



**Question 2 (20 points).** Write a *complete class* `MyCount` that contains a static function `howMany` that returns how many Integers in its parameter `Vector v` are 0. Assume that `v` is not **null**. Class `MyCount` should contain only one thing: the static function. Put a suitable javadoc specification on the function.

The elements of `Vector v` can be any type of object. Function `howMany` should count how many of `v`'s elements are of class `Integer` and contain the integer 0 and return that number as an **int**. Examples: Below, we use `?` for the value of an `Object` that is not of class `Integer`. For an object that is of class `Integer`, we use the integer that it wraps.

If `v` contains `(?, 0, ?, 1, ?, 0, ?)`, the result is 2.

If `v` is empty, which we can write as `()`, the result is 0.

If `v` is `(6, 0, -1, 1, 4)`, the result is 1.

The following methods in class `Vector` might be useful (not all of them are):

Return	Method	Purpose
Object	<code>v.get(int k)</code>	= <code>v[k]</code>
void	<code>v.set(int k, Object ob)</code>	replace <code>v[k]</code> by <code>ob</code>
int	<code>v.size()</code>	= the number of elements in <code>v</code> 's list
int	<code>v.indexOf(Object ob)</code>	= <code>i</code> , where <code>v[i]</code> is <code>ob</code> ; -1 if <code>ob</code> not in <code>v</code>

This method in class `Integer` might be useful:

int	<code>ob.intValue()</code>	= the value in this <code>Integer</code> , <code>ob</code> , as an <b>int</b>
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**Question 3 (21 points).** (a) What is the apparent type of a variable? What is the real type of a variable?

(b) Below are definitions of four classes.

```
public class Movie {
    private String title; // title of the movie
    private int length; // length in minutes

    /** Constructor: document with title t and
        length len */
    public Movie(String t, int len) {
        title= t;
        length= len;
    }

    /** = title of this Movie */
    public String getTitle()
    { return title; }

    /** = length of this document, in minutes */
    public int getLength()
    { return length; }

    /** = the popularity --shorter means more popular */
    public int popularity()
    { return 240 - length; }
}

public class Trailer extends Movie {
    /** Constructor: a trailer of movie t.
        Trailers are 1 minute long*/
    public Trailer(String t)
    {super(t, 1);}
}
```

```
public class Documentary extends Movie {
    private String topic; //
    /** Constructor: instance with title t,
        length n, and topic p */
    public Documentary(String t, int n, String p) {
        super(t, n);
        topic= p;
    }

    /** = "Documentary" */
    public String DocumentaryType()
    { return "Documentary"; }

    /** = popularity of this instance */
    public int popularity()
    { return 200 -getLength(); }
}

public class Short extends Documentary {
    /** Constructor: instance with title t, length n,
        and topic p */
    public Short(String t, int n, String p)
    { super(t, n, p); }

    /** = "Short Doc" */
    public String DocumentaryType()
    { return "Short Doc"; }
}
```

For each pairs of statements below, write the value of d after execution. If the statements lead to an error, write "BAD" and briefly explain the error. (The question continues on the next page.)

(1) Documentary e= new Short("War", 5, "Iraq");  
 boolean d= "Short Doc".equals(e.DocumentaryType())

Cornell net id \_\_\_\_\_ Name \_\_\_\_\_

(2) Movie c= **new** Documentary(**null**, 3, "Carter Peace Center");  
**int** d= c.popularity();

(3) Short b= (Short)(**new** Documentary("", 2, "WMD"));  
**int** d= b.DocumentaryType().length();

(4) Movie a= (Movie)(**new** Trailer("Harry Potter"));  
**int** d= a.popularity();

(5) Movie f= **new** Short("War", 1, "Vietnam");  
**char** d= f.DocumentaryType().charAt(1);

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**Question 4 (24 points).** (a) Write an instance method `equals(Object obj)` for class `Documentary` in Question 3. Here is the class definition, with only method `equals` for you to fill in.

```
public class Documentary extends Movie {
    /** = "obj is a non-null Documentary with the same values
        in its fields as this Documentary" */
    public boolean equals(Object obj) {

        }
    }
}
```

(b) Assuming that `d1` contains (the name of) a `Documentary` object, draw the frame for method call `d1.equals(null)`.

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**Question 5 (23 points).** Write a method `shortTitle()` in class `Movie` in Question 3. The method returns the title but with all vowels ‘a’, ‘e’, ‘i’, ‘o’, and ‘u’ removed except those that begin a word (i.e. are the first character of the title or are preceded by a blank).

Examples:

If the title is “ Harry Potter”, the output is “ Hrry Pttr”.

If the title is “On the Outer Bank ”, the output is “On th Otr Bnk ”.

If title is “ One Oclooock ”, the output is ““ On Oclck”.

You must write a loop. A loop invariant is given below, and you must use it to develop the loop. Your grades will be determined by how well you deal with the four loopy questions. Note: for a `String s`, `s.length()` yields the length of `s` and `s.charAt(int k)` yields the character at position `k`.

```
public class Movie {
    String title; // title of the Movie
    /** = the title but with vowels removed (except those that begin a word).
        Precondition: title != null */
    public String shortTitle() {

        //invariant: s contains title[0..k-1] but with vowels removed
        (except those that begin a word)

        while (                ) {

        }

        //postcondition: s contains title[0..] but with vowels removed
        (except those that begin a word)

    }
}
```