
# UNIVERSITÀ DEGLI STUDI DI GENOVA

## DIBRIS

DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY,
BIOENGINEERING, ROBOTICS AND SYSTEM ENGINEERING


## RESEARCH TRACK II

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# Statistics Assignment

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# 1 Introduction

The aim of this report is to perform a statistical analysis concerning the performances of the algorithm developed during the first assignment of the Research Track I class; in a fixed environment, a single robot has to match a specific number of golden tokens with silver ones, where the number of tokens and their positions can be changed.
The data taken into account were collected in three different scenarios, at first the number of tokens was equal to four, then five and in the end six; each time the boxes were randomly placed in the environment, as it can be observed in Figure 1, in order to test the average time required to finish the task and the number of success/-failures.

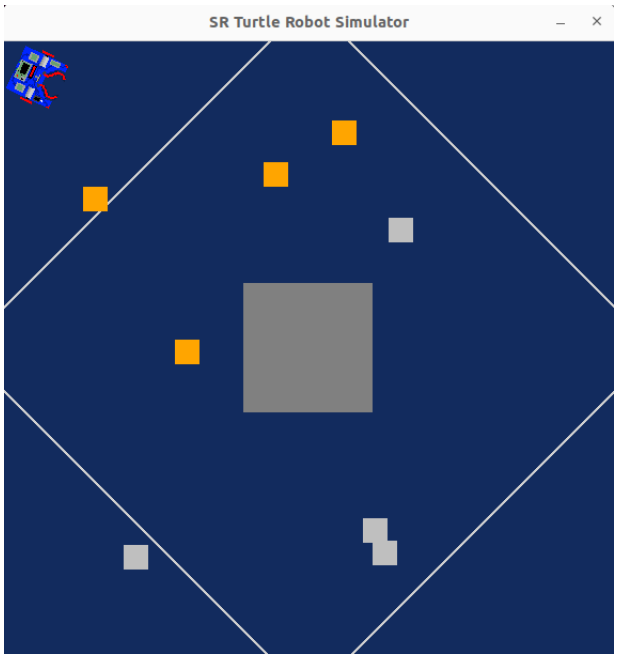


Figure 1: Environment with N = 4

My implementation was considered and compared to the solution adopted by my colleague Isabella Cebollada Gracia.

# 2 Hypotheses and data analysis

## 2.1 Initial hypothesis

Since the specifications and the task to be achieved posed by the first assignment are the same, we can assume for the two algorithms a null hypothesis.
For each scenario, the algorithms were tested to collect 25 samples from which a statistical analysis is then performed and the initial hypothesis is evaluated.

## 2.2 Lilliefors and T test

Based on the collected data, in Figure 2 we can observe the estimated average times for different scenarios. As the number of tokens increase, each algorithm tend to take more time in order to achieve the task, but Isabella's implementation tends to be on average faster and it also has a minor growth in time when increasing the amount of tokens randomly placed in the environment.

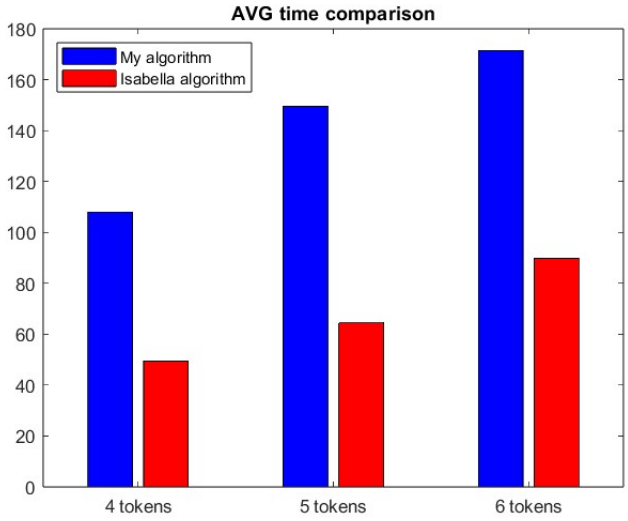


Figure 2: Average time comparison for the algorithms

Concerning the number of success and failures, since each environment is randomly generated at each iteration both algorithms happened to get stuck because of how the tokens were placed; neither one of the two implementations had an obstacle avoid collision feature, as a consequence there were cases were the robots ended up crashing against some tokens or corners and not being able to recover from it; therefore, we can observe in Figure 3 small failures are detected with a simple case where N = 4, whereas for N = 5 and for N = 6 the failures tend to increase significantly and my implementation tends to have a slightly higher number of success as the number of tokens is increased.

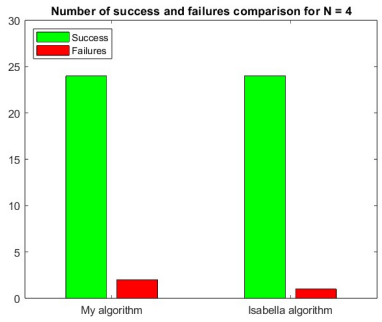


Figure 3: Success and failures for N = 4

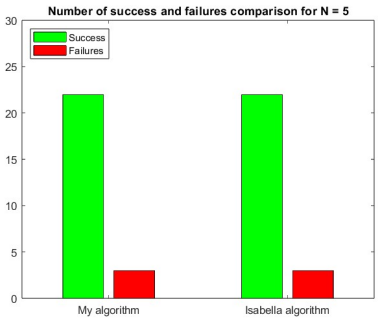


Figure 4: Success and failures for N = 5

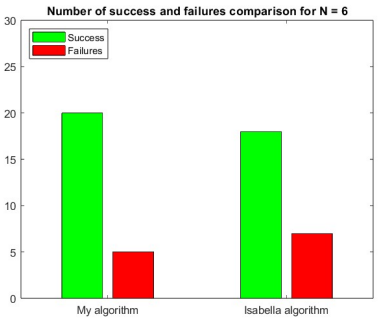


Figure 5: Success and failures for N = 6

Because the number of samples considered is equal to 25, the T-test was considered in order to evaluate the null hypothesis for the two algorithms. But, since this test relies on the fact that the statistical distributions of the collect data are normal, it was first necessary to use the Lilliefors test in order to ensure that the data acquired from the sample belongs to this distribution type.
These tests were carried out by using a dedicated developed script, with all the data collected, that can be found here; this script exploits built-in Matlab functions which they use for both tests a level of significance equal to 5%,
The results obtained from the Lilliefors test show that all the collected samples for each different scenario and algorithm belong to a normal distribution; moreover, the T-test with a single right tail rejected the null hypothesis for all the distinct situations.

# 3 Conclusion

Starting from an inital null hypothesis, the average time required to perform the task and the number of success/failures showed that the two algorithm, even though based on the same requirements and goals, are not equally good.
By further developing the analysis on the collected data with the Lilliefors and T-test, the null hypothesis was rejected and the alternative hypothesis has been verified; my implementation showed to be slower than Isabella's one, whereas it proved to be more efficient in term of success when the number of tokens in the environment is increased.