First Name (PRINT): _________________________________________________________

Last Name (PRINT): _________________________________________________________

University ID: _____________________________________________________________

Section/TAName: ____________________________________________________________

I pledge on my honor that I have not given or received any unauthorized assistance on this examination.

Your signature: ____________________________________________________________

Instructions

- This exam is a closed-book and closed-notes exam.
- Total point value is 100 points.
- The exam is an 80 minutes exam.
- Please use a pencil to complete the exam.
- WRITE NEATLY. If we cannot understand your answer, we will not grade it (i.e., 0 credit).

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CMSC132 Summer 2015 Midterm

True/False (10 points, 2 points each)
Indicate whether the statement is true or false.

_____ 1. The inheriting class cannot override the definition of existing methods by providing its own implementation.

_____ 2. Inserting a node into a single-linked list with n nodes always takes O(n). True or False. Explain

_____ 3. In Java, the actual method executed is determined by the type of the object and not the type of the reference.

_____ 4. An interface can have public and private methods.

_____ 5. An interface can only provide the signature, but cannot provide any code at all.

Multiple Choice(20 points, 2 points each)
Identify the choice that best completes the statement or answers the question.

_____ 6. The class "Parent" and its inherited class "Child" both implement a method "sayName()", printing "parent" and "child" respectively. Which of the 4 choices below reflects the correct output of the following program:

```
Parent v1 = new Parent();
Child v2 = new Child();
Parent v3 = new Child();
System.out.println(v1.sayName()+" "+v2.sayName()+" "+v3.sayName());
```

a. parent child child c. parent parent parent
b. parent child parent d. child parent child

_____ 7. Assume a linked list with start reference, and, in addition, a reference "current" that points to some Node in the list. How would you refer to the element after "current"?

a. current.next c. start.next
b. list.next d. next
8. Consider the following code

Stack<Character> s = new Stack<Character>();
String word = "carpets";
int i = 0;
while (i < word.length())
{
    s.push(word.charAt(i)); i++;
}
while(!s.empty()) {
    System.out.print(s.peek());
    s.pop();
}
What is written to the screen?

a. serc    c. carpets
b. steprac  d. caarrpeetts

9. Assume you have an array A of length 1000000 (1e6). In a test you find out that reading the element A[999] takes 1ms (you obviously have a slow computer). How long will it take to read the element A[999999]?
a. 1/10ms    c. 10ms
b. 1ms        d. 100ms

10. Which of the following is true?
a. A single reference can refer to multiple objects    c. An object can only be referred to by single reference
b. Multiple references can refer to the same, single object d. A reference always refers to a valid object

11. Choose correct equivalent statement of following code.

int[][] arr = new int[3][];
for (int i = 0; i < arr.length; i++)
    arr[i] = new int[3];

a. int [][] arr = new int[3][];    d. int [] [] arr = new int[3][3];
b. int [][] arr = new int[3][];    e. None
12. Here is an INCORRECT pseudo code for the algorithm which is supposed to determine whether a sequence of parentheses is balanced:

```java
declare a character stack
while ( more input is available) {
    read a character
    if ( the character is a '(' )
        push it on the stack
    else if ( the character is a ')' and the stack is not empty )
        pop a character off the stack
    else
        print "unbalanced" and exit
}
print "balanced"
```

Which of these unbalanced sequences does the above code think is balanced?

a. (((()  
   b. ((()()  
   c. ()(()  
   d. (()()()  

13. A method defined in a superclass is redefined in a subclass with an identical method signature is called__________.

   a. Dynamic binding  
   b. Method overriding  
   c. Method overloading  
   d. Late binding

14. What happens in the Java Virtual Machine (JVM) when the following line is processed?
   MyObject m = new MyObject();

   a. Nothing, the line is skipped, since no parameters are defined  
   b. An object of type MyObject is created, no reference is created  
   c. A reference to an object of type MyObject is created, no object is created  
   d. Both, a reference and an object of type MyObject are created

15. Pick the term that relates to polymorphism

   a. Dynamic Allocation  
   b. Static Typing  
   c. Static allocation  
   d. Dynamic binding

**Short Answer (45 points, 3 points each)**

16. How does a java program destroy an object that it creates?

   Answer:
17. Given the following contents of an arrat implementation of a stack

\[
\begin{array}{cccccc}
0 & 1 & 2 & 3 & 4 & 5 \\
stack & | & 10 & | & 50 & | & 12 & | & | & |
\end{array}
\]

Show the contents of the stack and the location of top after doing the following

stack.pop();
stack.push(7);
stack.push(8);
stack.push(9);
stack.pop();
stack.push(11)

\[
\begin{array}{cccccc}
0 & 1 & 2 & 3 & 4 & 5 \\
stack & | & | & | & | & |
\end{array}
\]

18. We want to insert node \( t \) immediately after \( x \). Is this code correct? If it is not correct, explain why?

\[
x.next = t;
\]

\[
t.next = x.next;
\]

