


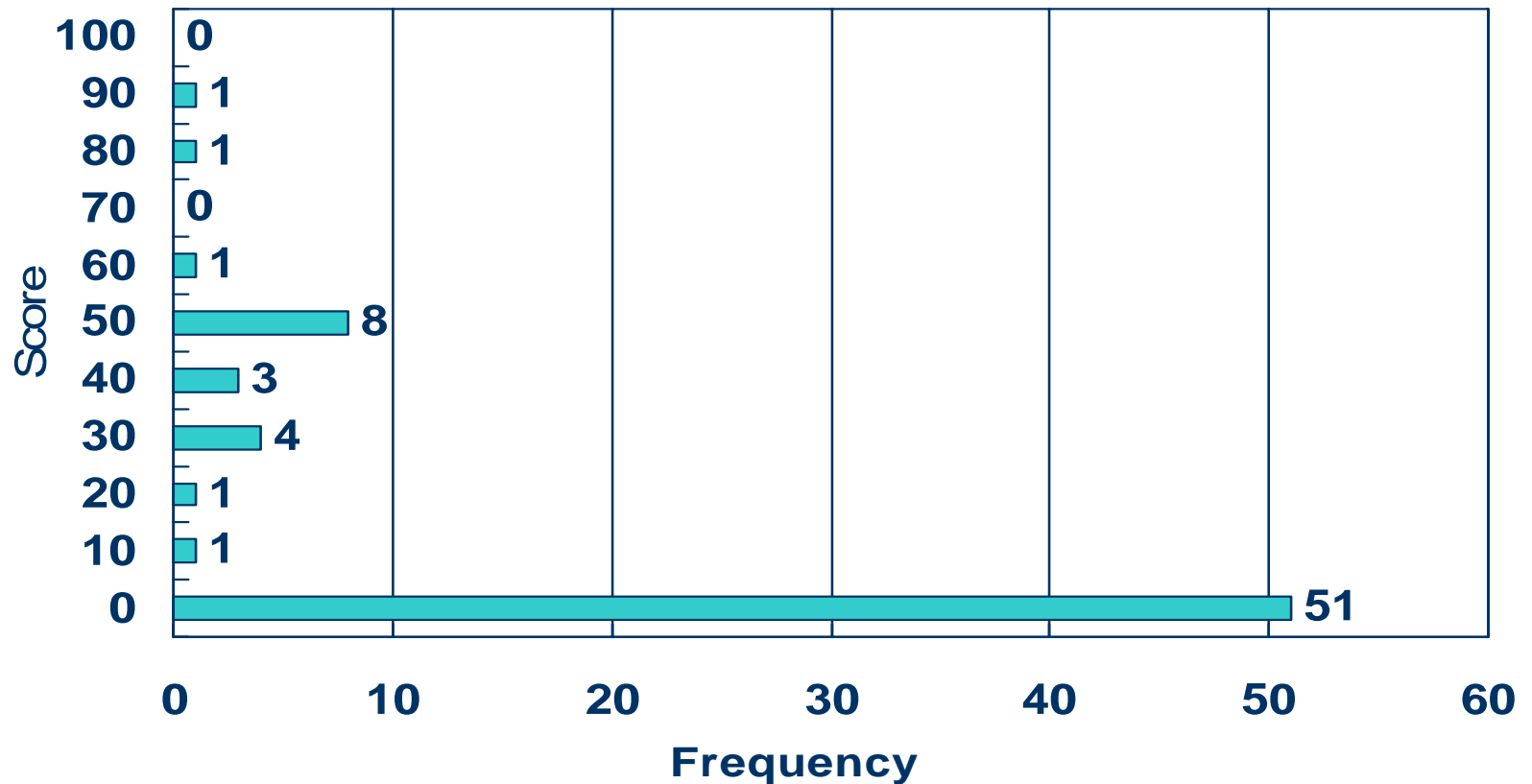
Amazing Robot

HKOI2004 Final Event
Junior Q4 Solution



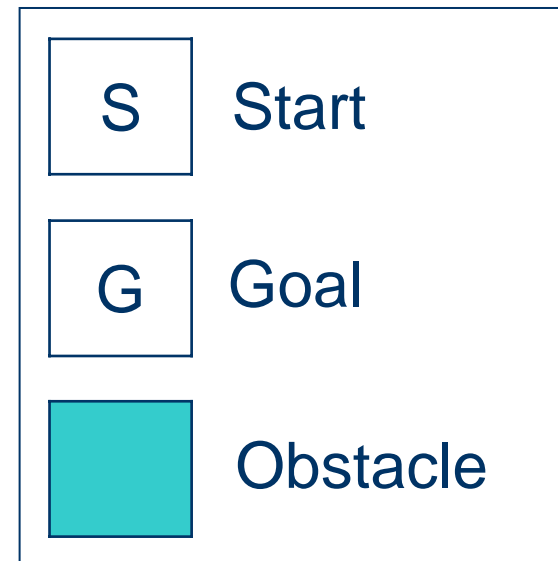
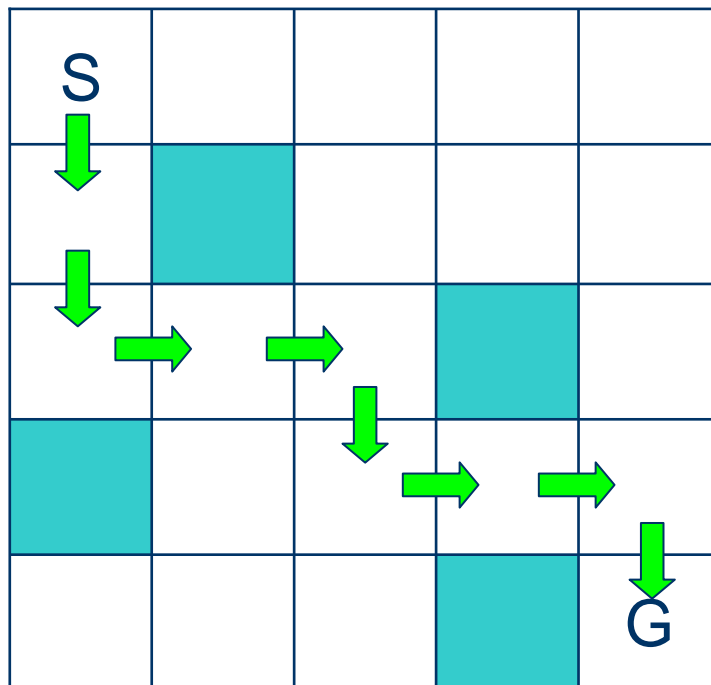
Statistical Diagram

HKOI2004 Final Event Junior Q4



Problem Description – Part I

- Given a grid maze, find a shortest path between two given points

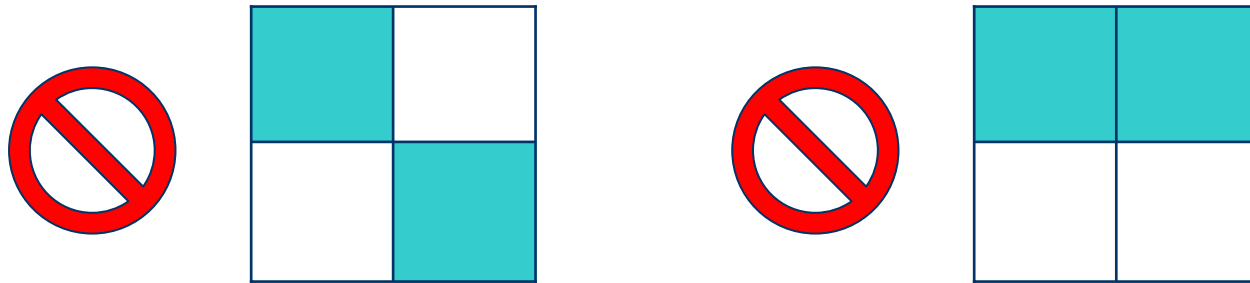


