

2018

AP[®]

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AP Computer Science A

Free-Response Questions

AP Computer Science A 2018 Free-Response Question #4 – Array Slice

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COMPUTER SCIENCE A

SECTION II

Time—1 hour and 30 minutes

Number of questions—4

Percent of total score—50

Directions: SHOW ALL YOUR WORK. REMEMBER THAT PROGRAM SEGMENTS ARE TO BE WRITTEN IN JAVA.

Notes:

- Assume that the interface and classes listed in the Java Quick Reference have been imported where appropriate.
- Unless otherwise noted in the question, assume that parameters in method calls are not `null` and that methods are called only when their preconditions are satisfied.
- In writing solutions for each question, you may use any of the accessible methods that are listed in classes defined in that question. Writing significant amounts of code that can be replaced by a call to one of these methods will not receive full credit.

AP Computer Science A 2018 Free-Response Question #4 – Array Slice

4. This question involves reasoning about arrays of integers. You will write two static methods, both of which are in a class named `ArrayTester`.

```
public class ArrayTester
{
    /** Returns an array containing the elements of column c of arr2D in the same order as
     * they appear in arr2D.
     * Precondition: c is a valid column index in arr2D.
     * Postcondition: arr2D is unchanged.
     */
    public static int[] getColumn(int[][] arr2D, int c)
    { /* to be implemented in part (a) */ }

    /** Returns true if and only if every value in arr1 appears in arr2.
     * Precondition: arr1 and arr2 have the same length.
     * Postcondition: arr1 and arr2 are unchanged.
     */
    public static boolean hasAllValues(int[] arr1, int[] arr2)
    { /* implementation not shown */ }

    /** Returns true if arr contains any duplicate values;
     * false otherwise.
     */
    public static boolean containsDuplicates(int[] arr)
    { /* implementation not shown */ }

    /** Returns true if square is a Latin square as described in part (b);
     * false otherwise.
     * Precondition: square has an equal number of rows and columns.
     * square has at least one row.
     */
    public static boolean isLatin(int[][] square)
    { /* to be implemented in part (b) */ }
}
```

AP Computer Science A 2018 Free-Response Question #4 – Array Slice

- (a) Write a static method `getColumn`, which returns a one-dimensional array containing the elements of a single column in a two-dimensional array. The elements in the returned array should be in the same order as they appear in the given column. The notation `arr2D[r][c]` represents the array element at row `r` and column `c`.

The following code segment initializes an array and calls the `getColumn` method.

```
int[][] arr2D = { { 0, 1, 2 },
                  { 3, 4, 5 },
                  { 6, 7, 8 },
                  { 9, 5, 3 } };

int[] result = ArrayTester.getColumn(arr2D, 1);
```

When the code segment has completed execution, the variable `result` will have the following contents.

`result: {1, 4, 7, 5}`

WRITE YOUR SOLUTION ON THE NEXT PAGE.

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Let `arr2D` be a two-dimensional array of integers.
Complete the method `getColumn` below.

```
/** Returns an array containing the elements of column c of arr2D in the same order as they
 * appear in arr2D.
 * Precondition: c is a valid column index in arr2D.
 * Postcondition: arr2D is unchanged.
 */
public static int[] getColumn(int[][] arr2D, int c)
```

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- (b) Write the static method `isLatin`, which returns `true` if a given two-dimensional square array is a *Latin square*, and otherwise, returns `false`.

A two-dimensional square array of integers is a Latin square if the following conditions are true.

- The first row has no duplicate values.
- All values in the first row of the square appear in each row of the square.
- All values in the first row of the square appear in each column of the square.

Examples of Latin Squares

1	2	3
2	3	1
3	1	2

10	30	20	0
0	20	30	10
30	0	10	20
20	10	0	30

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Examples that are NOT Latin Squares

1	2	1
2	1	1
1	1	2

Not a Latin square
because the first row
contains duplicate
values

1	2	3
3	1	2
7	8	9

Not a Latin square
because the elements of
the first row do not all
appear in the third row

1	2
1	2

Not a Latin square
because the elements of
the first row do not all
appear in either column

The `ArrayTester` class provides two helper methods: `containsDuplicates` and `hasAllValues`. The method `containsDuplicates` returns `true` if the given one-dimensional array `arr` contains any duplicate values and `false` otherwise. The method `hasAllValues` returns `true` if and only if every value in `arr1` appears in `arr2`. You do not need to write the code for these methods.

Class information for this question

```
public class ArrayTester
```

```
public static int[] getColumn(int[][] arr2D, int c)
public static boolean hasAllValues(int[] arr1, int[] arr2)
public static boolean containsDuplicates(int[] arr)
public static boolean isLatin(int[][] square)
```

Complete method `isLatin` below. Assume that `getColumn` works as specified, regardless of what you wrote in part (a). You must use `getColumn`, `hasAllValues`, and `containsDuplicates` appropriately to receive full credit.

```
/** Returns true if square is a Latin square as described in part (b);
 *     false otherwise.
 * Precondition: square has an equal number of rows and columns.
 *     square has at least one row.
 */
public static boolean isLatin(int[][] square)
```

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END OF EXAM