Modified Buffon's Needle Simulation

Our task was to develop a GUI, using MATLAB's integrated App Designer, to allow a user to simulate variations of the Monte Carlo simulation. Namely, Buffon's Needle where a modified version of Monte Carlo's theory could be used to estimate Pi's value.

This is done by dropping needles, which in our program we will model as plotted lines on a graph, on to planks on a floor and finding where they cross. We can find the intersections between these 'planks' and 'needles' where as aforementioned, the needles are plotted lines and so are the planks.

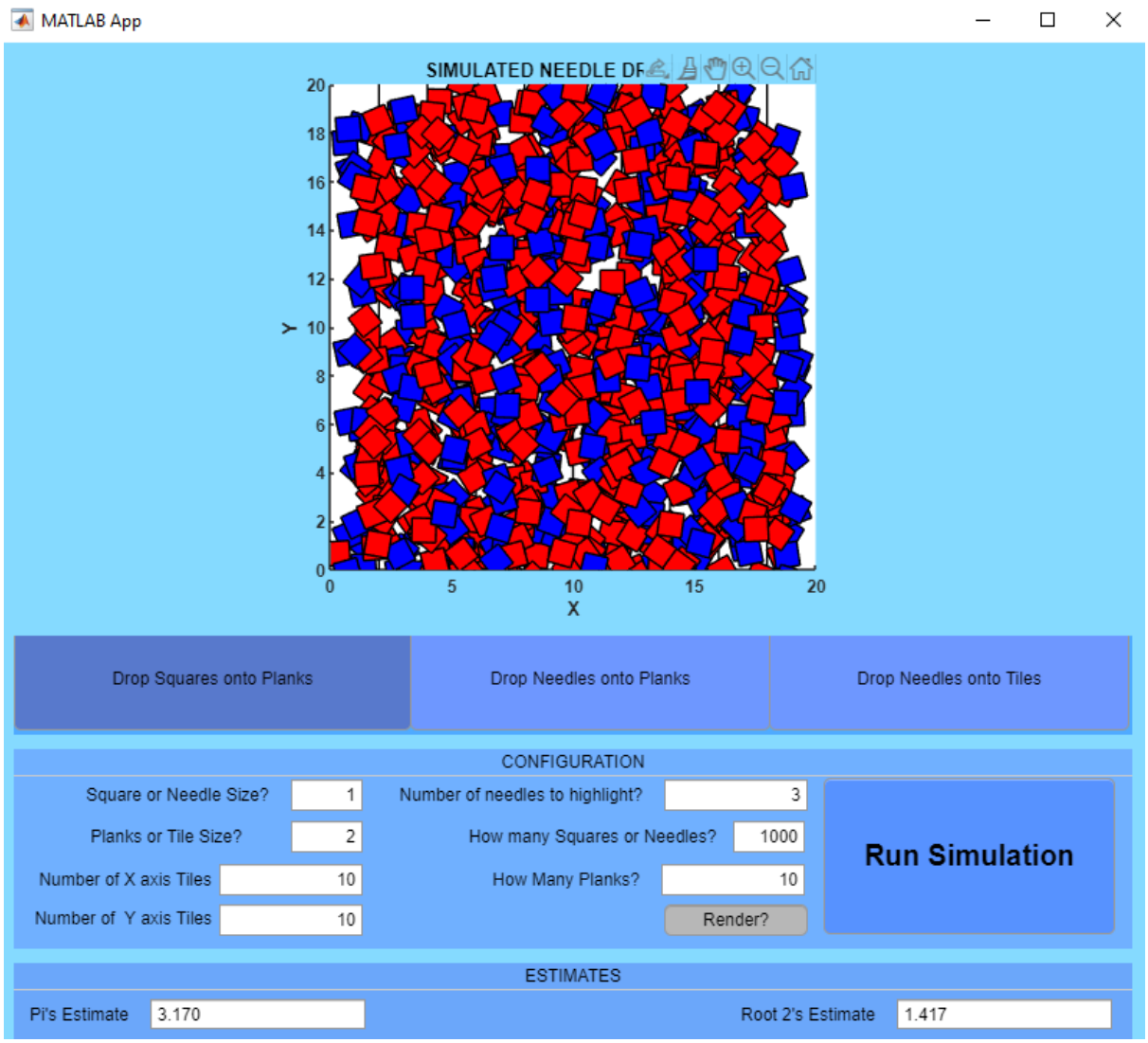
Our task was also extended to allow the user to modify variables such as plank and needle size etc. Furthermore, instead of simply dropping needles as done in Buffon's experiment to estimate pi, we had to drop squares instead and find the intersections with the square instead.

