

ESE5023_Assignments1_report_12532754

1. Flowchart

[10 points] Write a function `Print_values` with arguments `a`, `b`, and `c` to reflect the following flowchart. Here the purple parallelogram operator on a list `[x, y, z]` is to compute and print $x+y-10z$. Try your output with some random `a`, `b`, and `c` values. Report your output when `a = 5`, `b = 15`, `c = 10`.

`Print_values(5,15,10)` = 空白

2. Continuous ceiling function

[10 points] Given a list with `N` positive integers. For every element `x` of the list, find the value of continuous ceiling function defined as $F(x) = F(\text{ceil}(x/3)) + 2x$, where $F(1) = 1$.

当 `N = 10`

`a` = [19, 12, 24, 3, 28, 42, 23, 10, 14, 14]

`F(a)` = [59, 37, 71, 7, 89, 127, 69, 33, 43, 43]

3. Dice rolling

3.1 [15 points] Given 10 dice each with 6 faces, numbered from 1 to 6. Write a function `Find_number_of_ways` to find the number of ways to get sum `x`, defined as the sum of values on each face when all the dice are thrown.

随机生成 `x = 57`

10 个骰子总和 57 的 ways: 220 种

3.2 [5 points] Count the number of ways for any `x` from 10 to 60, assign the number of ways to a list called `Number_of_ways`, so which `x` yields the maximum of `Number_of_ways`?

最大 ways 对应的 `x`: 35

最大 ways: 4395456

4. Dynamic programming

4.1 [5 points] Write a function `Random_integer` to fill an array of `N` elements by randomly selecting integers from 0 to 10.

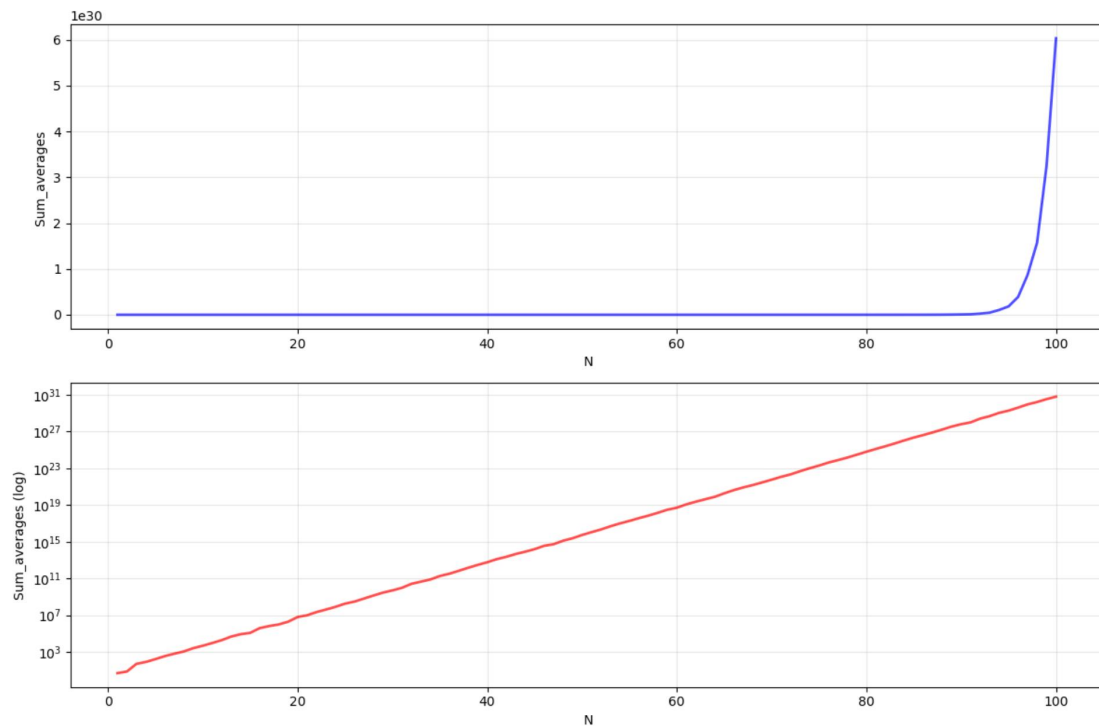
生成: [2, 1, 10, 7, 3, 2, 3, 9, 9, 9]

4.2 [15 points] Write a function `Sum_averages` to compute the sum of the average of all

subsets of the array. For example, given an array of [1, 2, 3], you Sum_averages function should compute the sum of: average of [1], average of [2], average of [3], average of [1, 2], average of [1, 3], average of [2, 3], and average of [1, 2, 3].

数组 [1, 2, 3] 所有子集平均值的总和: 14.0

4.3 [5 points] Call Sum_averages with N increasing from 1 to 100, assign the output to a list called Total_sum_averages. Plot Total_sum_averages, describe what do you see.



Sum_averages 的值随着 N 的增加呈现明显的指数级增长。

在对数坐标图中，数据点大致呈直线分布，属于指数增长。

曲线存在一定的波动，但整体指数趋势明显。

当 N 较小时增长相对平缓，但 N > 20 后增长极其迅速。

5. Path counting

5.1 [5 points] Create a matrix with N rows and M columns, fill the right-bottom corner and top-left corner cells with 1, and randomly fill the rest of matrix with integer 0 or 1.

生成: 10 行 8 列矩阵:

```
[[1 1 1 1 1 0 1 0]
 [0 1 0 0 0 0 1 1]
 [1 1 0 0 1 1 1 1]
 [0 1 1 0 1 1 1 0]
 [1 1 1 1 1 1 1 0]
 [1 0 1 1 0 1 1 0]
```

```
[1 1 1 0 0 0 1 0]
[1 1 0 1 1 1 1 0]
[0 1 1 1 0 1 1 1]
[0 1 1 0 0 1 1 1]]
```

5.2 [25 points] Consider a cell marked with 0 as a blockage or dead-end, and a cell marked with 1 is good to go. Write a function Count_path to count total number of paths to reach the right-bottom corner cell from the top-left corner cell.

Notice: for a given cell, you are only allowed to move either rightward or downward.

路径总数: 8

5.3 [5 points] Let $N = 10$, $M = 8$, run Count_path for 1000 times, each time the matrix (except the right-bottom corner and top-left corner cells, which remain being 1) is re-filled with integer 0 or 1 randomly, report the mean of total number of paths from the 1000 runs.

1000 次路径总数的平均值: 0.3140