Billiard Project

Software Development

Emma Santinelli, Selena Iskounen, Oumayma Khalifi

Master MIND

May 17, 2020

Abstract

The goal of this project is to be able to produce videos and widgets representing a point/ball in a billiard with a simple shape and showing its trajectory.

The github repository is available here :

https://github.com/emmas2210/Billiard

Table of Contents

Table of Contents

Square Case

Let us start we the simplest case : The square billiard

Remark

In this example, we assume that there is no friction and the Descartes rules are satisfied

Parameters set

- Size of the square
- Ball radius
- An empty word called "collision"
- Ball speed (random)
- Start angle (random)

Steps

- Creation of the window using tkinter
- Creation of the buttons of the window
- Creation of the ball Canvas widget
- Definition of the movement function

The animations

We have chosen to create two different animations:

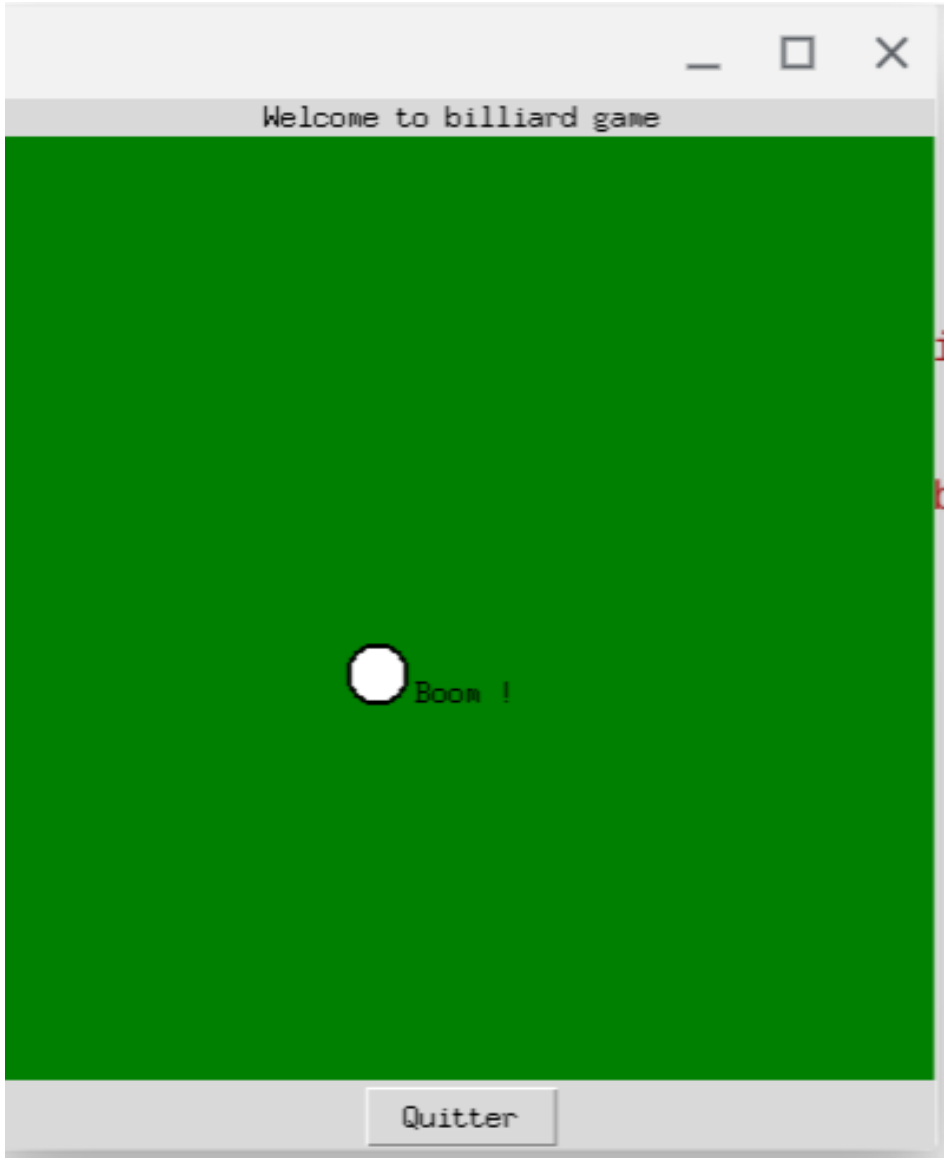
1. A Canvas Widget where we can interact we the ball with a Python class
2. An animation where we use words to analyse the trajectories

