

4. This question involves manipulating a two-dimensional array of integers. You will write two static methods of the `ArrayResizer` class, which is shown below.

```
public class ArrayResizer
{
    /** Returns true if and only if every value in row r of array2D is non-zero.
     * Precondition: r is a valid row index in array2D.
     * Postcondition: array2D is unchanged.
     */
    public static boolean isNonZeroRow(int[][] array2D, int r)
    { /* to be implemented in part (a) */ }

    /** Returns the number of rows in array2D that contain all non-zero values.
     * Postcondition: array2D is unchanged.
     */
    public static int numNonZeroRows(int[][] array2D)
    { /* implementation not shown */ }

    /** Returns a new, possibly smaller, two-dimensional array that contains only rows
     * from array2D with no zeros, as described in part (b).
     * Precondition: array2D contains at least one column and at least one row with no zeros.
     * Postcondition: array2D is unchanged.
     */
    public static int[][] resize(int[][] array2D)
    { /* to be implemented in part (b) */ }
}
```

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- (a) Write the method `isNonZeroRow`, which returns `true` if and only if all elements in row `r` of a two-dimensional array `array2D` are not equal to zero.

For example, consider the following statement, which initializes a two-dimensional array.

```
int[][] arr = {{2, 1, 0},
               {1, 3, 2},
               {0, 0, 0},
               {4, 5, 6}};
```

Sample calls to `isNonZeroRow` are shown below.

Call to <code>isNonZeroRow</code>	Value Returned	Explanation
<code>ArrayResizer.isNonZeroRow(arr, 0)</code>	<code>false</code>	At least one value in row 0 is zero.
<code>ArrayResizer.isNonZeroRow(arr, 1)</code>	<code>true</code>	All values in row 1 are non-zero.
<code>ArrayResizer.isNonZeroRow(arr, 2)</code>	<code>false</code>	At least one value in row 2 is zero.
<code>ArrayResizer.isNonZeroRow(arr, 3)</code>	<code>true</code>	All values in row 3 are non-zero.

Complete the `isNonZeroRow` method.

```
/** Returns true if and only if every value in row r of array2D is non-zero.
 *  Precondition: r is a valid row index in array2D.
 *  Postcondition: array2D is unchanged.
 */
public static boolean isNonZeroRow(int[][] array2D, int r)
```

Begin your response at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number. If there are multiple parts to this question, write the part letter with your response.

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- (b) Write the method `resize`, which returns a new two-dimensional array containing only rows from `array2D` with all non-zero values. The elements in the new array should appear in the same order as the order in which they appeared in the original array.

The following code segment initializes a two-dimensional array and calls the `resize` method.

```
int[][] arr = {{2, 1, 0},
               {1, 3, 2},
               {0, 0, 0},
               {4, 5, 6}};
int[][] smaller = ArrayResizer.resize(arr);
```

When the code segment completes, the following will be the contents of `smaller`.

```
 {{1, 3, 2}, {4, 5, 6}}
```

A helper method, `numNonZeroRows`, has been provided for you. The method returns the number of rows in its two-dimensional array parameter that contain no zero values.

Complete the `resize` method. Assume that `isNonZeroRow` works as specified, regardless of what you wrote in part (a). You must use `numNonZeroRows` and `isNonZeroRow` appropriately to receive full credit.

```
/** Returns a new, possibly smaller, two-dimensional array that contains only rows from array2D
 * with no zeros, as described in part (b).
 * Precondition: array2D contains at least one column and at least one row with no zeros.
 * Postcondition: array2D is unchanged.
 */
public static int[][] resize(int[][] array2D)
```

Begin your response at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number. If there are multiple parts to this question, write the part letter with your response.

Class information for this question

```
public class ArrayResizer

public static boolean isNonZeroRow(int[][] array2D, int r)
public static int numNonZeroRows(int[][] array2D)
public static int[][] resize(int[][] array2D)
```

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Question 4: 2D Array**9 points****Canonical solution****(a)**

```
public static boolean isNonZeroRow(int[][] array2D, int r)
{
    for (int col = 0; col < array2D[0].length; col++)
    {
        if (array2D[r][col] == 0)
        {
            return false;
        }
    }
    return true;
}
```

3 points**(b)**

```
public static int[][] resize(int[][] array2D)
{
    int numRows = array2D.length;
    int numCols = array2D[0].length;

    int[][] result = new int[numNonZeroRows(array2D)][numCols];
    int newIndex = 0;

    for (int r = 0; r < numRows; r++)
    {
        if (isNonZeroRow(array2D, r))
        {
            for (int c = 0; c < numCols; c++)
            {
                result[newIndex][c] = array2D[r][c];
            }
            newIndex++;
        }
    }
    return result;
}
```

6 points

(a) isNonZero

Scoring Criteria		Decision Rules
1	Compares an item from <code>array2D</code> with 0	Responses will not earn the point if they fail to attempt the comparison, even if they access an item from <code>array2D</code>
2	Accesses every item from row <code>r</code> of 2D array <i>(no bounds errors)</i>	Responses can still earn the point even if they return early from an otherwise correctly-bounded loop
3	Returns <code>true</code> if and only if row contains no zeros	Responses can still earn the point even if they process a column of the 2D array rather than a row
		Responses will not earn the point if they fail to return a value in some cases
		Total for part (a) 3 points

(b) resize

Scoring Criteria		Decision Rules	
4	Calls <code>numNonZeroRows</code> and <code>isNonZeroRow</code>	Responses can still earn the point even if they fail to use or store the return value	1 point
5	Identifies rows with no zeros (<i>in the context of an if</i>)	Responses will not earn the point if they <ul style="list-style-type: none"> • include incorrect number or type of parameters • call methods on an object or class other than <code>ArrayResizer</code> 	1 point
6	Declares and creates a new 2D array of the correct size	Response will not earn the point if they transpose the dimensions of the created array	1 point
7	Maintains an index in the new array	Responses will not earn the point if they <ul style="list-style-type: none"> • fail to declare, initialize, and update a different index • maintain the index in a way that overwrites, skips, or duplicates rows 	1 point
8	Traverses all necessary elements of <code>array2D</code> (<i>no bounds errors</i>)	Responses can still earn the point even if they <ul style="list-style-type: none"> • cause a bounds error by declaring and creating a new 2D array of an incorrect size • fail to maintain an index in the new array correctly, resulting in a bounds error • fail to access individual elements in a nested loop, if they access each row as an entire row 	1 point
9	Copies all and only rows identified as having no zero elements into the new array	Responses will not earn the point if they transpose coordinates, leading to a bounds error and/or copying columns	
		Responses can still earn the point even if they <ul style="list-style-type: none"> • copy a reference • identify rows incorrectly, if the logical sense can be determined and is correct • copy columns instead of rows, consistent with the dimensions of the created 2D array 	1 point

Responses **will not** earn the point if they

- remove or overwrite data from array2D (instead of or in addition to copying it to the new array)
- reverse the logical sense of which rows to copy

Total for part (b) 6 points

Question-specific penalties

-1 (u) Use `array2D[].length` to refer to the number of columns in a row of the 2D array

Total for question 4 9 points