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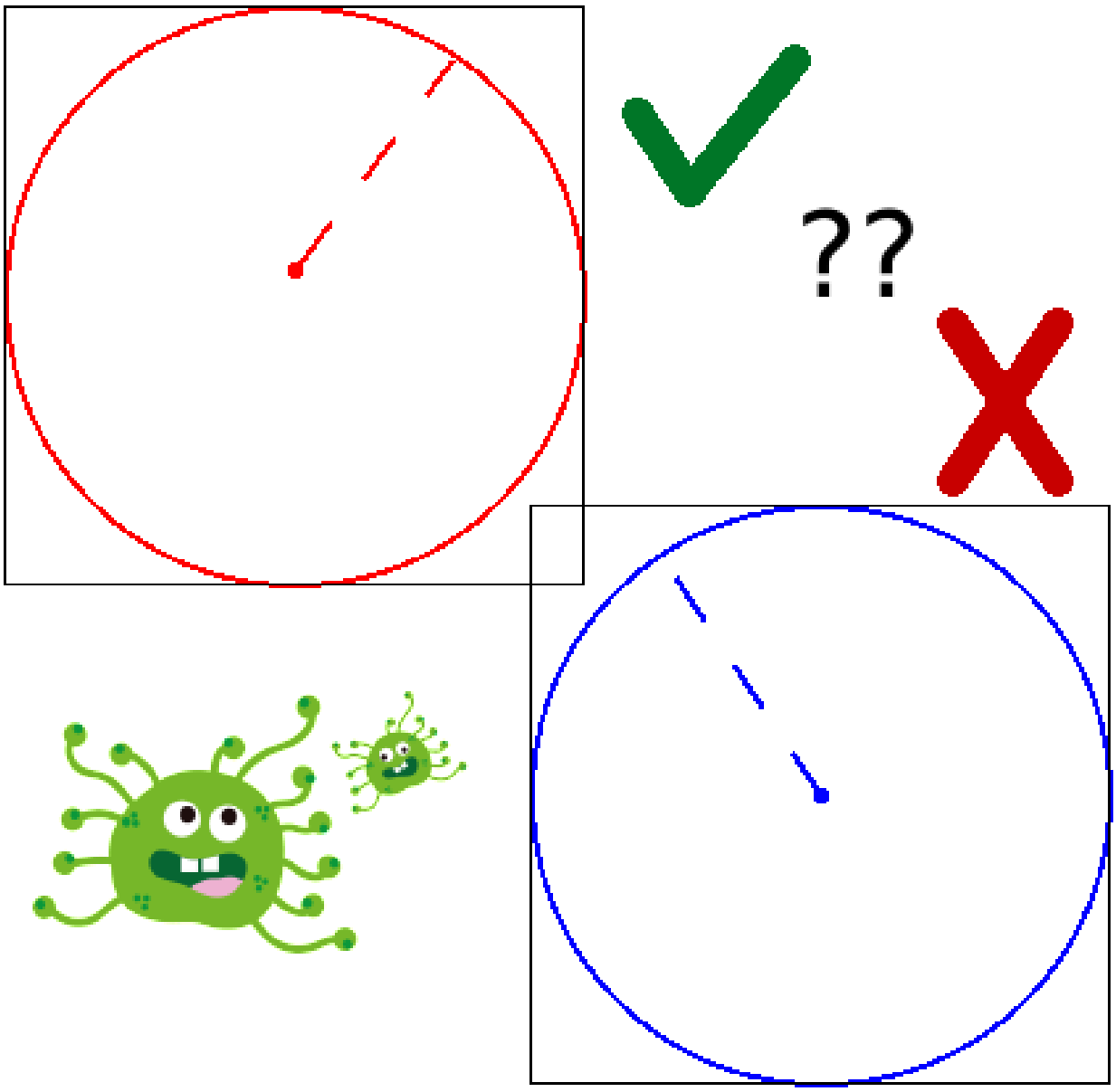
SAÉ 1.02 - Comparaison d'approches algorithmiques

For every step a file is linked to it, so if you wanna see a change on the code check the file to see the code.

Algorithmic optimisation for a covid diffusion simulation.



!!! Every underlined and Italic word is a reference to the code. !!!

