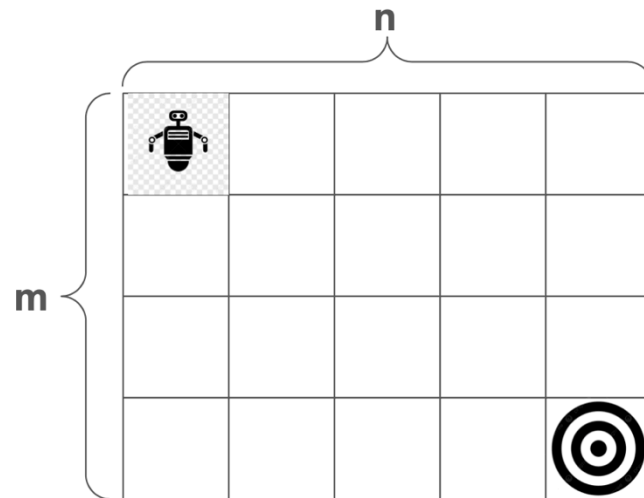
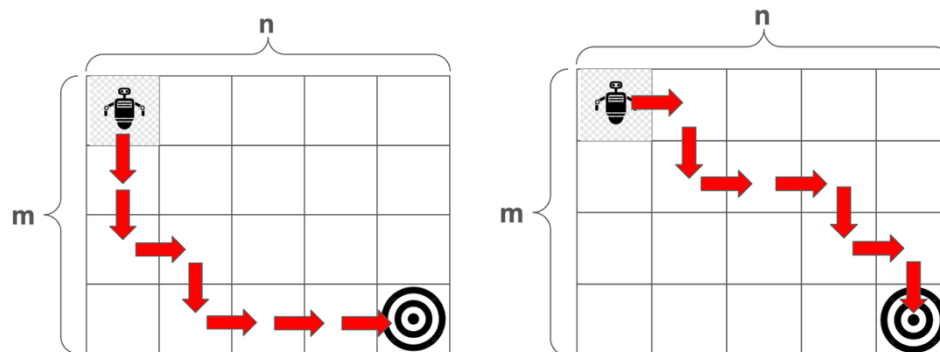


Robots on Grids



Let's consider a robot on an $m \times n$ grid of squares (that is, m rows and n columns). The robot starts in the top-left square, and its target is at the bottom-right. The robot has two moves available to it -- it can move one square to the right, or one square down -- so it must make a combination of rightward and downward moves to reach its target. It follows that the robot will take $(m + n - 2)$ steps to reach its target.

Here are two such paths it could take:



Your task is to write code that counts the number of possible paths for the robot, given an m and n .

1. Write a function `num_paths(m, n)` that recursively computes the number of paths from the top-left to bottom-right square of an $m \times n$ grid **without memoization**.
2. Write a function `num_paths_memo(m, n)` that does the same, but memoizes the smaller subproblem solutions.
3. The provided sample/driver code will do the runtime calculation for you. Take a screenshot of the output and submit it along with your python script.

Expected Output

- The expected result for $m=15$, $n=14$ is 20058300.
- The elapsed time / runtime can vary from system to system.

Comments Required!

Please add a few comments 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 num_paths() function	30
2	Implementation of num_paths_memo() function	50
3	Output screenshot (to report the runtimes)	10
4	Comments	10

Submission Instructions

(Please follow the instructions carefully and submit accordingly.)

Regular Submission

- Name your source code file as “FULL_NAME_HW2.py”
- Submit this file in iCollege folder ‘**Homework2**’
- Due date: **Friday, 09/27/2024 11:59 PM**

Late Submission

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

$$\text{PENALTY} = 0.4 * \text{NUMBER_OF_HOURS_LATE}$$

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.