QUADTREE VISUALIZER

Major Project

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FINAL PRESENTATION

Group ID: PHI – CS 73

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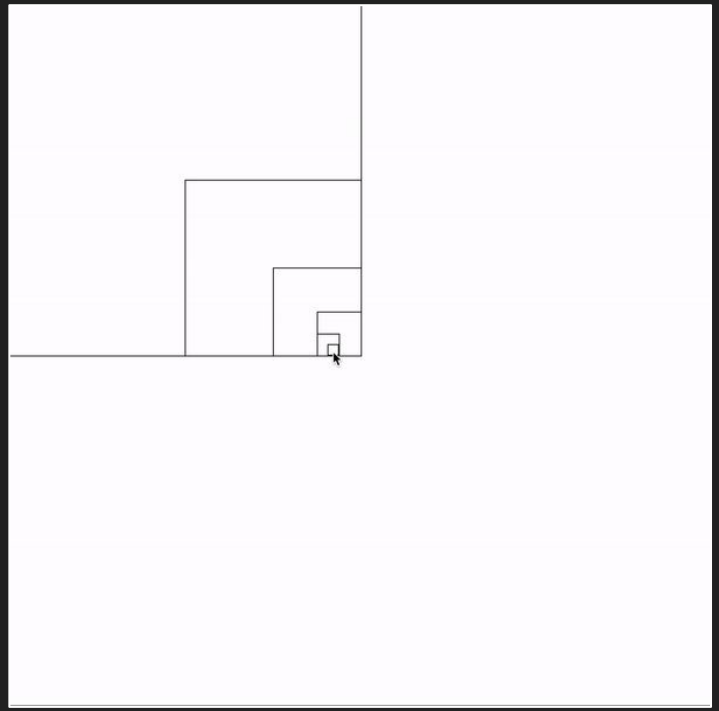
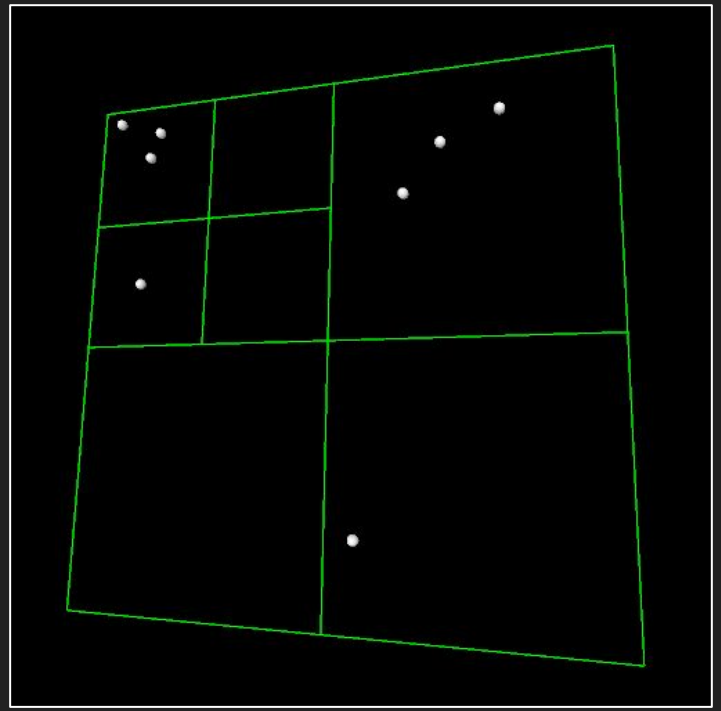




An application capable of presenting a view of the QuadTree.

Design and development of QuadTree view and data model.

ABSTRACT

- Develop a program that can show a QuadTree view and data model architecture using a single global library.

- Many digital map applications have the need to present large quantities of precise point data on the map. Such data can be weather information, the population in towns, etc. With the development of Internet of Things, we expect such data will grow at a rapid pace. How to visualize such magnitude of data on mobile devices and web browsers becomes a problem.

- This project aims to build an efficient library for interactively visualizing such data, using a combination of grid-based clustering and hierarchical clustering, along with quadtree spatial indexing.

PROBLEM STATEMENT

- The importance of data nowadays has increased significantly, as we are living in a data driven society. Many digital map applications have the need to present large quantities of precise point data on the map.
- With the development of the Internet of Things, we expect such data will grow at a rapid pace. However, visualizing and looking for a data point in such a magnitude of data becomes a problem.
- We are proposing the implementation of a quadtree library to visualize data more easily for any users

LITERATURE SURVEY

TYPES – Point Quadtree, Edge Quadtree, Polygonal Map QuadTree.

