CSCI 423 - Analysis of Algorithms
Rhode Island College **Spring 2019**

Project 4 - The 0-1 Knapsack Problem - Solved 3 Ways

This project is due **Friday, April 12th** at **11:59PM**. Upload a zipped file named `yourlastnameFirstinitial_proj4` to Blackboard. The file must include a(n):

1. Executive Summary Report in PDF format
2. Python (.py) file
3. readme.txt file with instructions on how to run your code

The Knapsack Problem is a well known NP-hard problem. This means that no polynomial-time (PT) algorithm is known to solve all possible knapsack problems. Many computer scientists believe that a PT algorithm cannot be found to solve Knapsack, although this hypothesis has not been proven.

For this project, you will explore three ways to solve three instances of the knapsack problem, and compare time and space efficiencies for them. Here is one knapsack example that has the capacity to carry 6 pounds (you will invent the other two):

Item	Weight	Value
1	3	25
2	2	20
3	1	15
4	4	40
5	5	50

Please write and test Python code for the following three different solution types:

1. Exhaustive Search - try all possibilities
2. Dynamic Programming (DP) Method - as discussed in class
3. Your Method of Choice - Do some research and choose another method. This method may not be optimal.

Here are the steps to complete the project:

- Step 1. Code an exhaustive search algorithm to find the optimal solution to the above problem.
- Step 2. Code a DP method to find the optimal solution to the problem.

- Step 3. Code your chosen method and try to find the optimal solution to the problem.
- Step 4. In addition to the above example, supply two other knapsack examples and use them to test your three functions.
- Step 5. For this project, code all three solutions in one .py file and have all three methods run without user input. I want to be able to run your code once and see your complete test.

  Answer the following questions in your report:

  1. What is the time/space efficiency of each of your algorithms?
  2. Do all three of your solutions provide an optimal solution? Why or Why not?
  3. Create and supply two other knapsack examples to test your 3 functions.
  4. Which is the better knapsack solution and why? Is this true for all your knapsack examples?
- Step 6. Write your professional report that includes an executive summary, answers to the above questions, and provides your timing charts, pseudo code, and other information you need to support your analysis.