Step 1: Display optimisation (check the step1 file)

In this step we were demanded to optimise the way that he the algorithms displays the simulation.

The problem is that the refreshment of the images is made after every single movement of a ball/person. Wich makes the whole simulation laggy and jerky. Not optimised!

By changing the time when the algorithm refreshes. We have fewer refreshments but more unity on the movement, coming from the refreshment of the movement only when the whole balls moves.

Changes:

The changes that we have made are on the Pandemic.py file. We simply decremented the draw. On the *Main*.

We putted the draw on the *line 93* of the main. After all the movements are processed.

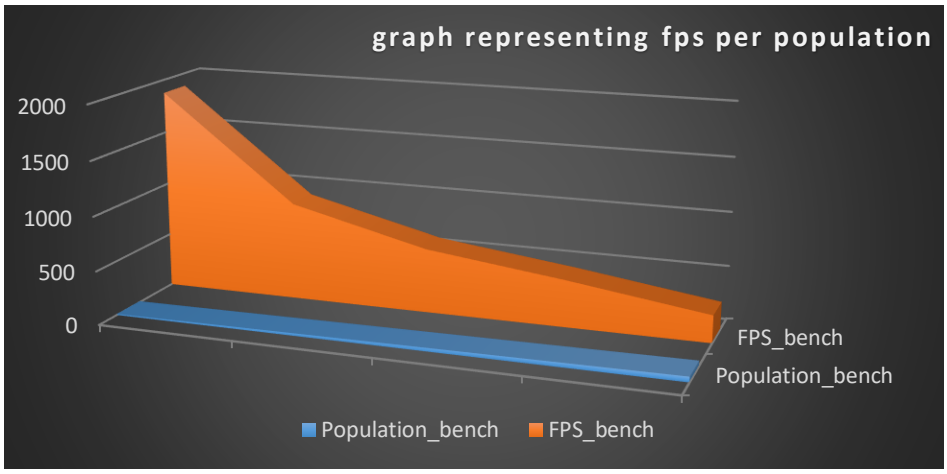
We did the same thing on the *FrameNumber*, so that the frames are more realistic.

Results:

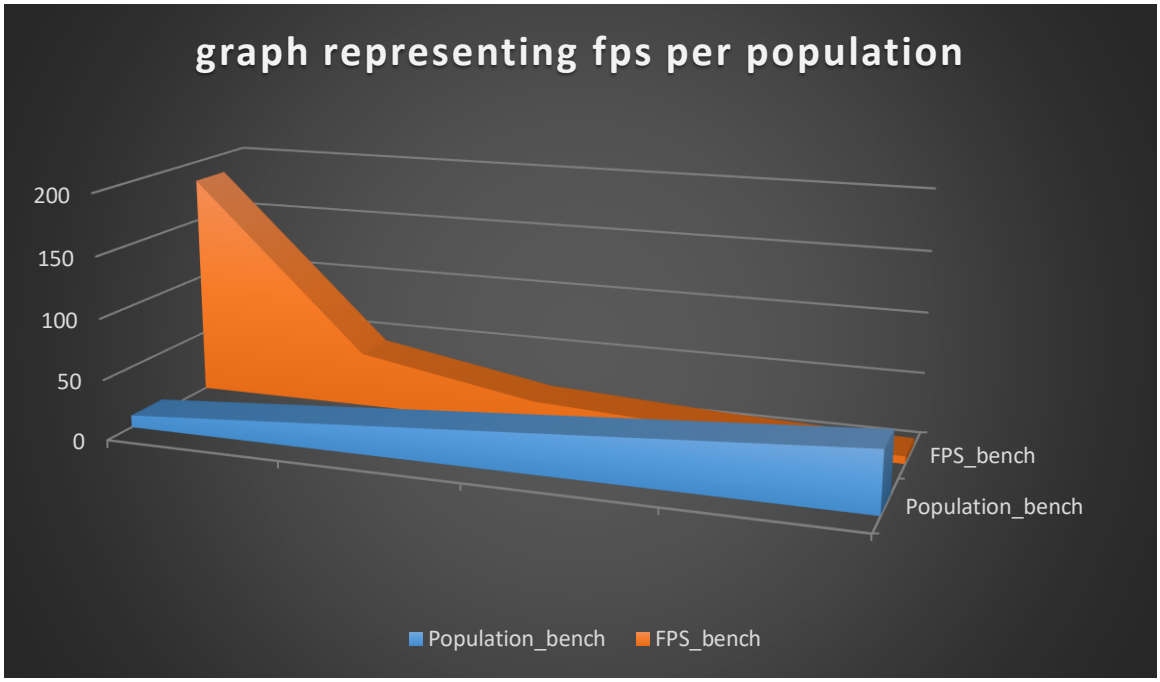
After the changes, we have had as results decreasing of the fps, which was predictable because we do not refresh, as oftener, in the other hand it is more realistic.