All forms of quadtrees share some common features:

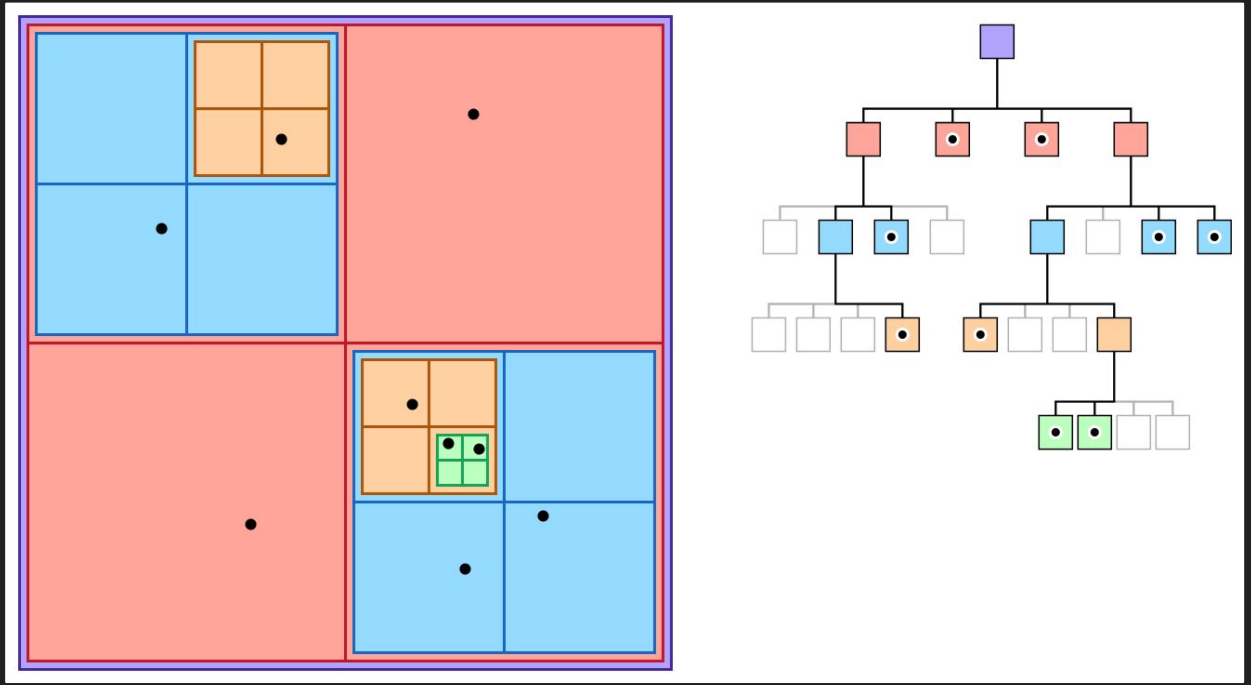
- ➔ They decompose space into adaptable cells.
- ➔ Each cell (or bucket) has a maximum capacity. When maximum capacity is reached, the bucket splits.
- ➔ The tree directory follows the spatial decomposition of the quadtree.

So to speak in layman's term,
A *quadtree* is a tree whose nodes either are leaves or have 4 children.
The children are ordered 1, 2, 3, 4.

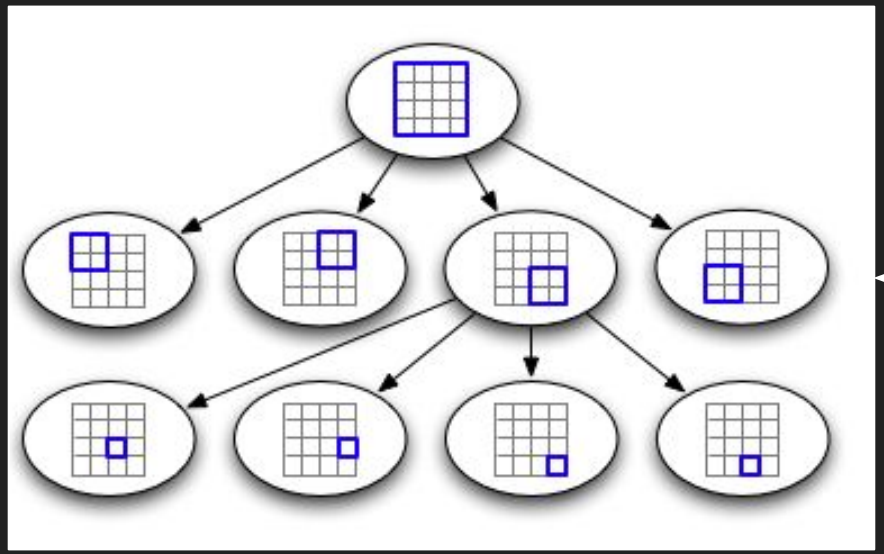
INTRODUCTION

What is QuadTree?

