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Program Structures & Algorithms

Spring 2021

Assignment No.1

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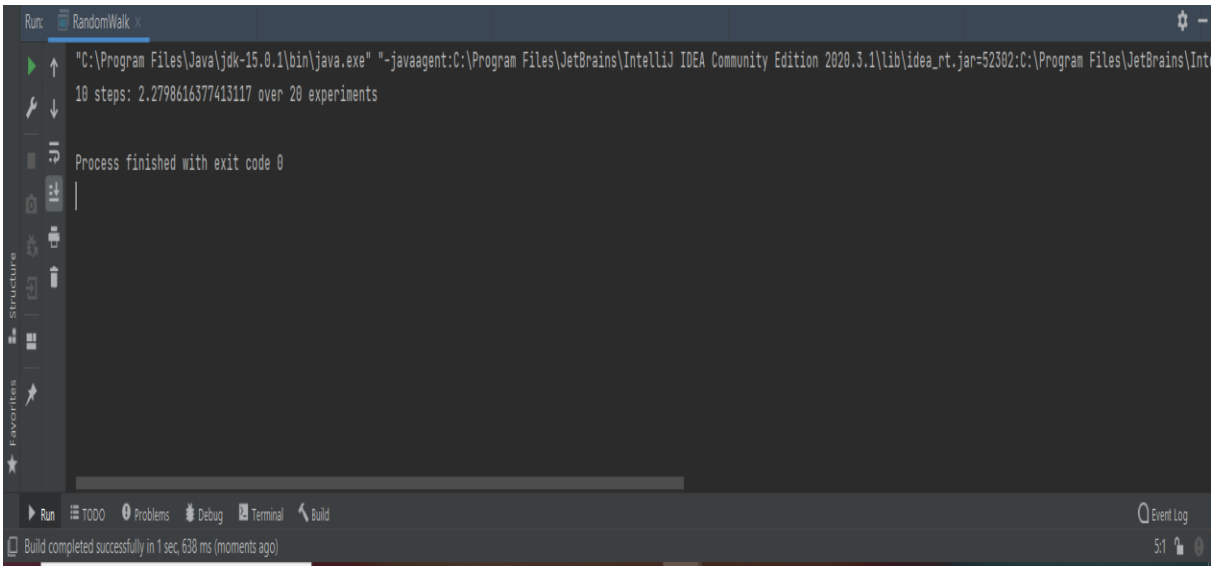
Task:

The following are the steps that were carried out,

- Cloned from the class repository and worked on ***RandomWalk.java*** file under randomwalk directory.
- Added logic to the functions - **move(), randomWalk() & distance()** that were asked to be implemented.
- Ran the main class in **RandomWalk.java** and got the desired output.

Output:

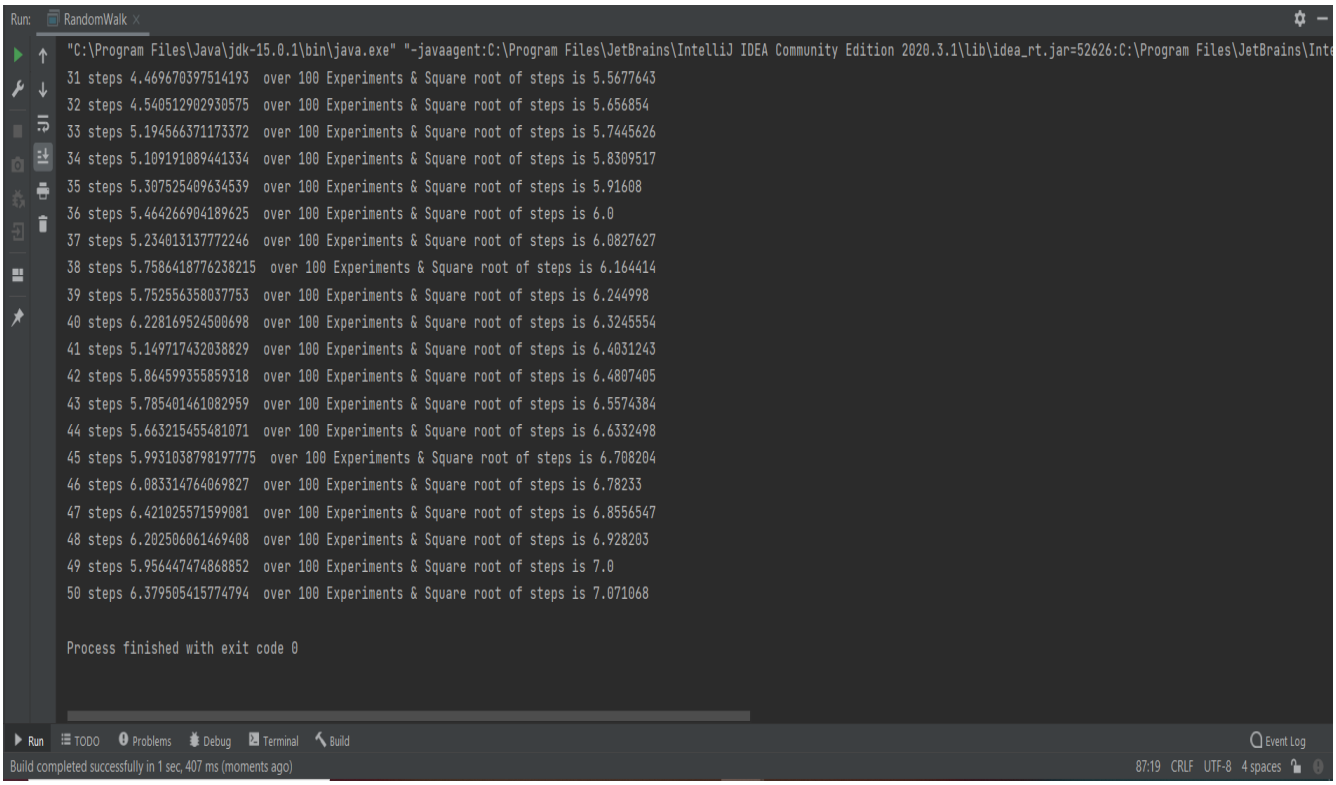
Following is a snap of the Sample Output, for the inputs: Number of Steps as 10 and Number of Experiments as 20



Relationship Conclusion:

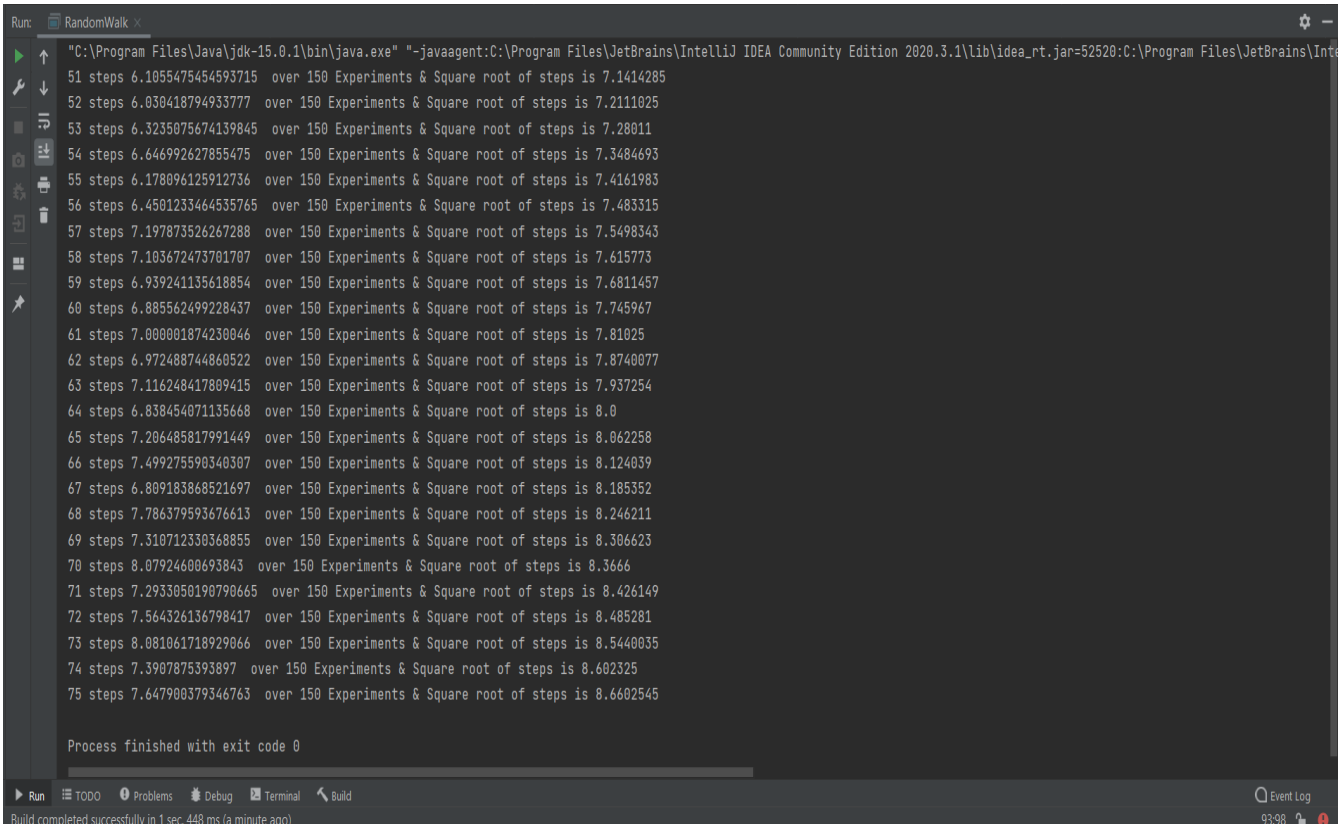
On running the main method inside the RandomWalk.java file multiple times to figure out and establish the relationship between the Number of Steps (N) and the distance (D) the Drunken man would have covered. I performed the following runs.

