壹、選擇題（26題，每題2分）

1. Which condition is sufficient for a deadlock to exist?
   a) Mutual exclusion
   b) Hold and wait
   c) Circular wait
   d) No preemption

2. What file organization would you choose to maximize efficiency in terms of speed of access if the data are updated infrequently and accessed frequently in random order?
   a) Sequential file
   b) Indexed sequential file
   c) Indexed file
   d) Hashed file

3. Which statement is false?
   a) MS-DOS supports a single user process and a single thread.
   b) OS/2 supports multiple user processes, but only supports one thread per process.
   c) A Java run-time engine is a process with multiple threads.
   d) Windows 2000 supports multiple user processes, each of which supports multiple threads.

4. Programs that can replicate themselves and send copies from computer to computer across network connection are called
   a) Bacteria
   b) Worm
   c) Trapdoor
   d) Trojan horse

5. Which statement is false?
   a) The storage cell in a SRAM is a flip-flop.
   b) The storage cell in a DRAM is a latch.
   c) A DRAM must be refreshed periodically.
   d) A flash memory is nonvolatile.
6. The boolean expression \((A + B + C)(A + B + \overline{C})(A + \overline{B} + \overline{C})(A + \overline{B} + C)(\overline{A} + \overline{B} + C)\) can be simplified into
   a) \(A(\overline{B} + C)\)
   b) \(A(B + \overline{C})\)
   c) \(B(A + \overline{C})\)
   d) \(B(\overline{A} + C)\)

7. Suppose that the network 163.13.0.0 is assigned the subnet mask 255.255.24.0, which IP address is not within the same subnet as the others?
   a) 163.13.25.72
   b) 163.13.23.71
   c) 163.13.48.96
   d) 163.13.80.80

8. Which protocol is used for mapping IP addresses to physical addresses?
   a) ARP
   b) RARP
   c) ICMP
   d) IGMP

9. If a host in the Internet receives an IP datagram that is not delivered for it, how should the host react?
   a) Simply discard the datagram
   b) Simply route the datagram to its default router
   c) Discard the datagram while reporting an error to the sender
   d) Could be a) or b) or c), depending on how the routing algorithm is implemented

10. Suppose that we have numbers between 1 and 1000 in a binary search tree and want to search the number 363. Which sequence could not be the sequence of nodes examined?
    a) 2, 252, 401, 398, 330, 344, 397, 363
    b) 924, 220, 911, 244, 898, 258, 360, 363
    c) 2, 399, 387, 219, 260, 382, 381, 278, 363
    d) 933, 277, 347, 621, 300, 392, 358, 363
11 Given the recurrence \( T(n) = 2T(n/2) + n\log n \), what is the order of \( T(n) \)?
   a) \( O(n\log n) \)
   b) \( O(n^2 \log n) \)
   c) \( O(n\log^2 n) \)
   d) \( O(n^3 \log n) \)

12 Which problem can be solved with the help of a queue?
   a) Evaluate a postfix arithmetic expression
   b) Traverse a binary tree in level order
   c) Determine whether a graph contains a Hamiltonian circuit
   d) Determine a minimum spanning tree of a graph

13 Which problem is not known to be NP-complete?
   a) Determine whether an integer \( \geq 2 \) is a prime number
   b) Determine whether a graph can be colored with 3 colors
   c) Determine whether a graph contains a Hamiltonian circuit
   d) Determine whether a boolean formula is a tautology

14 Which drive interface is essentially an extension of the computer’s bus?
   a) SCSI
   b) IDE
   c) EIDE
   d) ESDI

15 Which boolean formula is not a tautology?
   a) \( A \implies (\neg A \implies B) \)
   b) \( (A \implies B) \implies (B \implies A) \)
   c) \( (A \implies B) \implies ((C \implies A) \implies (C \implies B)) \)
   d) \( (A \implies A) \implies (B \implies B) \)

16 A tree has two vertices of degree 2, one vertex of degree 3, and three vertices of degree 4. How many vertices of degree 1 does it have?
   a) 7
   b) 8
   c) 9
   d) 10
17. UNIX password system usually employs a variant of
   a) RC5
   b) RSA
   c) PGP
   d) DES

18. Which network application doesn't maintain a TCP connection between client and server throughout a session?
   a) WWW
   b) FTP
   c) Telnet

19. Suppose the mergesort divides the elements to be sorted into two unequal halves—one half contains only 1 element and the other contains all the remaining elements. recursively sorts each half, and then merges the two sorted halves. Such mergesort is essentially the same as
   a) insertion sort
   b) selection sort
   c) bubble sort
   d) radix sort

20. Which is not a property of an Ethernet?
   a) It uses bus topology.
   b) Its access scheme is CSMA/CD.
   c) Its physical address has 48 bits.
   d) Its frame carries 256-bit data.

