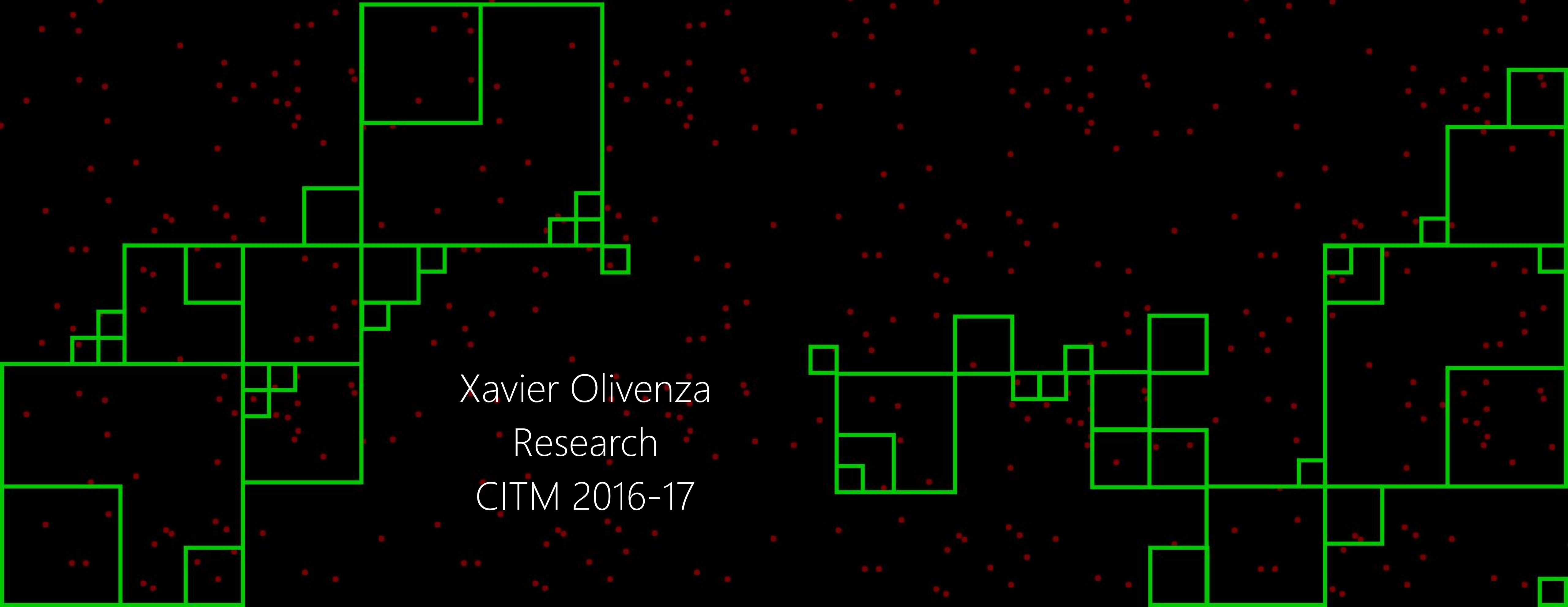
Optimized Search Manager



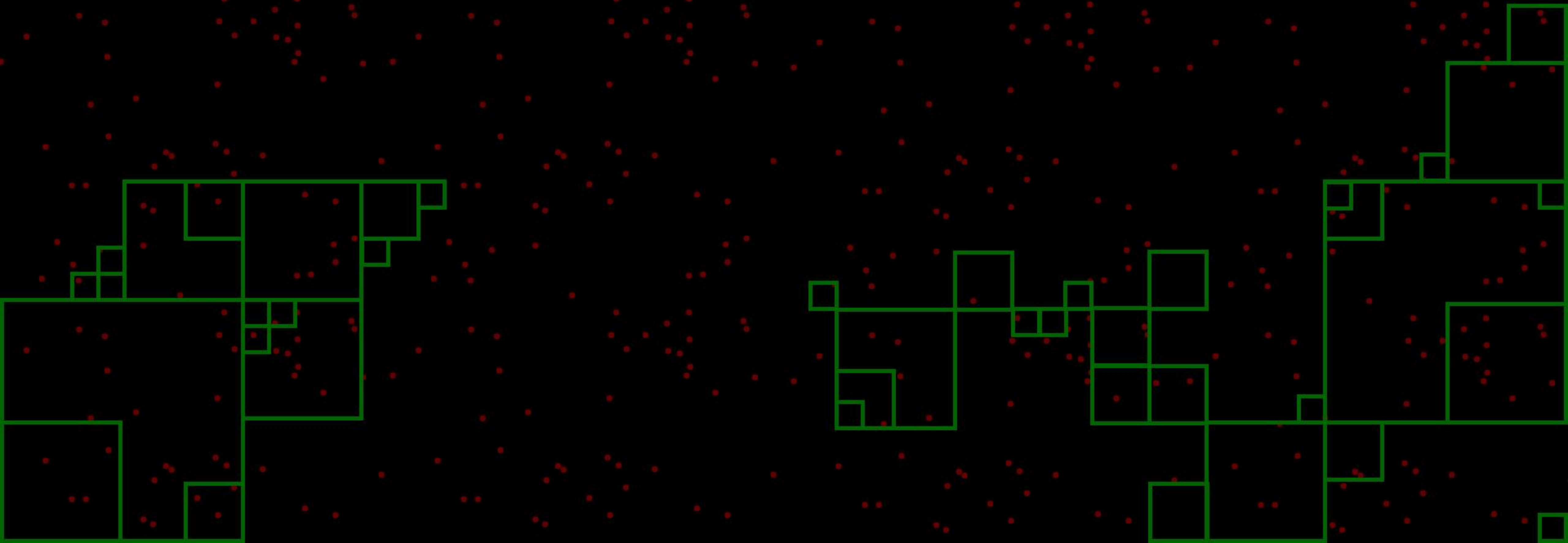
Xavier Olivenza

Research

CITM 2016-17

What is a search engine for?

-Search for an entity in an area/range



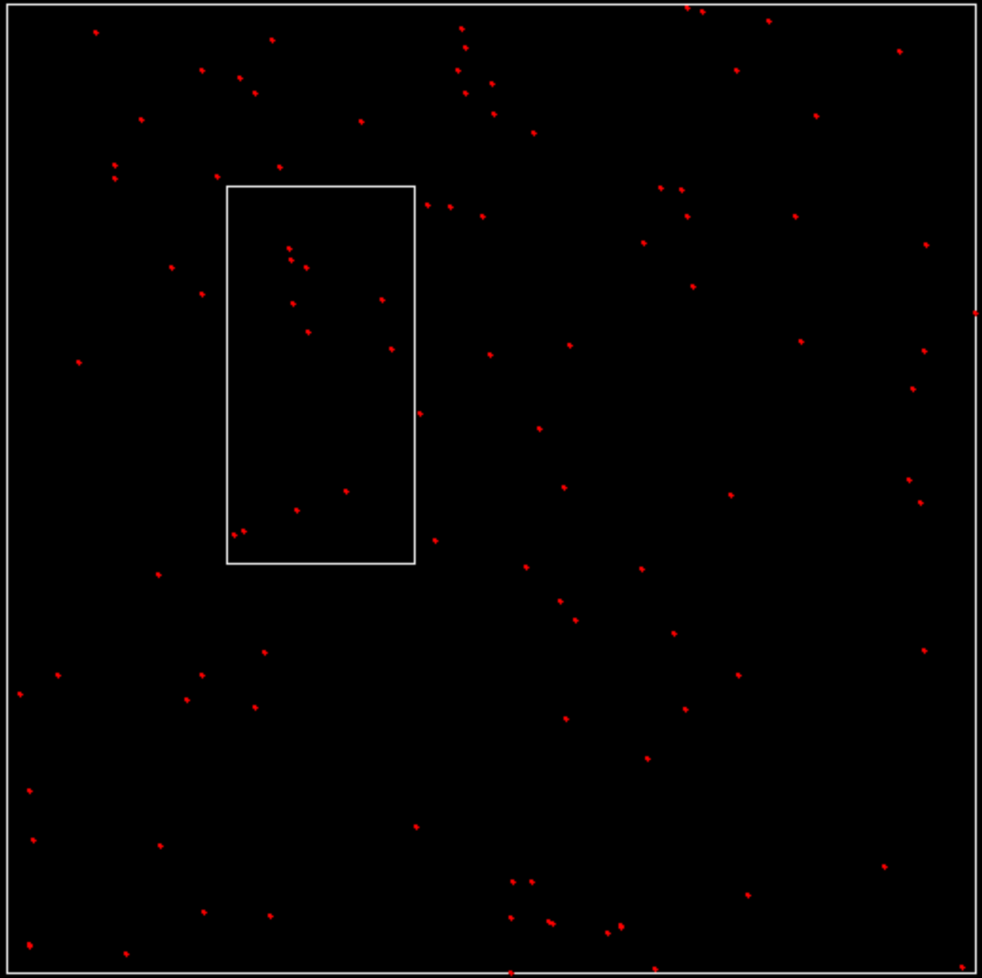
Where I can use this?

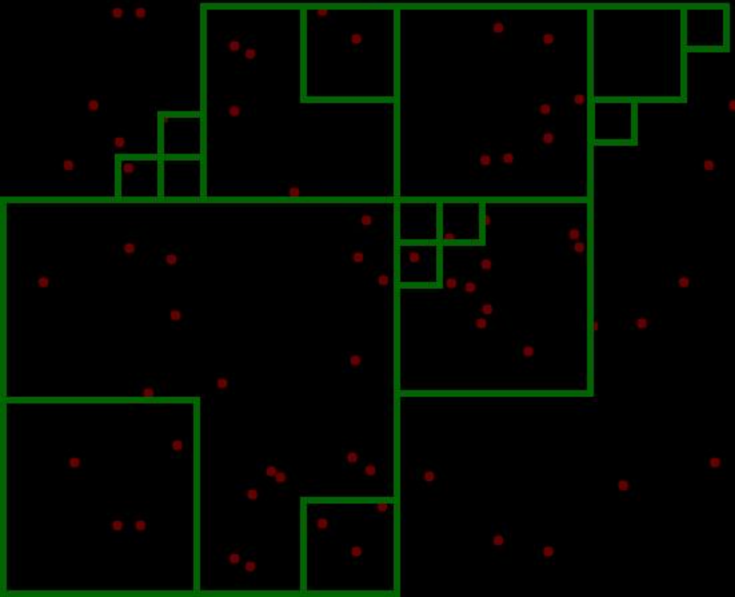
Brute force

-You have to do as many checks as entities are evaluated

…

-What happens if we group and order the entities?





Space Partitioning

·Dividing a space into two or more subsets which do not overlap

·Algorithms that tend to be hierarchical

Most common partition data structures:

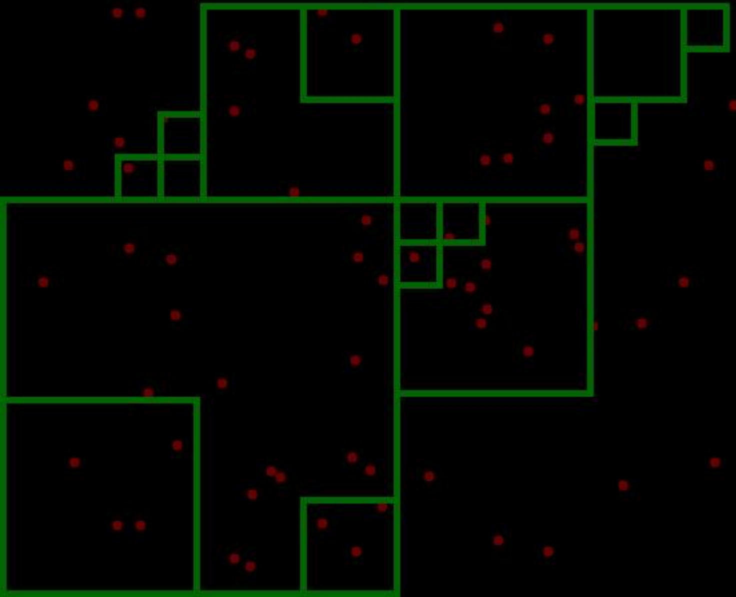
· BSP Trees

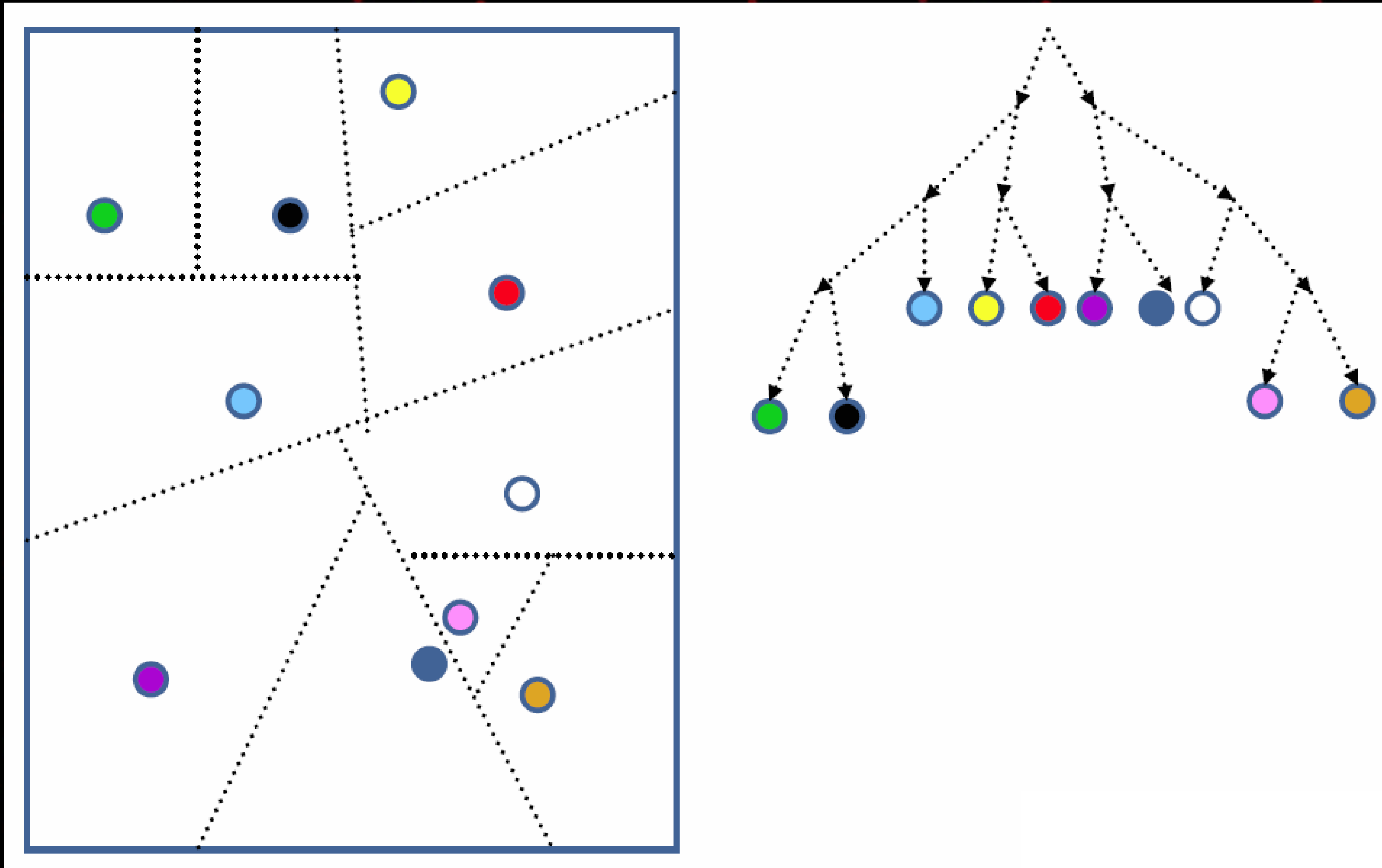
· Quadtrees

· Octrees

· K-dimensional trees

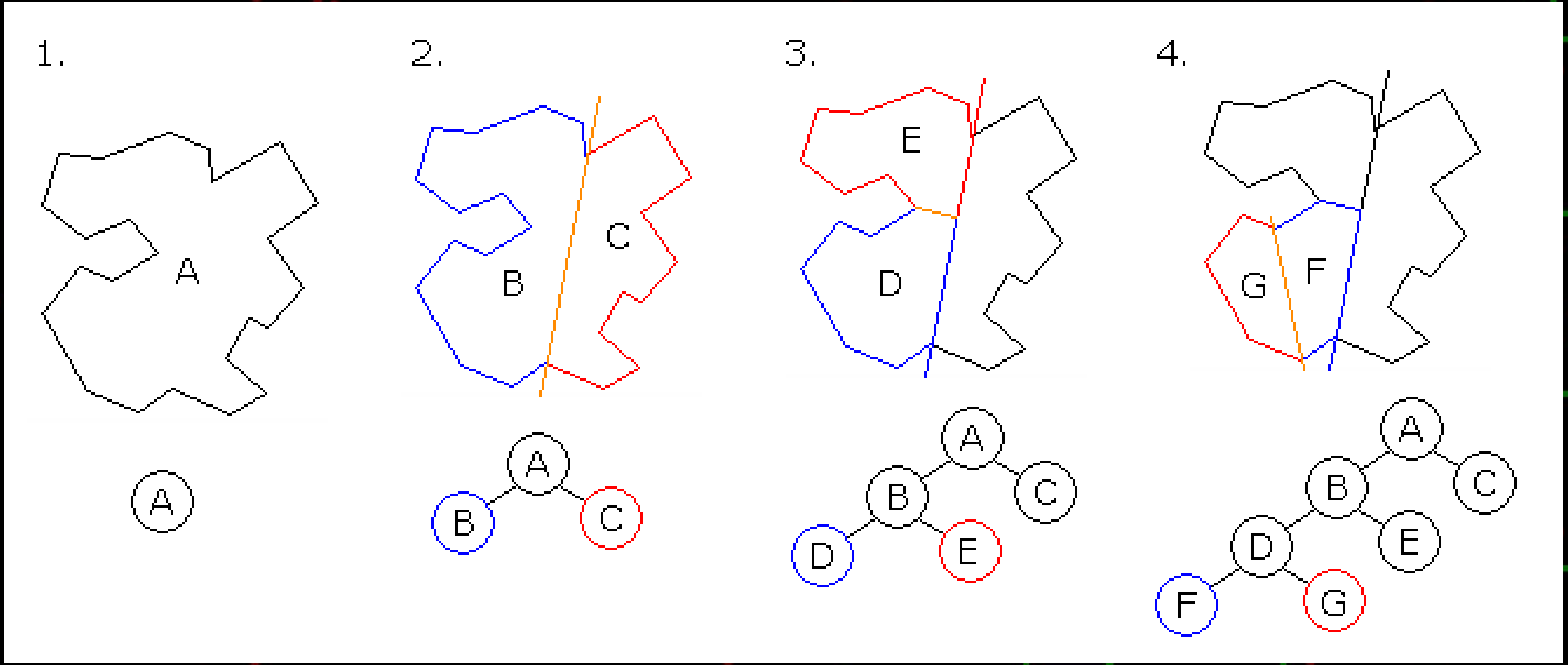
· R-Trees





Binary Space Partitioning (BSP)

- Generalization
- Origin: Quickly draw polygonal 3d scenes
- Slow generation -> Pre-calculate



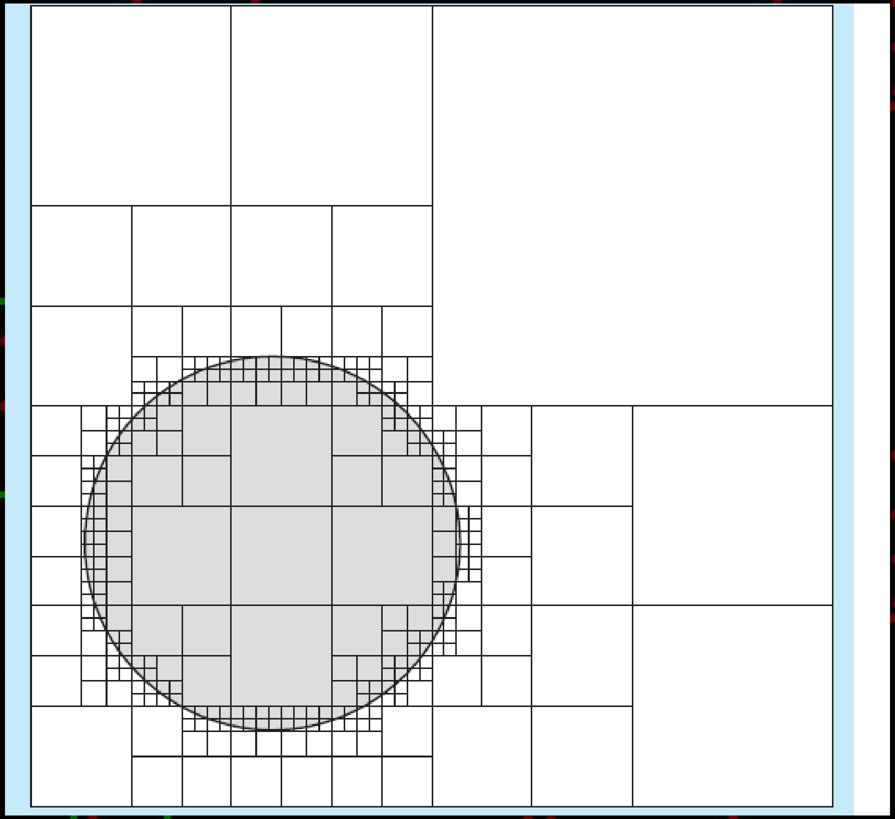
BSP, Where is used?

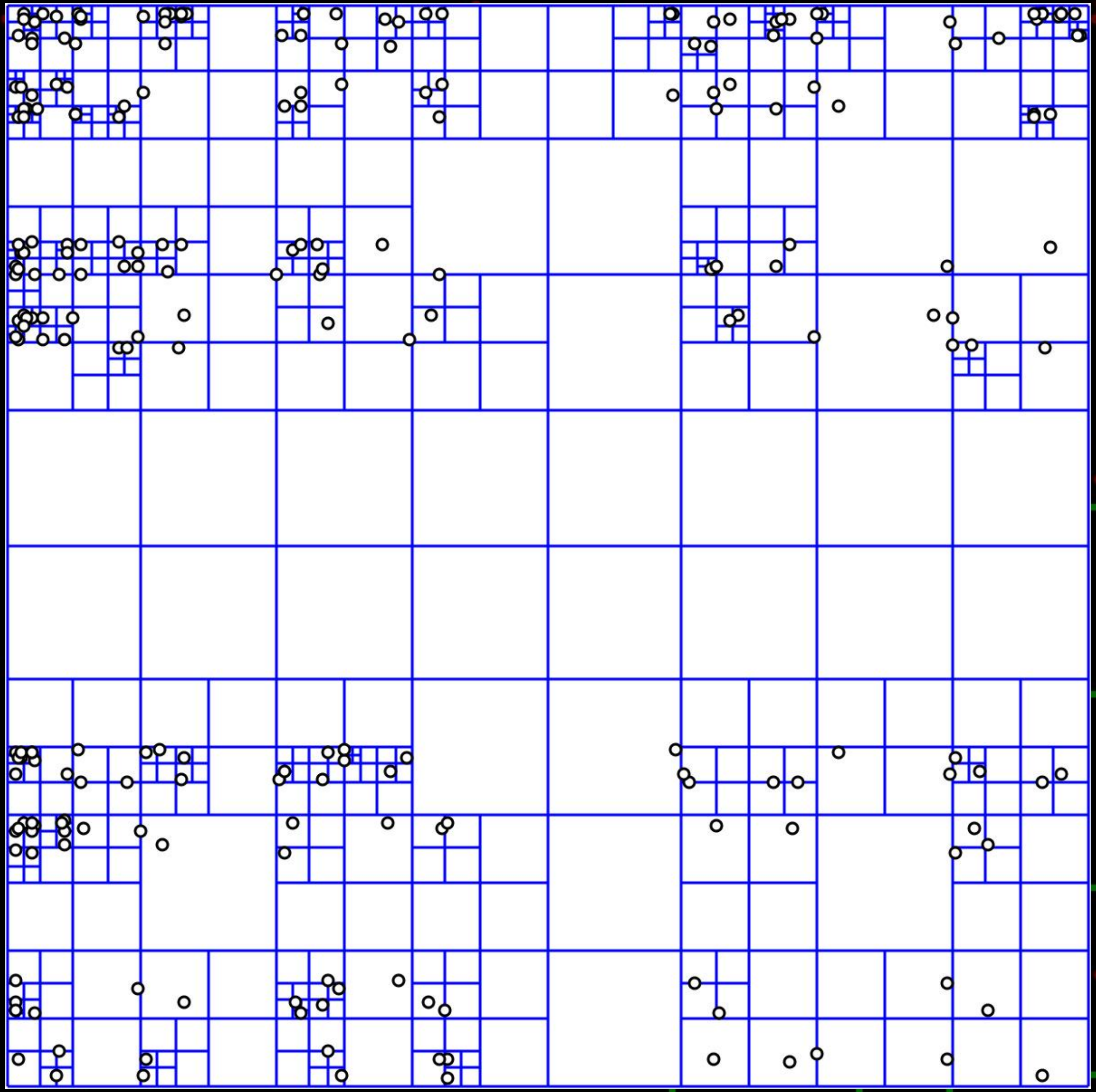
Id-Teck 1 Doom

Quake Engine + descendants

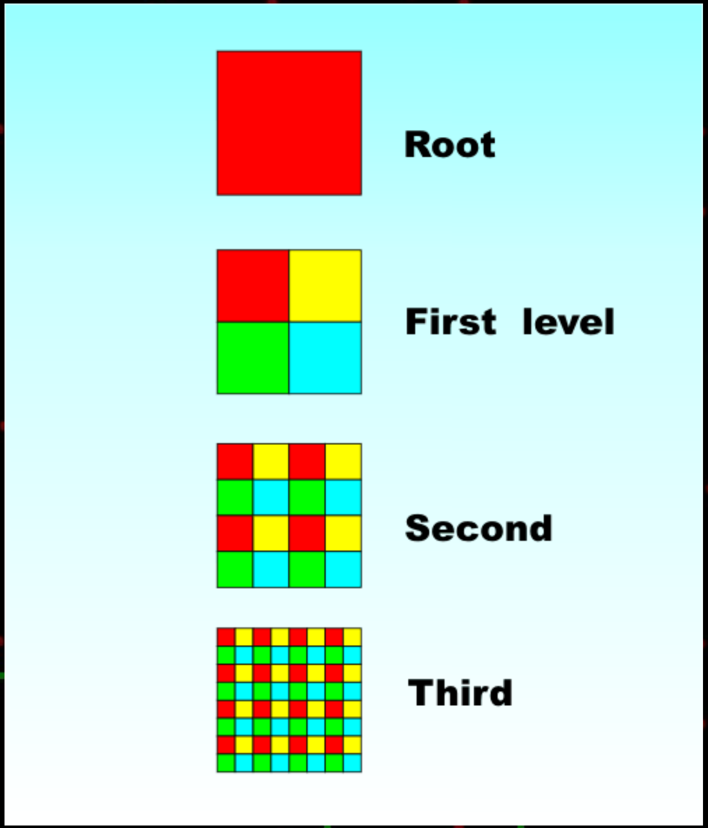
Quadtree

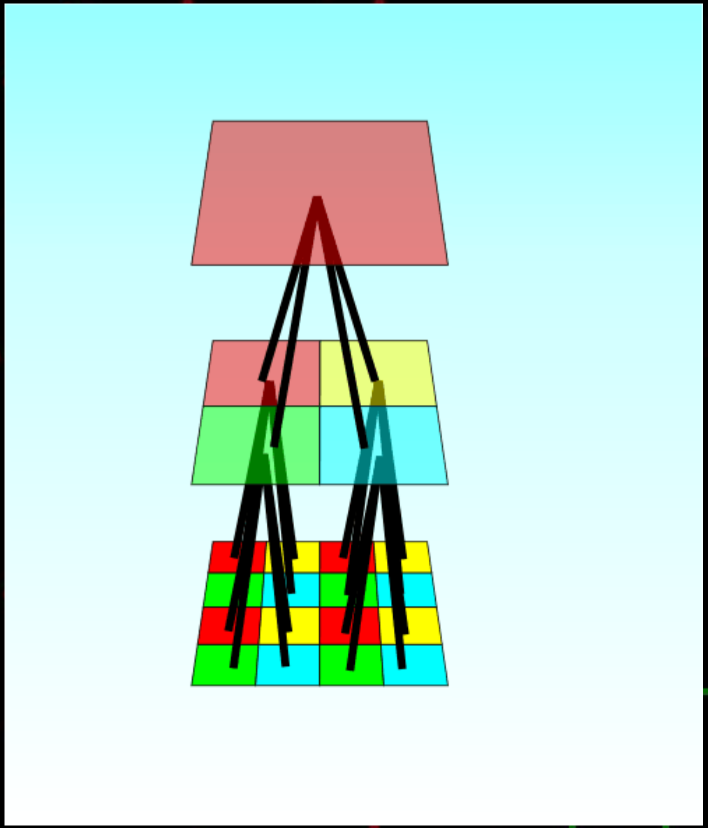
·Generally 2D
·When it reaches max node capacity -> split