Run 1: Number of Steps (N) – 20 Different Values of N; Number of Experiments – 100 for each value of N.

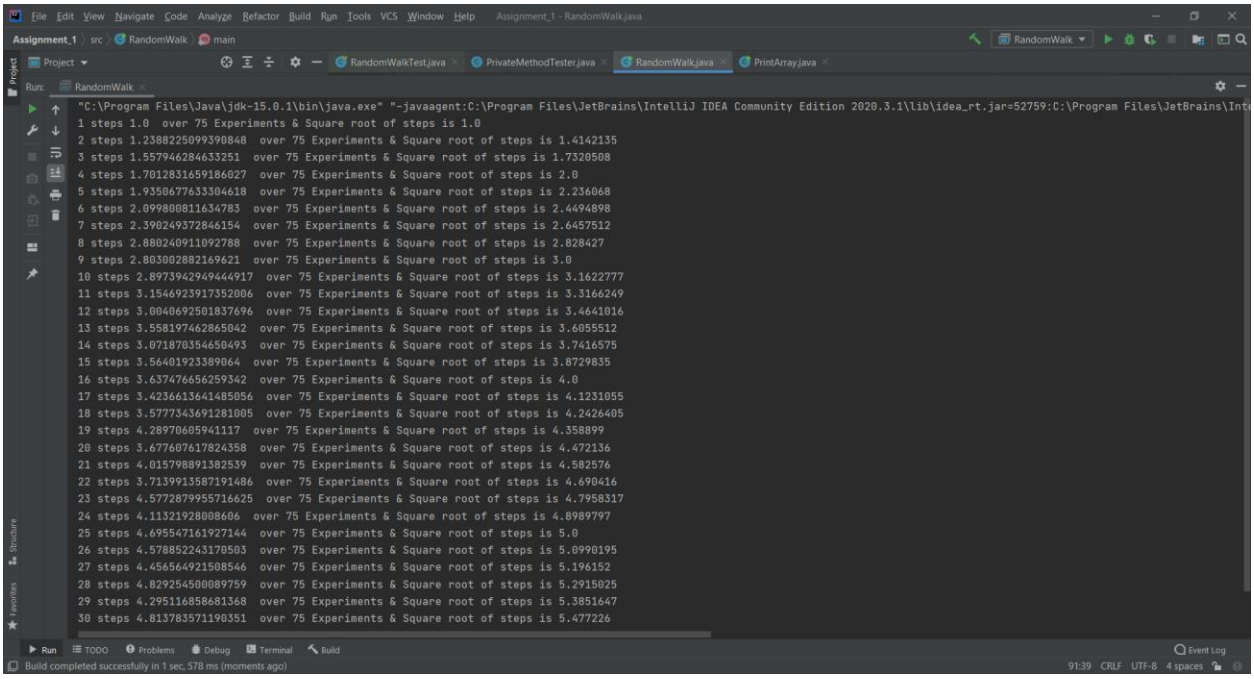


Note: I would like to bring to your notice that I have made some modifications inside the main method() of RandomWalk file to execute the program for different values of 'm' – Number of Steps at one shot, to assign the number of experiments value and have also tinkered the print statements. Apart from these minor adjustments that do not compromise the integrity of the code I haven't modified anything.