A data structure for organizing objects based on their locations in a two-dimensional space.



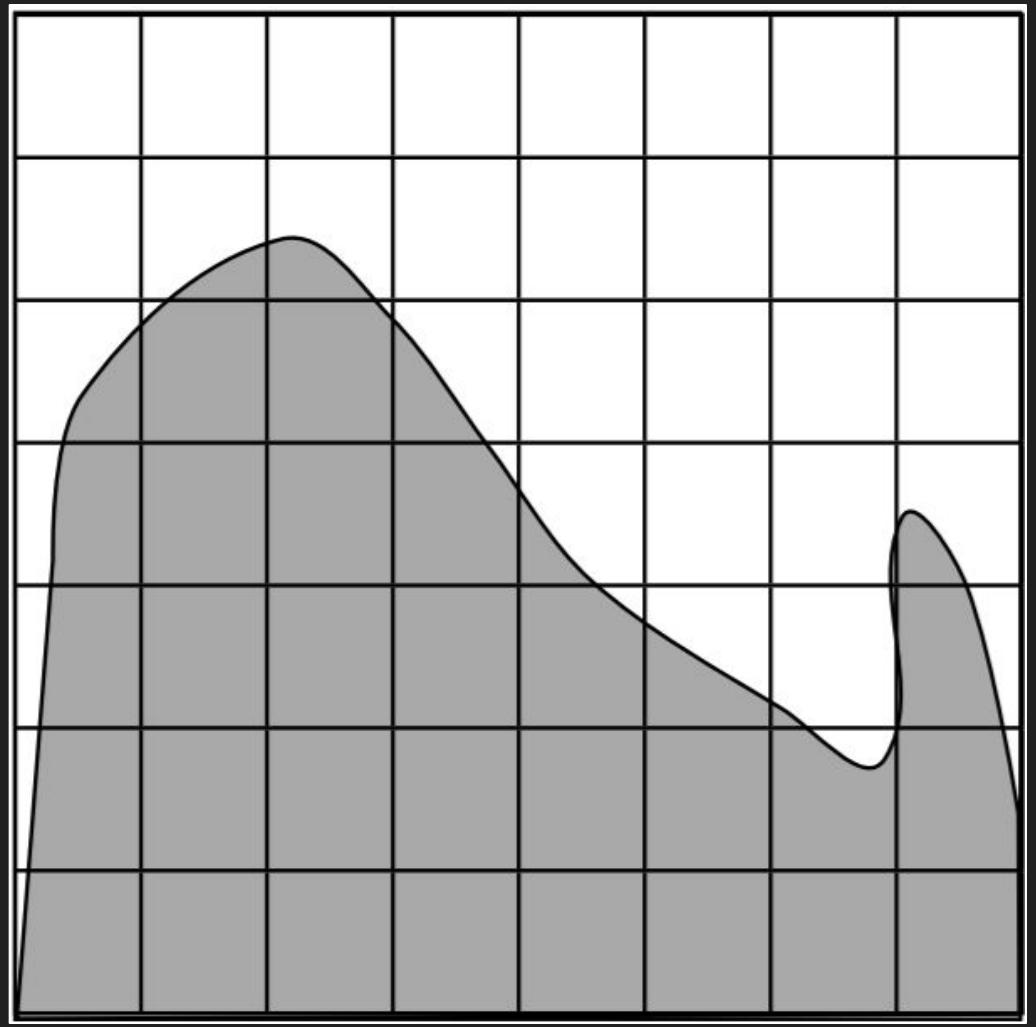
A similar partitioning is also known as a *Q-tree*.



The quadtree partitioning strategy divides space into four quadrants at each level. When a quadrant contains more than one object, the tree subdivides that region into four smaller quadrants, adding a level to the tree.

How does QuadTree Works?