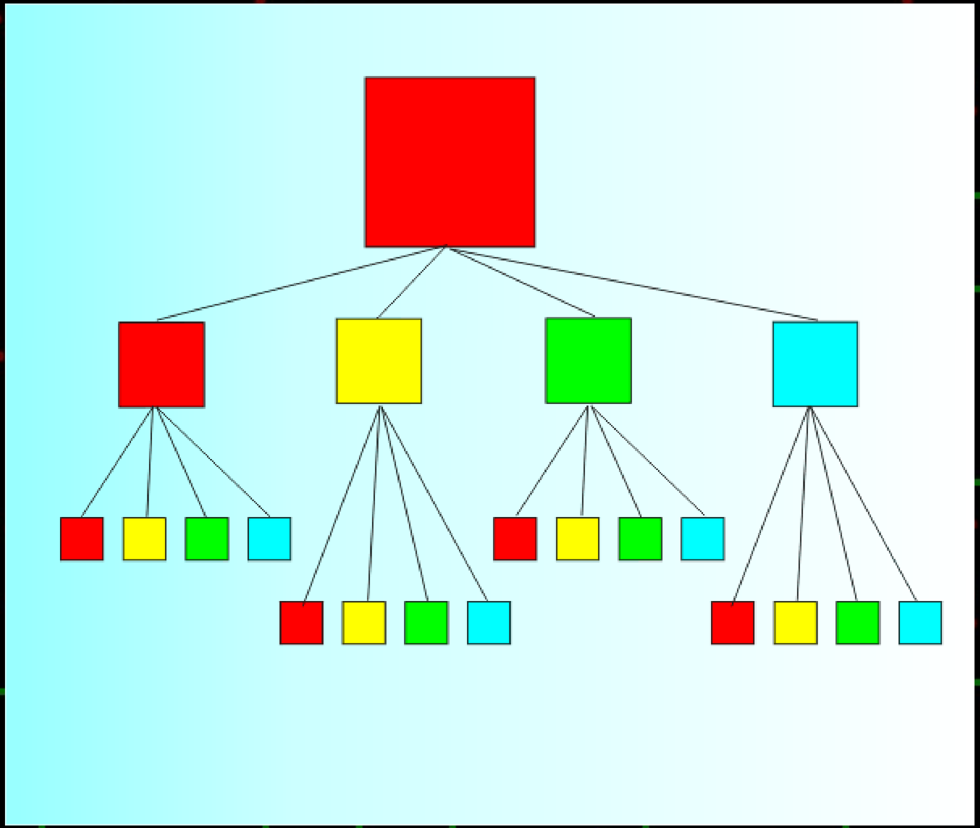




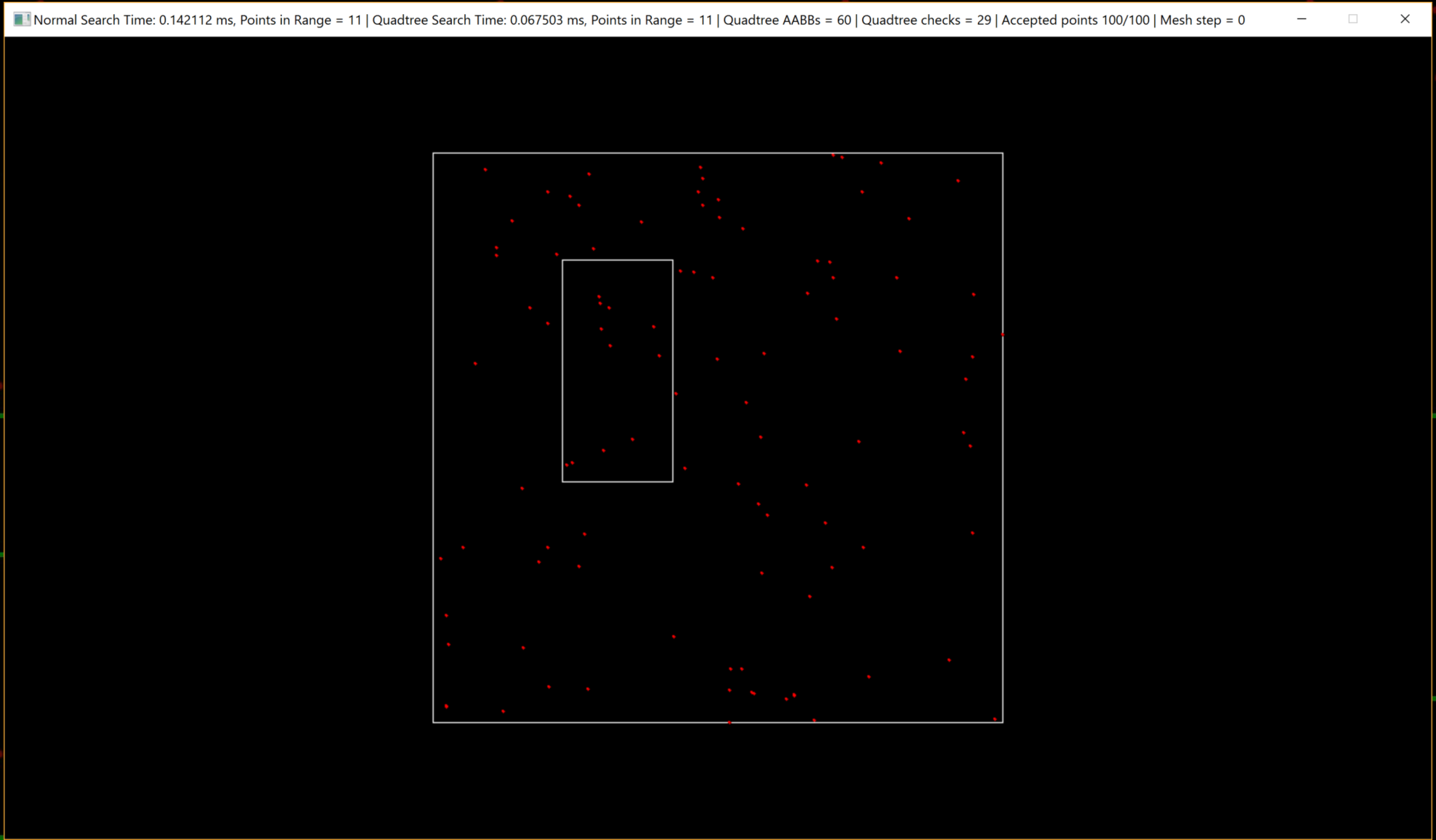
Quadtree, Tree





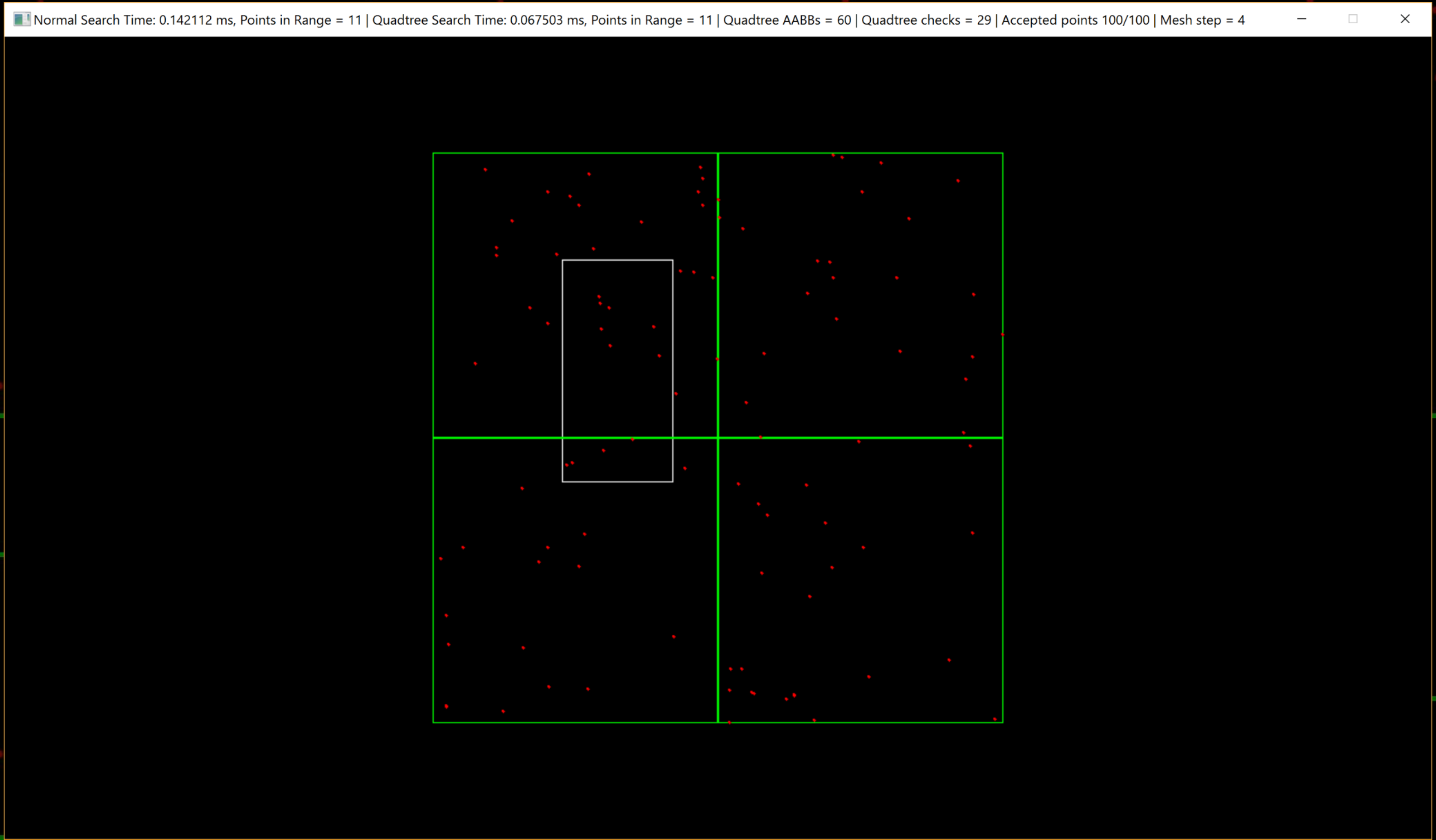


Quadtree, Tree



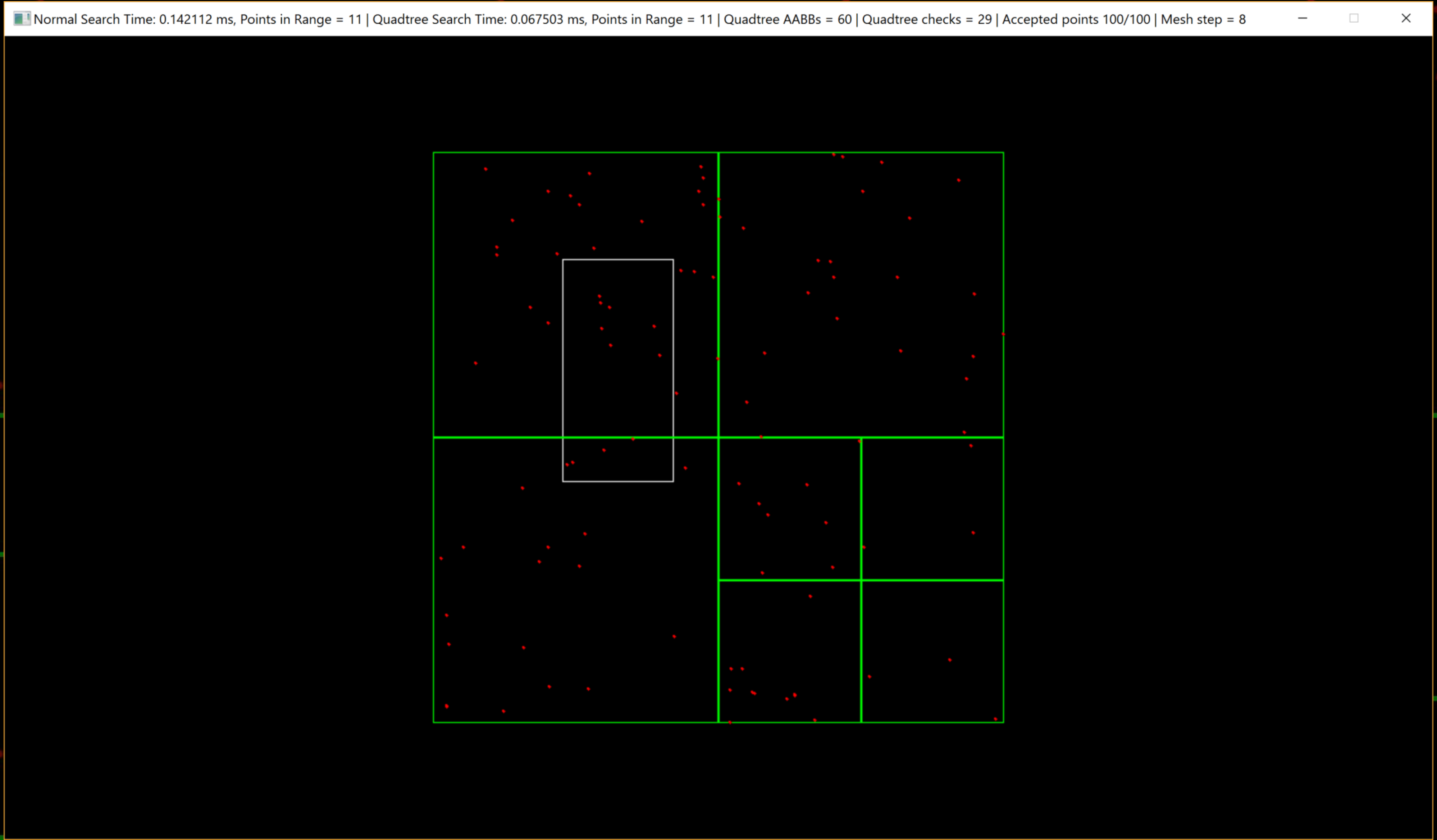
Normal Search Time: 0.142112 ms, Points in Range = 11 | Quadtree Search Time: 0.067503 ms, Points in Range = 11 | Quadtree AABBs = 60 | Quadtree checks = 29 | Accepted points 100/100 | Mesh step = 0

Quadtree, Tree

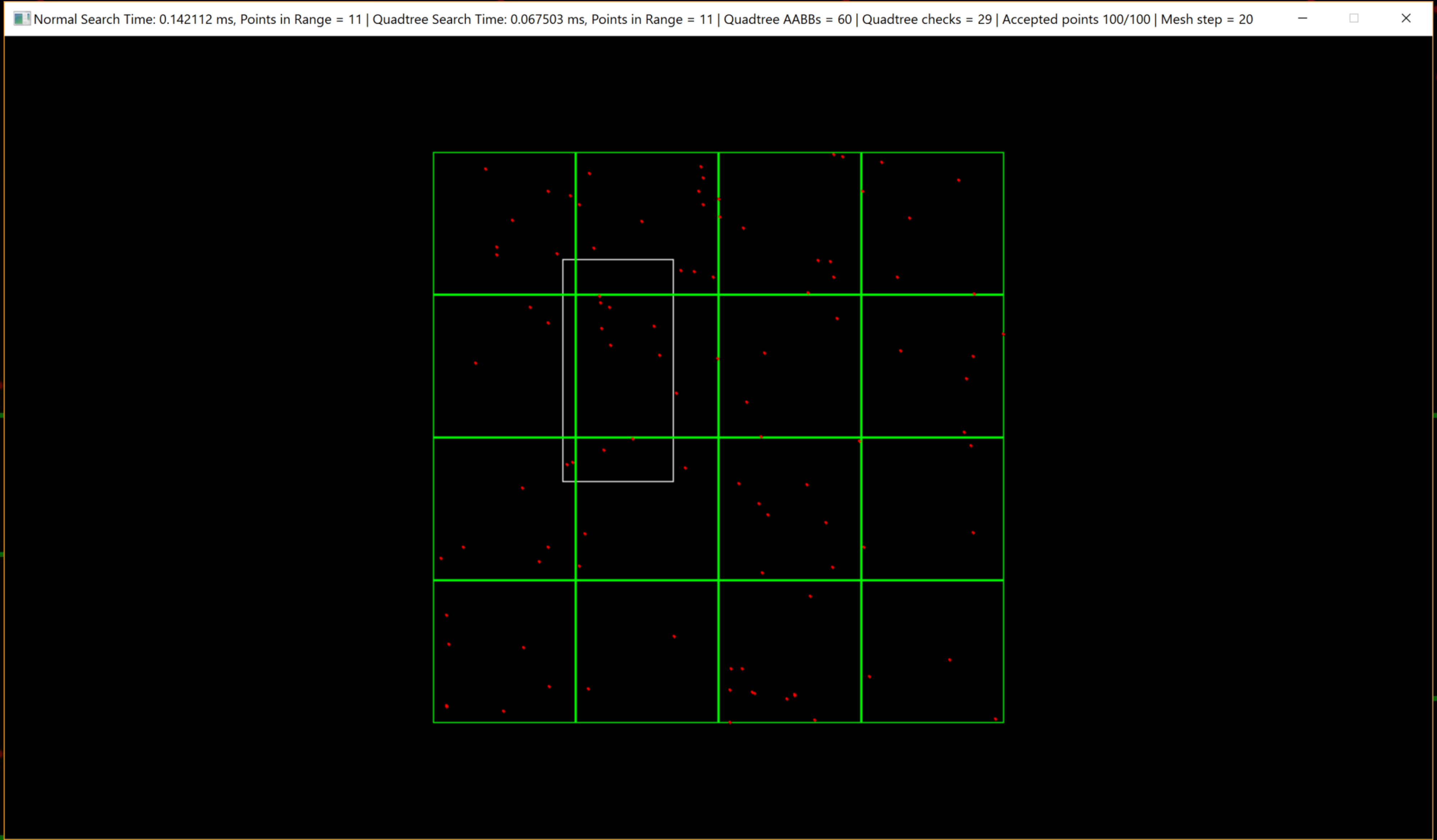


Normal Search Time: 0.142112 ms, Points in Range = 11 | Quadtree Search Time: 0.067503 ms, Points in Range = 11 | Quadtree AABBs = 60 | Quadtree checks = 29 | Accepted points 100/100 | Mesh step = 4

