2015 Academic Challenge

COMPUTER SCIENCE TEST - STATE

This Test Consists of 30 Questions

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GENERAL DIRECTIONS

Please read the following instructions carefully. This is a timed test; any instructions from the test supervisor should be followed promptly.

The test supervisor will give instructions for filling in any necessary information on the answer sheet. Most Academic Challenge sites will ask you to indicate your answer to each question by marking an oval that corresponds to the correct answer for that question. Only one oval should be marked to answer each question. Multiple ovals will automatically be graded as an incorrect answer.

Be sure ovals are marked as ⬤ , not ⊙ , ◐ , ◑ , etc.

If you wish to change an answer, erase your first mark completely before marking your new choice.

You are advised to use your time effectively and to work as rapidly as you can without losing accuracy. Do not waste your time on questions that seem too difficult for you. Go on to the other questions, and then come back to the difficult ones later if time remains.

*** TIME: 40 MINUTES ***

DO NOT OPEN TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO!

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WYSE Academic Challenge
Computer Science Test (State) – 2015

1. Given a zero operand instruction set using a stack architecture, which of the expressions given is the result of evaluating the instructions provided? The stack operands are as follows:

    ADD   - Pops top two items from stack, adds them, pushes the result on top
    SUB   - Subtracts top item from next item on stack, leaves only the result on top
    MUL   - Pops top two items from stack, multiplies them, pushes result on top
    PUSH - put item on top of stack
    POP   - take item off top of stack

    PUSH A; PUSH B; MUL; PUSH A; PUSH C; PUSH D; MUL; SUB; ADD; POP X

    a. X = (A * B) * D – C + A
    b. X = (A * B) + (D * C – A)
    c. X = (A * B) – (D – C * A)
    d. X = (A * B) - (D * C) + A
    e. X = (A * B) + (A – C * D)

2. Using the tree to the right, list the order in which the nodes would be visited using postorder traversal.

    a. 10, 12, 8, 14, 7, 6
    b. 10, 8, 12, 6, 7, 14
    c. 14, 12, 10, 8, 7, 6
    d. 14, 12, 7, 10, 8, 6
    e. None of the above.
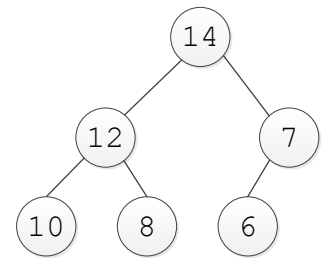
3. Given an array that starts at memory address 840 and is defined as `int a[10][5][5]`, what is the memory address of `a[6][4][4]`? (Assume that an integer is stored in one word and the array is stored in row major format with the columns coming second.)

    a. 1,014
    b.   204
    c. 1,840
    d.   244
    e. 1,024

4. Which of the following is NOT true regarding a max heap?

    a. The key in each node is no smaller than the key values in its children.
    b. It is a max tree.
    c. It is always a complete binary tree.
    d. It is always a full binary tree.
    e. All of the above are true.

5. If a binary tree has 8 levels, what is the maximum number of nodes the tree could have?

   a. 7
   b. 63
   c. 127
   d. 255
   e. 511

6. Biased numbers are used to represent the exponent on floating point numbers. The bias of an n bit number is given by $2^{(n-1)} - 1$ and is then subtracted from the original number. Using this, determine the decimal value of the 8 bit biased number: 10110110.

   a. B6   b. 182   c. 55   d. 54   e. 266

7. Determine the minimal sum of products expression for the Karnaugh map to the right.

   a. C'D + BCD + B'D'
   b. BD + B'C' + B'D'
   c. C'D + B'D' + BD
   d. C'D + B'C'D' + BD + B'CD'
   e. Answers b and c both are correct.