Graphics:

Before:



After:



As we can observe on the first graphic the fps were abnormally high. After the changes the fps are more coherent. However, they are low and we cannot have a high number of people in the population, this problem leads us to the second step.

STEP 2 : Mathematic optimisation (check the step2 file)

One of the problems of this algorithm is that it calculates the intersection on two persons but it does it X times depending on the number of people. In addition, this is supposed to be a simulation of Covid spreading so the number of people must be consequent. With the calculations of the intersections, it can rapidly be tricky. The current calculations are too heavy. We need to make them simpler.

Changes:

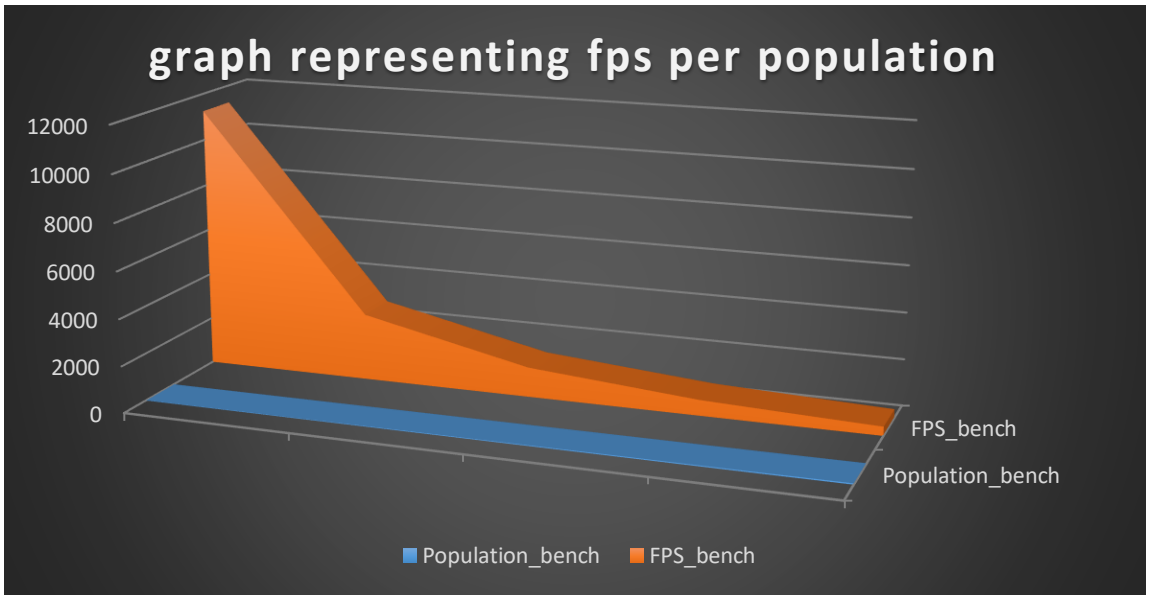
We eliminated the square root by squaring the radius. This helped the program to take less time on making the calculations.

$$AB=\sqrt{(x_B-x_A)^2+(y_B-y_A)^2}$$

Code:

```
def circleCollision(c1, c2):
    '''
    Determines if two circles intersect or not
    '''
    # We pick a point on the first circle
    d = ( (c2[0]-c1[0])**2) + ((c2[1]-c1[1])**2) #this is the
    # We then move to another point close to the previous one, until we loop a
      around c1
    # If this length is less than the radius of c2, then this point is inside
      the circle
    if d < ((constants.PERSON_RADIUS**2)*2):
        return True
    else:
        return False
    # No collision detected : c1 and c2 do not intersection
```

Graphics:



We perceive a great increase of the fps but a grand decrease on the increasing of the population.