Quadtree, Tree

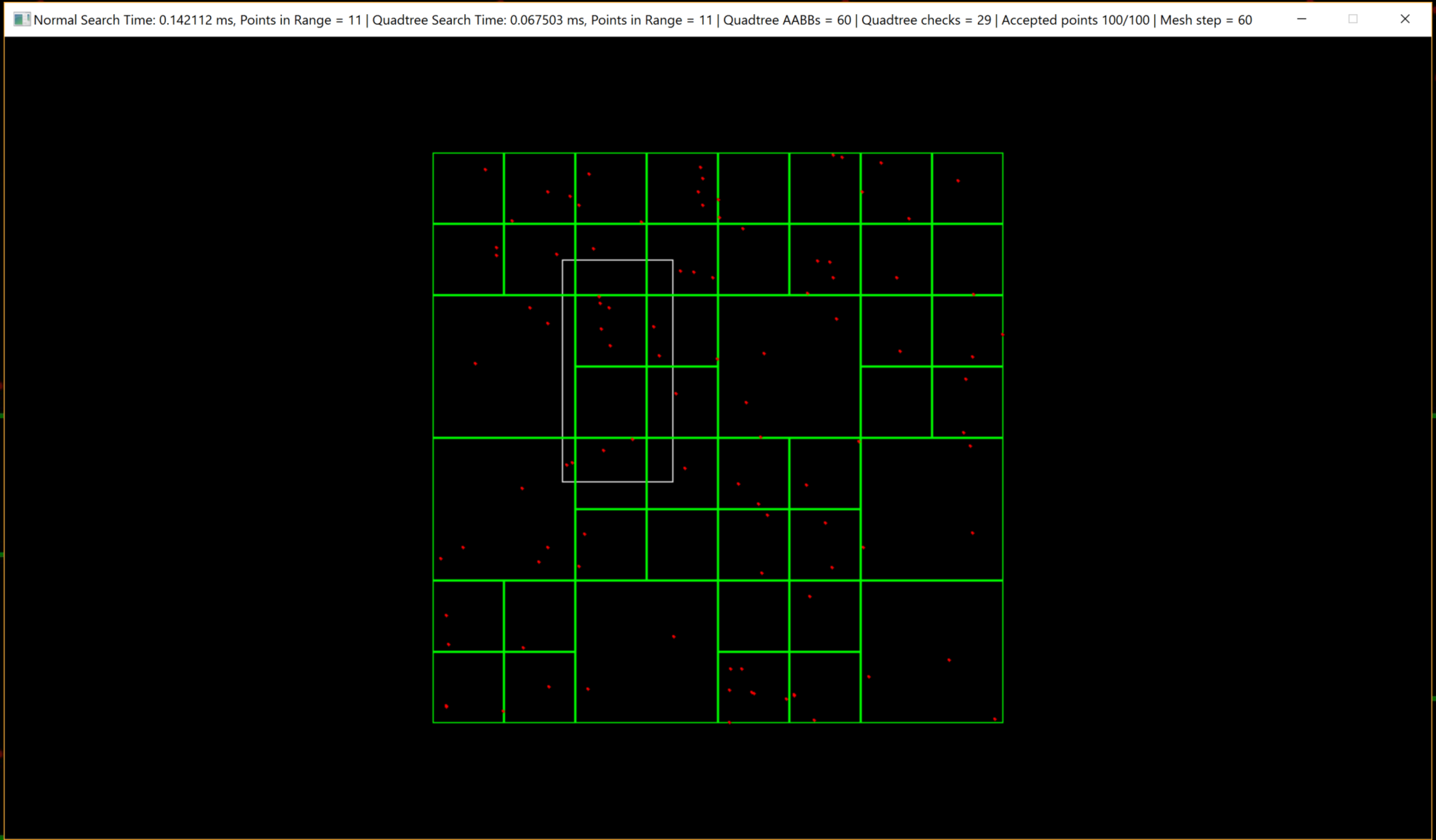

Normal Search Time: 0.142112 ms, Points in Range = 11 | Quadtree Search Time: 0.067503 ms, Points in Range = 11 | Quadtree AABBs = 60 | Quadtree checks = 29 | Accepted points 100/100 | Mesh step = 8

Quadtree, Tree



Normal Search Time: 0.142112 ms, Points in Range = 11 | Quadtree Search Time: 0.067503 ms, Points in Range = 11 | Quadtree AABBs = 60 | Quadtree checks = 29 | Accepted points 100/100 | Mesh step = 20

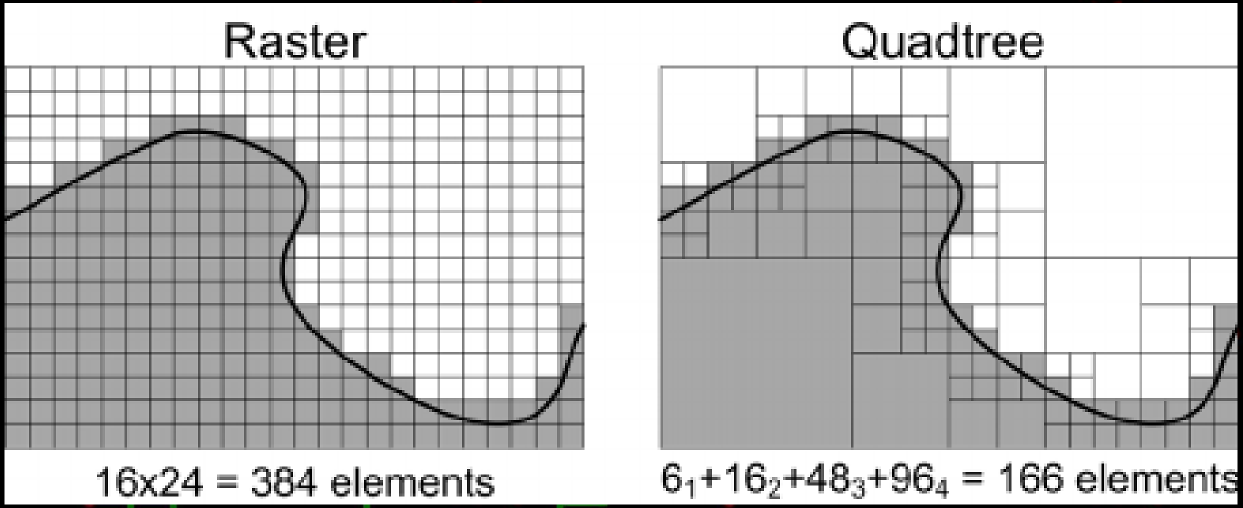
Quadtree, Tree



Normal Search Time: 0.142112 ms, Points in Range = 11 | Quadtree Search Time: 0.067503 ms, Points in Range = 11 | Quadtree AABBs = 60 | Quadtree checks = 29 | Accepted points 100/100 | Mesh step = 60

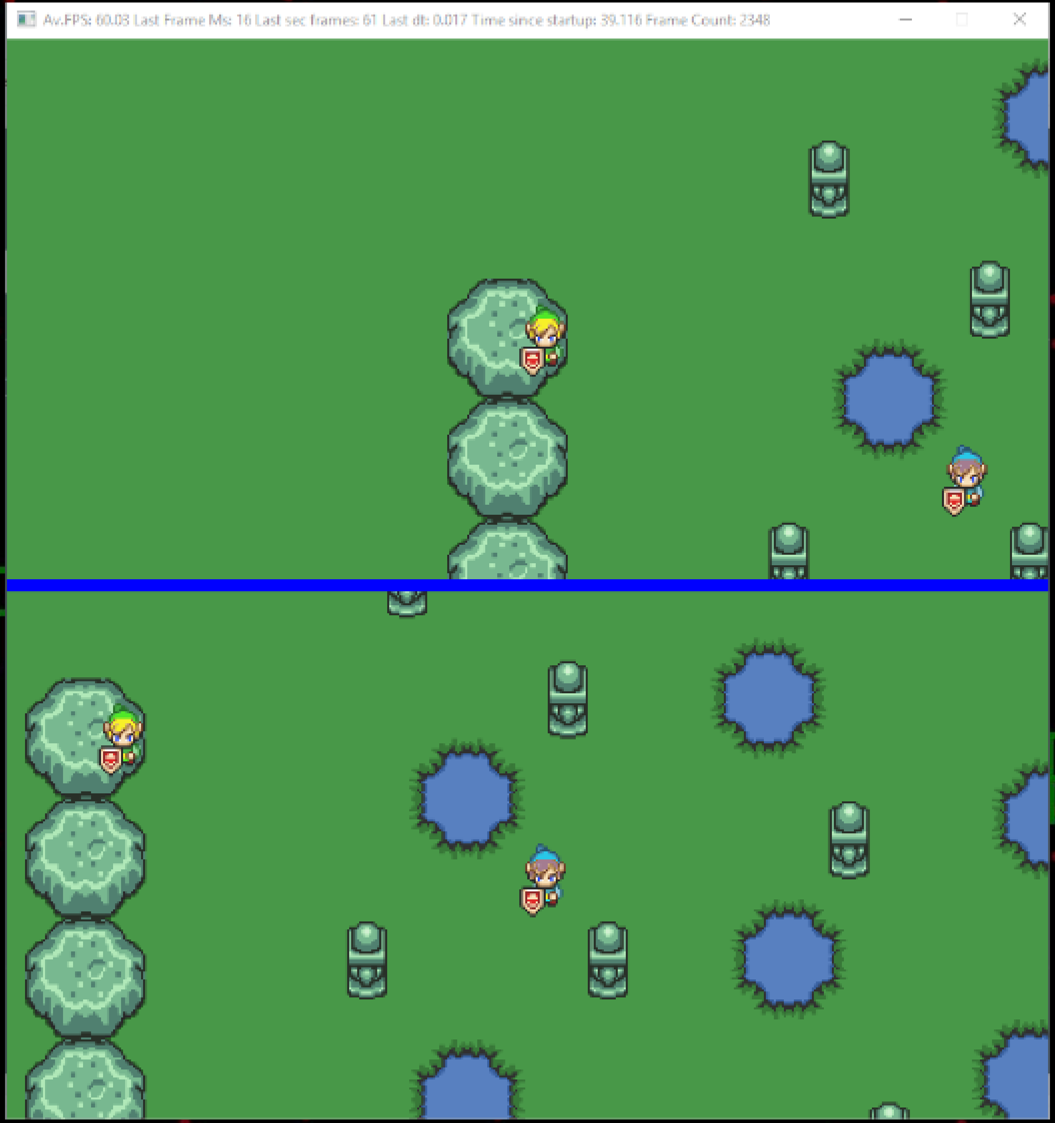
Quadtree, Where is used?

Image processing/compression



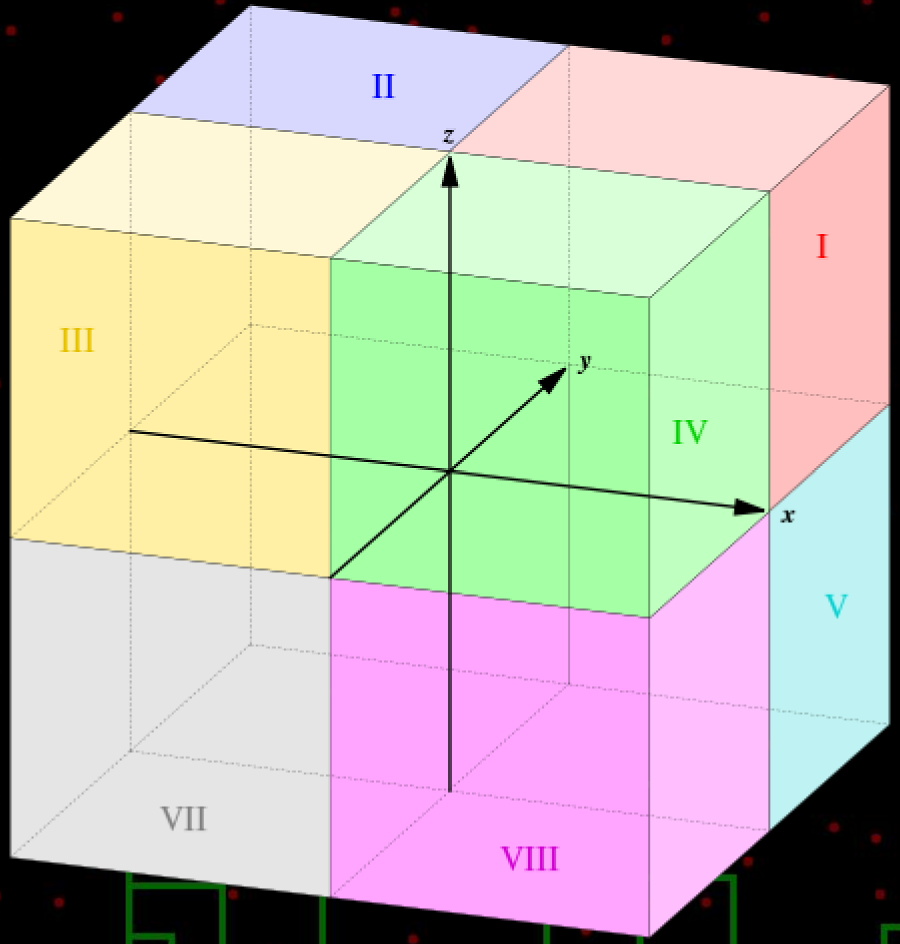
Quadtree, Where is used?