Run 2: Number of Steps (N) – 25 Different Values of N; Number of Experiments – 150 for each value of N



Run 3: Number of Steps (N) – 30 Different Values of N; Number of Experiments – 75 for each value of N



On plotting these datapoints in an excel and analyzing the value of **D** (distance) and **N** (Number of Steps) carefully, I have inferred that the value of **Distance** (D) **increases** as the **value of Number of Steps (N) increases** and hence I would like to conclude the following expression to deduce a relationship between D and N.

$$D \propto \sqrt{N}$$

That the **Distance(D) covered** by the Drunken Man during the Random Walk experiment is **directly proportional to the Square root of the value of Number of Steps(N)**.

Evidence to support the Conclusion:

On analyzing the below Datapoints generated for different values of Number of Steps, one could notice that the mean distance covered increases when the N also increases.

Steps	Distance	Number of Experiments	Sqrt of Steps
31	4.728325621	100	5.5677643
32	5.379922427	100	5.656854
33	5.061433773	100	5.7445626
34	5.368115827	100	5.8309517
35	4.969436454	100	5.91608
36	5.470528818	100	6
37	5.425015133	100	6.0827627
38	5.98616674	100	6.164414
39	5.458802073	100	6.244998
40	5.775251806	100	6.3245554
41	5.52570178	100	6.4031243
42	5.172112216	100	6.4807405
43	6.093740301	100	6.5574384
44	6.056497117	100	6.6332498
45	5.613788043	100	6.708204
46	6.417456801	100	6.78233
47	6.702508929	100	6.8556547
48	5.701773837	100	6.928203
49	5.920983263	100	7
50	6.174489031	100	7.071068