By dropping squares, we can find the square root of 2 using a modified version of the formula. The last requirement of our program was to let the user highlight clicked needles or squares and surrounding needles, trace lines from them and find needles with similar orientations.

Task 1

Simulation to find value of pi using dropped squares, tried three times with 1000 squares each time and using the default needle and plank size.

Most accurate simulation value: 3.170 (0.028 deviation from act. value)



Task 2

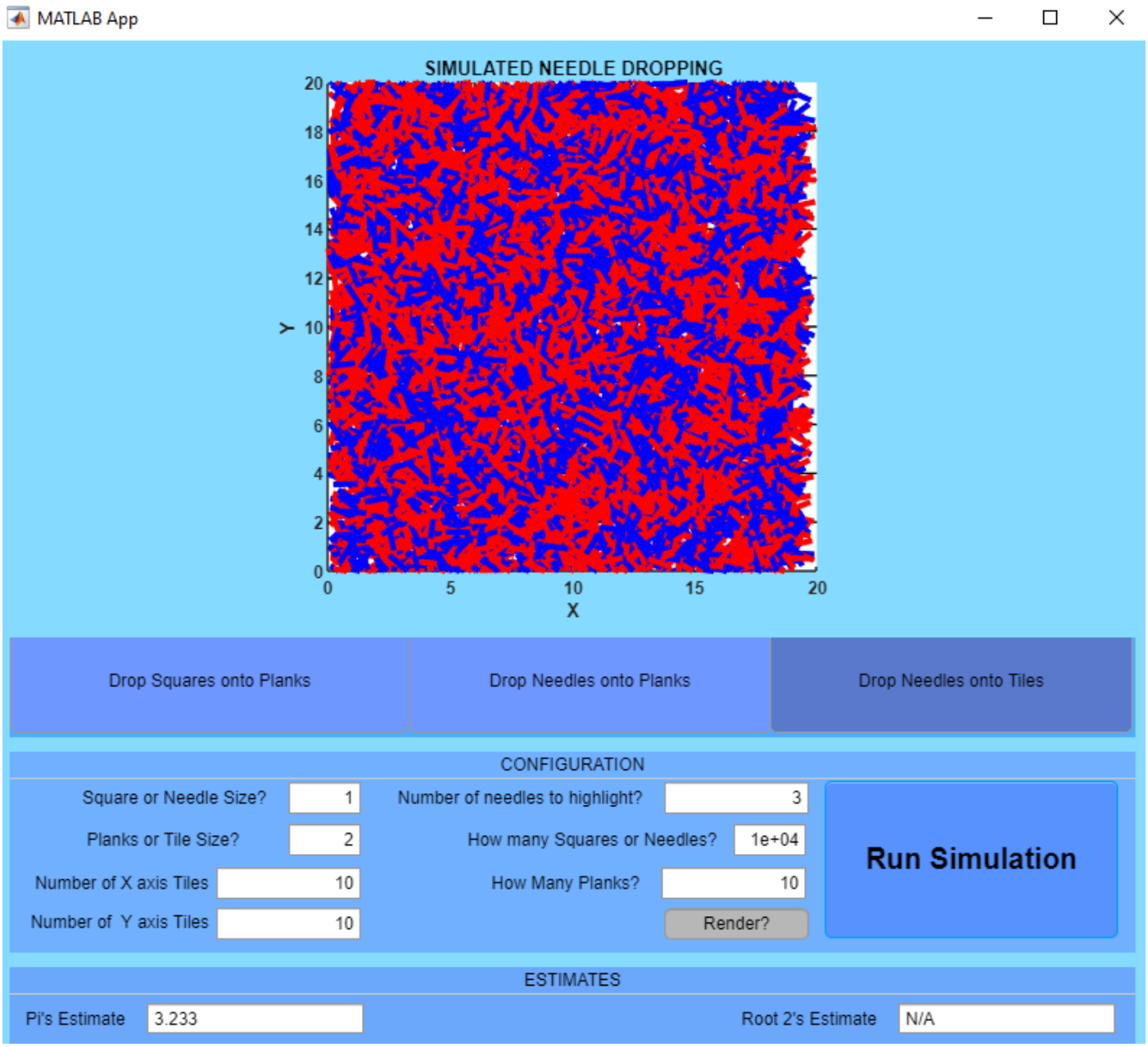
Simulation to find value of root 2 using dropped squares, tried three times with 1000 squares each time and using the default needle and plank size.