Canvas Widget

We can interact we the ball using the computer mouse :

- left click: grow the ball
- right click: shrink the ball
- clicking on the computer mouse wheel: change the ball's speed and its trajectory.
- "esc" button : leave the animation

Results of the Canvas Widget



Billiard's animation with words

We start with an empty word. Then, when the ball hit the top or bottom part we add an H (H for horizontal) and when the ball hit the left or right part, we add a V (V for vertical). Then, we perform a statistical analysis of the words creating depending on the angle use to start the trajectory (we restrict to words of size ¡2000).

Results of Billiard's animation with words

Word obtained : HVHHHVHHHVHHVHHHVHH

Table of Contents

Torus Case

In this part, we will deal with two different cases:

1. Flat Torus Billiard
2. 3D Torus Billiard

The goal of this two animations is to see the displacement of a ball into those different billiards.

Flat Torus Case

In mathematics, a flat torus is known as "square" flat torus, that is why we represent the flat torus by a square.

In this case, we will create a widget using tkinter. The ball moves in the following way: the ball enters on one side of the window and exits on the opposite side.

The different parameters taken into account in the creation of this widget are:

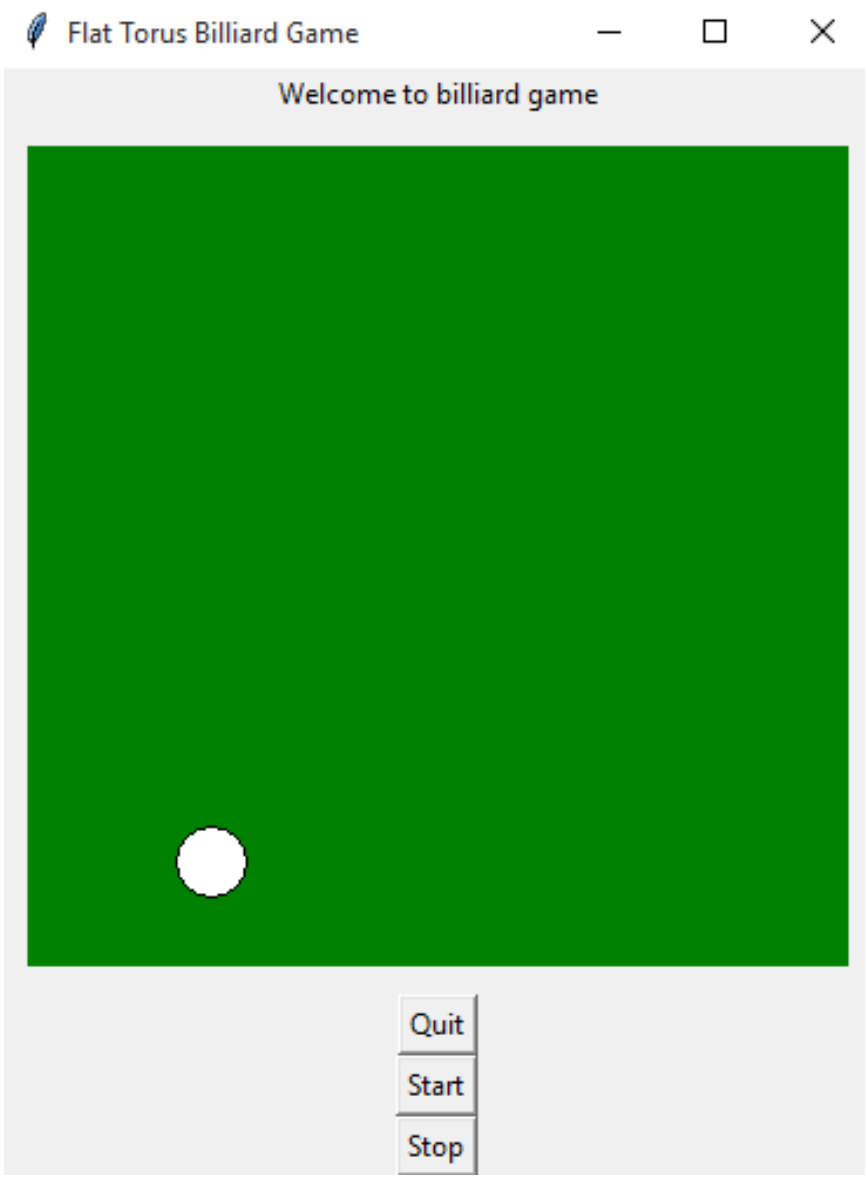
- The initial position of the ball.
- The radius of the ball.
- The random directions made by the ball.

