Teacher: Jessica Novillo Argudo
Unit Plan: Algorithms
Lesson: Recursive algorithm to solve the Towers of Hanoi puzzle
Grade: 12th Grade
Date: Spring 2023

Overall Goal/Objective of Lesson: Students will learn how to solve the Tower of Hanoi puzzle by developing a recursive algorithm in Python.

Content Objectives	Assessments
Students will practice and reinforce their knowledge about recursion.	1. Classwork/Homework 2. Exit Slip
Skill Objectives **9-12.CT.1:** Create a simple digital model that makes predictions of outcomes. **9-12.CT.7:** Design or remix a program that utilizes a data structure to maintain changes to related pieces of data. **9-12.CT.8:** Develop a program that effectively uses control structures in order to create a computer program for practical intent, personal expression, or to address a societal issue. **Content-specific vocabulary**: Algorithm, recursion, function.	1. Warm-up activity 2. Observation of the students' programming skills

Materials/Resources

Smartboard
Computers
Programming language Python
Exit Slip
Slides
Website for warm-up: https://www.mathplayground.com/logic_tower_of_hanoi.html

Sequence of Lesson Plan

Time Allotment 5 minutes	**Anticipatory Set (Warm-up)**
	
	The teacher introduces the lesson by telling the students that they are going to work on a solution for a puzzle called the Tower of Hanoi.
	
	The teacher asks:
	Have you heard about the Towers of Hanoi puzzle?
	
	The teacher starts using the slides to inform about the origins of the puzzle and explain the objective and rules of the puzzle.
	- Objective: Move the entire stack to another tower.
	- Rules:
	  - Move only one ring at a time.
	  - A larger ring may not be placed on top of a smaller ring.
	
	The teacher asks the students to open this webpage on their browsers (mute the tab) https://www.mathplayground.com/logic_tower_of_hanoi.html
	
	The teacher asks to solve the puzzle using 1, 2, and 3 rings and move them from the first tower to the last one using the least possible moves.
	
	Some students will share their solutions and the number of moves they used to solve the puzzle with 1, 2, and 3 rings.

20 minutes	**Lesson** The teacher explains the solution for 3 and 4 rings. The teacher asks questions to the students to have them participate in solving the puzzle games. The teacher explains how the Tower of Hanoi solution could be represented as a recursive algorithm. The teacher recalls the recursion definition: **Definition:** Recursion is a programming technique using a function or algorithm that calls itself one or more times until a specified condition is met at which time the rest of each repetition is processed from the last one called to the first. The teacher briefly explains the factorial of a number as an example of recursion. The teacher shows how the same solution can be applied for n rings and explains the steps to create the recursive algorithm to solve it. The teacher explains the formula used to calculate the minimum number of moves: $2^n - 1.$

15 minutes	**Practice** The teacher introduces the assignments mild, medium, and spicy. Students individually choose their assignments. Students start working on their assignments.
n/a	**Homework** Students who do not complete the assignment in class will finish it as homework.
5 minutes	**Closing** If the assignment is completed, then students should submit their code. If it is not, it should be completed and submitted from home. Complete Exit-Slip.