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Analysis and Design of Algorithms, Winter Term 2023
Programming Assignment 1: Clone Force 99 Episode Ω

Due: November 24th 2023

1. Problem Description:

Darth Sidious gave Order 66 and the Galactic Republic went into Chaos. The clone troops who were once fighting by the side of the Jedi are now the ones killing them! But how did that happen? When the clones were created on planet Kamino, a microchip was implanted in their brains. Of course, the Jedi did not know this but the Kaminoans were working with Darth Sidious all along. They programmed the microchips to respond to Order 66 by taking all the clones' free will away and ordering them to kill all the Jedi.

During the cloning process, the Kaminoans did a failed experiment which resulted in the creation of Clone Force 99, or what they called The Bad Batch. The Bad Batch was a group of enhanced clones with extraordinary physical and mental traits. When Order 66 was executed, their microchips did not respond like normal clones so they were one of the few batches that remained sane.

Seeing what was going on, the Bad Batch decided they would go on a mission to save the remaining Jedi Knights in the galaxy. They received intel that Jedi Master Windu is on planet Naboo with some young padawans, so they decided to travel to him. However, the Bad Batch were informed that the separatists issued a hefty bounty on their heads. For this reason, they need to be careful when travelling to Naboo.

The Bad Batch is currently on the planet Tatooine. To hide their tracks, they decided that they would only get fuel for their ship from their trusted allies on each planet they land on, enroute to Naboo. In order to go from one planet to the next, they need to do one hyperspace teleport. The one hyperspace teleport requires one litre of fuel. Upon landing on a planet, unfortunately, there is a malfunction in the engines of the ship that drains out all the fuel it has and they depend on the fuel that they can get from their trusted allies on that planet. However, if they want to teleport from one planet to the other by skipping a planet in the middle of the route, they must keep in mind if the amount of fuel that they currently hold would be enough for the number of hyperspace teleports that would get them to that further planet. ie. they need to do the hyperspace teleports in the order of the planets but they don't have to land and take the fuel from the trusted allies in the middle. May the Force be with them!

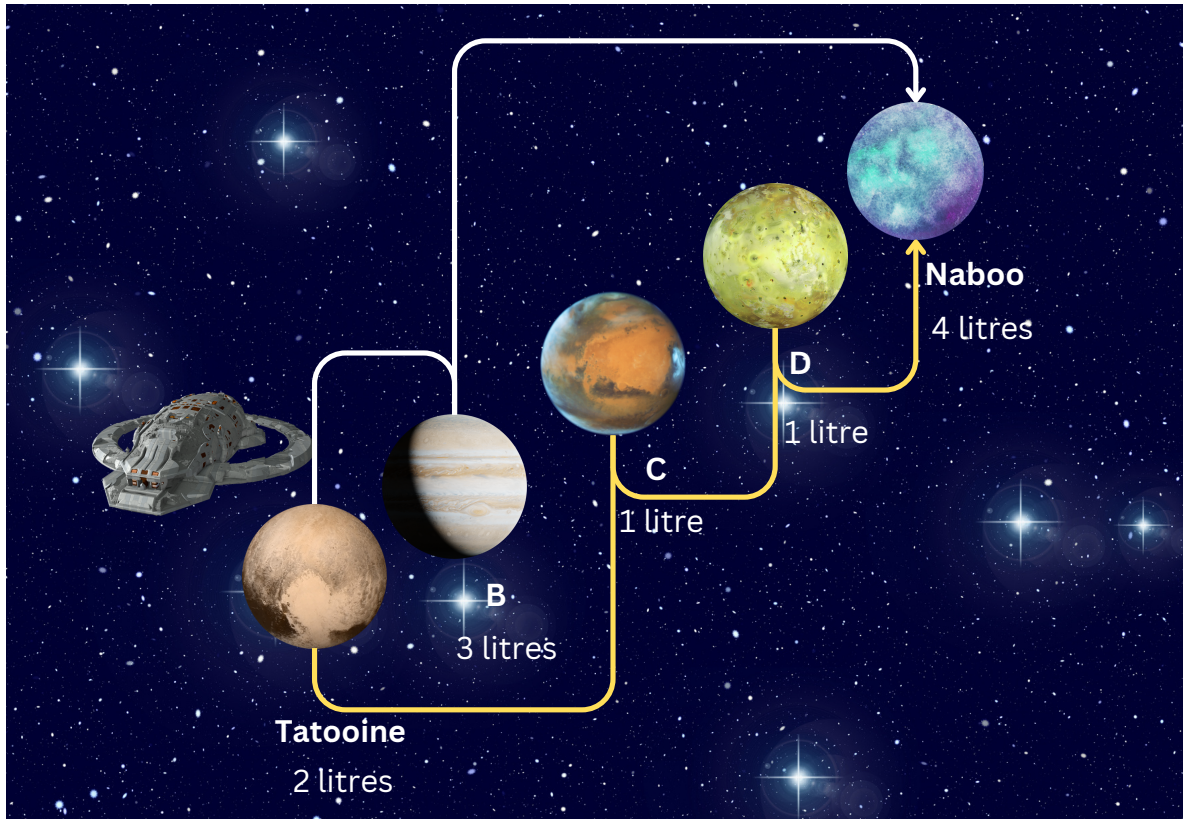


Figure 1: Example routes from Tatooine to Naboo

The Bad Batch managed to broadcast a message to all their trusted allies on the planets asking them to inform the Bad Batch of the fuel litres they can provide when they land on their planets. Now that the Bad Batch knows the amount of fuel each planet can provide and how much they require for their journey, they need to design:

- A Divide and Conquer algorithm that will tell them whether they can reach Naboo with the amount of fuel that their allies will provide.
- A Greedy algorithm that does the same thing and runs in $O(n)$.

An example can be seen in Figure 1. On each planet on the route from Tatooine and Naboo, there is a number of fuel litres that the trusted allies can provide. One way to go to Naboo is to do one hyperspace teleport (using one litre) to Planet B, then land there to fuel and thus the ship will have 3 litres of fuel (since the existing fuel drains upon landing). Then do three hyperspace teleports to reach Naboo (without landing in between). Another way would be to do two hyperspace teleports to planet C, fuel there, do one hyperspace teleport to planet D, fuel there, and finally one last hyperspace teleport to Naboo. Bottom line is, Naboo can be reached from Tatooine using only allies fuel in that case.

2. Deliverables. You are required to submit one **Java** file titled **TheBadBatch** containing the following methods. The class name must be **TheBadBatch** and the class must have a package name **cse703.main.assignment1**.

- a) `public static boolean TatooineToNabooDivideAndConquer(int [] fuel)` that implements a divide and conquer approach to finding whether Naboo can be reached using allies fuel only or not.
- b) `public static boolean TatooineToNabooGreedy(int [] fuel)` that implements the Greedy approach that does the same but runs in $O(n)$.

Failing to abide by the class and package naming will result in an automatic **Zero**. Therefore, it is recommended to use the provided template.

3. Sample Input/Output

`fuel=[2,3,1,1,4]`

Output: `true`

`fuel=[3,2,1,0,4]`

Output: `false`

4. Submission Guidelines.

- a) Your assignment will be auto-tested. For this reason, **you have to stick to the method signatures, the class name, the package name and the output format**. However, you are allowed to use any helper methods you need.
- b) You must enter your team number correctly as will be posted in the teams' list.
- c) This is the [link](#) for submission.