

CIS 180 – Object-Oriented Programming
Final Examination

1. (3 pts) Give the sum of the binary numbers 01011 and 01110 in:
a) binary 11001
b) decimal 25
2. (3 pts) Suppose that we are writing a word processing program where there are 8 different properties that can be applied to a string (bold, italic, underline, etc.). The different properties may be applied in any combination. How many bits are required to encode the set of properties applied to a string? 8
3. (5 pts) Give the output of the following program in the space provided:

```
class A
{
    char foo()
    { return 'A'; }
}
class B extends A
{
    char foo()
    { return 'B'; }
}
class C extends B
{
    char foo()
    { return 'C'; }
}
class D extends B { }
class E extends A
{
    public static void main(String[] argv)
    {
        A [] a =
            { new A(), new B(), new C(), new D(), new E() };
        for (int i = 0; i < 5; i++)
            System.out.print(a[i].foo() + " ");
    }
}
```

Output: A B C B A

4. (5 pts) Suppose that class C extends class B, and class B extends class A. Also, suppose the following variables are declared:

```
A a = new A ();
B b = new B ();
C c = new C ();
```

Which of the following are true? Circle the letter(s) of **all** that apply:

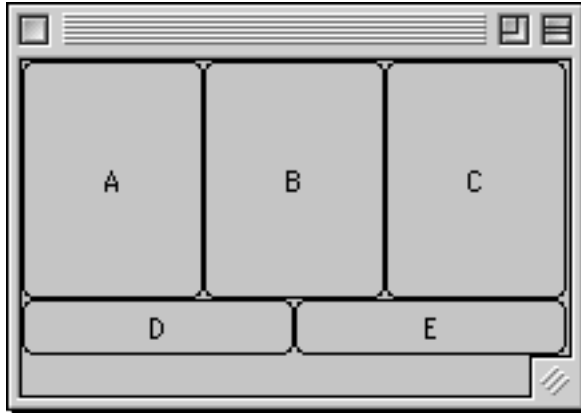
- a) Any message that can be sent to object **a** can be sent to object **c**.
 - b) Any message that can be sent to object **c** can be sent to object **a**.
 - c) Any message that can be sent to object **c** can be sent to object **b**.
 - d) The assignment $c = a;$ is legal.
 - e) The assignment $a = c;$ is legal.
5. (6 pts) Which of the following are true regarding the relationships between class and objects? Circle the letter(s) of **all** that apply:
 a) Every object belongs to a class.
 b) Every class must contain at least one object.
 c) Every class is an instance of an object.
 d) All objects of the same class share the same values for their instance variables.
 e) All objects of the same class share the same definitions of their methods.
 f) If x and y are objects belonging to the same class, containing method m , the messages $x.m()$ and $y.m()$ must return the same result.
 6. (3 pts) Briefly explain the difference between a Java Applet and a Java Application.

A java application is a normal program that runs by itself (standalone).

An applet is a small program that runs inside of another program such as

a web browser. (This topic was not covered, and will not appear on this year's exam.)

7. (14 pts) Complete the constructor for the ButtonFrame class given below to layout the buttons in the following arrangement:



Buttons A, B, and C should shrink and expand both vertically and horizontally to fill the available space in the frame, while maintaining the same relative size and positions. Buttons D and E should stretch and shrink horizontally, but retain their natural height, and should remain centered underneath the row containing buttons A, B, and C.

```
public class ButtonFrame extends JFrame
{
    private JButton a = new JButton("A");
    private JButton b = new JButton("B");
    private JButton c = new JButton("C");
    private JButton d = new JButton("D");
    private JButton e = new JButton("E");

    public ButtonFrame()
    {
        _____
        this.setLayout(new BorderLayout()); // optional (default)
        _____
        JPanel abc = new JPanel(new GridLayout(1,3));
        _____
        JPanel de = new JPanel(new GridLayout(1,2));
        _____
        _____
    }
}
```

```
abc.add(a);
_____

abc.add(b);
_____

abc.add(c);
_____

de.add(d);
_____

de.add(e);
_____

this.add(abc, BorderLayout.CENTER);
_____

this.add(de, BorderLayout.SOUTH);
_____

this.setSize(400, 300); // optional
_____

this.setVisible(true); // optional
_____

}
```