Canvas Widget

Functionality of the buttons on the window:

- Button start: change the speed of the ball and also its direction after pressing on 'stop'.
- Button stop: stop moving the ball.
- Button quit: leave the animation.

Results of the Widget



3D Torus Case

In this case, we use mayavi to create the widget that allows us to see the ball moves.

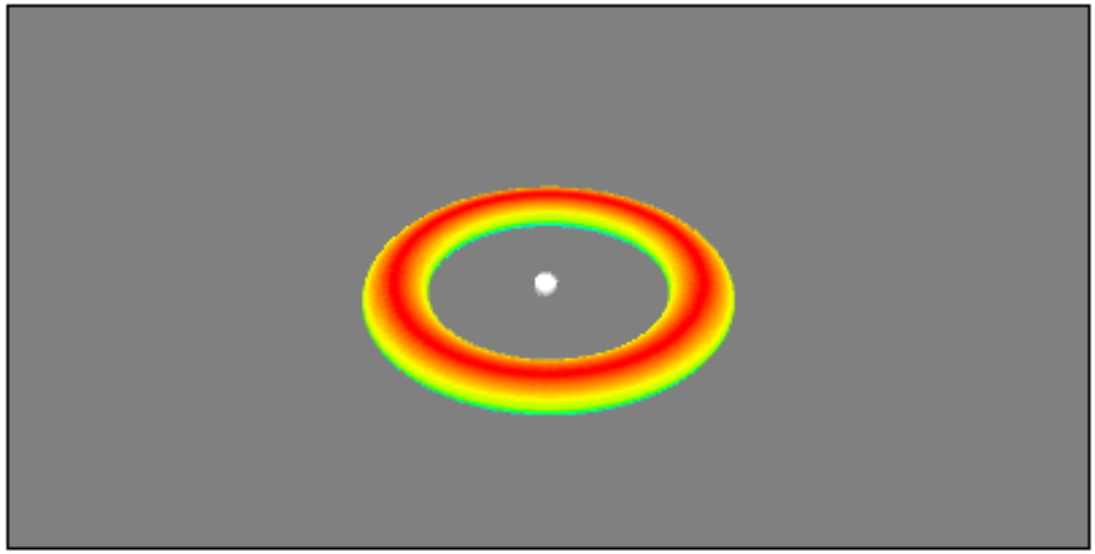
The goal here is to see the movement of the ball in the volume delimited by the 3d torus as well as the bounces of the ball on the surface of the torus.