Answer:

19. What does the following code fragment do to the queue \( q \), which has string objects?

\[
Stack<String> s = new Stack<String>();
while(!q.isEmpty())
    s.push(q.dequeue());
while(!s.isEmpty())
    q.enqueue(s.pop());
\]

Answer:
20. public class A {
    public static int x = 7;
    public int y = 3;
}

**Question:** What are the instance variables?
**Answer:**

21. The following code creates one array and one string object. How many references to those objects exist after the code executes? Is either object eligible for garbage collection?

```
Person[] persons = new Person[10];
Person manager = new Person("alice");
persons[0] = manager;
manager = null;
```

**Answer:**

22. What is the output of the following program

```
public class Test{
    public String name;
    public static int score;
    public static void main(String[] args){
        Test t1 = new Test();
        Test t2 = new Test();
        t1.name = "Java";
        t1.score = 90;
        t2.name = "Python";
        t2.score = 95;
        System.out.println(t1.name);
        System.out.println(t2.name);
        System.out.println(t1.score);
        System.out.println(t2.score);
    }
}
```

**Answer:**
23. What does “Comparable” mean in the following class definition.

```java
public class SortedBag<E extends Comparable<E>> extends Bag<E>
```

Answer:

24. `public class A {
   public static int x = 7;
   public int y = 3;
}
`  
**Question**: What are the class variables?  
**Answer**:

25. Given the following contents of a circular array implementation of a queue

Show the contents of the queue and locations of f (front) and b (back) after doing the following:

```java
Queue.dequeue();
Queue.enqueue(7);
Queue.enqueue(8);
Queue.enqueue(9);
Queue.dequeue();
Queue.enqueue(11);
```
26. public class A {
    public static int x = 7;
    public int y = 3;
}

Question: What is the output from the following code:
A a = new A();
A b = new A();
a.y = 5;
b.y = 6;
a.x = 1;
b.x = 2;
System.out.println("a.y = "+ a.y);
System.out.println("b.y = "+ b.y);
System.out.println("a.x = "+ a.x);
System.out.println("b.x = "+ b.x);
System.out.println("A.x = "+ A.x);
Answer:

27. Question: What's wrong with the following program?

Public class Person{
    public String name;
    public int age;
}

class A {
    public static void main(String[] args) {
        Person person;
        person.name="alice";
        person.age = 22;
        System.out.println("Name: " + person.name);
    }
}
Answer:
In the doubly linked list shown above, P reference a node “node2”. Write code to delete the node. You are not allowed to start from Head.
Answer:

29. What is the output of following program

```java
class A{
    public static void foo(){ System.out.println("A");}
}
class B extends A{
    public static void foo(){ System.out.println("B");}
}
public class C{
    public static void main(String[] args) {
        A obj = new B();
        obj.foo();
        A.foo();
        B.foo();
    }
}
```
Answer:
30. Abstract class Parent{
    void foo(){
        System.out.println("parent");
    }
}

class Child extends Parent
{
    void foo(int x){
        System.out.println("child");
    }
}

Check the following if each statement is valid or invalid. Circle your answer
Parent p1 = new Parent();
Parent p2 = new Child();
Child c = new Child();

p2.foo();
p1.foo(5);
c.foo()
c.foo(10);
Problem

31. (5 points)
   public class Bag<E> implements Iterable<E>, Cloneable{
       protected E[] items;
       protected int N;//number of items in the bag
       protected int capacity = 10;
       public Bag(){
           items = (E[])new Object[capacity];
       }
   }

   The Bag class uses an array to store its elements. The variable “items” references the array. Write a public method “max” for Bag class. This method returns the maximum item in the bag if the Bag is not empty. It returns “null” if the bags empty.
   Answer:
32. (5 points) Write the countOccurrences method with prototype

    public int countOccurrences(E target)

    that returns the number of times the given target element appears in this bag. Assume that null data
    elements are not allowed in the bag.

    Answer:

33. (3 points) Assume the Bag size is fixed and the size is provided by the user when the Stack is instantiated. Member variable “CAPACITY” represents the size of the stack, while N represents the number of items in the stack. Write a method “boolean isFull()”, which returns true if the stack is full. It returns false otherwise.
34. (7 points) We want to implement this Bag interface. Items in this Bag cannot be removed.

```java
public interface Bag<E extends Comparable<E>> extends Iterable<E> {

    public void enqueue(E item);

    public E peek();

    public int size();

    public E min();

    public boolean isEmpty();

}
```

The public method min returns the minimum item in the queue. Describe a constant time (O(1)) algorithm for the “min” method and implement it.

Answer:
35. Write a method “Node half(Node head)” that returns the first half of a given linked list. If the list length is odd, first half includes the middle node. “head” references the first node of the list. The length of the list is not given. For example: if the list is head->1->7->13->2->4, you return head->1->7->13. Node half(Node head)