Lesson 10: Finding Duplicates

45 minutes

Overview

How would I check whether a 1D array contained duplicate elements?

Students learn about nested loops and practice tracing these to explore their functionality. Using nested loops, students develop an algorithm to determine whether there are duplicate elements in a 1D array. Students plan their algorithms using manipulatives to identify the steps to solve the problem and write pseudocode before implementing them in Java.

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 (5 minutes)
- **Using Data**

Activity (35 minutes)
- **Nested Loops**
- **Finding Duplicates**

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 determine the presence or absence of duplicate elements in a one-dimensional (1D) array
- Traverse a one-dimensional (1D) array using nested `for` loops

Preparation

- Print copies of the Tracing Nested Loops handout (one for each student)
- Print copies of the Finding Duplicates handout (one for each pair of students)
- (Optional) Cut out the Finding Duplicates manipulatives
- Create code review groups if you are not reusing the same groups
- Print copies of the Unit 3 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

- **Finding Duplicates** - Handout
- **Tracing Nested Loops** - Handout
- **U3L10 Extra Practice** - Handout
- **Unit 3 Study Guide** - Resource

Vocabulary

- **nested loop** - a loop inside of another loop

Teaching Guide

Warm Up (5 minutes)

Using Data

Remarks

> You have learned a lot about how data can be used to find information and answer questions. Computer science and data play a large role in how decisions are made, products are designed, or to make predictions.

Do This: Introduce the dataset.

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

- *What is a question you could answer this using data?*
- *How would you use 1D arrays and algorithms to help you answer these questions?*

Discussion Goal: Students suggest questions they could answer using the data. Students share examples of how they would store the data in a 1D array and identify algorithms they learned in this unit to search or manipulate the data.

Teaching Tip

Have students consider their personal interests or topics of interest. Ask students about things they might want to know about these interests or topics and what datasets they might look for to answer these questions.

Activity (35 minutes)

Nested Loops (15 minutes)

Remarks

> In some cases, we need to repeat some action on the data in a 1D array as we traverse the array.

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: Nested Loops**

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 program uses nested loops and that the inner loop fully executes for each iteration of the outer loop. Students may wonder about other scenarios where nested loops would be useful.

Display: Show the video – *Nested Loops*.

Do This: Define *nested loop*.

Teaching Tip

Model completing the trace table for the first few iterations, then have students assist in identifying the values for the rest of the code segment.

Remarks

> When a loop is nested inside another loop, the inner loop must complete all its iterations before the outer loop can continue.

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

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

Do This: Have students complete the Tracing Nested Loops handout.

Finding Duplicates (20 minutes)

Remarks

> Sometimes, we need to evaluate our data for situations like invalid or duplicate values. Duplicate values could change the meaning of the data or tell us about things like the popularity of a certain element. Finding duplicates is another standard algorithm that can be applied to many scenarios.

Group: Place students in pairs.

Distribute: Give each pair a copy of the Finding Duplicates handout and manipulatives.

Do This: Have students write pseudocode for finding duplicate values in a one-dimensional array.

Do This: Direct students to Level 2 on Code Studio to complete Levels 2 and 3. Students complete a Check for Understanding, then continue to Level 3 to complete a choice level to implement their algorithm to find duplicate values.

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: Finding Duplicates**

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 3 Study Guide.

Do This: Introduce the Show What You Know week.

Do This: Introduce the Data for Social Good Project.

Teaching Tip

You can also choose to preview the user stories and data sets for the project and allow students to choose their user stories for the project.

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 4.4
- Topic Questions 5.8
- Topic Questions 5.9

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

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