SOC: Space Optimization for COVID-19

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1   Introduction

Given the contagious nature of the Covid-19 virus, it is important to isolate those who tested positive for the virus to minimize further spread of the virus. However, space is a luxury in this country. Hence it is a necessity to optimally house and isolate the patients.

Covid-19 is an unprecedented event and there are many facilities in various countries that are incredibly unprepared to tackle such a pandemic. We hope that this program can help isolation wards better plan their spaces and allow for greater allocation of patients. The program is available at `https://github.com/charutomo/SOC`.

Keywords: [**optimally**], [**isolate**], [**isolation wards**]

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2   Deliverables

A model that can optimally split a given space into as many subsections as possible in order to adequately isolate patients. It should maximise the given space and sustain the functionality of each ward, while also allowing for as many wards as possible.

The product is a model of a Top Down 2D paradigm drawn using the PyGame library. The program would output a diagram that splits into small sections of any 2D shape and considers optimizing the most effective space without a tradeoff of the operations of the original generic ward.

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3 Features

3.1 Frontend

Attach diagram here

3.2 Backend

3.3 UI/UX

3.4 Others

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4 Behind the math

4.1 Voronoi Diagram

4.2 Fortune Algorithm

Fortune's algorithm is used to generate a Voronoi diagram. It is a sweep line algorithm and has a time complexity of $O(nlogn)$.

4.2.1 Data Structures

We decided to implement a integrated binary search tree and priority queue to reduce the runtime of the algorithm

4.2.2 Classes

- Points:
Circumcircle

- Sweep Line:
A horizontal line that will travel across the plane either horizontally or vertically.

-Beach Line:
A piecewise defined function made up of multiple parabolas. It follows the sweep line. The breakpoints of the beach line lie on Voronoi edges of the final diagram. We shall define the beach line to be a mutable list of points, sorted from left to right. (Parabola – from Wolfram MathWorld, no date)

- Parabola:
A parabola is the set of all points in the plane equidistant from a given line L, the conic section directrix, and a given point F, the focus, not on the line. (Parabola – from Wolfram MathWorld, no date)

- Events:
There are two main events that the program will have to handle.

The first event will be called a Point Event. This happens when the sweep line passes through a point. When this happens, a new parabola will be created and it will be added to the beach line. To accommodate a new parabola, the nearest parabola to the point will be split into two.

Suppose B is the set containing the parabolas making up the beach line.
Suppose parabola J is the closest parabola to the point.
Then we split J into $J1$ and $J2$, s.t. $B = \{\dots J, \dots\} \implies \{\dots J1, J2, \dots\}$.
Then we add a new parabola Q into the beach line. $\{\dots J1, J2, \dots\} \implies \{\dots J1, Q, J2, \dots\}$.

The second event will be called a Vertex Event. This happens when the length of a parabola becomes 0. The parabola will be deleted and a new vertex will be created at that location. This vertex will be used for drawing the edges of the Voronoi diagram.

4.3   Program Characteristics

Discuss on later date

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5   Conclusions

Overall, it is an enriching experience for us to discover and learn more about optimization. Using the COVID-19 situation by maximising the resources of community and minimising space constraints using optimization. We hope that our program will be useful for better allocation of spaces in the pandemic.

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6   Definition/Indexes

Model - Top Down 2D drawn using the PyGame library.

SOC - Space Optimisation for COVID-19

s.t. - Such that

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7 References

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8 Appendix/Figures