QuadTree Visualizer

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Review - III Presentation
Group ID: PHI–CS-73

Under the Guidance of :
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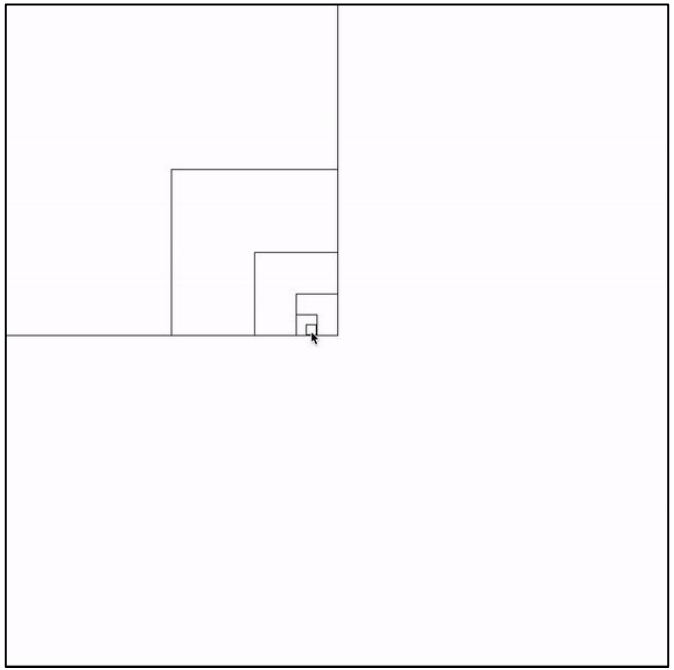
PROJECT GOAL

An application capable of presenting a view of the QuadTree.

Design and development of QuadTree view and data model.



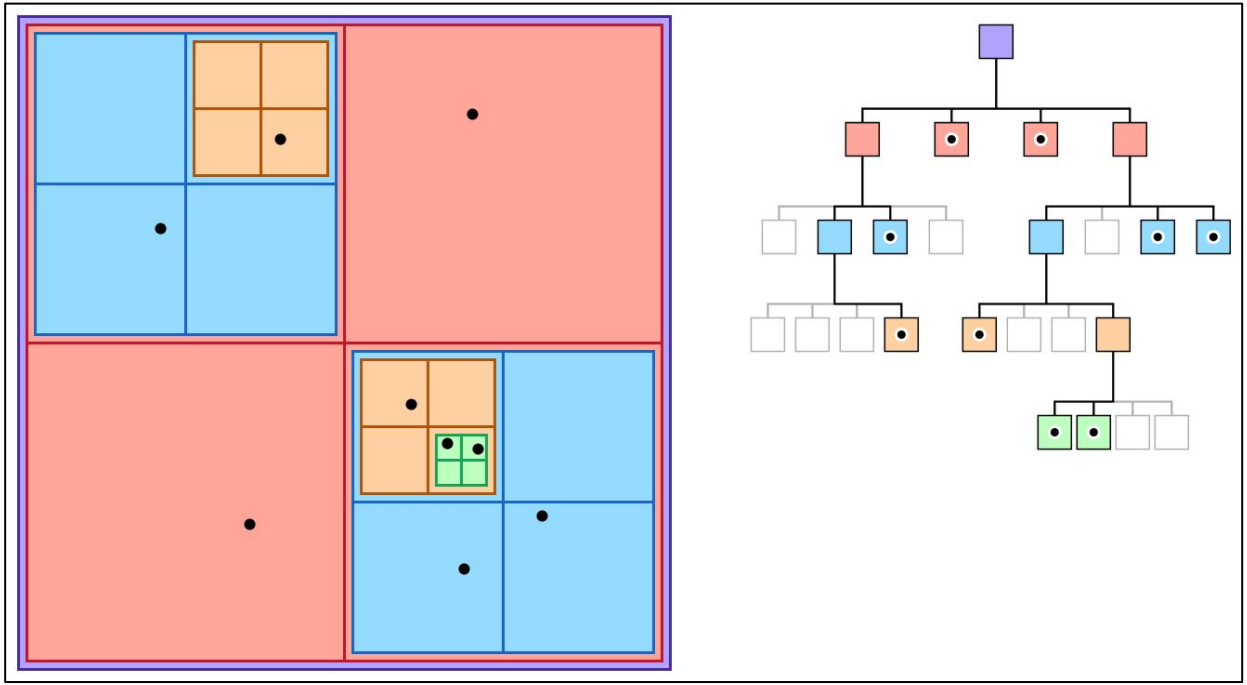
ABSTRACT

- Develop a program that can show a QuadTree view and data model architecture. 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 becomes a problem. This project aims to build an efficient visualizer for interactively visualizing such data, using a combination of grid-based clustering and hierarchical clustering, along with quadtree spatial indexing.

