

FIT1045 Algorithmic Problem Solving – Workshop 7.

Objectives

The **objectives of this workshop** are:

- To get familiar with greedy strategy.
- To implement greedy algorithms to solve problems.
- To develop skills and understanding of practical uses of greedy approach.

Useful Material

Greedy algorithm: https://en.wikipedia.org/wiki/Greedy_algorithm

Task 1:

Marc loves cupcakes, but he also likes to stay fit. He eats cupcakes in one sitting, and each cupcake i has a calorie count, C_i . After eating a cupcake with C calories, he must walk at least $2^j \times C$ (where j is the number cupcakes he has already eaten) miles to maintain his weight. That is if Marc ate n cupcakes, then he needs to run $\sum_{i=0}^{n-1} (2^i \times c_i)$ miles.

Given the individual calorie counts for each of the n cupcakes, write a python code using greedy approach to find and print a number denoting the minimum number of miles Marc must walk to maintain his weight. Note that you will determine the order in which Marc will eat the cupcakes to minimise the walking distance.

Example:

```
Please enter the number of cupcakes: 3
Respective calorie counts of each cupcake: 1 3 2
Marc should walk at least 11 miles.
```

Explanation: Let's say the number of miles Marc must walk to maintain his weight is "milesToRun".

He can minimise milesToRun by eating the 3 cupcakes in the following order:

Eat the cupcake with 3 calories, so $milesToRun = 0 + 3 \times 2^0 = 3$.

Eat the cupcake with 2 calories, so $milesToRun = 3 + 2 \times 2^1 = 7$.

Eat the cupcake with 1 calories, so $milesToRun = 7 + 1 \times 2^2 = 11$.

We then print the final value of milesToRun, which is 11, as our answer.

Task 2:

Part 1: Given some coin denominations, your goal is to make change for amount S using smallest number of coins. Write a python code to find the smallest number of coins using the greedy approach. For example: Given a coin denomination say, 1,5,10,20,50. You want change for 37 cents, optimal way is: 1x20, 1x10, 1x5, 2x1.

Example:

```
Please enter denominations:1, 5, 10, 20, 50
Please enter the amount you want to change:30
Your denominations:1x20, 1x10
```

Note: We covered the coin changing problem in tutorial 5, feel free to refer back to that as it may help you here

Part 2: Is your answer for Part 1 always give the correct answer? If yes justify it to your neighbour, otherwise give a counter example.

Task 3:

Part 1: A thief is robbing a store and can carry a maximal weight of W into his knapsack. There are n items available in the store and weight of i th item is w_i and its profit is p_i . The thief cannot take a fraction of any item, that is either the thief has to take the whole of it or nothing. The items descriptions are given in the file items.txt. What items should the thief take, if the thief decides to take a greedy approach?

Sample output:

```
Please enter file name with item details: items.txt
Please enter the capacity of the knapsack: 7 Kg
Optimal answer: item 2 and item 3, value =30$
```

Part 2: Suppose in Part 1, the thief is allowed to take fraction of items. Will your strategy give the optimal solution in every case in the updated scenario. Discuss this with your neighbour and tutor.