8. (13 pts) Consider the following declarations, and give the value and type of each expression in the table below. If the expression is not syntactically correct or will result in an error when evaluated, write "error" for type. **Answer each part assuming that the preceding expressions have all been evaluated.**

```
int i = 1, j = 5, k = 10;
double x = 0, y = 5, z = 10;
boolean p = false, q = true;
int [ ] a = { 1, 3, 5, 7, 9, 11 };
```

Expression	Type	Value
j / k	int	0
$(i < j) \ \&\& \ (j < k)$	boolean	true
y / k	double	0.5
$(j / k) < (y / z)$	boolean	true
$p = (i > j) \ \wedge \ !(k < j)$	boolean	true
$j / z + k * i$	double	10.5
$j -= 3$	int	2
$a[++]$	int	7
$a[j++]$	int	7
$a[j]$	int	9
$a[i--]$	int	3
$--a[i]$	int	0
$a[i]$	int	0

9. (10 pts) Give the output of the following program in the spaces provided.

```
public class A
{
    int x = 5;
    int y = 10;
    int z = 20;

    int foo(int x)
    {
        x = y;
        y = z;
        return x+y;
    }

    void print()
    {
        System.out.println(x + "," + y + "," + z);
    }
}

public class B
{
    public static void main(String[] argv)
    {
        int x = 1;
        int y = 2;
        int z = 3;

        A a1 = new A();
        A a2 = new A();

        x = a1.foo(z);
        System.out.println(x); // 30
        System.out.println(y); // 2
        System.out.println(z); // 3
        a1.print();           // 5, 20, 20
        a2.print();           // 5, 10, 20
    }
}
```

10. (7 pts) Give the output of the following program in the space provided.

```
public class A
{
    char c = 'a';
    StringBuffer s = new StringBuffer("abc");

    void print()
    { System.out.println(c + " " + s); }

    void setC(char c1)
    { c = c1; }

    void setS(StringBuffer s1)
    { s = s1; }

    public static void main(String[] argv)
    {
        char c1 = 'x';
        StringBuffer s1 = new StringBuffer("xyz");
        A a = new A();
        a.setC(c1);
        a.setS(s1);
        s1.setCharAt(1, 'b');
        a.print(); // x xbz
    }
}
```

Note: We did not cover StringBuffers, but we could have a similar problem with an array of chars.

11. (8 pts) Consider the code fragment below:

```
int count = 0;
for (int i = 0; i < 5; i++)
    for (int j = 0; j < i; j++)
        count++;
System.out.println(count);
```

What output is produced when the code is executed? 10

12. (8 pts) Consider the method, f, given below:

a) Reformat the body of the method below to use proper indentation:

```
int f(boolean p, boolean q)    int f(boolean p, boolean q)
{                               {
  if (p & q)                   if (p & q)
  if (p)                        if (p)
  return 1;                      return 1;
  else if (q)                    else if (q)
  return 2;                       return 2;
  else if (p && q)                 else if (p && q)
  return 3;                         return 3;
  else                             else
  return 4;                          return 4;
  else                               else
  return 5;                          return 5;
}
```

b) Complete the table below to show values returned from method f for various values of arguments p and q:

p	q	Return Value
true	true	1
true	false	5
false	true	5
false	false	5

13. (15 pts) Write a Java method that takes an array of integers and an integer, n, as arguments. Your method should shift the positions of the integers in the array n positions to the right. Integers that are shifted out of the array on the right, are “rotated” back to the beginning of the array. For example:

If the array originally contained:

2	3	5	7	10	20	30	16	8	7
---	---	---	---	----	----	----	----	---	---

After rotating by 3 positions the array would contain:

16	8	7	2	3	5	7	10	20	30
----	---	---	---	---	---	---	----	----	----

Do not create a new array. Instead, change the contents of the original array. **Hint:** The easiest solution is to “rotate” by one position, n times!

```
public void rotate(int[] a, int n) {
    // rotate one position, n times
    for (int i = 0; i < n; i++) {
        int tmp = a[a.length - 1]; // remove last element
        for (int j = a.length - 1; j > 0; j--) {
            a[j] = a[j-1]; // shift everything to right
        }
        a[0] = tmp; // move last element to beginning
    }
}
```