21. Which is a legal alternative notation for $a[3]$ in C/C++?
   a) *(a+3)
   b) $(a+5)[2]$
   c) $3[a]$
   d) All of a), b) and c)
22 Which language is context-sensitive?
   a) The language of arithmetic expressions
   b) The programming language C
   c) The language of integer constants
   d) The languages of identifiers, i.e. variables and keywords

23 Consider the following grammar
   \[ E \rightarrow V - E | V \]
   \[ V \rightarrow x | y | z \]
   What is the associativity of the operator -?
   a) left associativity
   b) right associativity
   c) non-associativity

24 What technique is used to pass data up a TCP/IP stack from the network interface layer to the application layer?
   a) Multiplexing
   b) Demultiplexing
   c) Decoding
   d) Encoding

25 Which is not an essential ingredient in object-oriented programming?
   a) Encapsulation
   b) Inheritance
   c) Polymorphism
   d) Overloading

26 Which is a format for vector graphics?
   a) GIF
   b) JPEG
   c) TIFF
   d) IGES
Problem A

Let \( R \) be a binary relation on the set of all strings of 0s and 1s such that

\[
R = \{(a, b) \mid a \text{ and } b \text{ have the same number of 0s}\}
\]

1. Is \( R \) a partial ordering relation?
2. Is \( R \) an equivalence relation?

Problem B

An IEEE single precision floating-point number is stored in 4 bytes as follows:

```
<table>
<thead>
<tr>
<th>s</th>
<th>e</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>30</td>
<td>23</td>
</tr>
</tbody>
</table>
```

The value of the floating-point number is given by \((-1)^s \times 2^{e-127} \times f\), where \(0 < e < 255\).

3. Why are \( e = 0 \) and \( e = 255 \) excluded from the above formula?
4. Suppose we use this format to store the real number 0.1, what would be the values of \( e \) and \( f \) in binary?
5. Suppose that the `float` type is represented as above, what would be the result of executing the following C++ code?

```cpp
float sum=0.0;
for (float x=0.1;x!=1.0;x+=0.1)
    sum+=x;
cout << sum << endl;
```
Problem C

Consider the following C++ function

```cpp
void B(int n, Stack<char>& a, Stack<int>& s)
{
    if (n==0)
        if (s.emptyStack())
            cout << a;
        else {
            a.push(')'); int n=s.pop(); B(n,a,s); a.pop();
        }
    else {
        a.push('(');
        for (int i=0; i<n; i++) {
            s.push(n-i-1); B(i,a,s); s.pop();
        }
        a.pop();
    }
}
```

where the overloaded operator `<<` prints out the contents of the char stack in a line in the order from stack bottom to stack top.

6. Is the overloaded operator `<<` a member, or a friend, or neither a member nor a friend of the `Stack` class?

7. Suppose that the function is called with $n=3$ and initially empty stack $a$ and $s$, what would be the output produced by the call?

8. In terms of $n$, how many lines of outputs will be produced by a call to the function?

9. In terms of $n$, what is the maximum size needed for the stack $a$? for the stack $s$?

10. Can the stack $a$ be passed by value? Can the stack $s$ be passed by reference?
Problem D

Below is the contents of the html file of the homepage of a WWW server

<HTML>
  <HEAD>
    <TITLE> Master Exam </TITLE>
  </HEAD>
  <BODY background="canada.gif">
    <A HREF="http://www.sun.com">
      <IMG SRC="javalogos.gif">
    </A>
    <A HREF="mailto:bill@microsoft.com">
      <IMG SRC="winlogo.gif">
    </A>
  </BODY>
</HTML>

11 In order to display this homepage on the screen, the client must request the server for more data. How many requests will be issued by the client? What is each request for?

12 How many hyperlinks are there? What is each hyperlink for?