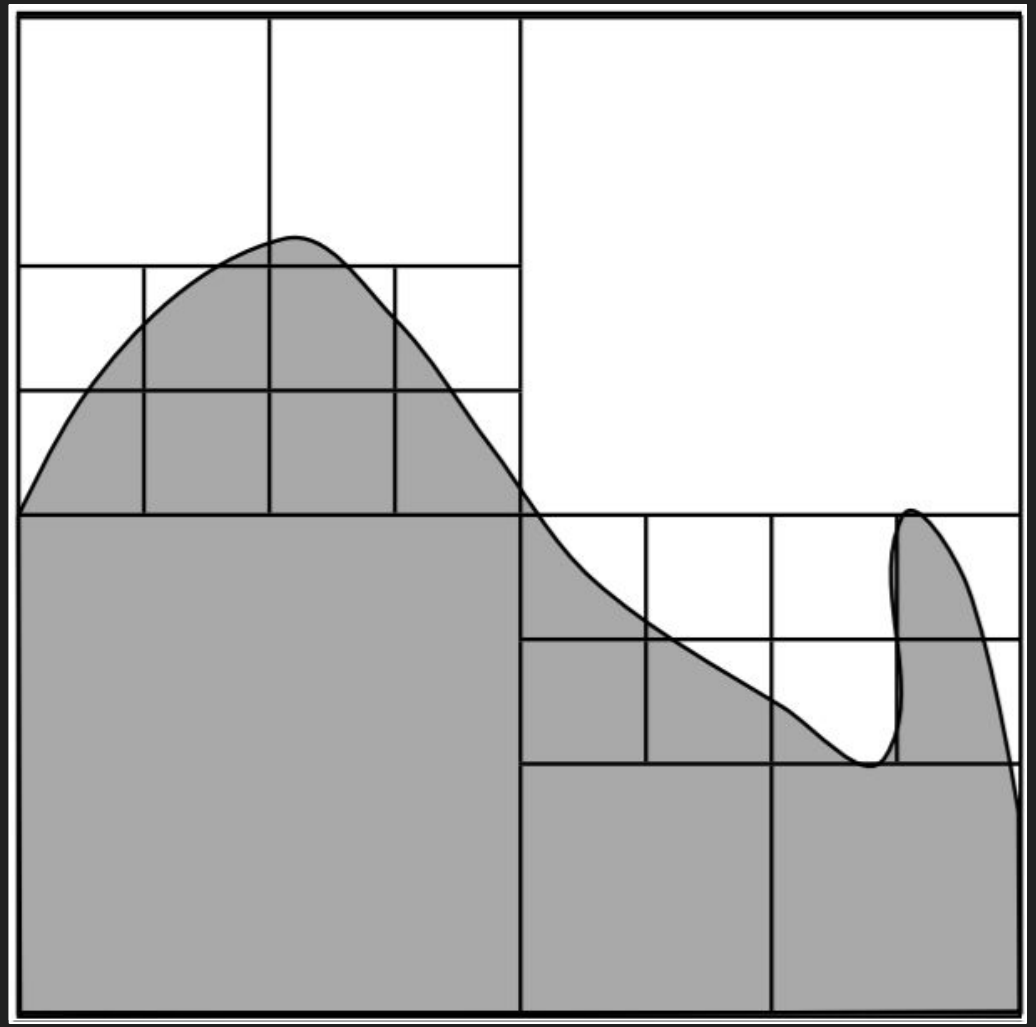
Subdivide into uniform blocks



How does QuadTree Works?