[SAME SIMULATION AS TASK 1 WAS MOST ACCURATE]

Most accurate simulation value: 1.417 (0.003 deviation from act. value) note that while it may be out of chance, when the simulation gave the most accurate value for pi, it also gave root 2's most accurate value.

Task 3

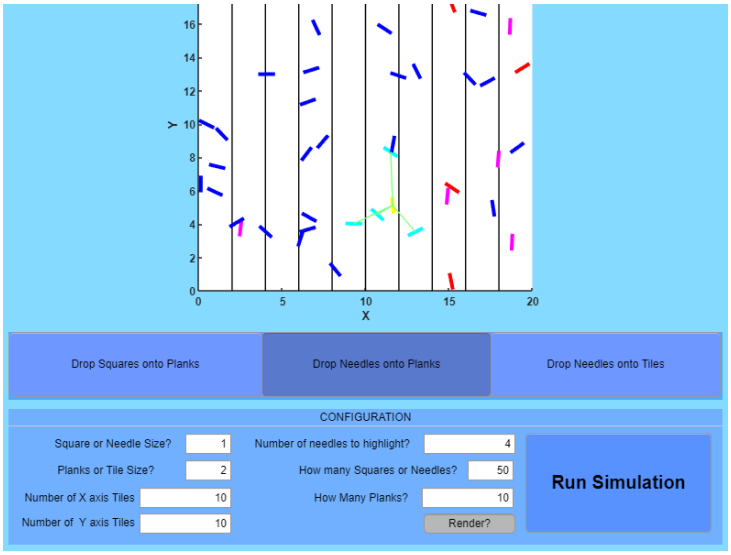
Simulation to find value of pi using dropped needles using on tiles (simulated as a grid), tried once with 10000 needles and default needle and tile size in a 10 x 10 simulated floor.



Most accurate simulation value: 3.233

Task 4

This is less of a simulation but more of a test of the GUI's features. As can be seen below 4 of the closest needles, as specified in the configuration, are indeed highlighted in cyan. Furthermore, needles highlighted in purple represent the needles most similar in orientation to the original one highlighted in yellow. Note that this initial highlighting of the clicked needle also works for squares which could be considered one of the novel extensions for Task 5.



Task 5

As part of our GUI we were told to add our own extensions to the task. The most prevalent one I used was the render button which allows the user to choose whether the graph is plotted. This saves on processing time, making larger simulations with more needles/planks/tiles etc. possible without waiting for huge amounts of time.

Secondly, the user can decide on the format of the tiled floor e.g. 10 x 100, make other amendments to the simulation in the configuration allowing for a much larger variety of potential simulations.