# Research Track II

Statistical Analysis

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Introduction

The Assignment is related to the statistical analysis Assignment 01 of research track 01. In Assignment is to make a robot that moves continuously in an arena to pick up the silver token and avoid from golden token The behavior of robot has to stand by the following rules constantly driving the robot around the arena and cannot touch any wall and move in the counter-clockwise direction, Avoiding the gold tokens, and once the robot will get close enough to a silver token, it should grab it and move it behind itself as shown in the figure
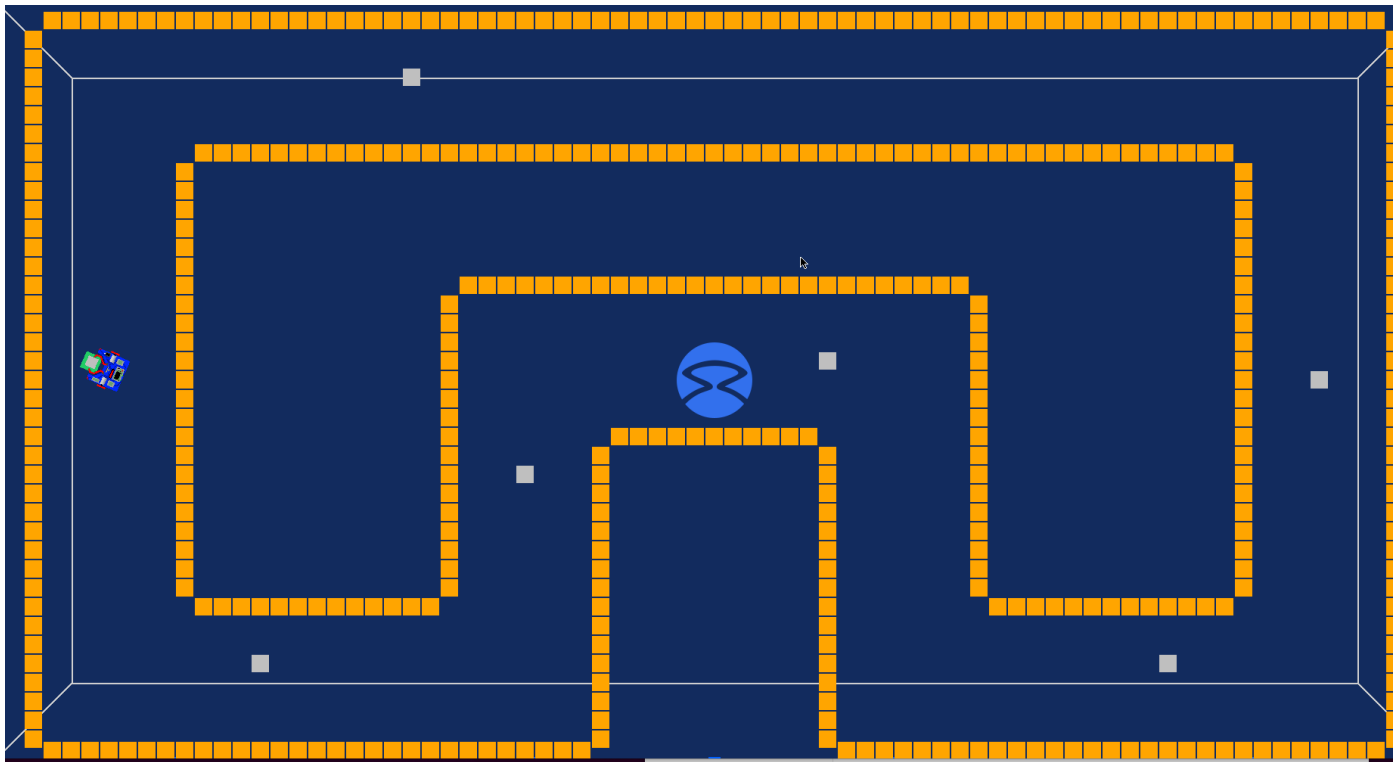
Theory

In statistics analysis consisted in collecting a certain number of data from experiments on the robot behavior and then states which one is better in the specific terms

Our experience

1-Lap time the tome robot used to complete a single lap

2- Distance the effective distance covered by robot during each lap

For this experiment we can use to differentiate one hypothesis from another, it is better to understand which nature of each of them:

Ho - The robot from Algorithm 1 and 2 finish the run in a particular time, so their mean are more or less equal

Ha - The robot from Algorithm 1 and 2 don't finish the run in a particular time, so the mean is not equal.

Usually, The difference of 5% as a level of significance in a hypothesis is acceptable, otherwise, the other hypothesis must be chosen. In this particular task, the null hypothesis is going to be tested first. Since all parameters as level of significance is set and samples from the experiment will be taken, the experiment can be started. Using the timer for both cases, both algorithms are going to be tested one by one. The position for the robot is set initially and the tokens are set by default. Since running both algorithms in the same map is convenient to make assumptions, then paired t-test is chosen. This paired t-test should either accept Ho (null hypothesis) or reject it. The steps for this test is described below:

1. The difference between first and second algorithms, where the formula can be easily calculated:

$d = time\_algo1 - time\_algo2$

2. the mean of this difference: d

3. the standard deviation of this difference: $std(d)$

4. the standard error of the mean difference: $se(d) = d\ samples$

5. T-statistics: $T = dse(d)$

6. T from table based on its sample size and a level of significance

Result

As it can be observed from Figure the sample size of the experiment is 20 and the level of significance is 5%. Based on the mathematical calculations, the T statistics value is lower than the Table value, which provides the acceptance of our hypothesis. In conclusion, the No hypothesis is accepted and the robot more or less satisfies the timing in the same condition.

Sampling	1st Algorithm	2nd Algorithm	Difference	Mean	Std	Std error	T	T_TABLE
1	199	202	3	4.05	9.356682104	2.092217723	1.935745002	2.086
2	195	201	6					
3	210	202	-8					
4	205	201	-4					
5	211	200	-11					
6	199	215	16					
7	185	205	20					
8	193	206	13					
9	199	217	18					
10	204	206	2					
11	226	223	-3					
12	205	218	13					
13	203	209	6					
14	203	205	2					
15	204	204	0					
16	209	197	-12					
17	203	201	-2					
18	204	221	17					
19	209	214	5					
20	201	201	0					

Conclusion

Through this statistical analysis, we can conclude that the teacher's robot performs better in every field than the student's robot.

Thus, the algorithm written by the professor guarantees:
• greater safety against obstacles.
• a shorter time required to complete a complete turn, with any type of map.
• a lower possibility of error.

Analyzing the professor's code, in fact, one can see a greater number of parameters controlling the robot's position and orientation compared to both the gold and silver tokens, thus confirming the results obtained