Solution – Part I

- Breadth-first Search (BFS)
 - Correct solution
 - Not easy to implement
 - We DIDN'T expect Junior contestants to know BFS
 - This method will be taught in later training sessions
- Alternative approach?

Problem Description – Part II

- Obstacles do not touch



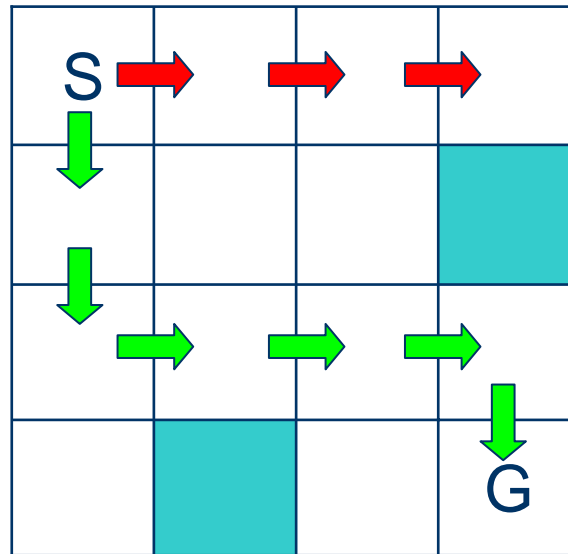
- From NW corner to SE corner
- Conclusion: only 2 directions – S and E

