Lesson 6: Static Variables and Constants

45 minutes

Overview

How can I define data that does not change or that all objects of a class share?

Students learn about static variables and constants and identify scenarios where these types of variables would be useful. Students differentiate between static variables and instance variables as they explore their functionality. Students practice using static variables and constants in program code, including implementing an algorithm to determine the number of elements meeting specific criteria.

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

▶ **MOD-2** - Programmers use code to represent a physical object or nonphysical concept, real or imagined, by defining a class based on the attirbutes and/or behaviors of the object or concept

▶ **VAR-1** - To find specific solutions to generalizable problems, programmers include variables in their code so that the same algorithm runs using different input values

Agenda

Warm Up (10 minutes)
- **Solve the Problem**

Activity (30 minutes)
- **Exploring Static Variables**
- **Exploring Constants**
- **Using Static Variables and Constants**

Wrap Up (5 minutes)
- **Revisiting the Food Trucks**
- **Assessment: Check for Understanding**

Objectives

Students will be able to:

- Implement an algorithm to determine the number of elements meeting specific criteria in a one-dimensional (1D) array
- Use constants to define values that cannot be changed
- Use static variables to define values to share across all instances of a class

Preparation

- 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

- **Constants** - Video
- **Static Variables** - Video
- **U3L6 Extra Practice** - Handout

Vocabulary

- **constant** - a variable whose value cannot be changed once it has been assigned
- **static variable** - a variable that is shared by all instances of a class

Teaching Guide

Warm Up (10 minutes)

Solve the Problem

Remarks

> The Project Mercury Pastries Food Truck business needs our help again! The owner has multiple food trucks in operation, and the business continues to grow. It is getting challenging to keep up with how many food trucks there are.

Do This: Click through the animated slide to review how each object gets a copy of the instance variables with their specific values.

Group: Place students in groups of three to four.

Discuss: *What could we add to the* `FoodTruck` *class to help the owner keep track of how many* `FoodTruck` *objects they have?*

Discussion Goal: Students suggest possible solutions, including creating an instance variable in the `FoodTruck` class to represent the number of `FoodTruck` objects and increase it either through the constructor or by calling a method. Students may also suggest creating an array that stores the `FoodTruck` objects so they can obtain the length of the array.

Teaching Tip

Ask students to consider the benefits and drawbacks of their solutions. For example, if students suggest creating an instance variable in the `FoodTruck` class, ask students whether updating the value for one object will update for all objects. If students suggest creating an array, ask students whether they know an ideal size for the array.

Activity (30 minutes)

Exploring Static Variables (10 minutes)

Remarks

> You may have considered creating an instance variable to represent the number of `FoodTruck` objects. This solution could work, but we would have to update the value for each object every time we create a new `FoodTruck` object. Objects do not share the values stored in the instance variables.

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: Static Variables**

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 class contains a static variable that is increased by one in the constructor. Students also notice that the value is updated each time an object is created. Students may wonder what the `static` keyword means and how it applies to the `main` method.

Display: Show the video – *Static Variables*.

Do This: Click through the animated slide to introduce the `static` keyword and define *static variable*.

Do This: Demonstrate how to access a static variable.

Teaching Tip

Have students consider whether the `static` keyword is limited to variables by asking what they think it means in the `main` method. Students learn about static methods in a future lesson.

Discuss: Click through the animated slide to display the prompts. Use the Hold That Thought strategy to discuss the prompts.

- *When we assign a value to an instance variable, it changes only for the object it belongs to. What happens if we assign a value to a static variable?*
- *When might we want to use a static variable in a program?*

Discussion Goal: Students note that the value assigned to a static variable is accessible by all objects of a class. Students suggest using static variables to track how many objects have been created from the class or share a value across all objects.

Do This: Explain the functionality of static variables.

Do This: Explain a common use of static variables.

Exploring Constants (10 minutes)

Remarks

> Sometimes, we need to share a value across all objects that should not change. In these cases, we can use a static variable that is a constant.

Do This: Define *constant*.

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

- *Where have you used constants before? How were they useful?*

Discussion Goal: Students share examples of constants they have seen or used before, such as pi in math class.

Display: Show the video – *Constants*.

Group: Place students in pairs.

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: Constants**

Using Static Variables and Constants (10 minutes)

Remarks

> Static variables and constants make it easy to share values across all objects and establish values that should not be changed.

Do This: Direct students to Level 3 on Code Studio to complete Levels 3, 4, and 5. Students complete a Check for Understanding, then continue to Level 4 to complete a choice level to use a static variable. On Level 5, students complete a choice level to use a constant and implement an algorithm to determine the number of elements in a 1D array that meet specific criteria.

3-5 **Using Static Variables and Constants**

3 4 5

Wrap Up (5 minutes)

Revisiting the Food Trucks

Remarks

> Now that we know about static variables and constants, let's help the owner of the Project Mercury Pastries Food Truck business solve their problem.

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

- *What could we add to the* `FoodTruck` *class to help the owner keep track of the number of* `FoodTruck` *objects?*
- *The owner wants to offer a special 15% discount for loyal customers who visit any food trucks. What could we add to ensure all food trucks can offer this discount?*

Discussion Goal: Students suggest using a static variable to keep track of the number of `FoodTruck` objects and using a constant to store the discount.

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.

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 5.7

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

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