Lesson 10: Shifting a 2D Array

45 minutes

Overview

How can I shift the elements in an array?

Students practice working with 2D arrays and modifying standard algorithms to plan and implement an algorithm to shift a 2D array. Students explore how the elements in a 1D array can be shifted and then write pseudocode to modify the algorithm to be applied to a 2D array.

Standards

Full Course Alignment

CSA Conceptual Framework

▶ **CON-2** - Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values

Agenda

Warm Up (10 minutes)
- **Shifting Elements**

Activity (30 minutes)
- **Planning Algorithms**
- **Shifting a 2D Array**

Wrap Up (5 minutes)
- **Show What You Know Week**
- **Assessment: Check for Understanding**
- **AP Classroom Topic Questions**

Objectives

Students will be able to:

- Implement an algorithm to shift elements in a 2D array in Java
- Plan an algorithm to shift elements in a 2D array using pseudocode

Preparation

- Print copies of the Shifting a 2D Array handout and manipulatives (one for each pair of students)
- (Optional) Cut out the manipulatives from the Shifting a 2D Array handout
- Create code review groups if you are not reusing the same groups
- Print copies of the Unit 5 Study Guide (one for each student)
- Check the **Teacher's Lounge** for verified teachers on the CSA Forum to find additional strategies or resources shared by fellow teachers

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the students

- **Shifting a 2D Array** - Handout
- **U5L10 Extra Practice** - Handout
- **Unit 5 Study Guide** - Resource

Teaching Guide

Warm Up (10 minutes)

Shifting Elements

Remarks

> We have learned how to implement algorithms to find information and perform manipulations on elements stored in an array. Let's explore how we might write an algorithm to shift elements in a 1D array.

Group: Place students in groups of three or four.

Do This: Have students write an algorithm to shift elements in a 1D array to the left one place.

Teaching Tip

Ask a student from each group to share the algorithms they developed with the class or have groups share their algorithms with each other.

Activity (30 minutes)

Planning Algorithms (15 minutes)

Remarks

> Shifting elements in an array can be tricky, but we can use what we have learned from developing other algorithms to perform this task. Let's take a look at how this algorithm works.

Do This: Review the lesson objectives.

Do This: Direct students to Level 1 on Code Studio to investigate the program with a partner. Students make the changes to the program as prompted.

1 **Investigate: Shifting Elements**

Discuss: Click through the animated slide to display the prompts.

- *What do you notice about the code in this program?*
- *What do you wonder about the code in this program?*

Discussion Goal: Students notice that the first element in the array is moved to the last position, and the rest of the elements are moved forward by one. Students may wonder how this algorithm might change if the elements needed to shift to the right or if the elements needed to shift by more than one place.

Do This: Click through the animated slide to explain the algorithm for shifting elements in a 1D array.

Discuss: Use the Hold That Thought strategy to discuss the prompt.

- *How would this algorithm change if we wanted to shift to the right?*
- *What if we wanted to shift by two places instead of one?*

Discussion Goal: Students suggest modifying the algorithm to move the last element to the first position and the rest of the elements backwards by one. Students share ways to shift by two places, such as using a variable to keep track of the new position or moving each value by two instead of one.

Teaching Tip

Have students consider how their algorithm might change if they needed to shift by more than two places or by an amount specified by a user. Ask additional guiding questions to help students consider using the mod operator in an expression to determine the new position of an element, such as:

- *How do we find the new position based on the amount to shift?*
- *If the new position is greater than the last index in the array, where should the element move to?*
- *If the new position is 8 and the last index of the array is 5, where should the element move to? What expression could we write that achieves that result?*

Group: Place students in pairs.

Distribute: Give each student a copy of the Shifting a 2D Array handout and manipulatives.

Do This: Have students write pseudocode for an algorithm to shift a 2D array.

Do This: Have students compare their algorithms with another group and make revisions as needed.

Shifting a 2D Array (15 minutes)

Remarks

> Now that we have our pseudocode to shift values in a 2D array, let's implement this algorithm in Java to solve some problems!

Do This: Direct students to Level 2 on Code Studio to complete Levels 2, 3, and 4. Students debug the program on Level 2, then continue to Level 3 to implement their algorithm. On Level 4, students complete a choice level to shift a 2D array using the console or The Theater.

2-4 **Shifting a 2D Array**

2 3 4

Do This: Click through the animated slide to have students participate in the Code Review Call and Response.

Do This: Direct students to complete a code review on Level 5.

5 **Code Review: Shifting a 2D Array**

Wrap Up (5 minutes)

Show What You Know Week

Remarks

> The next five lessons are an opportunity to Show What You Know! We begin with the unit project, then spend a day practicing answering AP-style free-response questions and wrapping up the unit with a multiple-choice assessment. You've learned so much in this unit, and now you're ready to show what you know!

Distribute: Give each student a copy of the Unit 5 Study Guide.

Do This: Introduce the Show What You Know week.

Do This: Introduce the Personal Narrative Project.

Do This: Review the concepts covered in this lesson.

Assessment: Check for Understanding

Check For Understanding Question(s) and solutions can be found in each lesson on Code Studio. These questions can be used for an exit ticket.

6 **Check for Understanding**

AP Classroom Topic Questions

To assign questions from the AP Classroom Question Bank that align with this lesson, create a custom quiz in AP Classroom by searching the Question Bank for the Essential Knowledge statements listed at the top of this lesson plan. You can find instructions and video demonstrations to do this on **AP Central**.

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