Solution – Part II

- Dynamic Programming (DP or DyP)
 - Correct solution
 - We DIDN'T expect Junior contestants to know DP
 - This method will be taught in later training sessions
- First E then S / First S then E
 - INCORRECT solution, but it sometimes works
 - Scored about 50%

Solution – Part II

- First E then S – Counter example



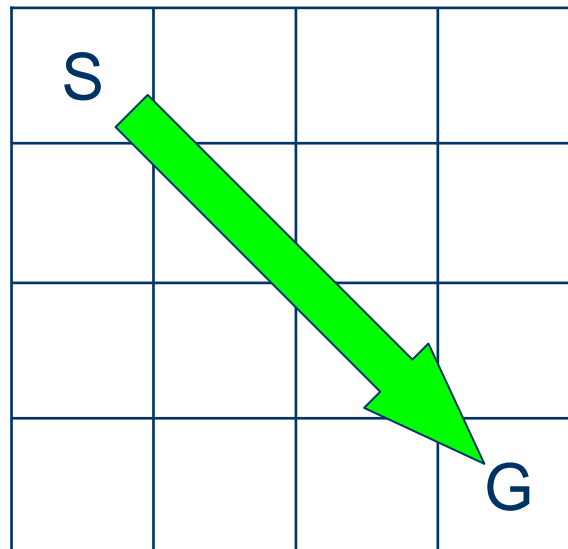
Correct solution: E SSEEES

Solution – Part II

- Why does the above solution easily go wrong?
 - Being “forced” to the “far side” too early
- How to deal with this?
 - Keep the path close to the “center”
 - What is meant by “center”?
- Is there any other important information in the problem description?

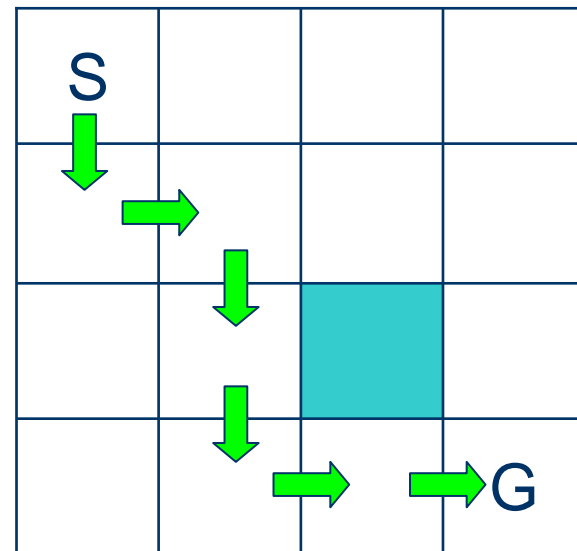
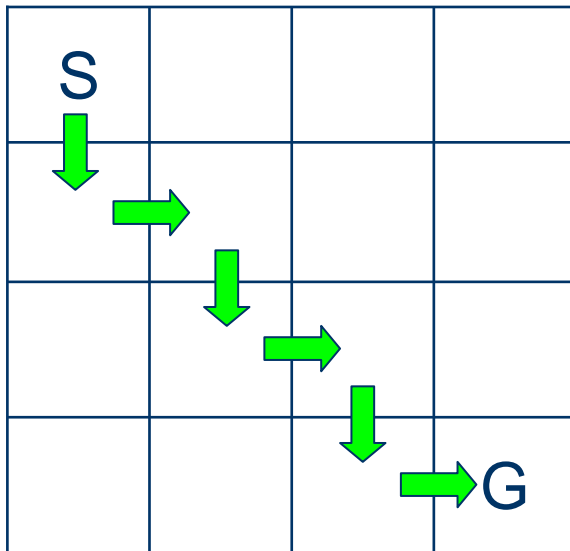
Problem Description – Part III

- The maze is of size $P \times P$
 - It is a square!
 - The word “center” refers to the main diagonal