Subdivide into uniform blocks

Merge Similar Brothers

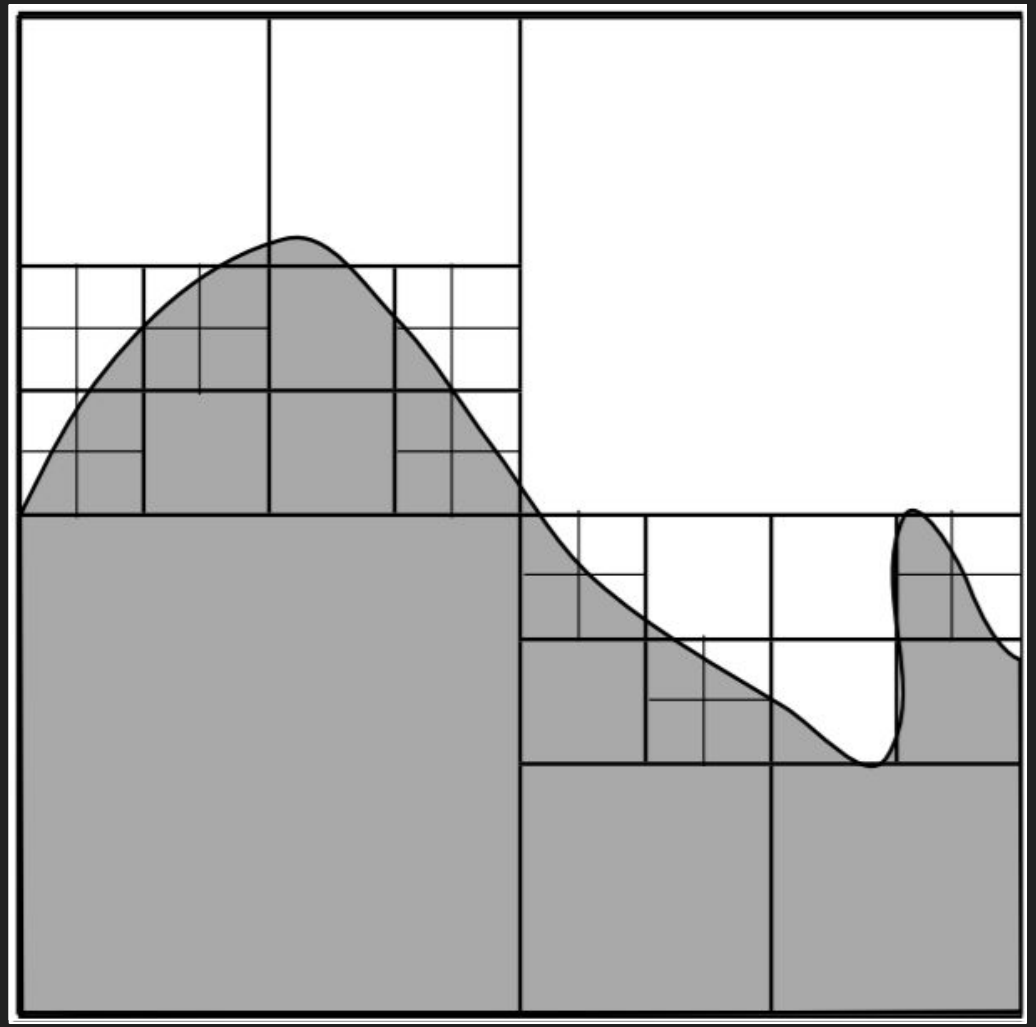


How does QuadTree Works?

Subdivide into uniform blocks

Merge Similar Brothers

Subdivide Non-homogenous Cells



How does QuadTree Works?