- Collisions
- Camera culling

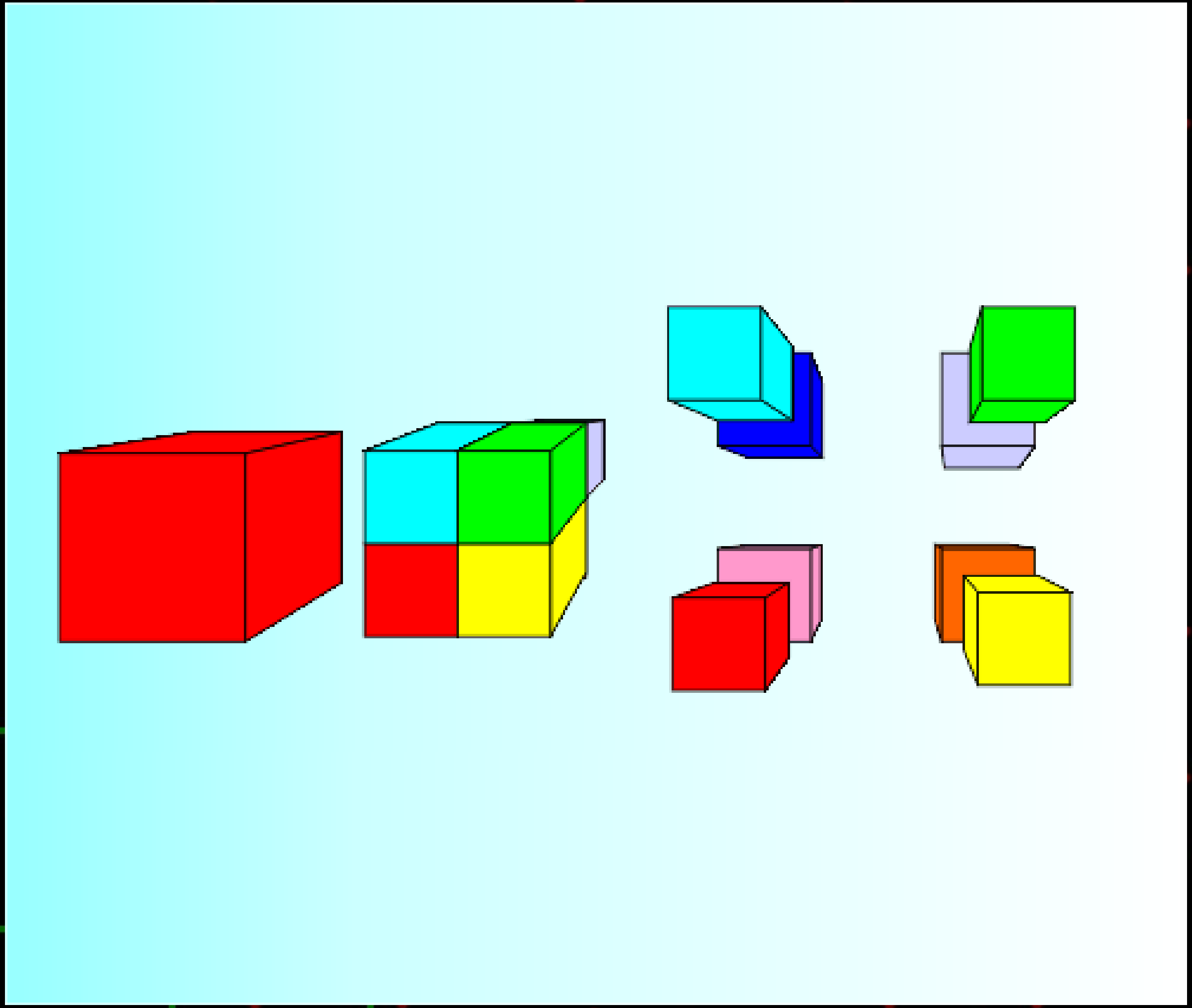

Av.FPS: 60.03 Last Frame Ms: 16 Last sec frames: 61 Last dt: 0.017 Time since startup: 39.116 Frame Count: 2348

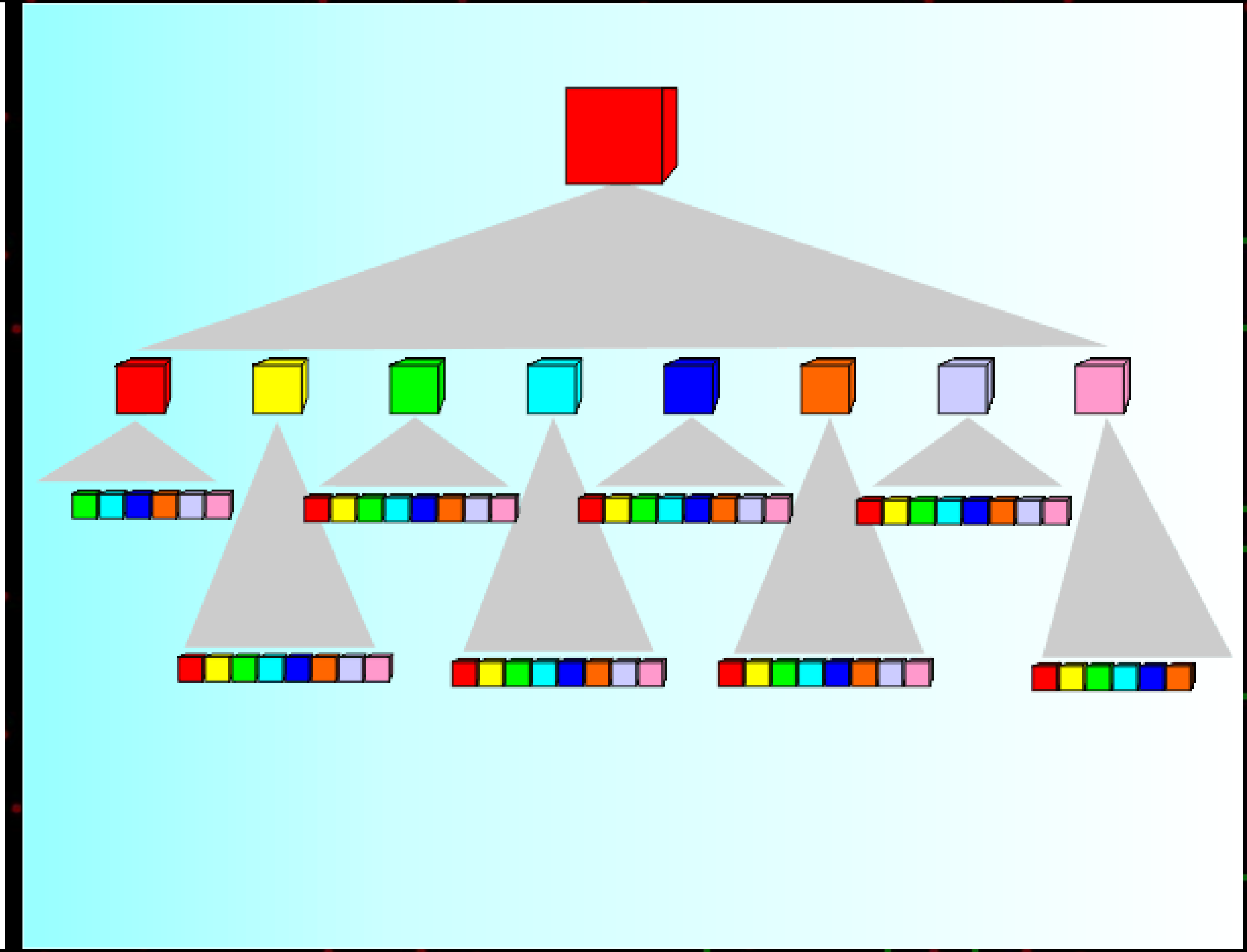
Octree

·Quadtree analogue in 3D
·3D graphics and video game engines



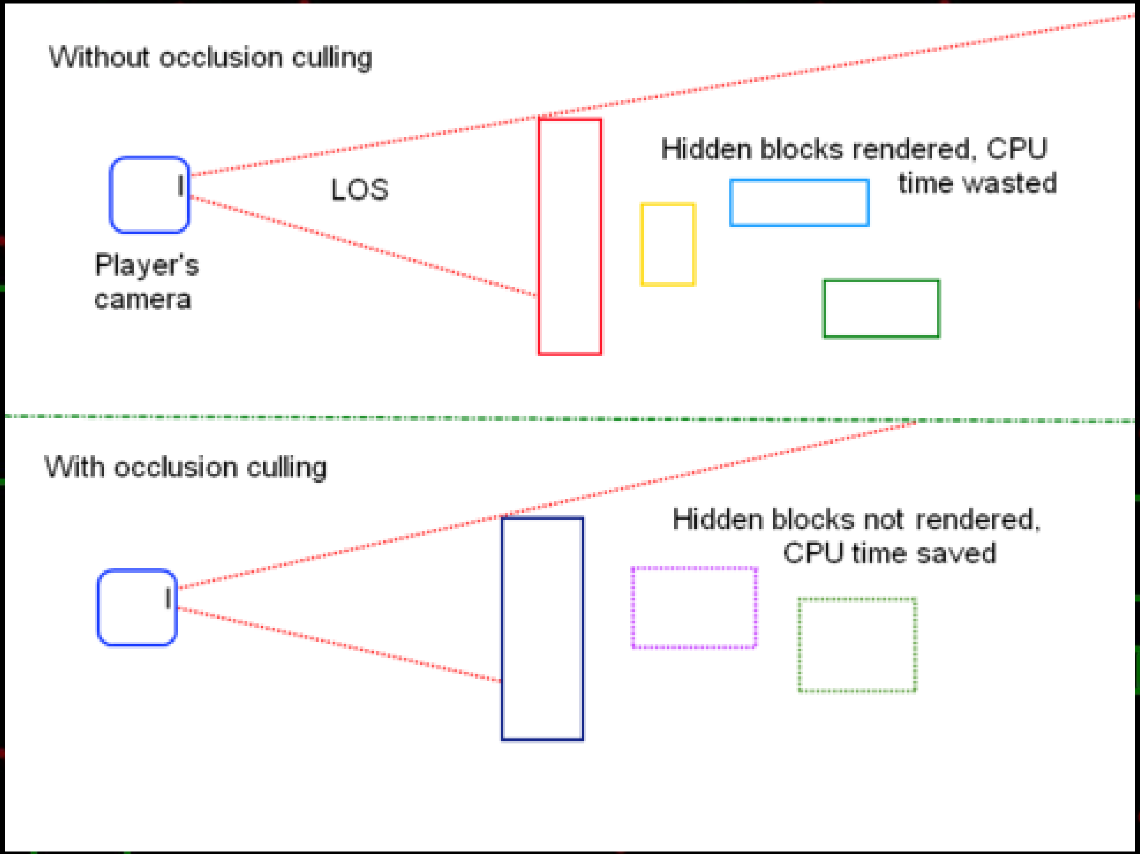
Octree, Tree

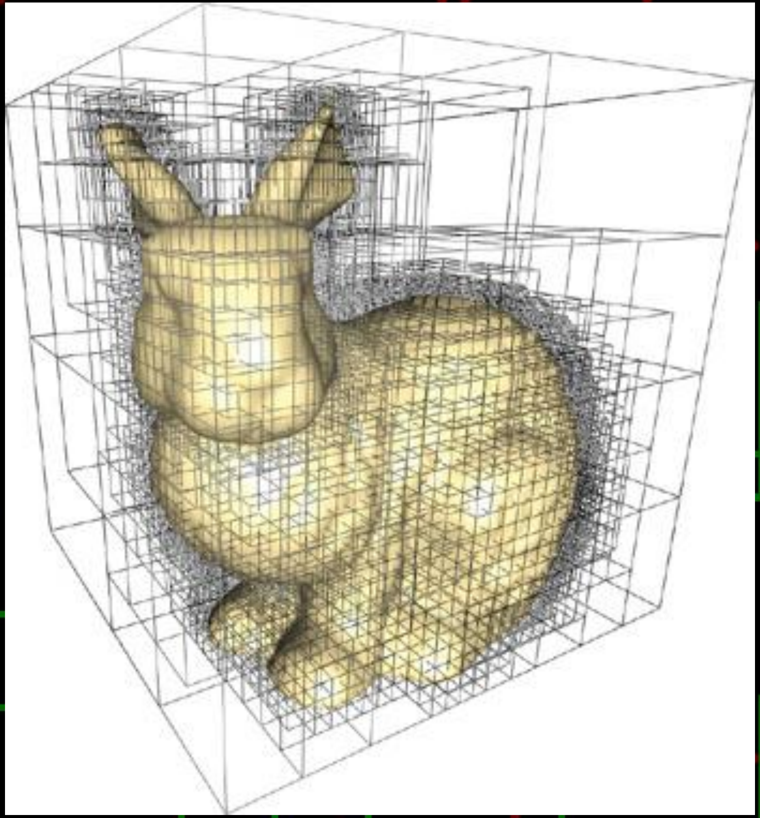




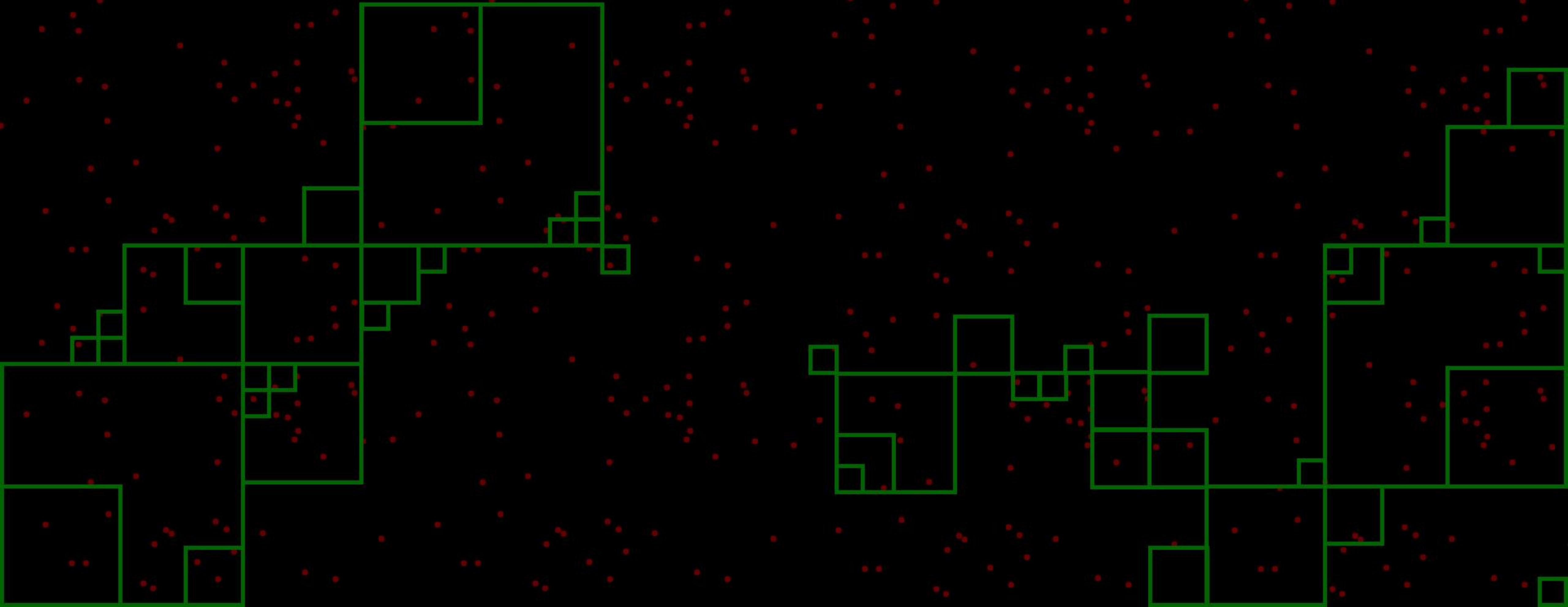
Octree, Where is used?

