Homework 3

Due date: Friday, Oct 24, 2024, 11:59PM

Task 1

A counting-out game is a pseudorandom way of selecting someone out of a group - someone recites a rhyme and points to the next successive member of the group with each word of the rhyme. For example, in the game "One Potato, Two Potato", the counter recites (per Wikipedia):

> One potato, two potato, three potato, four Five
> potato, six potato, seven potato, more

And each time they say a number (or the word "more"), they point to the next member of the group. More formally, given an ordering of people in the group, the game selects the eighth member in that ordering, modulo `n`, where `n` is the size of the group. For example, with the group:

```
A B C D E F G H I J K
```

if we started on `A`, we would land on `H`. Now consider an elimination game of "One Potato, Two Potato" that works as follows. We start on A, and when the first iteration of the rhyme lands on H, H is removed from the group leaving us with:

```
A B C D E F G I J K
```

And the next round starts on I, since I came after H. When we reach K ("three potato"), we wrap around to A as the count increases, so the second iteration of the rhyme lands on E, who is also eliminated (and so the next round starts on F).

Your task is to write a function that simulates such a game of "One Potato, Two Potato." It should take two arguments:

- `n`, the number of people in the group
- `k`, the number of steps we take in one iteration of the rhyme (can be assumed to be an integer greater than zero)

Assume the members of the group are numbered from 0 to n-1. Your function should return the number of the last remaining person in the group. For example, in the above example, 'I' would be the last remaining member of the group, and it is the ninth letter, so you would return 8 (since the numbering starts at zero).

Your function **must use a linked list to represent the members of the group!** An important hint is that you will want your list to be **circular**, meaning the last element in the list points back to the head (i.e. its `next`value is precisely `head`).

Task 2:

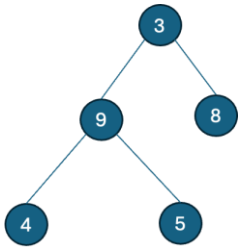
Consider a class representing nodes in a binary tree:

```
class TreeNode:
    def ____init_____(self, value, left, right): self.value =
        value
        self.left = left self.right = right
```

Write a function named 'tree_info(node)' that takes a 'TreeNode' object as the parameter (the root node of a binary tree) and prints the following information about that binary tree:

i) Height of the tree
ii) Number of leaf nodes
iii) If the binary tree is 'full' or not.
(Note: every node of a 'full' binary tree has either 0 or 2 children)
iv) If the binary tree is 'balanced' or not.
(Note: for any node of a 'balanced' binary tree, the height of the left and right subtree di=ers by at most 1)

Expected output:
If you construct the following binary tree and call the 'tree_info(node)' method with 'root' node as the parameter, the following information should be printed:



Height of the tree: 2
Number of leaf nodes: 3
Is Full: Yes
Is Balanced: Yes

Comments Required!
Please add between 5 to 8 comments **for each task** in your Python script to explain the functionality and logic of your code. Ensure that the comments are concise and meaningful.

Grading Breakdown

Task	Description	Points
1	Implementation of the counting-out game	50
2	Implementation of the 'tree_info()' function	50

Submission Instructions
(Please follow the instructions carefully and submit accordingly.)

Regular Submission

- Name your source code file as "FULL_NAME_HW3.py"
- Submit this file in iCollege folder '**Homework3**'
- Due date: Friday, 10/25/2024 11:59 PM

Late Submission

The late submissions penalty will be determined based on the following formula:

PENALTY = 0.4 * NUMBER_OF_HOURS_LATE

Examples:
If your submission is 2 hours late, PENALTY = 0.8%
If your submission is 24 hours late, PENALTY = 9.6%
If your submission is 72 hours late, PENALTY = 28.8%

Note:
- Only late submissions that are <= 3 days late will be considered for grading.
-All submissions must be made through iCollege. No email submission will be accepted.