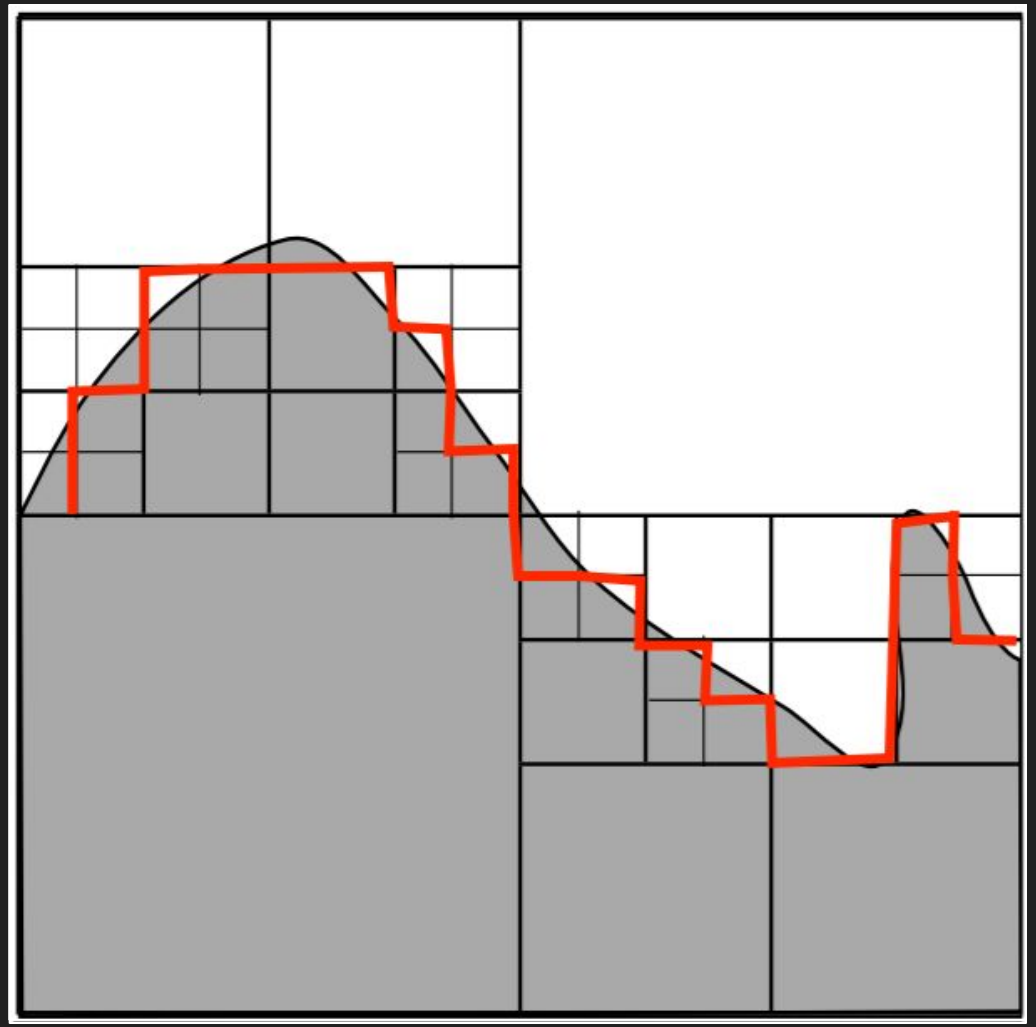
Subdivide into uniform blocks

Merge Similar Brothers

Subdivide Non-homogenous Cells

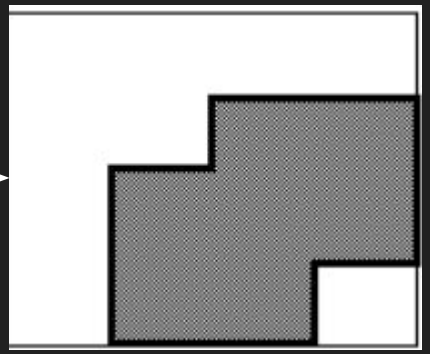
Group Identical Blocks

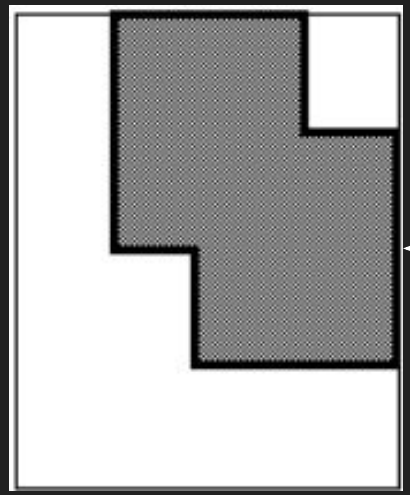
to get regions



LIMITATIONS OF QUADTREE

First Image





Rotated Image

- The main disadvantage of quadtrees is that it is almost impossible to compare two images that differ only in rotation or translation. This is because the quadtree representation of such images will be so totally different.

- The algorithms available for rotation of an image are restricted to rotations of 90 degrees (or multiples thereof). No other rotation is available, nor is there a facility for translation.

OBJECTIVES

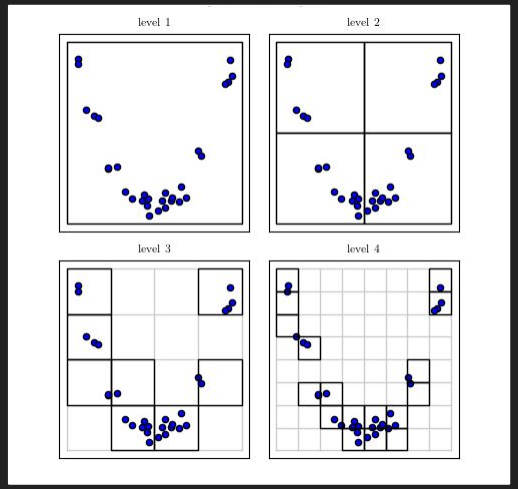
This project's objective is to provide a single global library that can be shared, reused, and readily accessed.

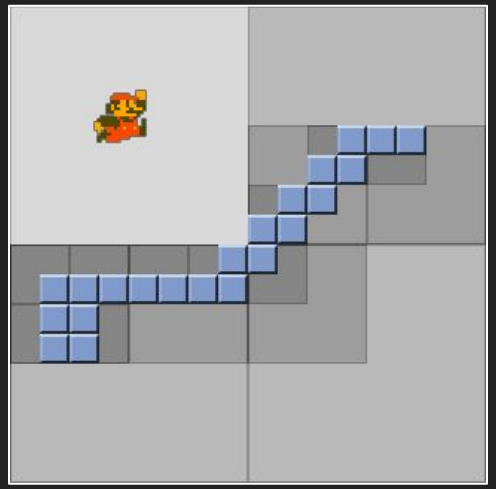
Quadtree aims to be:

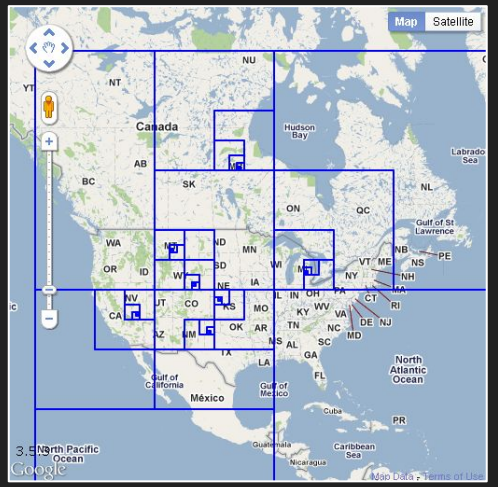
- ➔ Versatile (can be used in dynamic and static contexts)
- ➔ Simple
- ➔ Lightweight
- ➔ Easy to use
- ➔ Fast
- ➔ Header only
- ➔ Implemented with modern C/C++ features

