BEES COLLAPSE

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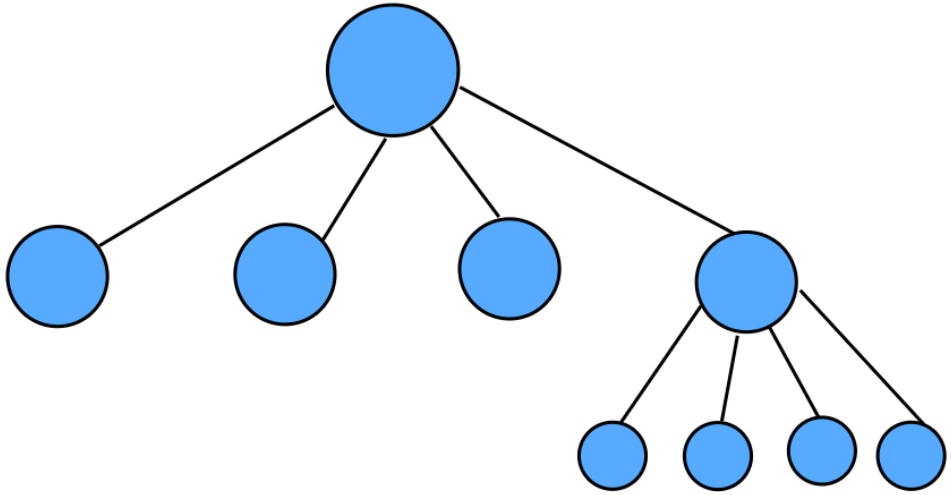
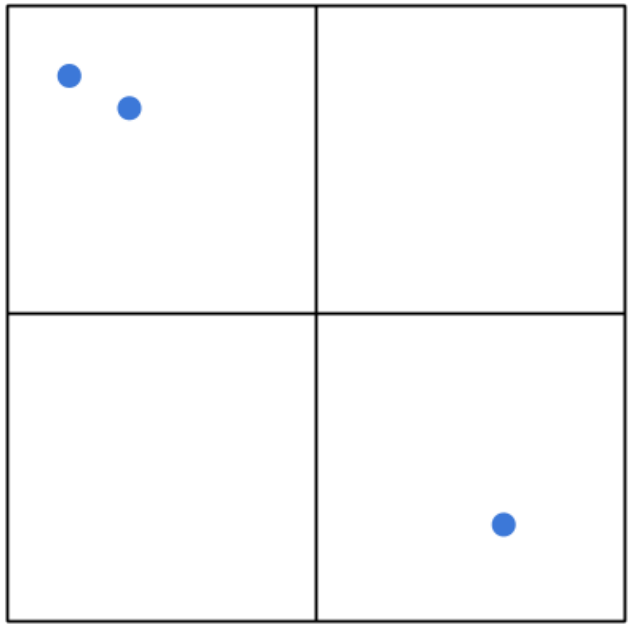
Designed data structure

Quadtrees are a type of data structure in which each node has four child nodes in turn. This can be used to separate our scenario into four equal areas recursively, let's see the Quadtree the next way.





Data structure complexity analisys

Tabla de complejidad	
Insert	O(n)
Calculo Colisiones	$O(n^2)$
AgregarNodo(abeja)	O(n)
Imprimir Txt	O(n)

Table 1: Complexity of the data structure used.

Criteria of Design of the Data Structure

- Choosing the QuadTree allows several things, such as :
- An efficient detection of collision between objects in a 2d field
- This, compared to other data structures has a better organization of the space of objects, this thanks to its constant division of quadrants
- The QuadTree algorithm is responsible for recursively decomposing the space.

Time and memory consumption

Amount of data	Memory used
200000	611.5 mb
100000	81,26 mb
10000	51,8 mb
10	10 mb

Tabla 2: Memory used by the program depending on the amount of data

Amount of data	Time
200000	50 segundos
100000	26 segundos
1000	3 segundos
10	0.1 segundos

Tabla 3: Amount of time taken by the algorithm depending on the amount of data

Developed Software

Finally we see how the program returns the collisions between 2 points.

```
Distancia entre 2 puntos: 151.61197248122994
colision entre: abeja: 1896.0 y abeja: 1890.0
Distancia entre 2 puntos: 151.6106821158615 2
colision entre: abeja: 1896.0 y abeja: 1896.0
Distancia entre 2 puntos: 151.61088855726553
colision entre: abeja: 1896.0 y abeja: 1916.0
Distancia entre 2 puntos: 151.60824958099255
colision entre: abeja: 1896.0 y abeja: 1935.0
Distancia entre 2 puntos: 151.611520014395 64
```

Gráfico 2: Output that the running program gives