Interview Question
The Labyrinth Problem

Tharsus Limited

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1 Introduction

The myth of Theseus and the Minotaur within the Labyrinth of Crete is one of the most famous stories of ancient Greek Methodology. The story is told by the hero Theseus, a mythical king and founder-hero of Athens. The Minotaur is a giant, ferocious creature that has been imprisoned in the Labyrinth of Crete. The Minotaur is said to be the most dangerous foe in the Labyrinth. Whereas in the story the hero must find and defeat the Minotaur, in this interview question the hero and the Minotaur both wish to enter and escape the Labyrinth without ever having the possibility to fight.

2 The Problem

Given a square labyrinth as in Figure 1 of size $n \times n$ with $n \geq 4$, with 2 entry points (blue) and 2 exit points (reds) on the border of the labyrinth. Plan a set of paths from each entry point to a unique exit point, such that, no two paths pass through the same exact coordinate point. If no such set of paths exists then the labyrinth is impossible to escape without conflict and should be detected.

We have supplied you with a set of labyrinths, which are stored as .png files within the test inputs folder of the project. An example of a labyrinth which has a solution is shown in Figure 1. Within these images, the entry points are marked with a blue square and the exit points are marked with a red square. Traversal of the labyrinth is allowed via any white square.

Likewise, an example of a labyrinth which has no solution is shown in Figure 2.

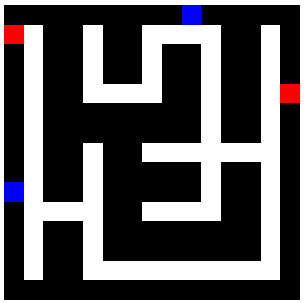

Figure 1: An example of a labyrinth with a solution.

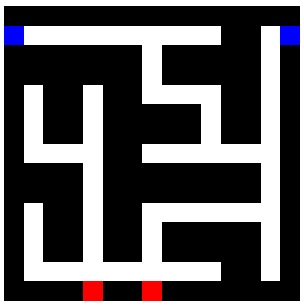

Figure 2: An example of a labyrinth without a solution.

3 Assessment Criteria

We have supplied you with a basic boilerplate which can load these images into the program into a numpy array and decomposes these images into exact coordinates of the entry points, exit points, walls and traversable squares. Beyond this it is completely up to you how you solve this problem (but feel free at ask us questions).

We would expect that you should not use any external libraries other than numpy, PIL, os, sys and pytest to solve this problem. For any analysis of your results feel free to use any tools available to you. This is primarily so that we can assess your ability to solve these types of problem from scratch.

Once you are confident that you have solved the problem we would like you to write a presentation which will summarise your solution, the approaches which you took (even the ones that failed!) and the results you achieved. You should prepare this presentation in advance of a face to face interview with some of the members of the Digital Technologies team. Be prepared to discuss your implementation and execute your code during the interview.

Hint: A nuance Labyrinth

We have included an additional labyrinth within the test inputs folder named "labyrinth-0-E1.png" (shown in Figure 3) which has a solution. Your algorithm should be able to solve this labyrinth.

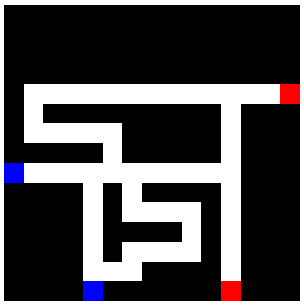

Figure 3: An example of a labyrinth with a solution (labyrinth-0-E1.png).

4 Can I use another programming language?

We would highly encourage you to use python. You may wish to implement a solution in C++ but no other programming languages are permitted. If you choose to use C++ then please take particular care to only use necessary libraries for importing the labyrinth data and all other aspects of solving the problem should be written from scratch. If you are unsure if you should use a library then please ask us.