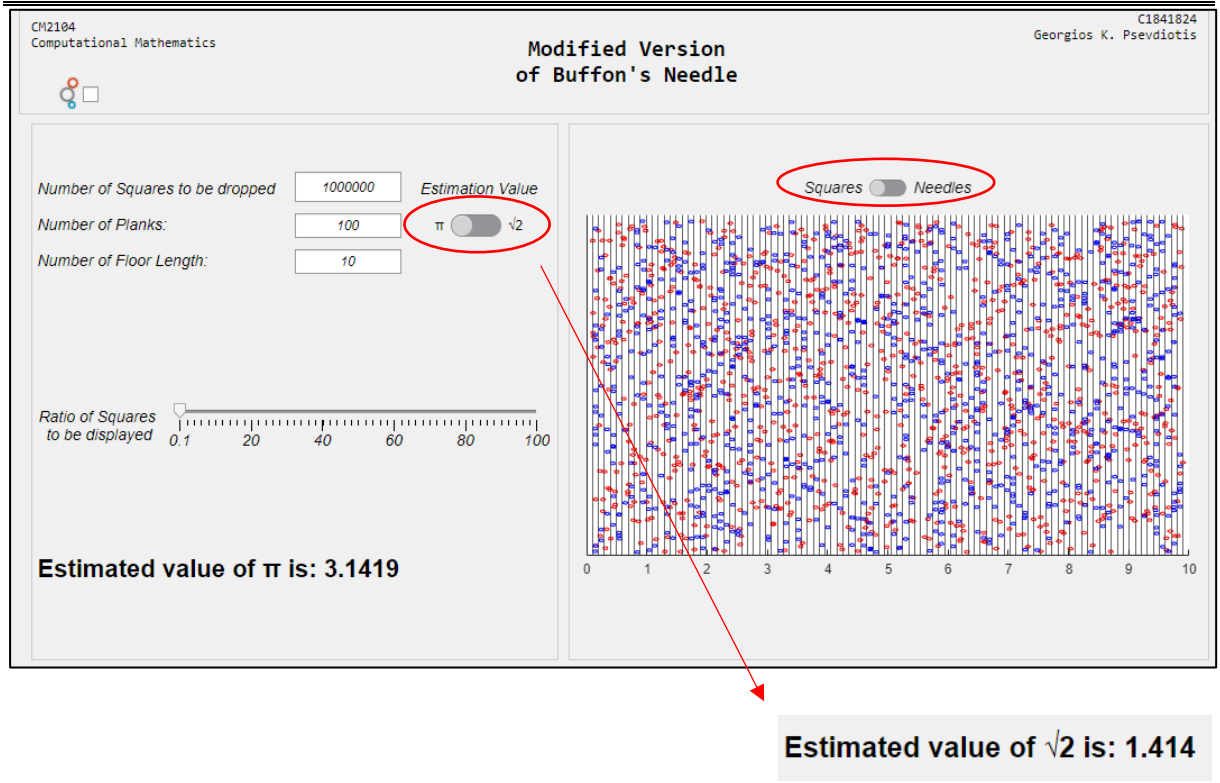
CM2104 – Computational Mathematics
Coursework 1 – Buffon's Needle – C1841824

The MATLAB tool created, creates a Monte Carlo simulation of a Modified Version of Buffon's needle experiment. The modification allows the user to drop squares or needles on a floorboard made of parallel wooden planks or square tiles respectively. Furthermore, it provides estimation values of π and √2 and it allows interactivity to compare needles with most similar orientation. Finally, it supports additional features such as Advanced GUI layout (eg. Auto Updating switches / sliders), allows a mixture of different sized needles and the elements displayed are customizable.