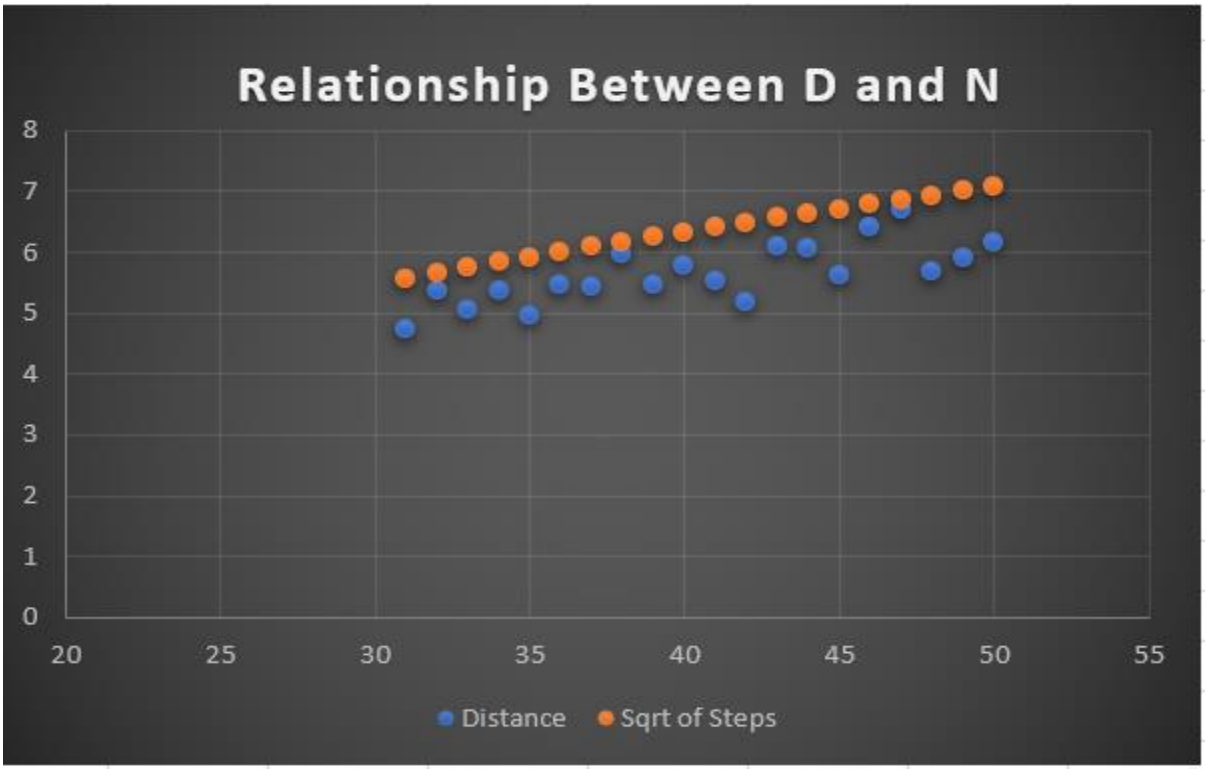
Datapoint 2

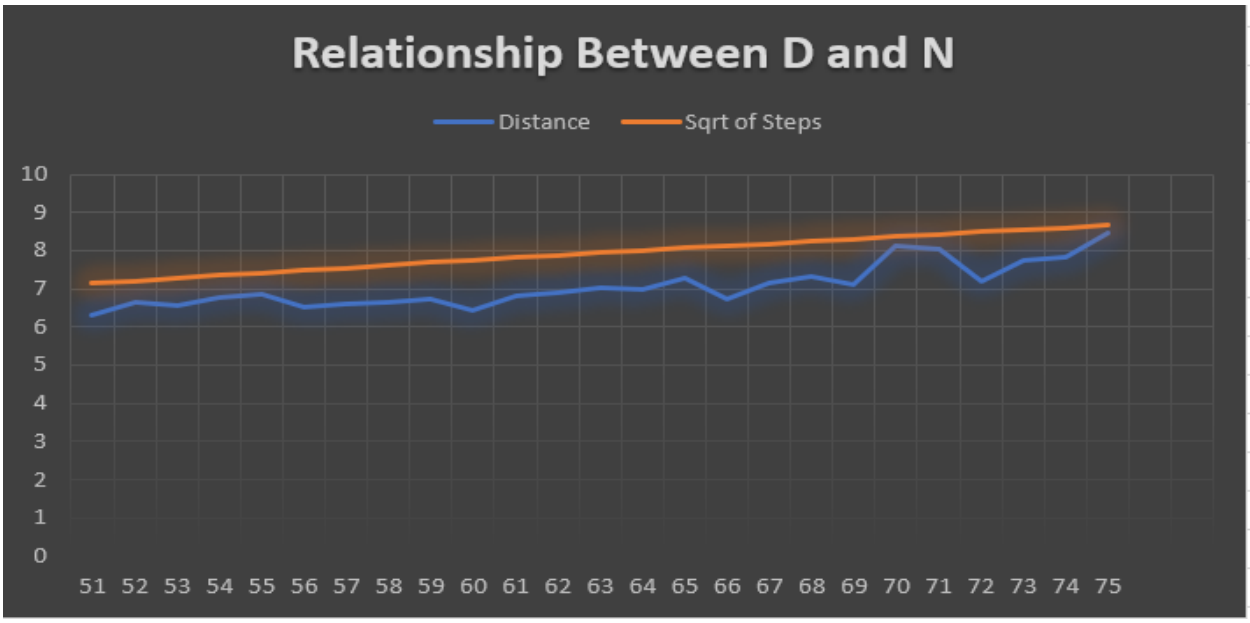
Steps	Distance	Number of Experiments	Sqrt of Steps
1	1	75	1
2	1.14320154	75	1.4142135
3	1.56813204	75	1.7320508
4	1.67053697	75	2
5	2.04652341	75	2.236068
6	2.15489539	75	2.4494898
7	2.38507598	75	2.6457512
8	2.77687904	75	2.828427
9	2.99600152	75	3
10	2.98259587	75	3.1622777
11	3.04686246	75	3.3166249
12	3.07921738	75	3.4641016
13	3.26849931	75	3.6055512
14	3.17602152	75	3.7416575
15	3.59321348	75	3.8729835
16	3.61472324	75	4
17	3.48018576	75	4.1231055
18	3.84478098	75	4.2426405
19	3.93751939	75	4.358899
20	3.74088455	75	4.472136

