UNIVERSITÀ DEGLI STUDI DI GENOVA

DIBRIS

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

RESEARCH TRACK 2

First Assignment

Statistical Analysis

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1 Introduction

The aim of this assignment is to prepare a statistical analysis of the first assignment of the research track one. In that assignment, a robot was supposed to gather all the silver tokens next to the golden ones in fixed coordinates. In contrast, for this analysis, the tokens are placed in random coordinates in the environment and the average time to finish this task is measured.

In order to place the tokens in the random coordinates, the arena settings are changed. Then, the experiments are made. The experiments are repeated for 6, 8 and 10 tokens in the environment and the pairing time is measured.

After the experiments, Carmine Miceli's algorithm is used to prove the hypothesis.

2 Hypothesis

It can be assumed that the null hypothesis for both algorithms is because the specifications are the same. For the case of 6 tokens 20 samples are taken, for the next case which is 8 tokens, 25 samples are taken and finally, for the last case which is 10 tokens, 15 samples are taken.

3 Average Time Comparison

As shown below, for the 3-3 tokens case, my algorithm tends to be faster than the other algorithm. However, in the other cases, Carmine's algorithm is faster than mine.

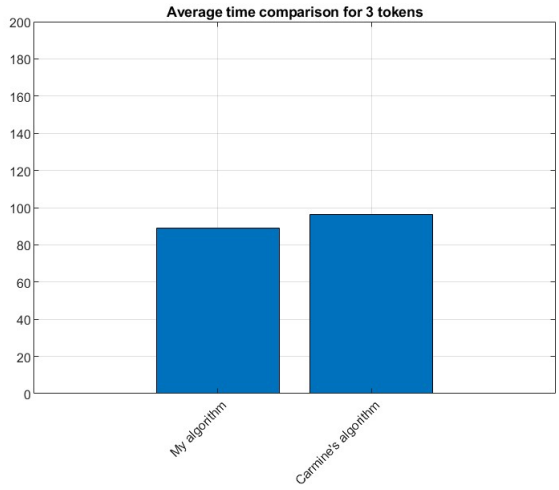

Figure 1: Average time comparison for 3 tokens

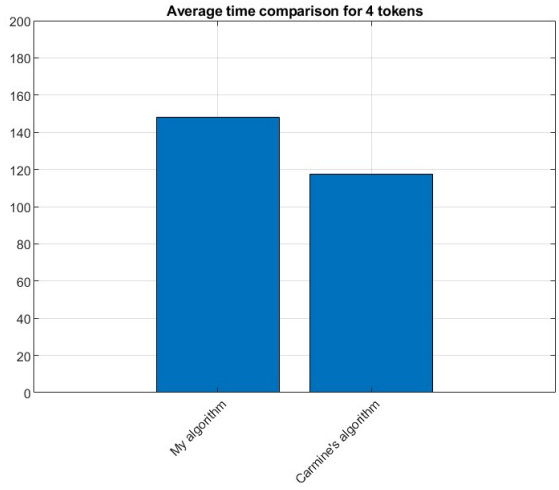

Figure 2: Average time comparison for 4 tokens

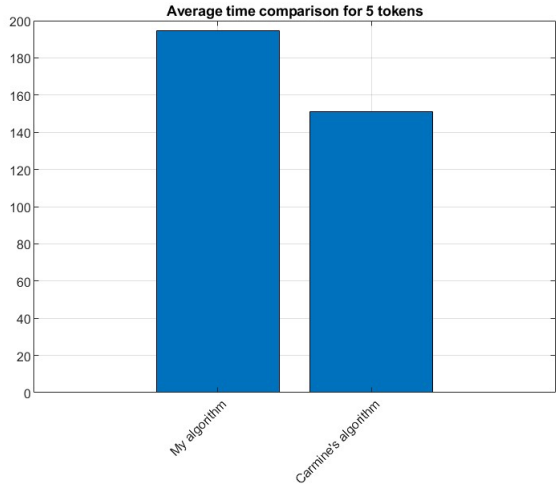

Figure 3: Average time comparison for 5 tokens

4 Lilliefors Test

After executing the code, the variable h will contain the test result as a logical value. If h is equal to 0, it indicates that the null hypothesis (data coming from a normal distribution) cannot be rejected. If h is equal to 1, it suggests that the null hypothesis is rejected, indicating that the data may not follow a normal distribution. The experiment results, the Lilliefors test showed 0 for both algorithms in the 6 tokens case, 1 for both algorithms in the 8 tokens case and for the 10 tokens case gave 0 to my algorithm and gave 1 for Carmine's algorithm.

