CS-390
Fundamental Programming Practices
Final Exam Sample

Name: _____ ID: _____

I (16)	II (16)			III (24)		SCI (3)

Part I. Multiple Choice & True/False Questions. (2 points each) For multiple choice, circle the best answer; circle *only one* answer in each problem. For True/False, mark it either 'T' or 'F'.

1. Which of the following statements is true?
   a. Use `ArrayList` when a lot of insertions and removals are needed.
   b. There is no need to shift elements when we remove elements from `ArrayList`.
   c. `LinkedList` implements `RandomAccess`.
   d. Resizing is not necessary for a `LinkedList` when a lot of insertions are done.
   Answer: d

2. __ T __(True/False) Suppose you create a class `Key` in which you override `equals` and `hashCode`. Suppose that your way of overriding `hashCode` is the following:

```
hashCode() {
   return 1;
}
```

   If you use instances of `Key` as keys in a `Hashmap`, the `Hashmap` operations of `put`, `get`, `remove` will be no more efficient than the corresponding operations of adding, getting, and removing elements in a linked list.

3. _T__(True/False) In-order traversal will visit nodes in a binary search tree in sorted order.

4. _F__(True/False) The following code is a full implementation of an `Employee` class and includes an implementation, as an inner class, of the `Comparator` interface. Is the implementation shown consistent with equals?

```
public class Employee  {
   private String name;
   private double salary;
   public Employee(String name, double salary) {
      this.name = name;
      this.salary = salary;
   }
   class NameComparator implements Comparator<Employee> {
      @Override
      public int compare(Employee e1, Employee e2) {
         if(e1.name.equals(e2.name)) return 0;
         else return e1.name.compareTo(e2.name);
      }
   }
   public boolean equals(Object ob) {
      if(ob == null) return false;
      if(!(ob instanceof Employee)) return false;
      Employee e = (Employee)ob;
      Return e.name.equals(name) && e.salary == salary;
   }
}
```

5. The new `forEach` method that was introduced in Java 8 is an example of which of the following (circle the best answer)
    a. A static method in an interface
    b. A default method in an interface
    c. A new implemented method in the Iterator interface
    d. None of the above
    Answer: b

6. When the `main` method is run in the `Main` class (shown below), which of the following is output to the console? Circle only one answer.

    a. true
    001:data

    b. true
    null

    c. false
    001:data

    d. false
    null

    Answer: b

```
public class Main {
    HashMap<Key, Record> map = new HashMap<>();
    Key defaultKey = new Key("secret");
    public Main() {
        map.put(defaultKey, new Record("001", "data"));
    }
    public static void main(String[] args) {
        Main m = new Main();
        Key k = new Key("secret");
        System.out.println(k.equals(m.defaultKey));
        Record recFound = m.map.get(k);
        System.out.println(recFound);
    }
}
```

```
public class Key {
    private String key;
    public Key(String k) {
        this.key = k;
    }

    @Override
    public boolean equals(Object ob) {
        if(ob == null) return false;
        if(!(ob instanceof Key)) return false;
        Key theKey = (Key)ob;
        return key.equals(theKey.key);
    }
}

public class Record {
    private String recordId;
    private String data;
    public Record(String id, String data) {
        this.recordId = id;
        this.data = data;
    }
    public String getRecordId() {
        return recordId;
    }
    public String getData() {
        return data;
    }

    @Override
    public String toString() {
        return recordId + ":" + data;
    }
}
```

Part II. Short Answer

1. [3 points] Draw the 10-item hash table: keys 1, 4, 3, 8, 2, 9, 11, 19, 20, and 5 using the following hash and hashcode methods and assuming collisions are handled by chaining. value = 2* key. Each bucket (slot) of Hash table is LinkedList. each element of LinkedList is Entry<Key, Value>.

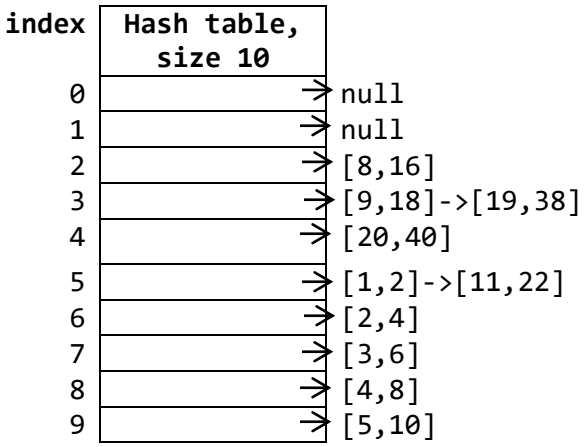
   Key = 1
   `bigNum = 7 + 11*7+1 = 85`
   index = 85%10 = 5
   `Entry<1, 2>`

   ```
   tableSize = 10;
   bigNum = hashCode();
   index = hash(bigNum);
   ```

   key = 4
   bigNum = 7 + 11*7+4 = 88
   index = 88%10 = 8
   entry <4,8 >

   key = 11
   bigNum = 7 + 11*7 + 11 = 95
   index = 95%10 = 5
   Entry<11, 22>

   ```
   @Override
   public int hashCode() {
      int result = 7;
      result = result + 11 * result + this.key;
      return result;
   }
   private int hash(int bigNum) {
      return (int)Math.abs(bigNum % tableSize);
   }
   ```



2. [4 points] Draw the binary search tree obtained from successively adding the following integers to an initially empty BST: 5, 9, 2, 3, 1, 4, 8, 7