	C'D' 00	C'D 01	CD 11	CD' 10
A'B' 00	1	1	0	1
A'B 01	0	1	1	0
AB 11	0	1	1	0
AB' 10	1	1	0	1

8. What is the decimal result of adding the following 8-bit two's complement numbers?

   ```
     01011010
   + 01000111
   ```

   a. 2011121   b. 10100001   c. -65   d. 161   e. Overflow

9. What is the logical equivalent expression for the circuit to the right?
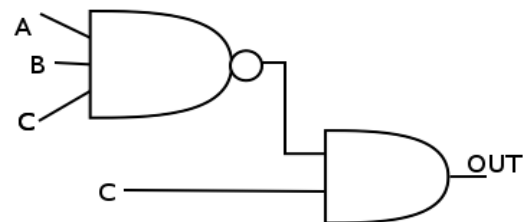
   a. A'C + B'C
   b. (ABC)' + C
   c. (ABC)C
   d. A'B'C + AB'C
   e. None of the above.

10. Given a 2-byte system bus that operates at 2KHz and takes 4 bus cycles to transfer one word of memory, how many bits per second can the system transfer?

   a. 8000   b. 32000   c. 128   d. 1000   e. 2Kbits

Use the following code for questions 11 thru 15.

```
1    /********************* POINT ********************/
2    class Point {
3       public:
4          Point( int = 1, int = 1 ); // default constructor
5          void setX (int xVal) { x = xVal; };     // set x in coordinate pair
6          void setY (int yVal) { y = yVal; };     // set y in coordinate pair
7          int  getY () const { return y; };
8          int  getX () const { return x; };
9          string getName() const { return "Point"; };
10         void print() const;                     // output Point object
11      private:
12         int x;  // x part of coordinate pair
13         int y;  // y part of coordinate pair
14   }; // end class Point
15
16   Point::Point( int xValue, int yValue ) {
17      setX(xValue);
18      setY(yValue);
19   }
20
21   void Point::print() const {
22      cout << '[' << getX() << ", " << getY() << ']';
23   } // end function print
24
25   /********************* CIRCLE  ********************/
26   class Circle : public Point {
27      public:
28         Circle( int = 0, int = 0, double = 0.0 );
29         void   setRadius( double );   // set radius
30         double getRadius()        const { return radius; };
31         double getDiameter()      const { return radius*2; };
32         double getCircumference() const { return 3.14159*getDiameter(); };
33         double getArea()          const { return 3.14159*radius*radius; };
34         string getName()          const { return "Circle";};
35         void print() const;           // output Circle object
36         bool operator<(const Circle &right) const
37            { return radius < right.radius; };
38         Circle operator++();          // pre-increment
39      private:
40         double radius;  // Circle's radius
41   }; // end class Circle
42
43   // default constructor
44   Circle::Circle( int xValue, int yValue, double radiusValue )
45        : Point( xValue, yValue )  // call base-class constructor
46   { setRadius( radiusValue ); }
47
48   // set radius
49   void Circle::setRadius( double radiusValue ) {
50      radius = ( radiusValue < 0.0 ? 0.0 : radiusValue );
51   } // end function setRadius
52
53   void Circle::print() const {
54      cout << "center ";
55      Point::print();  // invoke Point's print function
56      cout << "; radius " << getRadius();
57   } // end function print
58
59   Point p, *pPtr, list[5];
60   Circle c, arr[3];
```

11. Which of the following is not a valid initialization of the pointer `pPtr` from line 59?

    a. `pPtr = &c;`   b. `pPtr = list;`

    c. `pPtr = *list;`   d. `pPtr = &(list[0]);`

    e. `pPtr = &p;`

12. Which best describes the relationship between Point and Circle?

    a. Point and Circle are not related.   b. Point Has-A Circle.

    c. Circle Has-A Point.   d. Point Is-A Circle.

    e. Circle Is-A Point.

13. Which block of code properly displays the area of each Circle in arr?

    a. `for (int i=0; i<3; i++)`   b. `for (int i=0; i<3; i++)`
       `cout << 3.14*pow(arr[i].radius,2);`   `cout << arr.getArea();`

    c. `for (int i=0; i<3; i++)`   d. Both a and c work.
       `cout << arr[i].getArea();`

    e. a, b, and c work.

14. Which principle of object oriented coding best describes the code on lines 29 & 33?

    a. Encapsulation   b. Abstraction

    c. Inheritance   d. Polymorphism

    e. None of the above.