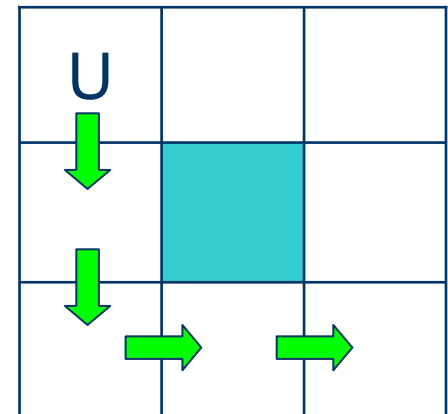
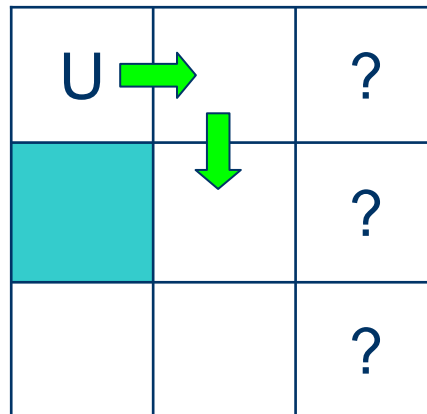
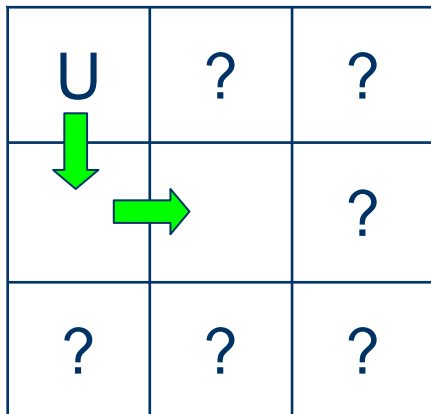
Solution – Part III

- Follow-the-Main-Diagonal
 - Try your best to keep on the main diagonal



Solution – Part III

- Follow-the-Main-Diagonal
 - Recall: obstacles do not touch
 - When you are on the main diagonal, there are only 3 cases:



Solution – Part III

- Follow-the-Main-Diagonal
 - We come back to the main diagonal in all 3 cases
 - Algorithm:
 - Start at the upper-left corner
 - While destination not reached
 - Determine the case
 - Carry out the corresponding moves
 - Implementation:
 - Your job

Conclusion...?

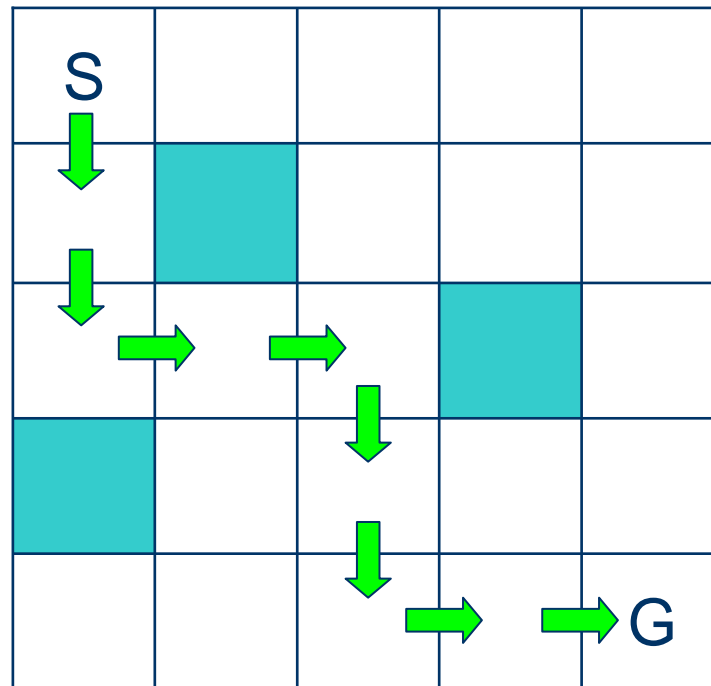
- So we have “discovered” an “easy” and correct solution to the problem
- Is this the end?
 - No, you may think of alternative ways to solve this problem
 - No, you may think of some INCORRECT solutions to this problem

Another Correct Solution

- Recursion
 - At each step, try E (or S), if no solution is found, try S (or E)
 - Correct, but SLOW in large mazes
 - Somebody got 90% with this solution

INCORRECT Solutions

- Change direction every time you hit an obstacle or “edge of the maze”



INCORRECT Solutions

- Random
 - When you can go either E or S, random!
 - Incorrect, but not bad, why?
 - Recall the Follow-the-Main-Diagonal solution

Solutions from YOU

- “Bugged” Breadth-first Search (BFS)
- “Bugged” Dynamic Programming (DP)
- Recursion
- First E then S / First S then E (very common)
- 6 ESSESE (very common, but 0%)
- EEEE...EESSSS...SS

More about this Problem...

- Attempt rate: very low
- Mean score: very low
- Why?
 - This problem **WAS** the hardest among the five
 - Most of you could not identify the “keys” to solve it
 - The last question on the question paper
 - Misconception: the last question is always the hardest
 - Follow the question number order

Time to Conclude...

- Standard algorithms (BFS, DP) may work, but ad hoc algorithms may be better
 - More straightforward?
 - Easier to implement?
 - Better performance?
- Identify the “keys” to solve the problem
 - Minor things in the problem description may affect a lot
- Optional assignment: finish this problem

Amazing Robot - Solved

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