SCOPES OF QUADTREE DATA STRUCTURE

- ➔ Computer Graphics, Games, Movies
- ➔ Computer Vision, CAD, Street Maps (Google Maps/Google Earth)
- ➔ Human-Computer Interface Design (Windowing Systems)
- ➔ Virtual Reality
- ➔ Visualization (Graphing Complex Functions)







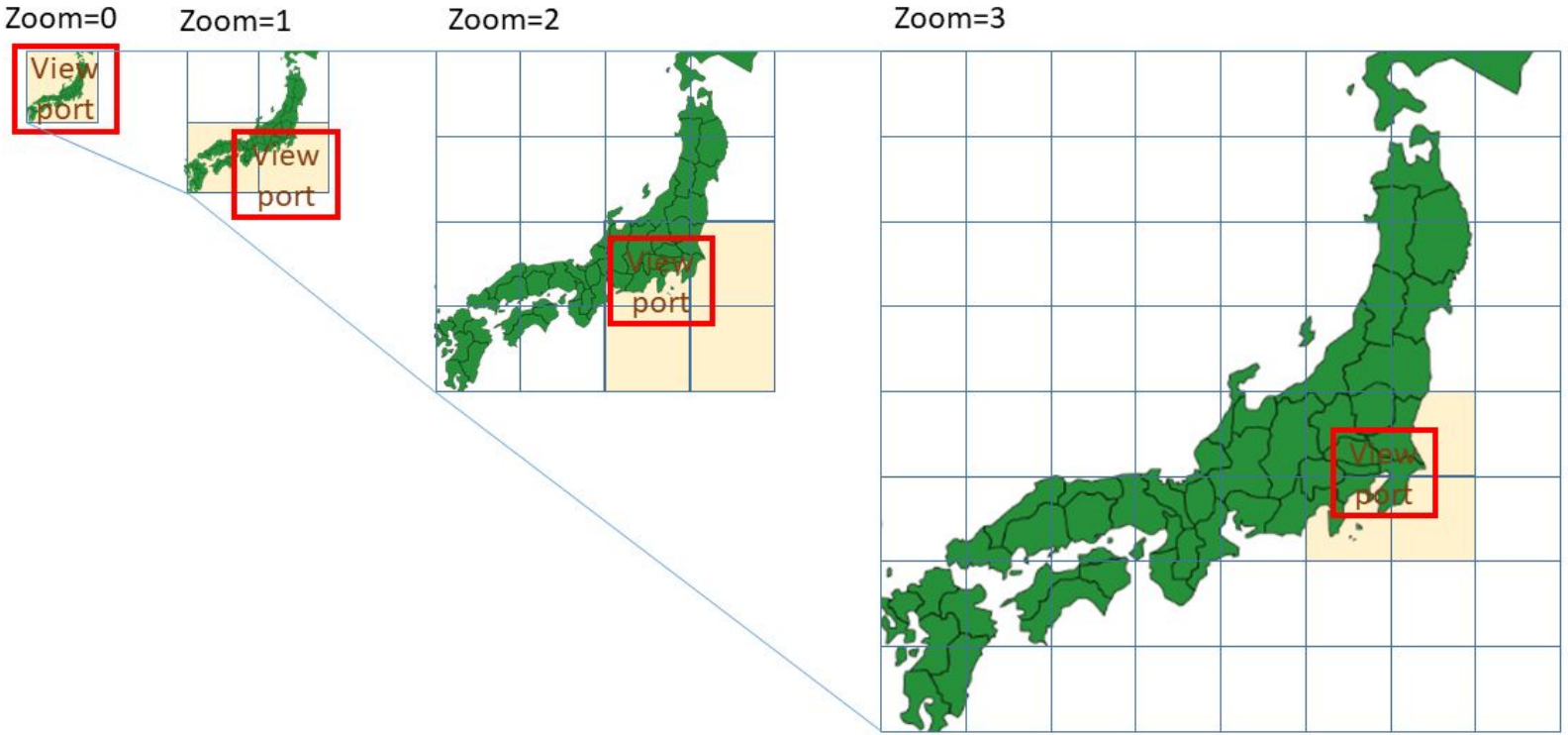
QuadTree Compression of an image

step by step

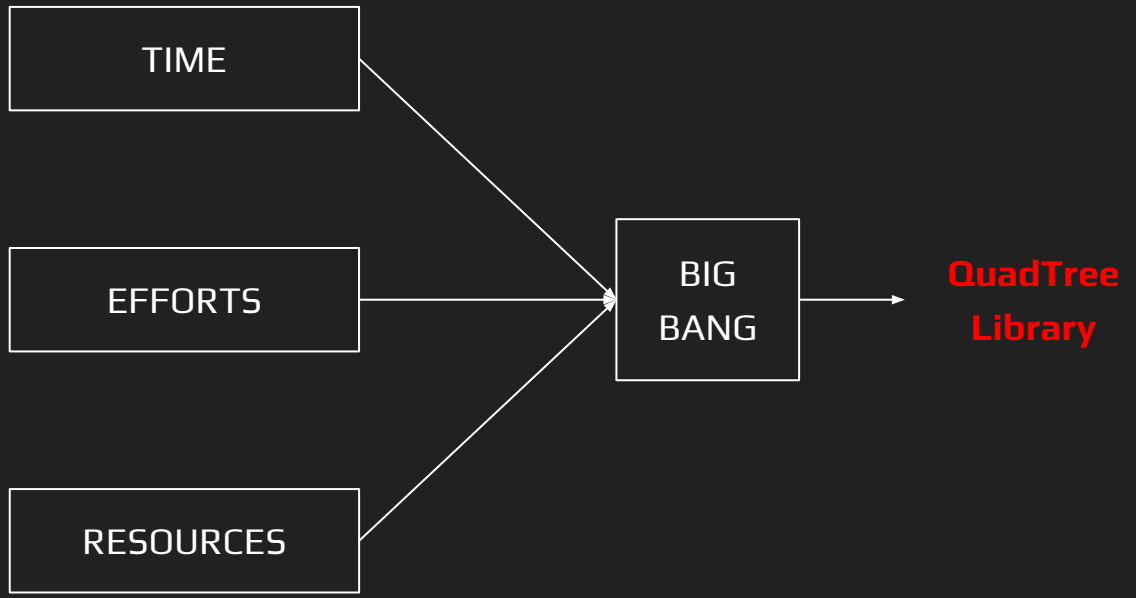
Left shows the compressed image with the tree bounding boxes while the right shows just the compressed image.

Pyramid of tiles

- To be able to read efficiently according to zooming



THE BIG BANG MODEL



REQUIREMENTS, TOOLS AND TECHNOLOGIES

SOFTWARE REQUIREMENTS

- C Compiler
- GNU Make
- X11 window system for graphical output and development libraries

HARDWARE REQUIREMENTS

- 2 GB RAM
- Any Operating System

TOOLS USED

- CMake
- Visual Studio Code
- TinyXML

TECHNOLOGIES USED

- C/C++ Language

PROJECT PLAN

#	Task	Start Date	End Date
1	Understand Object-Oriented Programming in C	17-09-2021	01-10-2021
2	Understand Design Patterns in C	01-10-2021	15-10-2021
3	Learn how to use TinyXml	15-10-2021	29-10-2021
4	Define ADT for QuadTree	29-10-2021	12-11-2021
5	Define the file format for QuadTree	12-11-2021	26-11-2021
6	Get your hands on the pcf_ui library	26-11-2021	10-12-2021
7	Understand the Drawing View Control of pcf_ui	10-12-2021	24-12-2021