15. Which block of code correctly implements the overloaded ++ pre-increment method for the Circle class? This method should add one to the radius of the given Circle.

    a.
```
Circle Circle::operator++(){
    Circle temp = this;
    temp.radius++;
    return temp;
}
```
    b.
```
Circle Circle::operator++(){
    radius++;
    return *this;
}
```
    c.
```
Circle Circle::operator++(){
    Circle temp = this;
    radius++;
    return temp;
}
```
    d.
```
Circle Circle::operator++(){
    ++radius;
    return this;
}
```
    e. None of the above.

16. A hard drive spins at 6000 RPM. Given this information, what is the best estimate of the longest time that it would take to locate the data on the hard drive?

    a. 1/6000 of a second
    b. 1/100 of a second
    c. 1/200 of a second
    d. 1/3000 of a second
    e. None of the above.

17. Which of the following is NOT a function of a modern operating system?

    a. Provide device drivers for the hardware.
    b. Schedule which processes (programs) are being run.
    c. Provide a user interface.
    d. Provide an email application for the user.
    e. All are services provided by an operating system.

18. An attempt to slow down or stop a computer system or network by flooding it with requests for information and data best describes which of the following?

    a. Rogue Wi-Fi hotspot
    b. Trojan horse
    c. Virus
    d. Denial of service attack
    e. None of the above.

19. What is displayed by the following code?

```
1    int a=7, b=10;
2    cout << ( (a%b) ? 1 : 2 );
```

    a. 1   b. 2   c. 3   d. 7   e. 0

20. The following code is an example of what?

```
1    int max(int array[], int len);
2    long max(long array[], int len);
3    double max(double array[], int len);
```

    a. Operator interchanging
    b. Parameter shifting
    c. Repeated function calls
    d. Syntax error
    e. Function overloading

The remainder of this page is intentionally left blank.

Use the following code for questions 21, 22, & 23.

```
1    int func(int n) {
2        int retval;
3        if (n<2)
4            retval = 1;
5        else
6            retval = fun(n-1) + fun(n-2);
7        return retval;
8    }
```

21. What is displayed by the following call to the function above?

```
func(6);
```

    a. 0   b. 1   c. 3   d. 5   e. 13

22. Including the initial function call, how many times does the function execute with the call from the previous problem?

```
func(6);
```

    a. 1   b. 6   c. 25   d. 32   e. None of the above.

23. Which of the following is the best description of the function?

    a. recursive   b. sorting   c. static   d. searching   e. None of the above.

24. Within C++, what is a pointer?

    a. An operator used to access individual characters within a string.
    b. A variable that stores an address of another variable of a particular type.
    c. An operator that allows for the addition of variables within a function.
    d. Another name for the address-of operator.
    e. None of the above.

25. Which reserved word is used to dynamically allocate memory within C++?

    a. new   b. another   c. get   d. more   e. None of the above.

26. A(n) _____ occurs when several processes access and manipulate the same data concurrently and the outcome of the execution depends on the particular order in which the access takes place.

    a. deadlock   b. race condition
    c. infinite loop   d. abnormal termination
    e. None of the above.

Use the following code for questions 27,28, & 29.

```
1   template<class T> T func(T x[], int len) {
2       T z = x[0];
3       for(int i=1; i<len; i++)
4           if(z < x[i])
5               z = x[i];
6       return z;
7   }
8
9   int main(void) {
10      int array1[] = { 1,24,34,22};
11      long array2[] = { 23456,245,123,1,234,2345};
12      cout << func(array1, 4) << endl;
13      cout << func(array2, 6) << endl;
14      return 0;
15  }
```

27. What will the output be from line 12?

    a. 0   b. 1   c. 24   d. 34   e. 22

28. What will the output be from line 13?

    a. 245   b. 23456   c. 123   d. 1   e. 234

29. Which of the following types would need the < operator overloaded before it could be used with func?

    a. int   b. long   c. The circle   d. double   e. char
                                            object as
                                            defined for
                                            questions 11-
                                            15

30. Given the following declaration, what type is x?

    int ** x;

    a. int
    b. pointer to an int
    c. pointer to a pointer to an int
    d. pointer to a pointer to a pointer to an int
    e. None of the above.