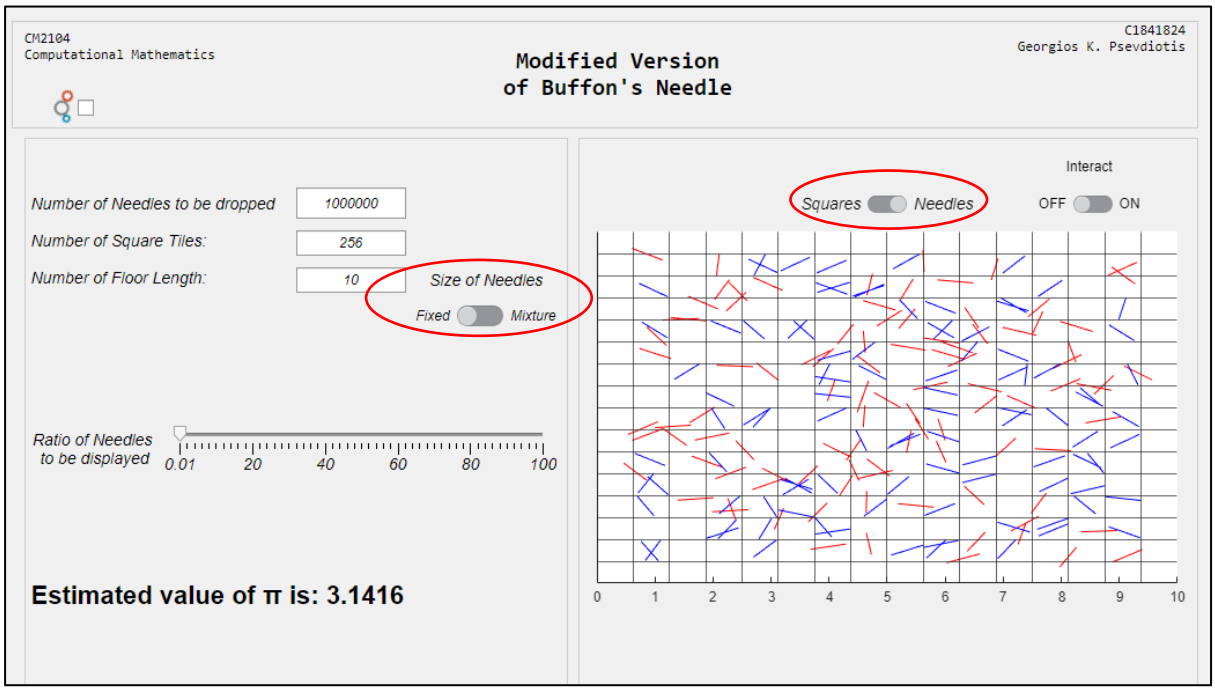
TASK 1 & TASK 2



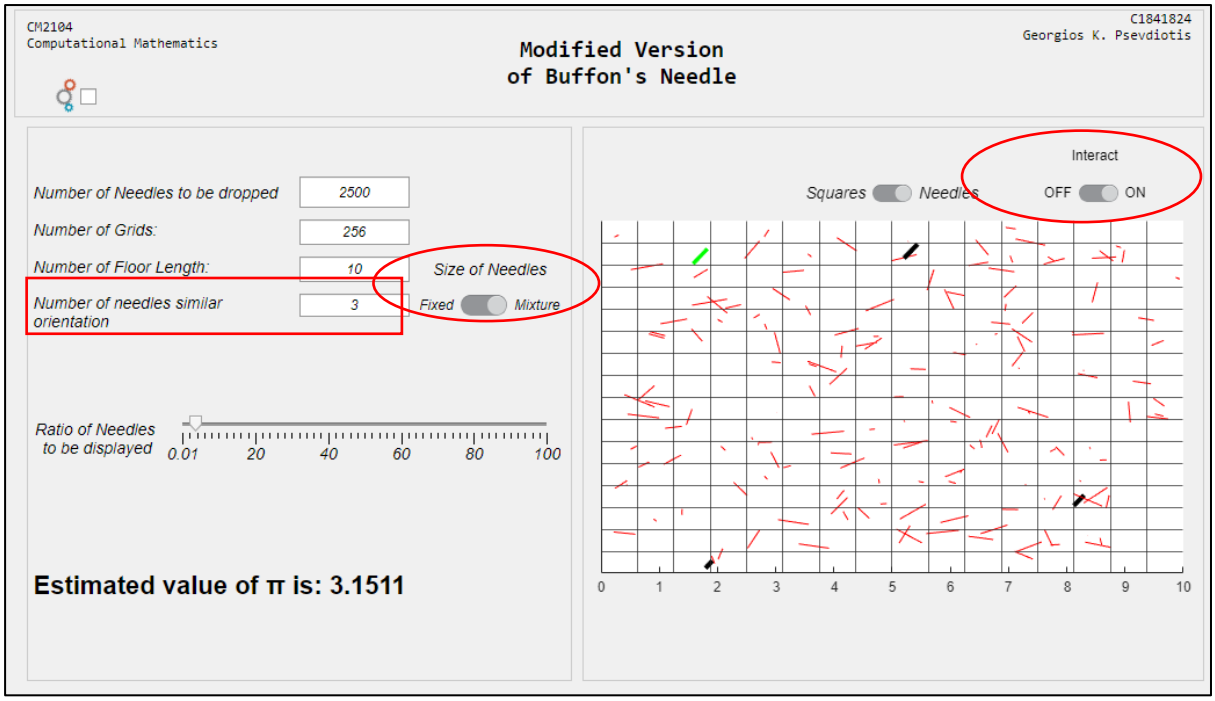
Estimated value of √2 is: 1.414

In the 1st and 2nd task, the user can create a simulation dropping 1 million squares to estimate π and √2. The squares are randomly rotated and translated to fall on the floor and it checks which squares intersect with the planks. The squares that intersect with the planks are coloured red and the rest are blue. Then they are counted and the value of π or √2 are estimated using mathematical formulae. The user has the option to adjust the number of squares to be dropped, number of planks and the floor length using 3 edit text fields. Moreover, a slider is provided to adjust the ratio of the squares to be displayed in the UIAxes so that the user gets a better quality image displayed but still estimating by the number of squares dropped of his selection.

