Lesson 3: For Loops

45 minutes

Overview

How do I search for elements in a 1D array?

Students learn about the structure and functionality of a `for` loop and use a for loop to traverse a one-dimensional (1D) array. Before using `for` loops with 1D arrays, students practice identifying the number of times a loop will execute and using trace tables to track the changing values of variables. Additionally, students differentiate between `while` loops and `for` loops and convert between both types of loops. Students practice writing `for` loops to traverse 1D arrays to access elements.

Standards

Full Course Alignment

CSA Conceptual Framework

- ▶ **CON-1** - The way variables and operators are sequenced and combined in an expression determines the computed result.
- ▶ **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
- ▶ **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)
- **Data and the Music Industry**

Activity (30 minutes)
- **For Loops**
- **Using For Loops**

Wrap Up (10 minutes)
- **Closing the Loop**
- **Assessment: Check for Understanding**

Objectives

Students will be able to:

- Determine the number of times a loop will execute
- Differentiate between `while` loops and `for` loops
- Explain the functionality of a `for` loop
- Use trace tables to track the changing values of variables

Preparation

- Print copies of the Tracing Loops handout (one for each student)
- 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

- **For Loops** - Video
- **Tracing Loops** - Handout
- **U3L3 Extra Practice** - Handout

Vocabulary

- `for` **loop** - a loop used to repeat a block of code a known number of times

AP Classroom Topic Questions

- **decrement** - to decrease a value by one
- **increment** - to increase a value by one
- **loop control variable** - a variable that is changed by a constant value and determines the end of a loop
- **traverse** - to access elements in a data structure one by one

Teaching Guide

Warm Up (5 minutes)

Data and the Music Industry

Remarks

> Data helps us find trends and even make predictions about our society. This visual shows us the popularity and revenues of music formats over the years.

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

- *What surprises you about this data?*
- *What information would be stored in a data structure? How could a program determine these results?*
- *What questions could someone answer with this data? What problems might this help address?*

Discussion Goal: Students may be surprised that streaming and downloading music has led to decreased revenue in comparison to CDs. Students suggest that a data structure would store revenue for each year or revenue for each format. Students also suggest that a program would add up the values for each year or each format so it could be displayed in this visual.

Teaching Tip

Ask students to identify the specific data points in the visual, such as the total revenue for each year and each format. You can also have students consider the appropriate data types for each type of information.

Activity (30 minutes)

For Loops (15 minutes)

Remarks

> To find this type of information from a set of data, software engineers use loops to go through a data structure and perform searches and calculations. In the previous lesson, we used a `while` loop to access and print all the values in a 1D array.

Do This: Review the lesson objectives.

Display: Show the video – *For Loops*.

Do This: Click through the animated slide to identify the components of a `for` loop.

Teaching Tip

Have students compare a `for` loop to a `while` loop. Ask students where the parts of a `for` loop are present in a `while` loop.

Do This: Click through the animated slide to explain the functionality of the increment and decrement operators.

Do This: Click through the animated slide to demonstrate writing a trace table to trace a `for` loop.

Teaching Tip

Model tracing the first two iterations of the loop, then ask students to assist in completing the rest of the trace table.

Do This: Click through the animated slide to define traverse and demonstrate traversing a 1D array with a `for` loop.

Teaching Tip

Point out to students that the condition is less than the length of the array rather than less than or equal to its length. Have students identify the length and the last index of the array in the code segment. Ask students to predict what might happen if the condition was less than or equal to the length and trace the code to demonstrate the result.

Distribute: Give each student a copy of the Tracing Loops handout.

Do This: Have students complete the Tracing Loops handout.

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

- *How can we tell how many times a* `for` *loop will execute?*

Discussion Goal: Students note that the number of times is determined by counting from the value the loop control variable is initialized to and the value that stops the loop.

Teaching Tip

Have students refer to the Tracing Loops handout if they struggle to identify the number of times a `for` loop will execute. Ask students to compare their trace table to the starting value of the loop control variable and the condition to identify the relationship.

Using For Loops (15 minutes)

Remarks

> `for` loops are much easier to use with 1D arrays, but both a `while` loop and a `for` loop can be used interchangeably.

Do This: Direct students to Level 1 on Code Studio to complete Levels 1 through 3. Students

complete a Check for Understanding on Level 1, then continue to Level 2 to convert a `while` loop to a `for` loop. On Level 3, students complete a choice level to use a `for` loop with a 1D array in the console or The Neighborhood.

1-3 **Using for Loops**

1 2 3

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 for Loops**

Wrap Up (10 minutes)

Closing the Loop

Remarks

> We have learned a lot about using loops to repeat a block of code and traverse 1D arrays. Let's recap some of the key concepts we have learned.

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

- *What are some differences between* `while` *loops and* `for` *loops? What are some similarities?*
- *What are some scenarios you have encountered before where a* `for` *loop would have been better to use?*
- *What were you confident about in this lesson? What would you like to practice?*

Discussion Goal: Students identify similarities and differences between `while` loops and `for` loops, such as that both loops have the same components but are structured differently in each type of loop. Students suggest using a `for` loop to traverse a 1D array and for situations when the number of times to repeat a block of code is known. Students share concepts from the lesson and the unit they are confident about and concepts they might be confused about.

Do This: Review the concepts covered in this lesson.

Display: Key Vocabulary

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 4.2
- Topic Questions 6.2

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

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