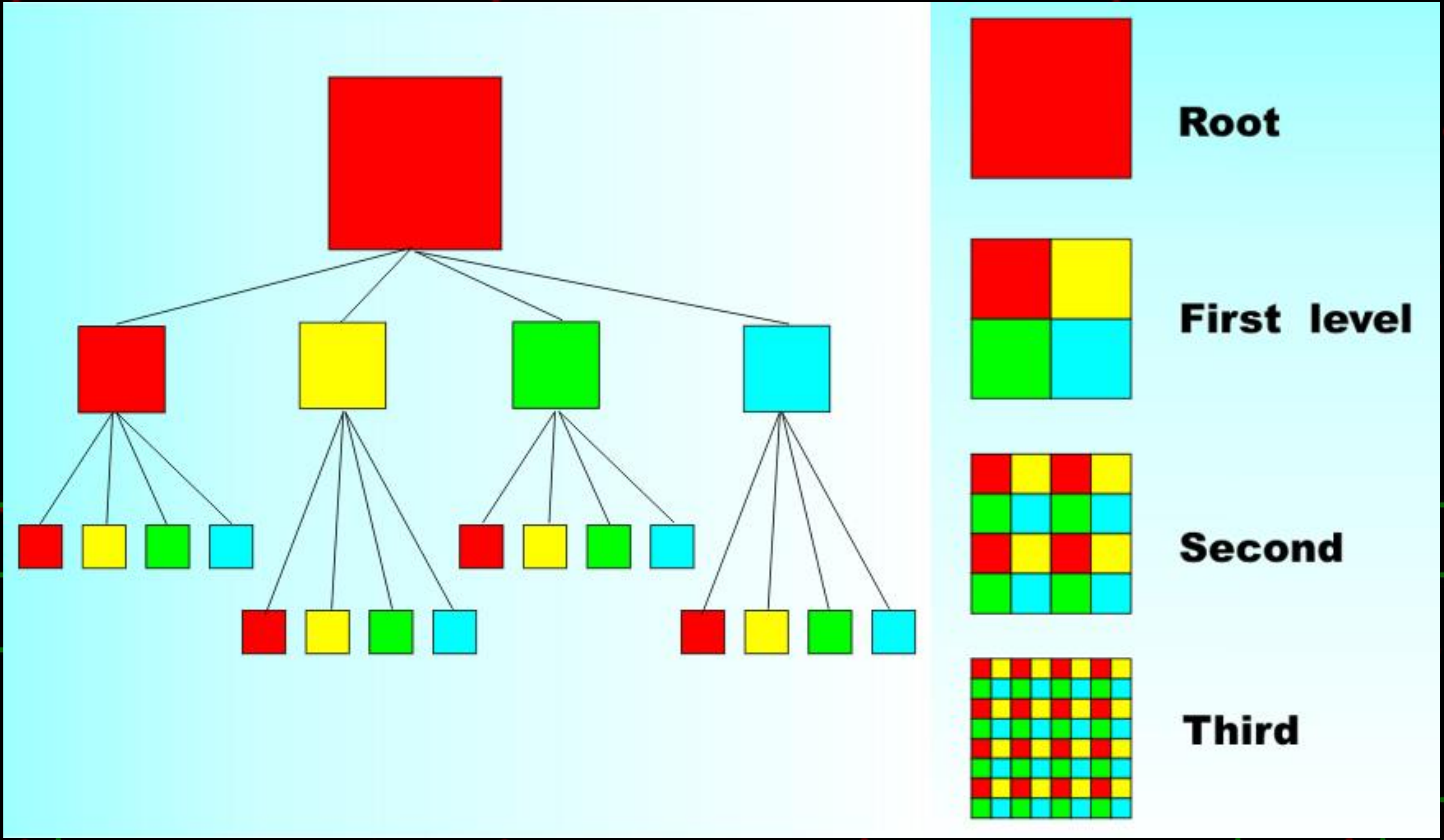
- 3D Graphics
- Efficient collision detection in three dimensions
- Occlusion Culling (OC)

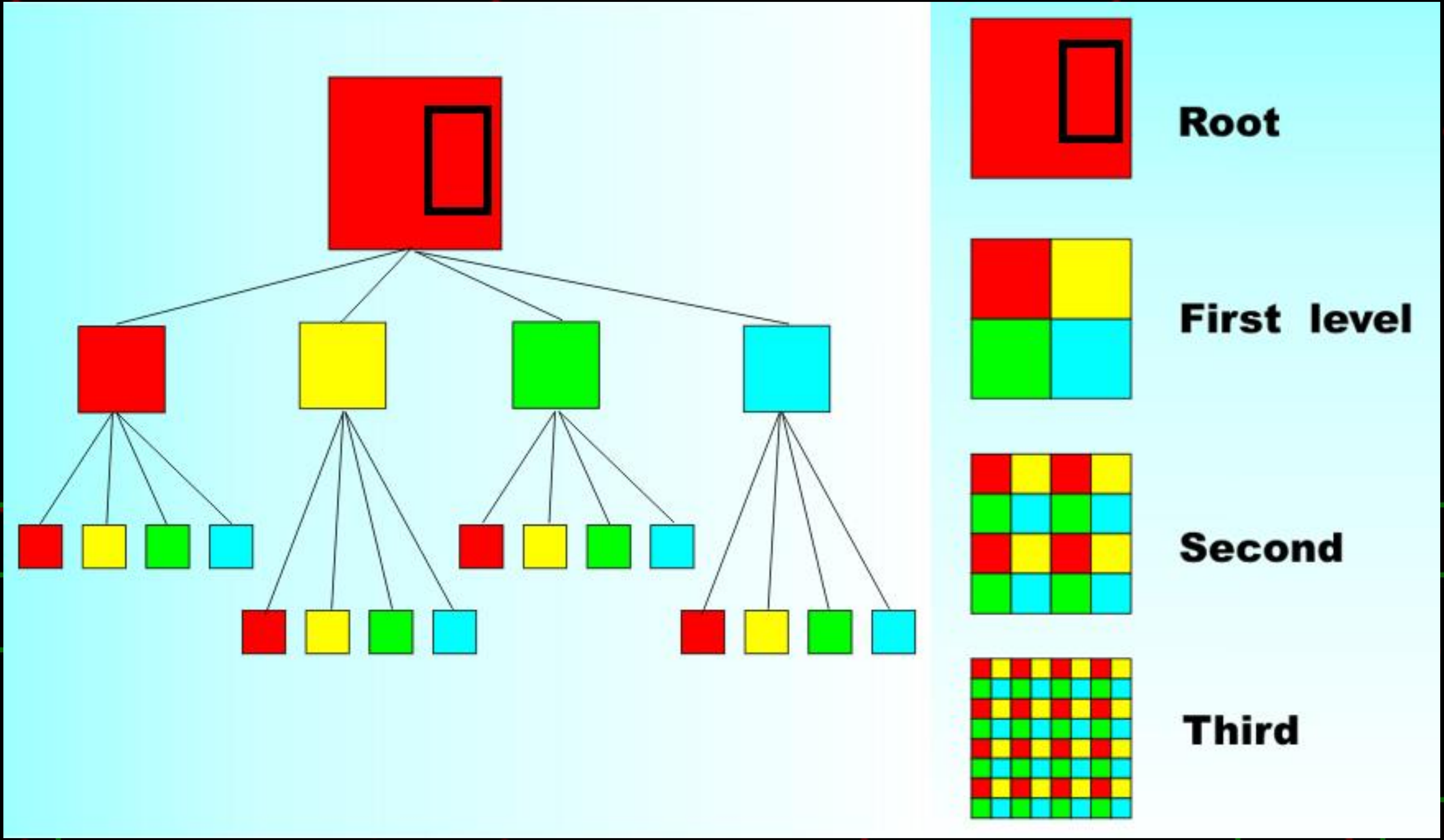

Without occlusion culling
LOS
Hidden blocks rendered, CPU time wasted
Player's camera
With occlusion culling
Hidden blocks not rendered, CPU time saved

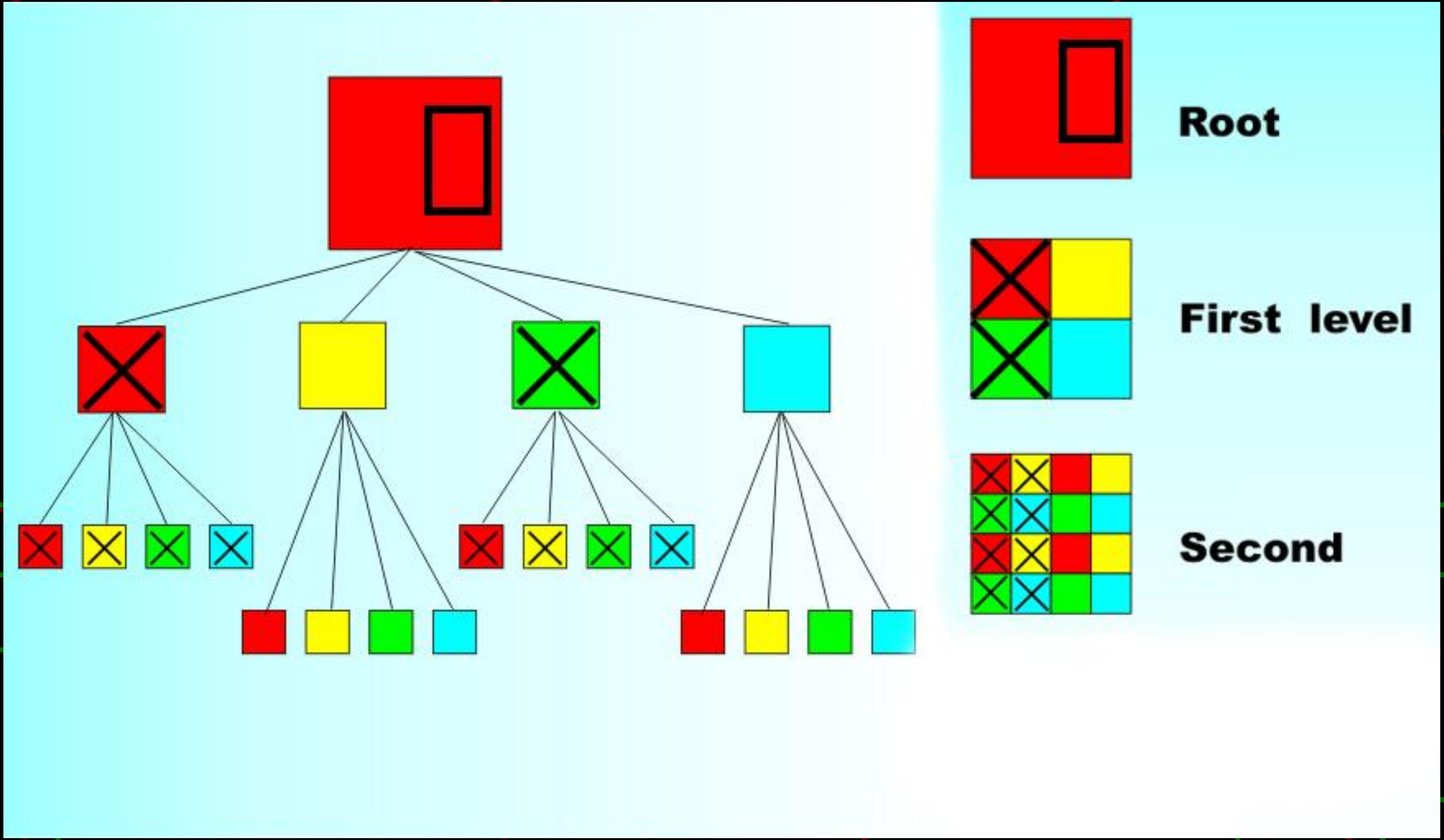


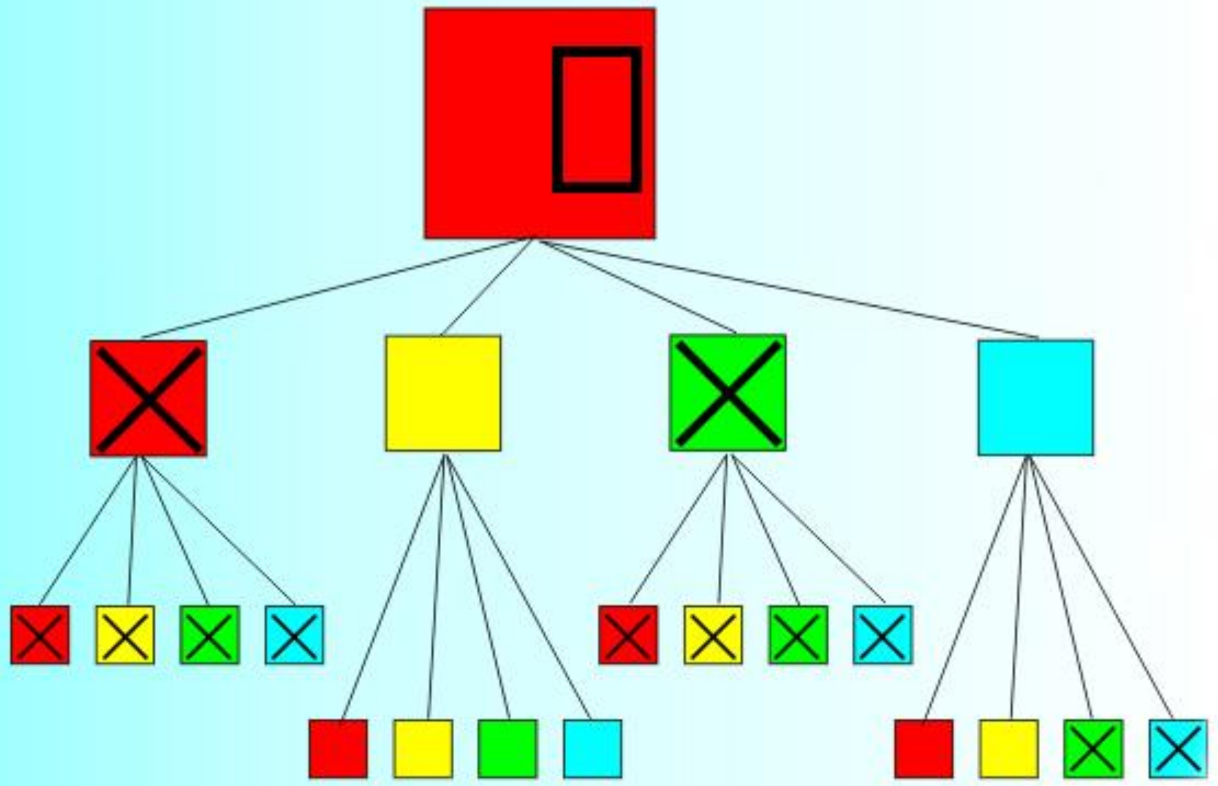
Why they are faster?

