

## 2024 AP DAILY: PRACTICE SESSIONS

# AP Computer Science A Session 8 – FRQ (Question 4: 2D Array)

This question involves pieces of candy in a box. The `Candy` class represents a single piece of candy.

```
public class Candy
{
    /** Returns a String representing the flavor of this piece of candy */
    public String getFlavor()
    { /* implementation not shown */ }

    // There may be instance variables, constructors, and methods that are not shown.
}
```

The `BoxOfCandy` class represents a candy box where the candy is arranged in a rectangular grid. The instance variable of the class, `box`, is a rectangular two-dimensional array of `Candy` objects. A location in the candy box may contain a piece of candy or may be empty. A piece of candy is represented by a `Candy` object. An empty location is represented by `null`.

You will write two methods of the `BoxOfCandy` class.

```
public class BoxOfCandy
{
    /** box contains at least one row and is initialized in the constructor. */
    private Candy[][] box;






    /**
     * Moves one piece of candy in column col, if necessary and possible, so that the box
     * element in row 0 of column col contains a piece of candy, as described in part (a).
     * Returns false if there is no piece of candy in column col and returns true otherwise.
     * Precondition: col is a valid column index in box.
     */
    public boolean moveCandyToFirstRow(int col)
    { /* to be implemented in part (a) */ }

    /**
     * Removes from box and returns a piece of candy with flavor specified by the parameter, or
     * returns null if no such piece is found, as described in part (b).
     */
    public Candy removeNextByFlavor(String flavor)
    { /* to be implemented in part (b) */ }

    // There may be instance variables, constructors, and methods that are not shown.
}
```

- a. Write the `moveCandyToFirstRow` method, which attempts to ensure that the `box` element at row `0` and column `col` contains a piece of candy, using the following steps.
- If the element at row `0` and column `col` already contains a piece of candy, then `box` is unchanged and the method returns `true`.
  - If the element at row `0` and column `col` does not contain a piece of candy, then the method searches the remaining rows of column `col` for a piece of candy. If a piece of candy can be found in column `col`, it is moved to row `0`, its previous location is set to `null`, and the method returns `true`; otherwise, the method returns `false`.






In the following example, the grid represents the contents of `box`. An empty square in the grid is `null` in `box`. A non-empty square in the grid represents a `box` element that contains a `Candy` object. The string in the square of the grid indicates the flavor of the piece of candy.

	0	1	2
0		 "lime"	
1		 "orange"	
2			 "cherry"
3		 "lemon"	 "grape"






The method call `moveCandyToFirstRow(0)` returns `false` because the `box` element at row `0` and column `0` does not contain a piece of candy and there are no pieces of candy in column `0` that can be moved to row `0`. The contents of `box` are unchanged.

The method call `moveCandyToFirstRow(1)` returns `true` because the `box` element at row `0` and column `1` already contains a piece of candy. The contents of `box` are unchanged.

The method call `moveCandyToFirstRow(2)` moves one of the two pieces of candy in column `2` to row `0` of column `2`, sets the previous location of the piece of candy that was moved to `null`, and returns `true`. The new contents of `box` could be either of the following.

	0	1	2
0		 "lime"	 "cherry"
1		 "orange"	
2			
3		 "lemon"	 "grape"

or

	0	1	2
0		 "lime"	 "grape"
1		 "orange"	
2			 "cherry"
3		 "lemon"	

Complete the `moveCandyToFirstRow` method.










```
/**
 * Moves one piece of candy in column col, if necessary and possible, so that the box
 * element in row 0 of column col contains a piece of candy, as described in part (a).
 * Returns false if there is no piece of candy in column col and returns true otherwise.
 * Precondition: col is a valid column index in box.
 */
public boolean moveCandyToFirstRow(int col)
```

- b. Write the `removeNextByFlavor` method, which attempts to remove and return one piece of candy from the box. The piece of candy to be removed is the first piece of candy with a flavor equal to the parameter `flavor` that is encountered while traversing the candy box in the following order: the last row of the box is traversed from left to right, then the next-to-last row of the box is traversed from left to right, etc., until either a piece of candy with the desired flavor is found or until the entire candy box has been searched.









If the `removeNextByFlavor` method finds a `Candy` object with the desired flavor, the corresponding `box` element is assigned `null`, all other `box` elements are unchanged, and the removed `Candy` object is returned. Otherwise, `box` is unchanged and the method returns `null`.

The following examples show three consecutive calls to the `removeNextByFlavor` method. The traversal of the candy box always begins in the last row and first column of the box.








The following grid shows the contents of `box` before any of the `removeNextByFlavor` method calls.

	0	1	2	3	4
0	 "lime"	 "lime"		 "lemon"	
1	 "orange"			 "lime"	 "lime"
2	 "cherry"		 "lemon"		 "orange"

The method call `removeNextByFlavor("cherry")` removes and returns the `Candy` object located in row 2 and column 0. The following grid shows the updated contents of `box`.

	0	1	2	3	4
0	 "lime"	 "lime"		 "lemon"	
1	 "orange"			 "lime"	 "lime"
2			 "lemon"		 "orange"

The method call `removeNextByFlavor("lime")` removes and returns the `Candy` object located in row 1 and column 3. The following grid shows the updated contents of `box`.

	0	1	2	3	4
0	 "lime"	 "lime"		 "lemon"	
1	 "orange"				 "lime"
2			 "lemon"		 "orange"

The method call `removeNextByFlavor("grape")` returns `null` because no grape-flavored candy is found. The contents of `box` are unchanged.

Complete the `removeNextByFlavor` method.

```
/**
```

```
 * Removes from box and returns a piece of candy with flavor specified by the parameter,
```

```
 * or returns null if no such piece is found, as described in part (b).
```

```
*/
```

```
public Candy removeNextByFlavor(String flavor)
```