Step3: optimization by approximation(check the step3 file)

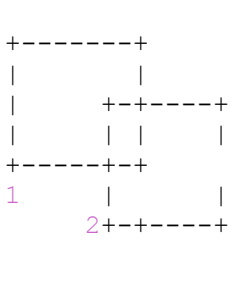
We can now to optimize even more conciderarte the persons hitbox as a square.

That helps a lot, because the intersection of two squares that does not rotate is a lot easier to calculate.

Changes:

From our researches, we've found out this rule.

For 2 given squares or rectangles.



maxleft=max(x1,x2)

minright=min(x1+width1,x2+with2)

maxdown=max(y1,y2)

minup=min(y1+height1,y2+height2)

There is an intersection if :

maxleft<minright and maxup<minup

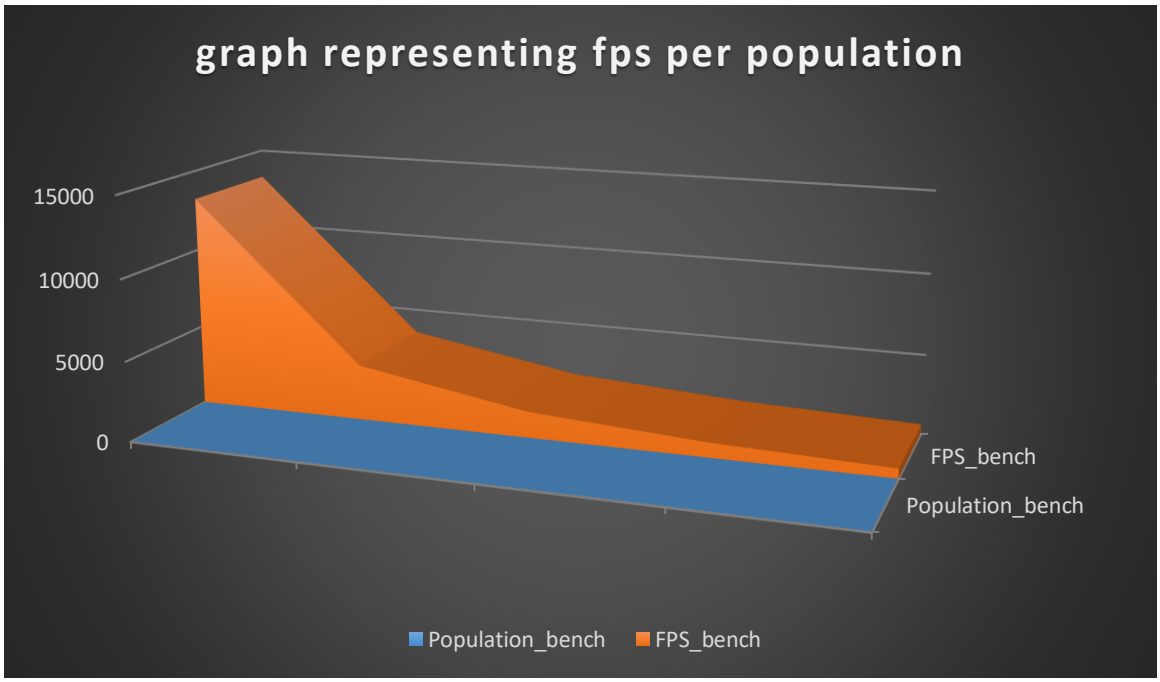
This rule in python and with our variables gives on the Function *circlecollision*:

```
    if max(c1[0], c2[0]) < min(c1[0]+(constants.PERSON_RADIUS*2),
c2[0]+(constants.PERSON_RADIUS*2)) and max(c1[1], c2[1]) <
min(c1[1]+(constants.PERSON_RADIUS*2),c2[1]+(constants.PERSON_RADIUS*2)):
        return True
    else:
        return False
```

Results:

We found out that the fps on the bench.py have increased again. Caused by the simplicity of the calculations.

Graphic:



As we can see here the fps are a lot better even if the population increases a lot. This is already a lot better.

Nevertheless, we can do better.

