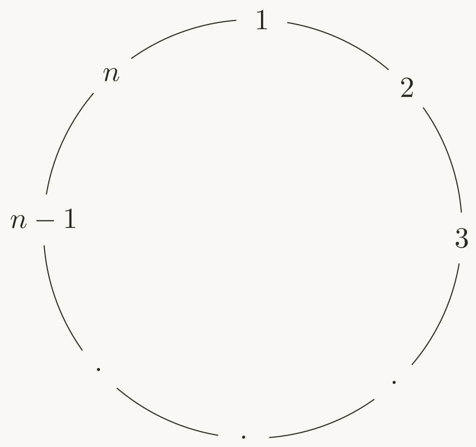
420-4P6-AB Programming IV
Winter 2024

April 15th, 2024
Worth ~6.5%

# Assignment V: Links

(Due on On Léa)

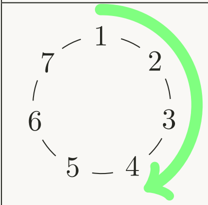
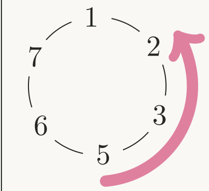
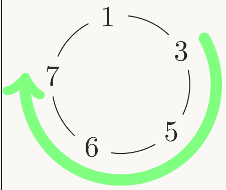
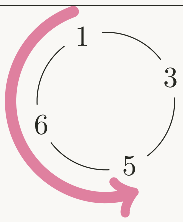
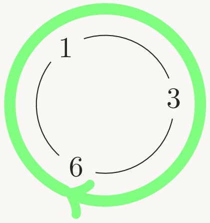
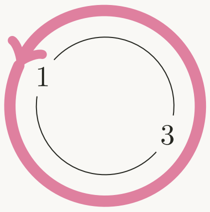
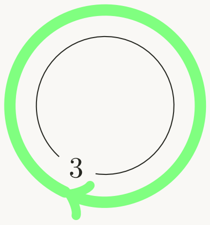
Imagine that there are $n$ people in a circle, numbered 1, 2, …, $n$:



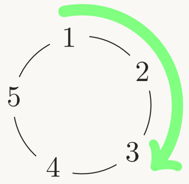
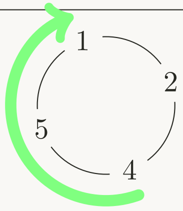
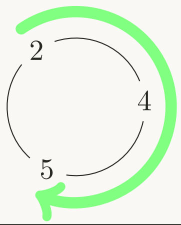
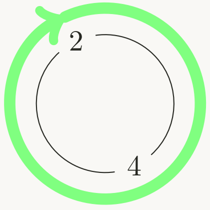
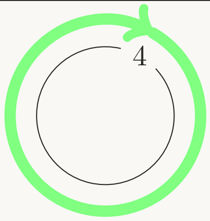
Starting from the first person (number 1), count clockwise around the circle, to the $m$-th person and remove them from the circle. The circle closes up when a person is removed. Now, count counter-clockwise around the circle to the $o$-th person from were you were, and remove that person.

Repeat this process of counting and removing, switching between the clockwise and counter-clockwise directions and counts. Who is the last person in the circle and what is the order in which they are removed?

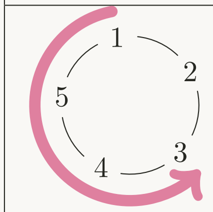
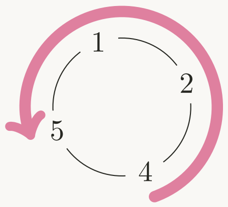
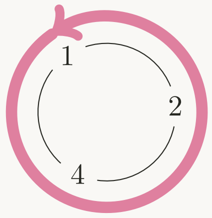
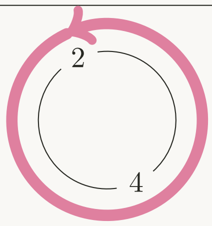
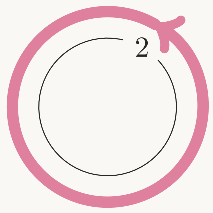
**Example:** ($n$ = 7, $m$ = 4, $o$ = 3)

| Circle | Current Position | Count | Remove |
|---|---|---|---|
|  | 1 | 1 2 3 4 | 4 |
|  | 5 | 5 3 2 | 2 |
|  | 3 | 3 5 6 7 | 7 |
|  | 1 | 1 6 5 | 5 |
|  | 6 | 6 1 3 6 | 6 |
|  | 1 | 1 3 1 | 1 |
|  | 3 | 3 3 3 3 | 3 |

**Example** (n = 5, m = 3, o = 0):

| Circle | Current Position | Count | Remove |
|---|---|---|---|
|  | 1 | 1 2 3 | 3 |
|  | 4 | 4 5 1 | 1 |
|  | 2 | 2 4 5 | 5 |
|  | 2 | 2 4 2 | 2 |
|  | 4 | 4 4 4 | 4 |

**Example** (n = 5, m = 0, o = 4):

| Circle | Current Position | Count | Remove |
|---|---|---|---|
|  | 1 | 1 5 4 3 | 3 |
|  | 4 | 4 2 1 5 | 5 |
|  | 1 | 1 4 2 1 | 1 |
|  | 2 | 2 4 2 4 | 4 |
|  | 2 | 2 2 2 2 | 2 |

## Implementation

Write a python program to solve this problem using the circular link chain programming technique. Specifically, you should use a *doubly*-linked chain. Use the following definition of a link:

```
class DoubleLink(Generic[T]):
    def __init__(self, element: Optional[T] = None):
        self.element: Optional[T] = element
        self.next: Optional[DoubleLink[T]] = None
        self.prev: Optional[DoubleLink[T]] = None
```

### Class `Circle`

Start from the class `Circle` in the file `circle.py`. You can add additional methods but must at least implement the following two operations:

| | |
|---|---|
| Signature | `def remove_next(self) → int` |
| Description | Remove the next person (only one!) from the circle according to the rules. |
| Pre-conditions | Circle is created. |
| Mutator | Yes |
| Returns | The number (name) of the person removed. |

| | |
|---|---|
| Signature | `def print_circle(self)` |
| Description | Prints the numbers (names) of the people currently in the circle. Starts from the current counting position and proceeds clockwise. Format is one-line, comma separated. Ex: `circle is now 4, 5, 1, 2.` |
| Pre-conditions | Circle is created |
| Mutator | No |
| Returns | None |

## Requirements

Your program *must* meet the following requirements:

1. Implement the circle in the file `circle.py`. Implement the two methods outlined in the previous section.
2. Create a `main.py` that will take user input and print the results.

3. Read the integers $n$, $m$ and $o$ from standard input (console). Only accept valid values, that is

   - $n > 0$
   - $m, o \geq 0$
   - $m + o > 0$ (at least remove in one direction).

   Re-prompt the user for input of any of the above are false.

4. Print the order or people removed to standard output (console). Your output must look like:

```
n> 7
m> 4
o> 3
circle: 1, 2, 3, 4, 5, 6, 7

4 is removed
circle now is 5, 6, 7, 1, 2, 3

2 is removed
circle now is 3, 5, 6, 7, 1

7 is removed
circle now is 1, 3, 5, 6

5 is removed
circle now is 6, 1, 3

6 is removed
circle now is 1, 3

1 is removed
circle now is 3

3 is removed
```

## Submission

Once you've made your final `git push` to GitHub, submit a text file with the commit id to LEA.

## Style

Your program should be clear and well commented.  It must follow the Coding Standards as given in the class notes