Task 3 & 4

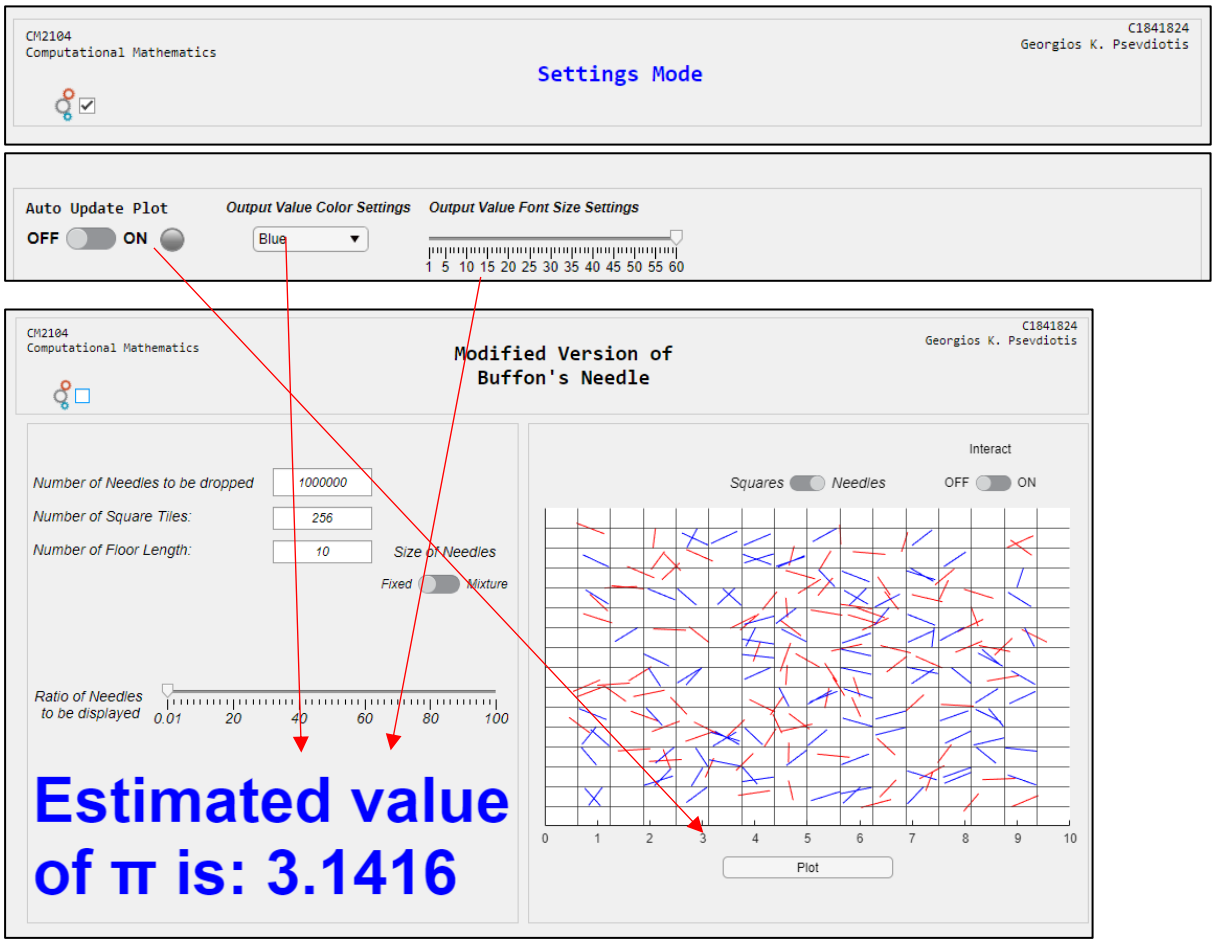


In the 3rd task the user is able to select to drop Needles instead of Squares and create a simulation of the Buffon's Needle experiment, but the needles are thrown on square tiles. The needles that intersect with the planks are counted and coloured differently. The user interface is the same except of 2 new switches. The Size of Needles switch allows the user to keep the needle's length fixed or a random mixture. The other switch allows the user to interact with the displayed simulation and select needles.



If the user wants to interact with the simulation, another option is given to enter the number of needles with similar orientation he wants to see. Then if the user selects a needle, an n number of needles will be highlighted in a different colour to indicate that they have a very similar slope as the needle selected.

Task 5 – Additional features



Additional features were added to the program and were placed under the settings mode which can be accessed by clicking the Settings CheckBox on the top left corner. The features are that the user can select if he wants the program to update on itself on every value / slider changed or a switch turned. If he chooses not to, a button is introduced that allows manual functionality. Moreover, the output value can be changed by a dropdown to various colours while the font size can be compromised by another slider. Lastly, when the program starts, the pre-generated squares / needles are displayed along with the estimated value of π.

Programming the algorithm

To program the algorithm for this coursework, I have used quite a few for loops and if statements and within those statements matrix and arrays were included along with indexing and operations for those. Additionally, I have used different MATLAB functions such as patch, find, length, unique to achieve the results above. Finally, mathematical formula's where used to calculate the probability and provide as accurate as possible estimations for π and √2.