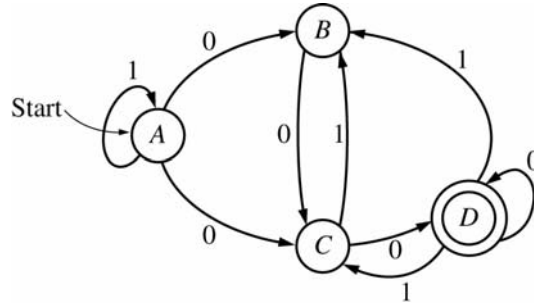
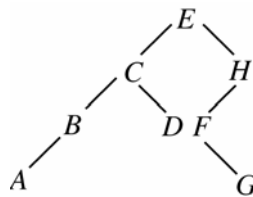


## Major Field Test in Computer Science Sample Questions

The following questions illustrate the range of the test in terms of the abilities measured, the disciplines covered, and the difficulty of the questions posed. They should not, however, be considered representative of the entire scope of the test in either content or difficulty. An answer key follows the questions.



1. If  $D$  is the accepting state of the nondeterministic finite automaton above, which of the following does the automaton accept?
  - (A) 001
  - (B) 1101
  - (C) 01100
  - (D) 000110
  - (E) 100100



2. If a node in the binary search tree above is to be located by binary tree search, what is the expected number of comparisons required to locate one of the items (nodes) in the tree chosen at random?
  - (A) 1.75
  - (B) 2
  - (C) 2.75
  - (D) 3
  - (E) 3.25

Questions 3 and 4 are based on the following information.

If the variables are suitably initialized, and if  $i$  remains within appropriate bounds, then the following code implements the stack operations *Push* and *Pop* when the stack is represented as an array  $V[1..N]$  with an index variable  $i$ .

*Push*: begin  $V[i] := x$  ;  $i := i + 1$  ; end

*Pop*: begin  $i := i - 1$ ;  $x := V[i]$  ; end

3. Which of the following gives the correct initialization for this stack implementation?

- (A)  $i := 0$
- (B)  $i := 1$
- (C)  $i := N - 1$
- (D)  $i := N$
- (E)  $i := N/2$

4. If it is assumed that suitable changes in the initialization code were also made, which of the following changes to *Push* and *Pop* would yield a correct implementation of stacks?

- I. Replacing the code for *Push* with that for *Pop* and vice versa
- II. Making *Push* decrement  $i$  and *Pop* increment  $i$
- III. Reversing the order of the statements in both *Push* and *Pop*

- (A) I only
- (B) II only
- (C) III only
- (D) I and II only
- (E) II and III only

5. In a computer with a cache memory interposed between the processor and the primary memory, the cache is  $k$ -way set-associative (for some fixed  $k$ ); i.e., each location in primary memory “maps to” (can be cached in) any of  $k$  locations in the cache. Let there be  $P$  locations in primary memory and  $C$  locations in the cache.

On the average, how many different locations in primary memory map to a particular location in the cache if  $k = 2$ ?

- (A) 1
- (B) 2
- (C)  $P / C$
- (D)  $2 P / C$
- (E)  $P$

6. Which of the following regular expressions generate(s) no string with two consecutive 1's?  
(Note that  $\epsilon$  denotes the empty string.)

- I.  $(1 + \epsilon)(01 + 0)^*$
- II.  $(01 + 10)^*$
- III.  $(0 + 1)^* (0 + \epsilon)$

- (A) I only
  - (B) II only
  - (C) III only
  - (D) I and II only
  - (E) II and III only
7. Which of the following C++ expressions does NOT always correctly compute the mathematical average of the integer variables a, b, c, and d?

- (A) `float ((a + b + c + d) / 4.0)`
- (B) `(float (a + b + c + d)) / 4`
- (C) `(a + b + c + d) / 4`
- (D) `(a + b + c + d) / 4.0`
- (E) `(a + float (b) + c + d) / 4`

8. Consider the following recursive function.

```
int Fun ( int n )
{
    if ( n == 4 )
        return 2;
    else
        return 2 * Fun ( n + 1 );
}
```

What is the value returned by the function call `Fun ( 2 )` ?

- (A) 2
- (B) 4
- (C) 8
- (D) 16
- (E) 24

9. If  $A$  is an array with  $n$  elements and procedure `Swap` exchanges its arguments, then the following code segment sorts  $A$  in descending order.

```
for ( int j = 0; j < n - 1; j++ )
    for ( int k = 0; k < n - j - 1; k++ )
        if ( A[k] < A[k + 1] )
            Swap ( A[k], A[k + 1] );
```

How many calls to `Swap` are made if initially,  $A[i] = i$ , for  $i = 0, 1, 2, \dots, n - 1$ ?

- (A)  $n - 1$   
 (B)  $n$   
 (C)  $n(n - 1) / 2$   
 (D)  $(n - 1)(n - 2)$   
 (E)  $n(n - 1)$
10. Which of the following statements about static RAM (SRAM) and/or dynamic RAM (DRAM) is true?
- (A) SRAM is implemented using transistors and capacitors that must be periodically refreshed.  
 (B) DRAM has a faster access time than SRAM.  
 (C) DRAM is less expensive than SRAM.  
 (D) SRAM is capable of operating at speeds closely approximating processors.  
 (E) DRAM is capable of operating at speeds closely approximating processors.
11. Suppose that  $\{S_1, S_2, \dots, S_N\}$  is a set of  $N$  fixed-length strings ordered alphabetically so that  $S_1 < \dots < S_N$ . If these strings are held, in order, in an array of  $N$  elements, then the time required to find the location of  $S_{i+1}$ , given the location of  $S_i$ ,  $1 \leq i < N$  has order
- (A) 1  
 (B)  $\log_2 N$   
 (C)  $N$   
 (D)  $N \log_2 N$   
 (E)  $N^2$
12. Suppose that  $V$  is a vector with indices from  $a$  to  $b$  and that each element of  $V$  occupies two words. If the elements of  $V$  are stored in consecutive words of memory and  $\alpha V[a]$  is the address of word 1 of  $V[a]$ , then the address of word 1 of  $V[i]$ , where  $a \leq i \leq b$ , is
- (A)  $(\alpha V[a] - a) + i$   
 (B)  $2(\alpha V[a] - a) + 2i$   
 (C)  $(\alpha V[a] - 2a) + 2i$   
 (D)  $(\alpha V[a] - 2a) + i$   
 (E)  $(\alpha V[a] - a) + 2i$

13. If A, B, C are Boolean variables, and if “ $\wedge$ ” and “ $\vee$ ” denote Boolean “and” and “or,” respectively, which of the following is (are) true?

- I.  $A \wedge (B \vee C) = (A \wedge B) \vee (A \wedge C)$
- II.  $A \vee (B \wedge C) = (A \vee B) \wedge (A \vee C)$
- III.  $(B \wedge A) \vee C = C \vee (A \wedge B)$

- (A) I only
- (B) II only
- (C) I and II only
- (D) II and III only
- (E) I, II, and III

**Answer Key**

- |      |      |       |       |
|------|------|-------|-------|
| 1. E | 5. D | 9. C  | 13. E |
| 2. C | 6. A | 10. C |       |
| 3. B | 7. C | 11. A |       |
| 4. E | 8. C | 12. C |       |



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