5 T Test

After executing the code, the first hypothesis gives 0 and the others give 1. So, it can be said that the first hypothesis is accepted but the remaining are rejected.

6 Conclusion

After initially assuming that both algorithms have equal performance, the investigation revealed that the average time taken to complete the task differed between the two algorithms. Despite having the same requirements and objectives, the analysis using the Lilliefors and T-test on the gathered data led to the rejection of the null hypothesis. The findings indicated that my implementation was slower compared to Carmine's algorithm.

7 Resources

Average time required to finish the task:

$$
\begin{aligned}
N_3 &= 20;\\
\text{my\_data\_3} &= [107.1040, 134.6363, 102.6126, 95.1054, 88.0943, 74.0860, 85.0909, 77.0851,\\
&\quad 90.6047, 92.5934, 116.6329, 47.0495, 72.5734, 47.0502, 99.6051, 78.5872, 72.0924, 118.6605];\\
N_4 &= 25;\\
\text{my\_data\_4} &= [127.6521, 185.7463, 124.6469, 139.1680, 87.2107, 119.3019, 197.3688, 98.2056,\\
&\quad 103.6464, 119.6957, 129.8069, 244.5982, 127.8194, 225.4517, 135.2836, 83.1070, 213.4675,\\
&\quad 151.1967, 212.7743, 96.6076, 199.7555, 224.2779, 113.1457, 146.1815, 100.6661];\\
N_5 &= 15;\\
\text{my\_data\_5} &= [129.7089, 95.1508, 114.1729, 119.1870, 227.3328, 279.0438, 189.8008,\\
&\quad 293.4422, 273.9867, 272.5162, 280.4156, 101.6543, 184.8263, 150.2588, 208.2669];\\
\text{his\_data\_3} &= [80.0825, 82.0875, 86.5938, 97.1016, 100.1045, 92.5908, 83.5890, 83.0867,\\
&\quad 127.1449, 112.1215, 74.0771, 79.0796, 88.5979, 70.0730, 68.0709, 95.0969, 140.1573,\\
&\quad 157.6837, 98.1201, 109.1407];\\
\text{his\_data\_4} &= [145.1592, 117.6179, 97.0971, 111.6077, 114.6276, 94.5995, 120.6563,\\
&\quad 88.0909, 105.6062, 116.6269, 119.6196, 114.1115, 104.1187, 119.6291, 105.1177,\\
&\quad 123.1332, 136.1410, 112.1208, 106.1100, 217.7599, 136.6398, 102.1059, 110.1188,\\
&\quad 109.1126, 113.6522];\\
\text{his\_data\_5} &= [113.1526, 131.6461, 212.2374, 167.6803, 154.6635, 134.1367, 149.6664,\\
&\quad 149.6665, 125.1289, 156.1886, 140.1639, 138.1722, 149.6787, 145.1872, 197.7406];
\end{aligned}
$$

Lilliefors:

$$
\begin{aligned}
[h_1, p_1] &= \text{lillietest}(\text{my\_data\_3});\\
[h_{c1}, p_{c1}] &= \text{lillietest}(\text{his\_data\_3});\\
[h_2, p_2] &= \text{lillietest}(\text{my\_data\_4});\\
[h_{c2}, p_{c2}] &= \text{lillietest}(\text{his\_data\_4});\\
[h_3, p_3] &= \text{lillietest}(\text{my\_data\_5});\\
[h_{c3}, p_{c3}] &= \text{lillietest}(\text{his\_data\_5});
\end{aligned}
$$

T Test:

$$
\begin{aligned}
[h_1, p_1, \text{ci1}, \text{stats1}] &= \text{ttest2}(\text{my\_data\_3}, \text{his\_data\_3}, 'Tail', 'right')\\
[h_2, p_2, \text{ci2}, \text{stats2}] &= \text{ttest2}(\text{my\_data\_4}, \text{his\_data\_4}, 'Tail', 'right')\\
[h_3, p_3, \text{ci3}, \text{stats3}] &= \text{ttest2}(\text{my\_data\_5}, \text{his\_data\_5}, 'Tail', 'right')
\end{aligned}
$$