Lesson 5: Enhanced For Loops

45 minutes

Overview

How can I use enhanced for loops to traverse a 2D array?

Students revisit enhanced `for` loops to explore how these are used with 2D arrays. In the process, students discover that objects can be modified using an enhanced `for` loop because the loop variable is an alias of the object reference in the array. Students explore how enhanced `for` loops can be used with 2D arrays and identify similarities and differences between using enhanced `for` loops with 1D arrays and 2D arrays. Students then practice using enhanced `for` loops with 2D arrays.

Standards

Full Course Alignment

CSA Conceptual Framework

▶ **VAR-2** - To manage large amounts of data or complex relationships in data, programmers write code that groups the data together into a single data structure wihtout creating individual variables for each value.

Agenda

Warm Up (5 minutes)
- **Anticipation Guide**

Activity (35 minutes)
- **Enhanced For Loops and Objects**
- **Enhanced For Loops and 2D Arrays**
- **Using Enhanced For Loops with 2D Arrays**

Wrap Up (5 minutes)
- **Revisiting the Anticipation Guide**
- **Assessment: Check for Understanding**
- **AP Classroom Topic Questions**

Objectives

Students will be able to:

- Identify the similarities and differences between using enhanced `for` loops with 1D arrays and 2D arrays
- Write nested enhanced `for` loops to traverse a two-dimensional (2D) array

Preparation

- Print copies of the Enhanced For Loops Anticipation Guide (one for each student)
- Print copies of the Tracing Enhanced For Loops handout (one for each pair of students)
- Create code review groups if you are not reusing the same groups
- 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

- **Enhanced For Loops Anticipation Guide** - Handout
- **Enhanced For Loops and 2D Arrays** - Video
- **Tracing Enhanced For Loops** - Handout
- **U5L5 Extra Practice** - Handout

Teaching Guide

Warm Up (5 minutes)

Anticipation Guide

Remarks

> We learned about using enhanced `for` loops as we were learning ways to traverse a 1D array. Let's revisit what you remember about enhanced `for` loops and make predictions about how they could be used with 2D arrays.

Distribute: Give each student a copy of the Enhanced For Loops Anticipation Guide handout.

Do This: Have students respond to each statement in the Before column on the Enhanced For Loops Anticipation Guide handout.

Teaching Tip

Emphasize to students that they should focus on answering based on what they already know about enhanced `for` loops. If time permits, you can have students share their responses with a neighbor.

Remind students to hang on to their anticipation guides for the wrap up.

Activity (35 minutes)

Enhanced For Loops and Objects (10 minutes)

Remarks

> One thing we learned about enhanced `for` loops is that they cannot be used to modify the values stored in a 1D array. The enhanced `for` loop variable only stores a copy of the value from the array rather than referencing the value itself. When the array stores object references, this works a little differently.

Do This: Review the lesson objectives.

Do This: Direct students to Level 1 on Code Studio to predict the program's outcome, then run the program to compare their predictions to the actual outcome.

1 **Predict: Enhanced For Loops and Objects**

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 values stored in the instance variables for each object are modified in the enhanced `for` loop. Students may wonder why objects can be modified in an enhanced `for` loop when primitive values cannot be modified.

Discuss: Use the Retrieve-Pair-Share strategy to discuss the prompt.

- *Why do you think the changes made to the loop variable affected the original object reference?*

Discussion Goal: Students recall that the enhanced `for` loop variable stores a copy of the value stored in the array. Students realize that the enhanced `for` loop variable is storing a copy of the object reference, which makes it an alias of the object reference stored in the array. Since the enhanced `for` loop variable is an alias, both variables reference the same object.

Teaching Tip

Ask additional guiding questions to help students recall aliases and identify the relationship between the enhanced `for` loop variable and the object reference stored in the array. For example,

- *The enhanced* `for` *loop makes a copy of the value stored in the array. If the value is an object reference, what is the enhanced* `for` *loop making a copy of?*
- *What is it called when a reference variable points to the same object as another reference variable?*
- *When two reference variables are aliases, do changes made using one variable impact the other variable?*

Do This: Click through the animated slide to demonstrate using an enhanced `for` loop to modify an object.

Enhanced For Loops and 2D Arrays (10 minutes)

Remarks

> 1D and 2D arrays are both objects. Since a 2D array is an array of array, the outer array stores references to inner 1D arrays. Let's take a look at how enhanced `for` loops can be used with 2D arrays.

Do This: Direct students to Level 2 on Code Studio to investigate the program with a partner. Students make the changes to the program as prompted.

2 **Investigate: Enhanced For Loops and 2D Arrays**

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

- *How is using an enhanced* `for` *loop with a 2D array similar to using it with a 1D array?*
- *How is it different?*

Discussion Goal: Students identify the similarities in the syntax and that the enhanced `for` loop traverses each row and column from first to last. Students note that traversing a 2D array requires nested loops to traverse each row with the outer loop and each column with the inner loop.

Display: Show the video – *Enhanced For Loops and 2D Arrays*.

Remarks

> When using nested enhanced `for` loops to traverse a 2D array, the outer loop traverses the row. The

> enhanced `for` loop variable in the outer loop must be the type of each row, which is a 1D array. The inner loop traverses a single row, so the enhanced `for` loop variable for the inner loop must be the same type as the elements stored in the 1D array.

Do This: Click through the animated slide to demonstrate using an enhanced `for` loop with a 2D array.

Using Enhanced For Loops with 2D Arrays (15 minutes)

Remarks

> Traversing a 2D array using enhanced `for` loops is similar to traversing a 1D array using enhanced `for` loops. Tracing an enhanced `for` loop with a 2D array is also similar to tracing it with a 1D array.

Group: Place students in pairs.

Distribute: Give each pair a copy of the Tracing Enhanced For Loops handout.

Do This: Have students complete the Tracing Enhanced For Loops handout.

Teaching Tip

You can choose to model completing the first few rows of the trace table as a class first, then have students work with their partners to complete the remaining rows.

Remarks

> Let's practice using enhanced `for` loops with 2D arrays!

Do This: Direct students to Level 3 on Code Studio. Students complete a choice level to use an enhanced `for` loop with a 2D array using the console or The Theater.

3 **Using Enhanced For Loops with 2D Arrays**

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 4.

4 **Code Review: Using Enhanced For Loops with 2D Arrays**

Wrap Up (5 minutes)

Revisiting the Anticipation Guide

Remarks

> We have learned a lot about using enhanced `for` loops with objects and 2D arrays! Let's revisit our responses on the anticipation guide from the beginning of the lesson to see how our thinking might have changed.

Do This: Have students respond to each statement in the After column on the Enhanced For Loops Anticipation Guide handout.

Teaching Tip

Have students share their new responses with a neighbor and reflect on how their responses changed from the beginning of the lesson. You can also choose to have students share their reflections as a class.

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.

5 **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**.

The following Topic Questions in AP Classroom can be assigned as a formative assessment for this lesson:

- Topic Questions 8.2

Note: *Some Learning Objectives and Essential Knowledge statements in the suggested Topic Questions are covered in later units.*

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