1

The classes \( A \), \( B \) and \( C \) are related as follows.

![Diagram showing the relationship between classes A, B, and C]

How are these two relations reflected in the implementation of class \( A \)?

2

Consider the classes \texttt{Named} and \texttt{Contact}, the code of which can be found at the end of the test. Consider the following snippet of client code.

```java
String name = "Franck";
String address = "franck@cse.yorku.ca";
Contact contact = new Contact(name, address);
```

Draw the memory diagram corresponding to the execution having reached the end of the third line of the above client code.

3

Implement the method \texttt{sumOfSquares} of the class \texttt{MyMath}. For a given integer \( n \), with \( n \geq 1 \), this method returns the integer

\[
\sum_{i=1}^{n} i^2 = 1 + 4 + \cdots + (n-1)^2 + n^2.
\]

Only \texttt{recursive} solutions will receive marks.
/**
 * Returns 1 + 4 + ... + (n-1)*(n-1) + n*n
 *
 * @param n an integer.
 * @pre. n >= 1
 * @return the corresponding sum of squares.
 */
public static int sumOfSquares(int n) {

4

The method areAllEven of the class MyList checks if all elements of the given list are even.

/**
 * Tests if all the elements of the given list are even.
 *
 * @param list a list of integers.
 * @pre. list != null and list does not contain null
 * @return true if all the elements of the given list are even, false otherwise.
 */
public static boolean areAllEven(List<Integer> list) {
    boolean areAllEven;
    if (list.size() == 0) {
        areAllEven = true;
    } else {
        Integer first = list.get(0);
        List<Integer> rest = new ArrayList<Integer>(list.subList(1, list.size()));
        areAllEven = (first % 2 == 0) && MyList.areAllEven(rest);
    }
    return areAllEven;
}

(a) Prove the recursive method correct.

(b) Prove the recursive method terminates.
public abstract class Named {
    private String name;

    public Named(String name) {
        super();
        this.name = name;
    }
}

public class Contact extends Named {
    private String address;

    public Contact(String name, String address) {
        super(name);
        this.address = address;
    }
}