STEP 4: algorithmic logic optimization(check the step4 file)

We did a good job on optimizing the algorithm. However, we still check for collision between all the circles/persons. We are simply going to verify if the circle/person is infected before validating a collision.

Changes:

We simply added the verification in the function computecollisions, knowing that p and q are persons and that p[2] and q[2] refers to the state [HEALTHY = 0 ; INFECTED = 1 ; IMMUNE = 2].

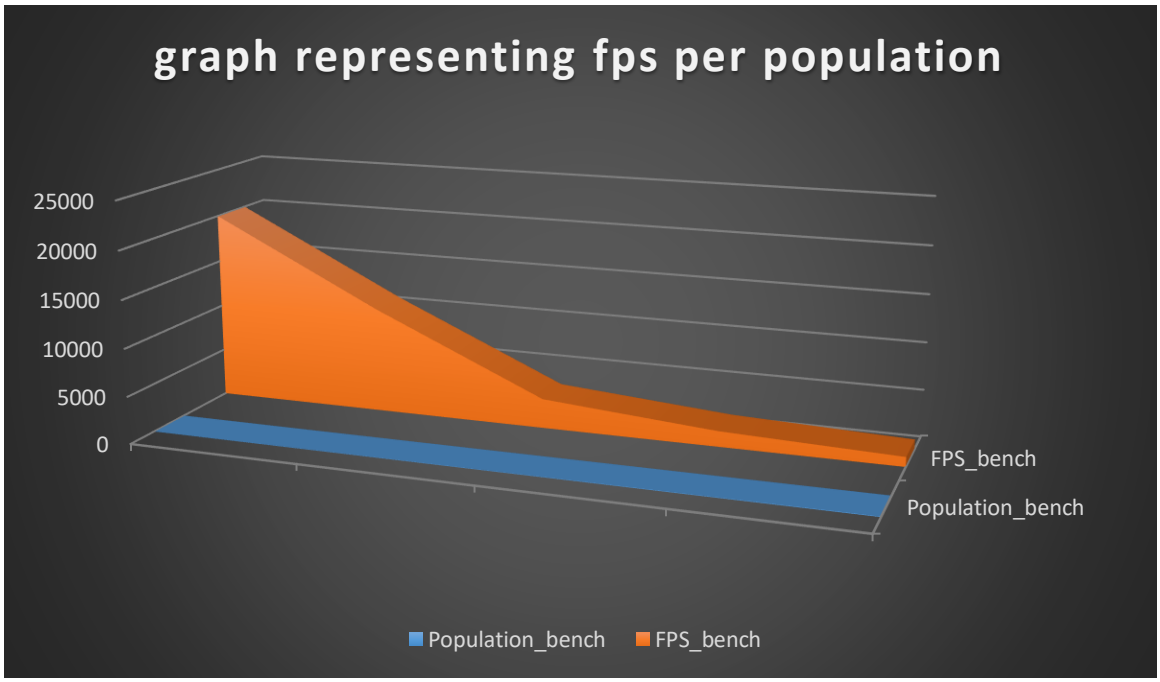
Code:

```
            if p[2]==1 or q[2]==1:
```

Results:

We can see now that the fps are a lot better even if the population is at high rate.

Graphic:



Conclusion:

This program was a good start for the simulation. However, after analysing it, we quickly realise that there is multiple optimisations possible to put on it. By the help of the SAE document, we were able to find were some optimisations are possible, and we did them. The program is now a lot more efficient. However, there is more possible optimisations, with more time and more pygame studying by our own we would probably would be able to optimise a lot more this simulation. To run it smooth and to have many options. Like changing the fps, adding people without leaving the program, contaminating someone with the mouse, etc. Thank you for reading us.

The Sources :

- https://www.developpez.net/forums/d776649/general-developpement/algorithme-mathematiques/algorithmes-structures-donnees/detecter-l-intersection-entre-rectangles/
- https://www.it-swarm-fr.com/fr/algorithm/intersection-de-deux-rectangles/1070665969/
- https://les-mathematiques.net/vanilla/index.php?p=discussion/comment/1453278#Comment_1453278
- https://stackoverflow.com/questions/25068538/intersection-and-difference-of-two-rectangles
- https://stackoverflow.com/questions/25068538/intersection-and-difference-of-two-rectangles
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Thanks for Reading!