Steps followed

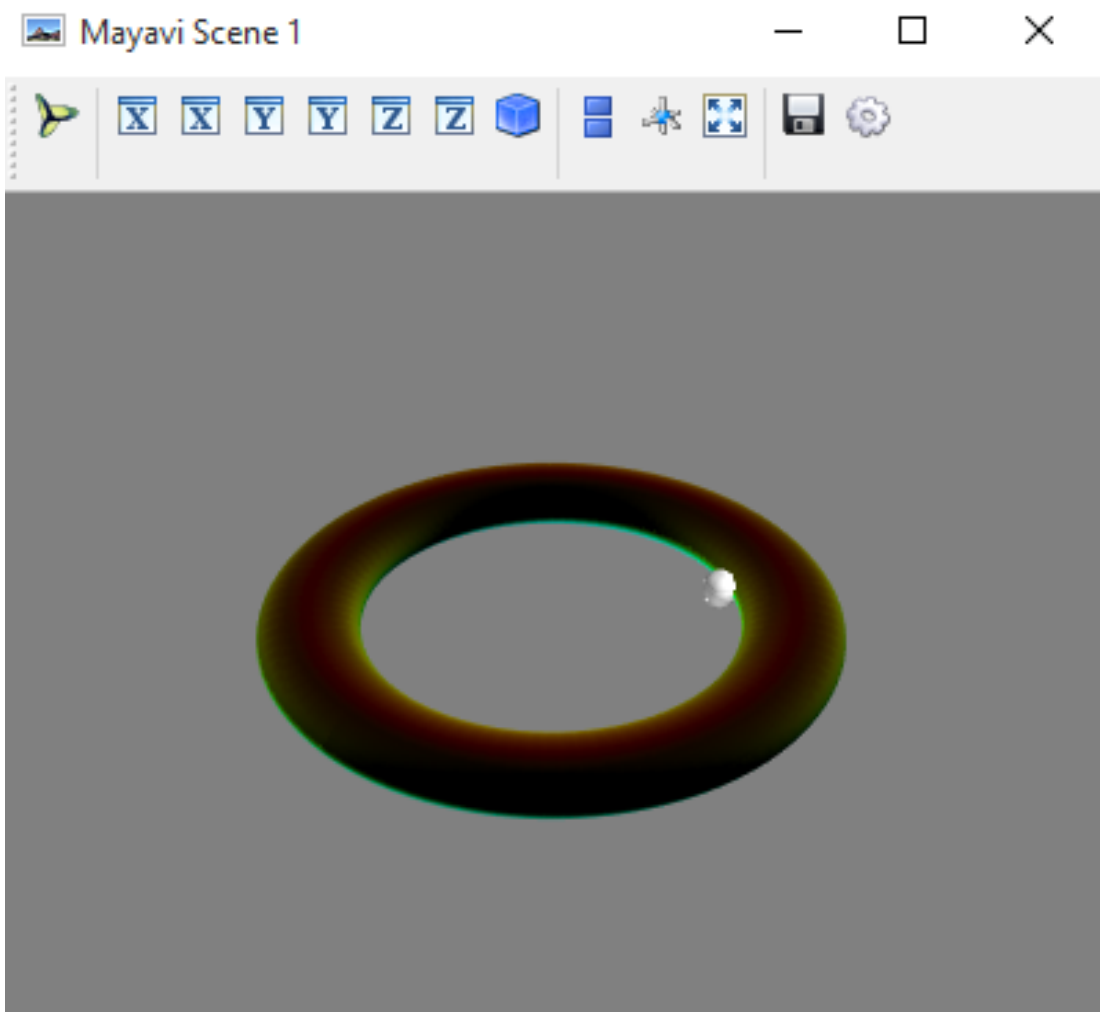
In order to reach our goal we will follow these steps:

- Create a 3d torus with a ball in this center.
- Create a function called 'anim' to move the ball and rebound it.

Results of first step



Results of the widget



Conclusion

Through this project, we've learned how to use :

- Python scientific libraries (Matplotlib,Tkinter),
- (Unitary) tests,
- Documentation generation,
- Git and Bash.

If you are interested in learning more about our project, look at this page for further information :

https://github.com/emmas2210/Billiard/blob/master/report/Billiard_Report.ipynb