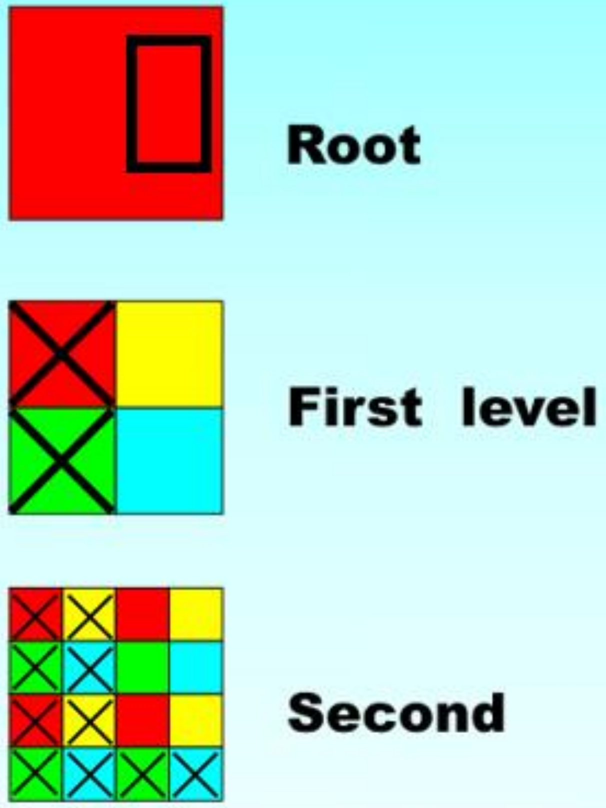



Root
First level
Second
Third

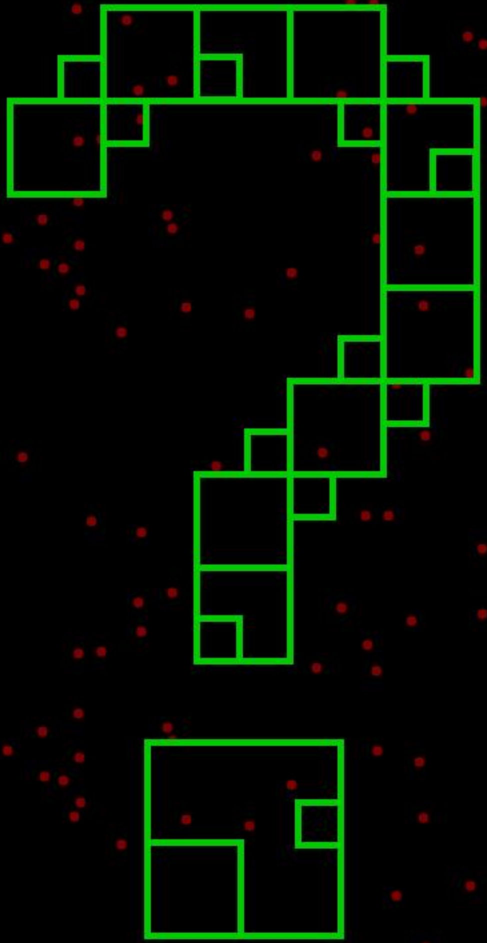

Root
First level
Second
Third


Root
First level
Second

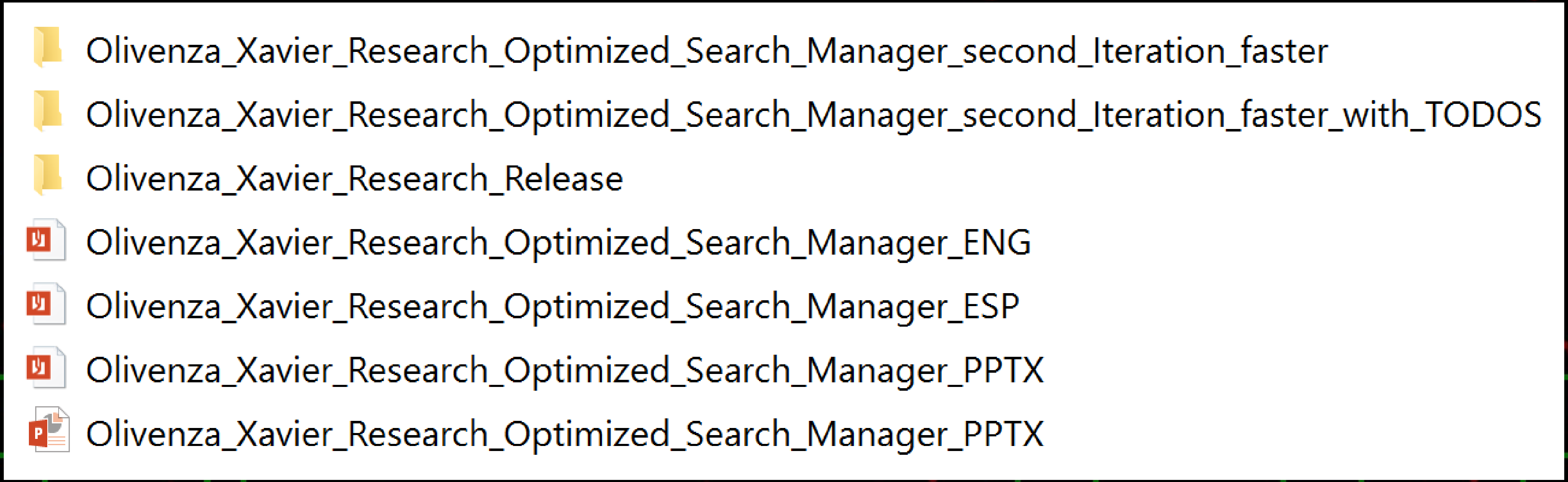



Root
First level
Second

Any question?



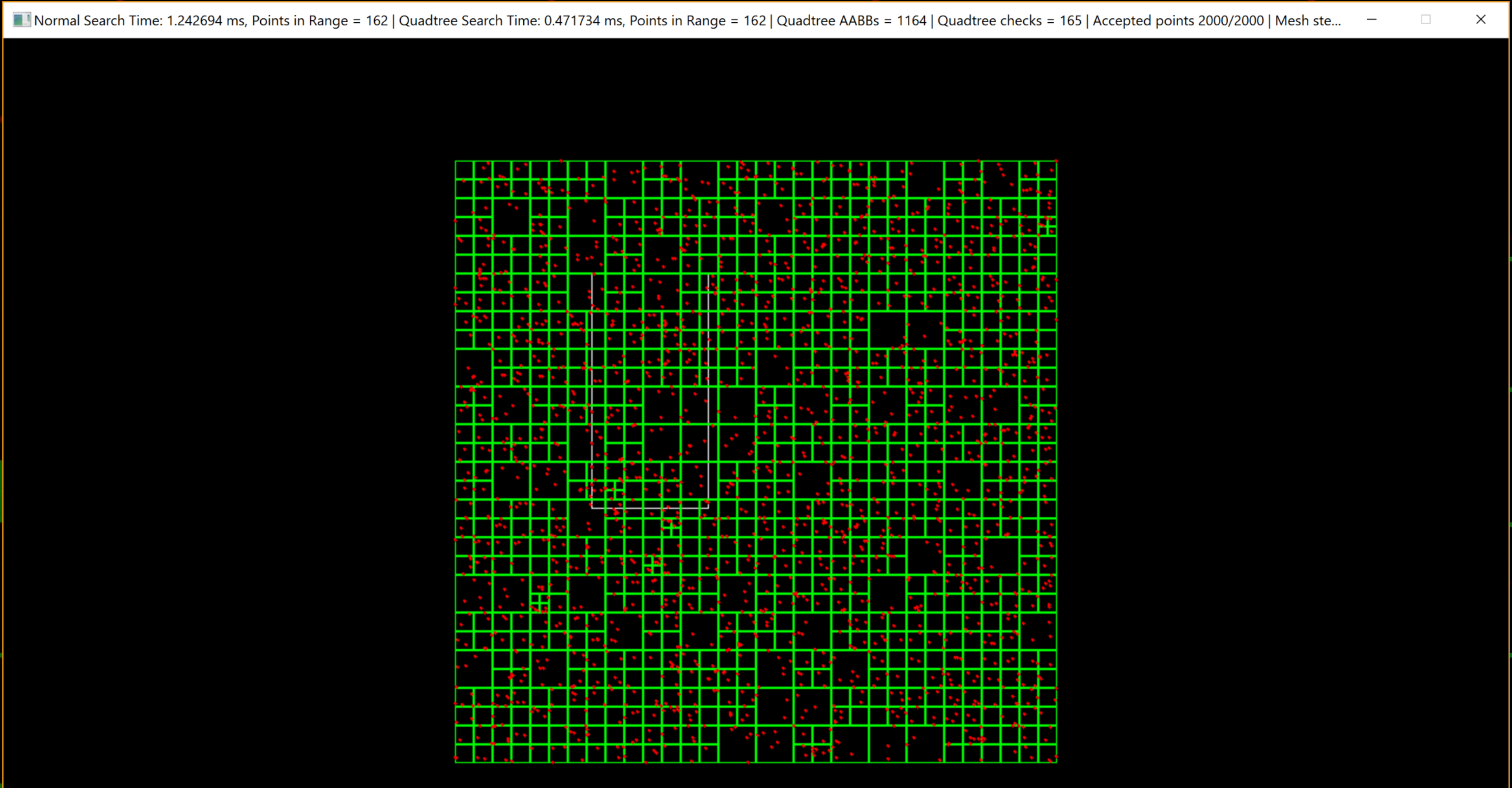
Before TODOs



Olivenza_Xavier_Research_Optimized_Search_Manager_second_Iteration_faster
Olivenza_Xavier_Research_Optimized_Search_Manager_second_Iteration_faster_with_TODOS
Olivenza_Xavier_Research_Release
Olivenza_Xavier_Research_Optimized_Search_Manager_ENG
Olivenza_Xavier_Research_Optimized_Search_Manager_ESP
Olivenza_Xavier_Research_Optimized_Search_Manager_PPTX
Olivenza_Xavier_Research_Optimized_Search_Manager_PPTX

R,S,F1,F2,Q,A

Before TODOs



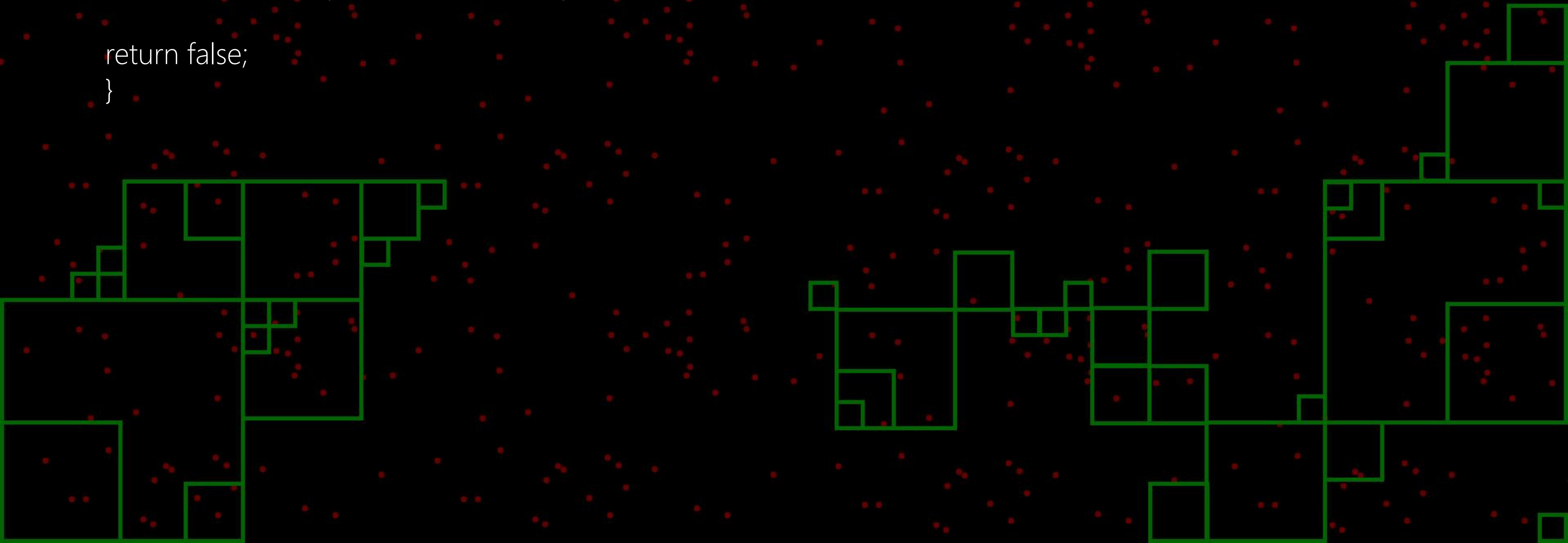
Normal Search Time: 1.242694 ms, Points in Range = 162 | Quadtree Search Time: 0.471734 ms, Points in Range = 162 | Quadtree AABBs = 1164 | Quadtree checks = 165 | Accepted points 2000/2000 | Mesh ste...

TODOs with the Quadtree implementation

Now get the release of my repository and proceed to do the TODOs in SDLQuadtree.cpp

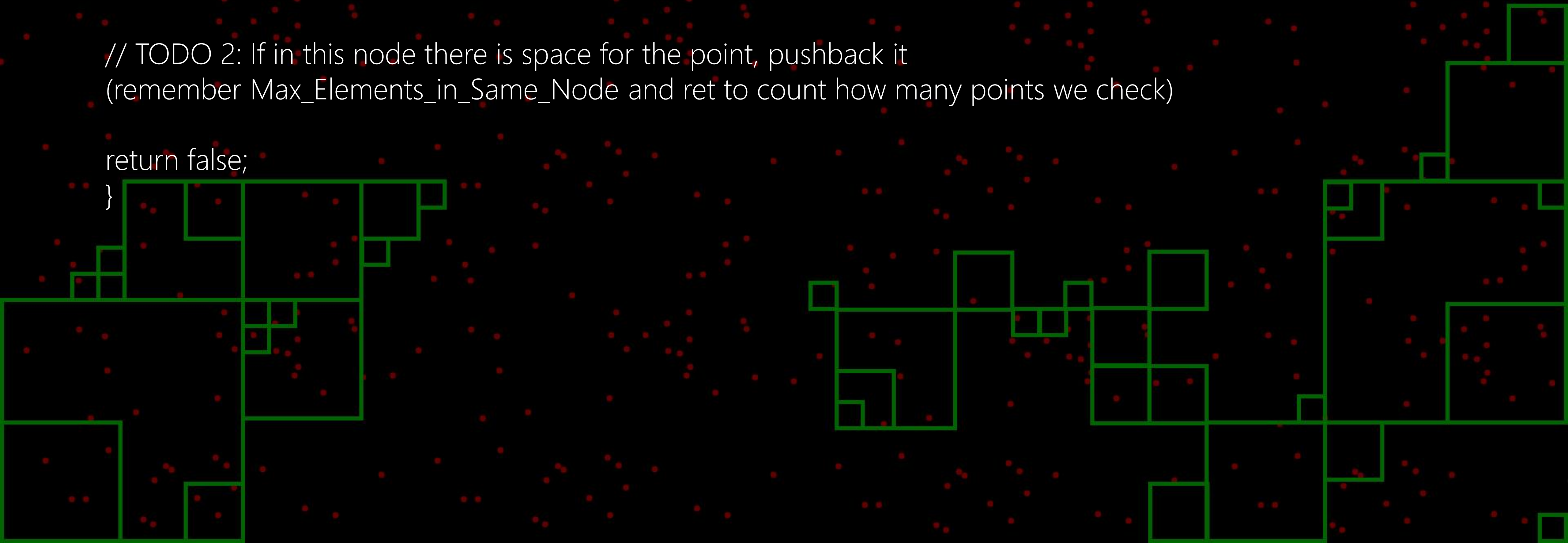
TODO 1

```
bool AABB::Insert(iPoint* newpoint)
{
// TODO 1: If new point is not in the quadtree AABB, return

return false;
}
```



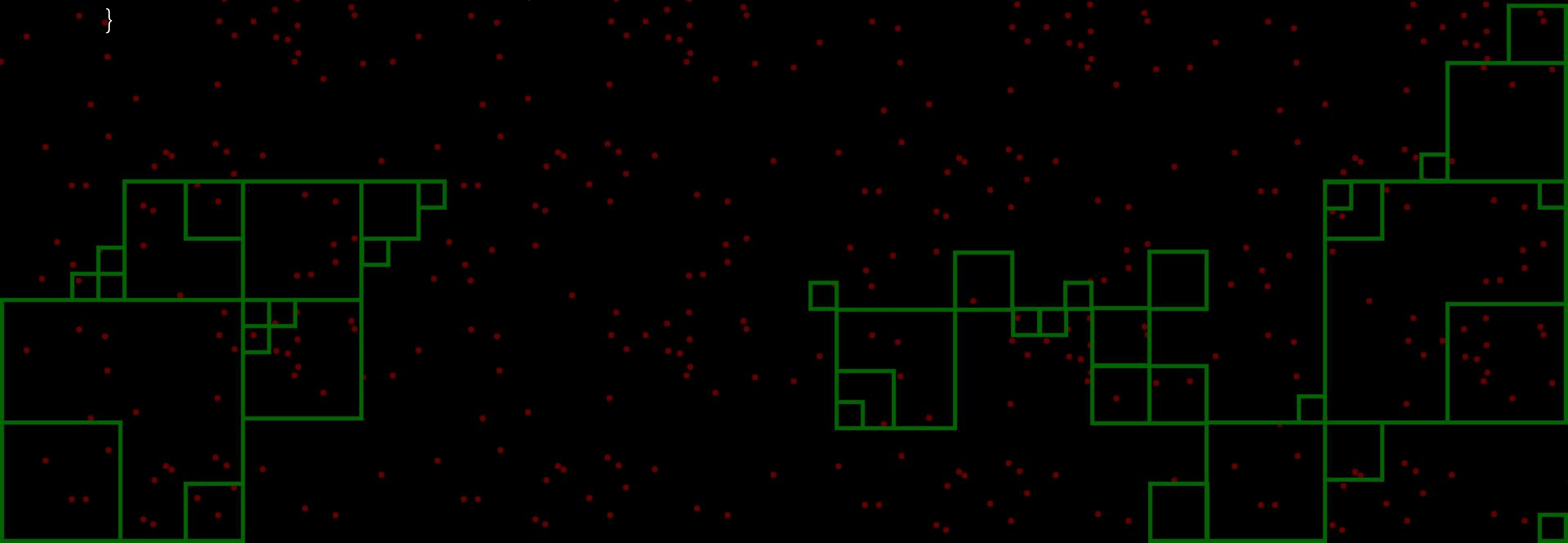
TODO 2

```
bool AABB::Insert(iPoint* newpoint)
{
// TODO 1: If new point is not in the quadtree AABB, return

// TODO 2: If in this node there is space for the point, pushback it
(remember Max_Elements_in_Same_Node and ret to count how many points we check)

return false;
}
```