8	Sequence diagram for your final application	24-12-2021	08-01-2022
9	Implement the Visualizer	08-01-2022	05-02-2022
10	Design the architecture of the application	05-02-2022	12-02-2022

EXPECTED OUTCOMES

- A generic Quadtree library in C language, which can be used by anyone to visualize a quadtree.
- The library should be easy to use and the visualisation must be simple yet functional.
- Users should be able to perform basic functions such as adding, deleting, updating new data points as well as searching for a particular point.

CONCLUSION

By the time of completion of this project, we'll be able to develop a full-featured, scalable, multi-purpose library for Quadtree implementations in C language alongside understanding the principles of object-oriented philosophy and design thinking in writing production-grade programs.

REFERENCES

- Q. Cai and Y. Zhou, "A quadtree-based hierarchical clustering method for visualizing large point dataset," 2016 Sixth International Conference on Information Science and Technology (ICIST), 2016, pp. 372-375, doi: 10.1109/ICIST.2016.7483441.

- “An effective way to represent quadtrees” Communications of the ACM, Volume 25, Issue 12, Dec 1982 pp 905–910, doi:10.1145/358728.358741

- “Optimal quadtree construction algorithms” Computer Vision, Graphics, and Image Processing, Volume 37, Issue 3, March 1987, pp 402–419, doi:10.1016/0734-189X(87)90045-4

THANK YOU