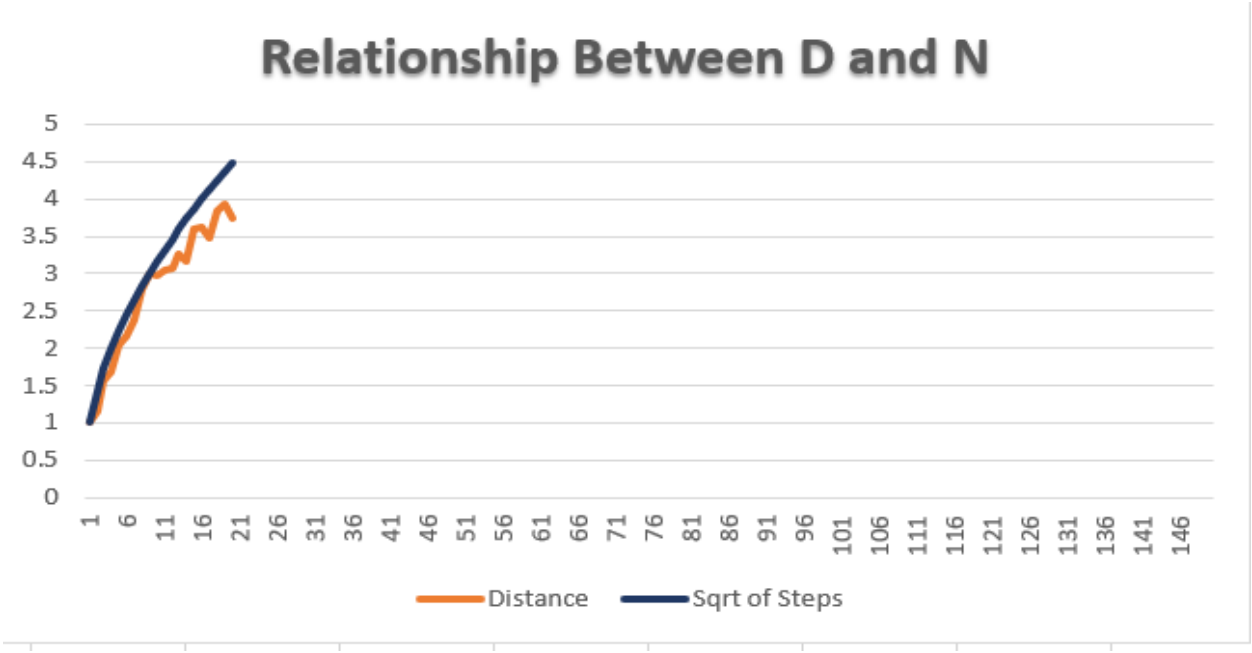
Datapoints 3

Steps	Distance	Number of Experiments	Sqrt of Steps
51	6.295631786	150	7.1414285
52	6.630384326	150	7.2111025
53	6.546053712	150	7.28011
54	6.784217763	150	7.3484693
55	6.839024583	150	7.4161983
56	6.537996841	150	7.483315
57	6.598882069	150	7.5498343
58	6.634932955	150	7.615773
59	6.748021269	150	7.6811457
60	6.430710566	150	7.745967
61	6.828318668	150	7.81025
62	6.889632528	150	7.8740077
63	7.02516093	150	7.937254
64	6.998551237	150	8
65	7.273039471	150	8.062258
66	6.732868318	150	8.124039
67	7.163436338	150	8.185352
68	7.331062099	150	8.246211
69	7.103560485	150	8.306623
70	8.144414748	150	8.3666
71	8.034321648	150	8.426149
72	7.214703784	150	8.485281
73	7.758663307	150	8.5440035
74	7.820290682	150	8.602325
75	8.451887957	150	8.6602545

Graphical Representation







Please be informed that these Graphical Representations are available with much more details in the spreadsheet that I am attaching along in the .zip file.

Unit Tests Result:

- All 6 Test Cases Passing as Expected

Thank you for the read 😊 !!