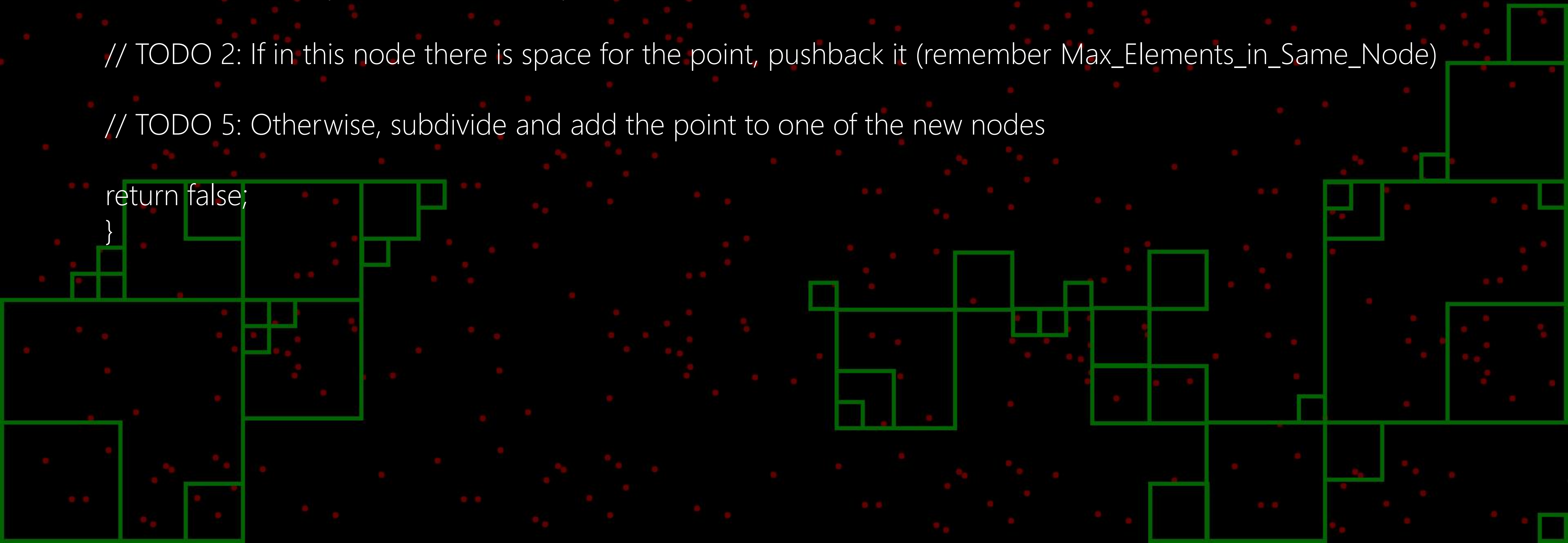
TODO 3

```
void AABB::subdivide()
{
// TODO 3: Calculate the size and position of each of the 4 new nodes
}
```



TODO 4

```
void AABB::subdivide()
{
// TODO 3: Calculate the size and position of each of the 4 new nodes

// TODO 4: Now we have all the positions and size of each number we
// can create each child with its AABB
// ! Don't forget to set child root!
}
```

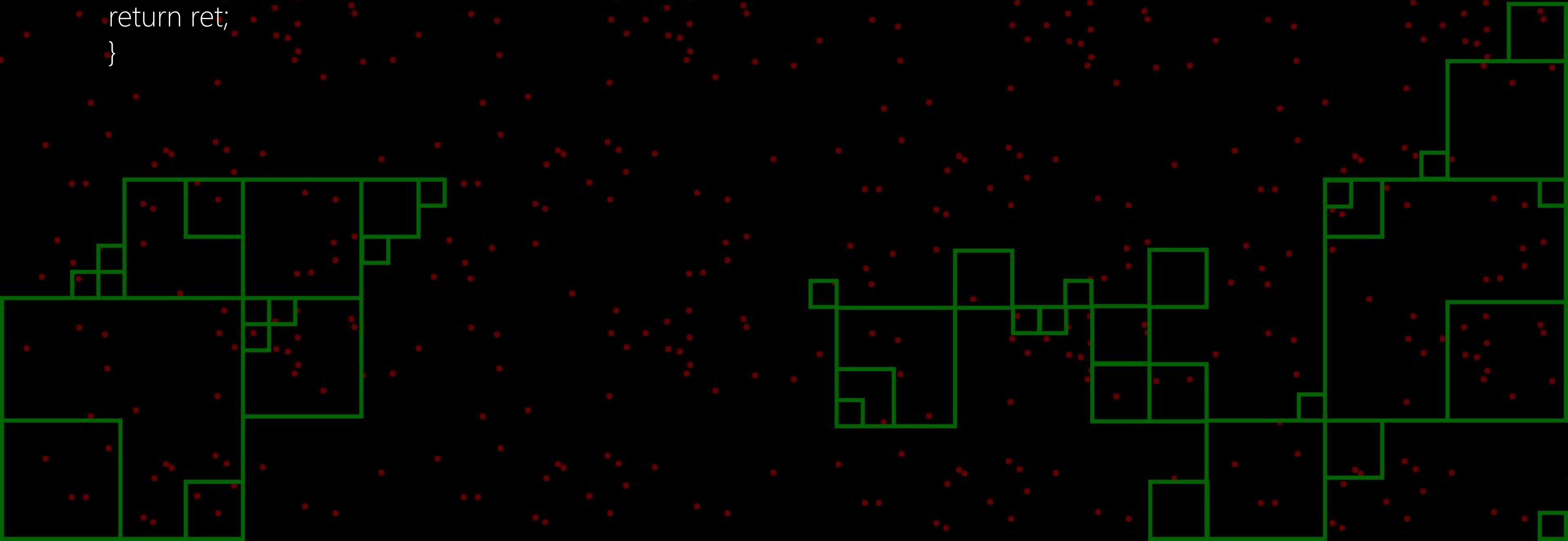


TODO 5

```
bool AABB::Insert(iPoint* newpoint)
{
// TODO 1: If new point is not in the quadtree AABB, return

// TODO 2: If in this node there is space for the point, pushback it (remember Max_Elements_in_Same_Node)

// TODO 5: Otherwise, subdivide and add the point to one of the new nodes

return false;
}
```

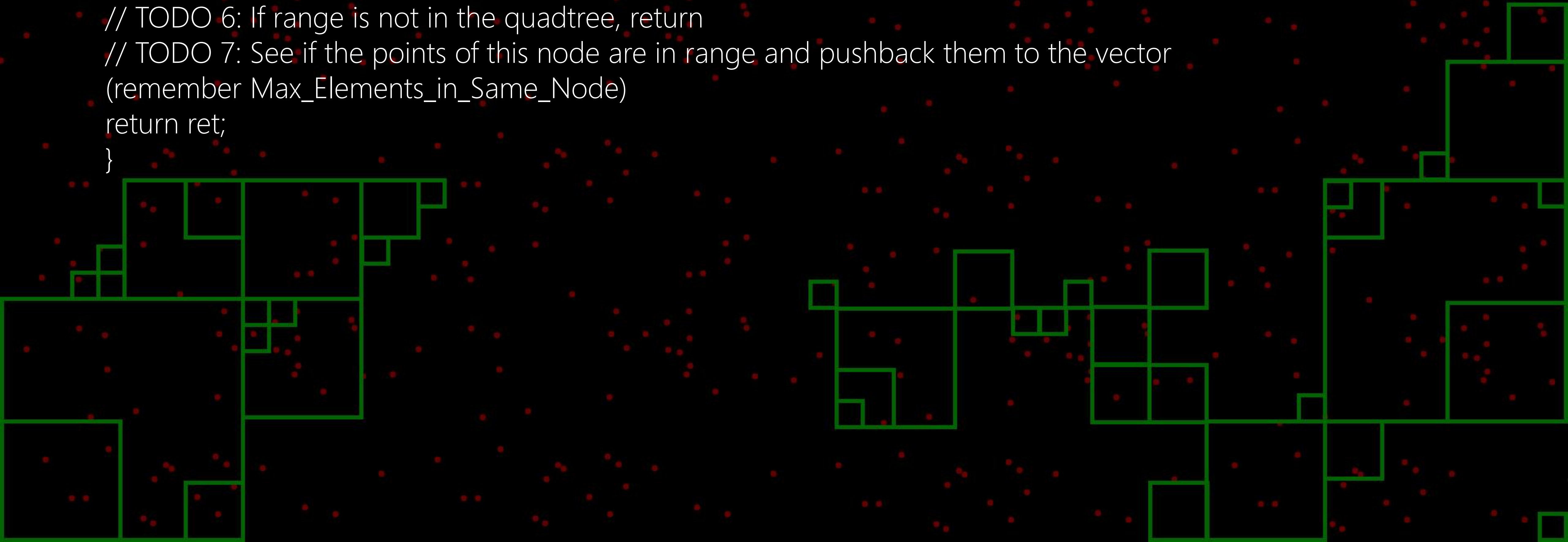
TODO 6

```
int AABB::CollectCandidates(std::vector< iPoint* >& nodes, const SDL_Rect& r)
{
uint ret = 1;
// TODO 6: If range is not in the quadtree, return
return ret;
}
```



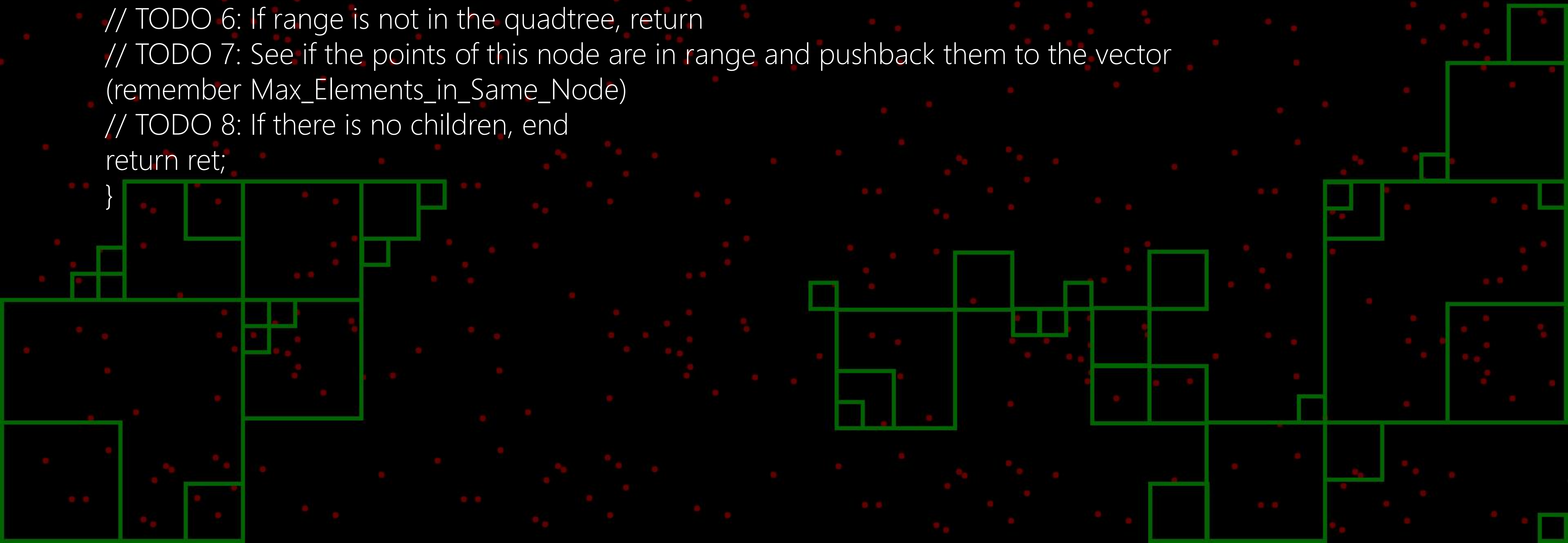
TODO 7

```
int AABB::CollectCandidates(std::vector< iPoint* >& nodes, const SDL_Rect& r)
{
uint ret = 1;
// TODO 6: If range is not in the quadtree, return
// TODO 7: See if the points of this node are in range and pushback them to the vector
(remember Max_Elements_in_Same_Node)
return ret;
}
```



TODO 8

```
int AABB::CollectCandidates(std::vector< iPoint* >& nodes, const SDL_Rect& r)
{
uint ret = 1;
// TODO 6: If range is not in the quadtree, return
// TODO 7: See if the points of this node are in range and pushback them to the vector
(remember Max_Elements_in_Same_Node)
// TODO 8: If there is no children, end
return ret;
}
```

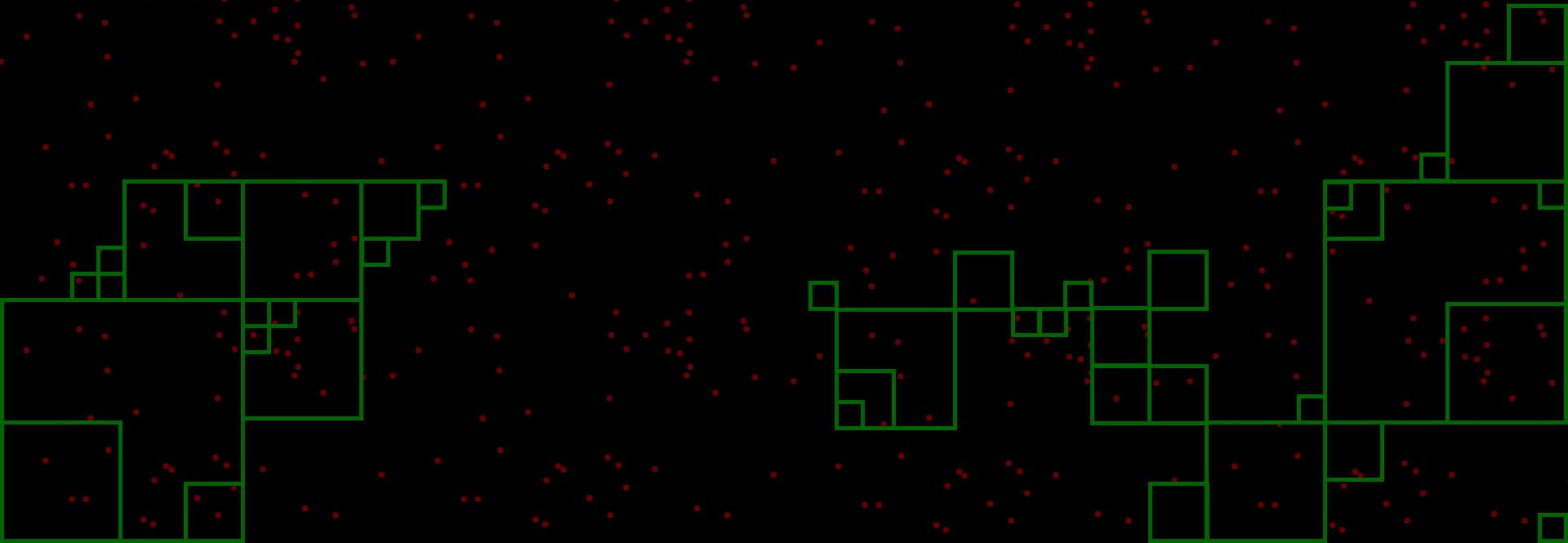


TODO 9

```
int AABB::CollectCandidates(std::vector< iPoint* >& nodes, const SDL_Rect& r)
{
uint ret = 1;
// TODO 6: If range is not in the quadtree, return
// TODO 7: See if the points of this node are in range and pushback them to the vector
(remember Max_Elements_in_Same_Node)
// TODO 8: If there is no children, end
// TODO 9: Otherwise, add the points from the children (Recursive)
return ret;
}
```

Optional Homework

·Moving entities?
Adapt the code for it.
Maybe you will need a Remove method…



Any last question?