INTRODUCTION

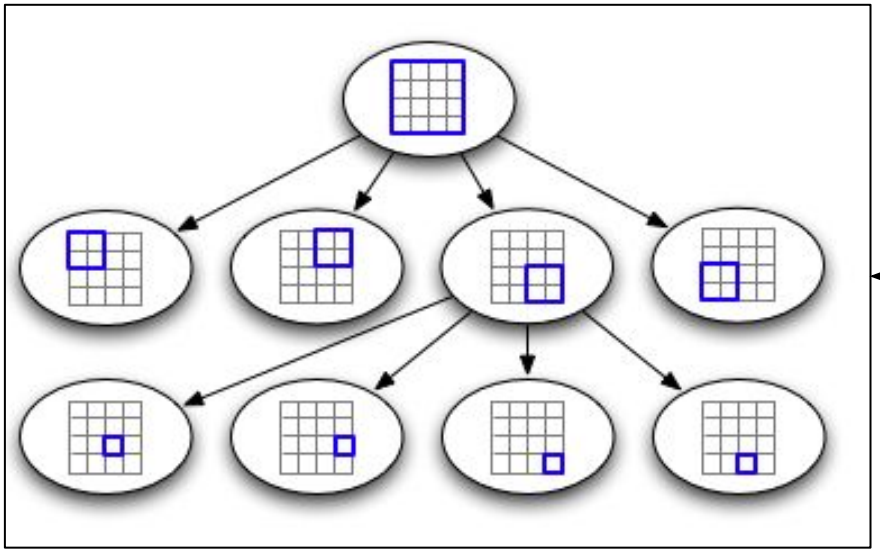
What is QuadTree?

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



INTRODUCTION

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.

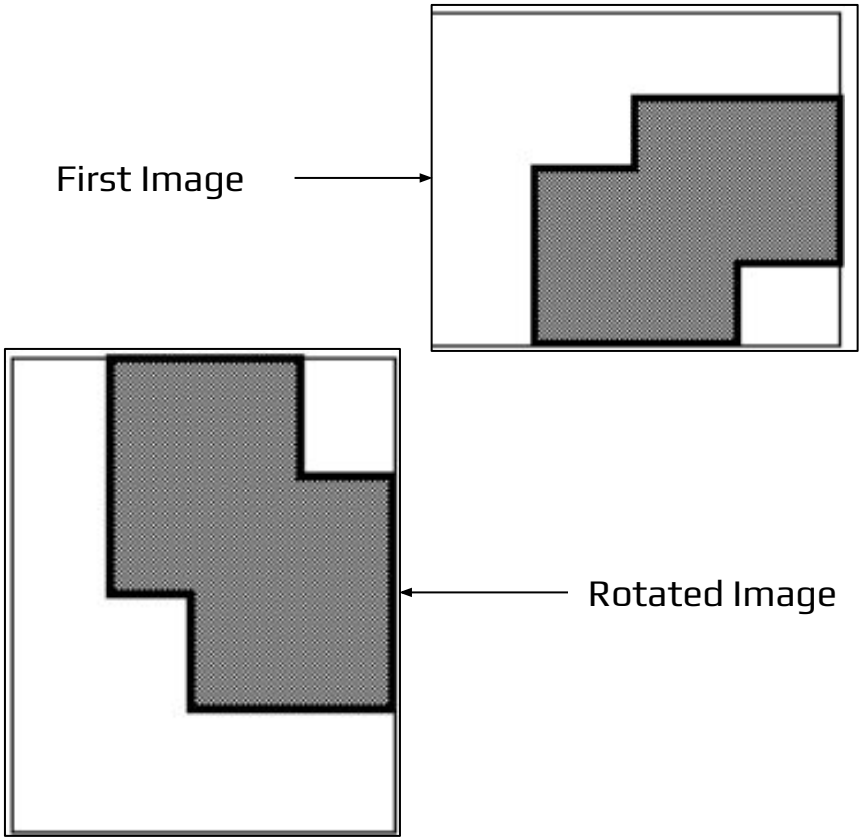
INTRODUCTION

- Types of QuadTree**:**
  - ➔ 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.

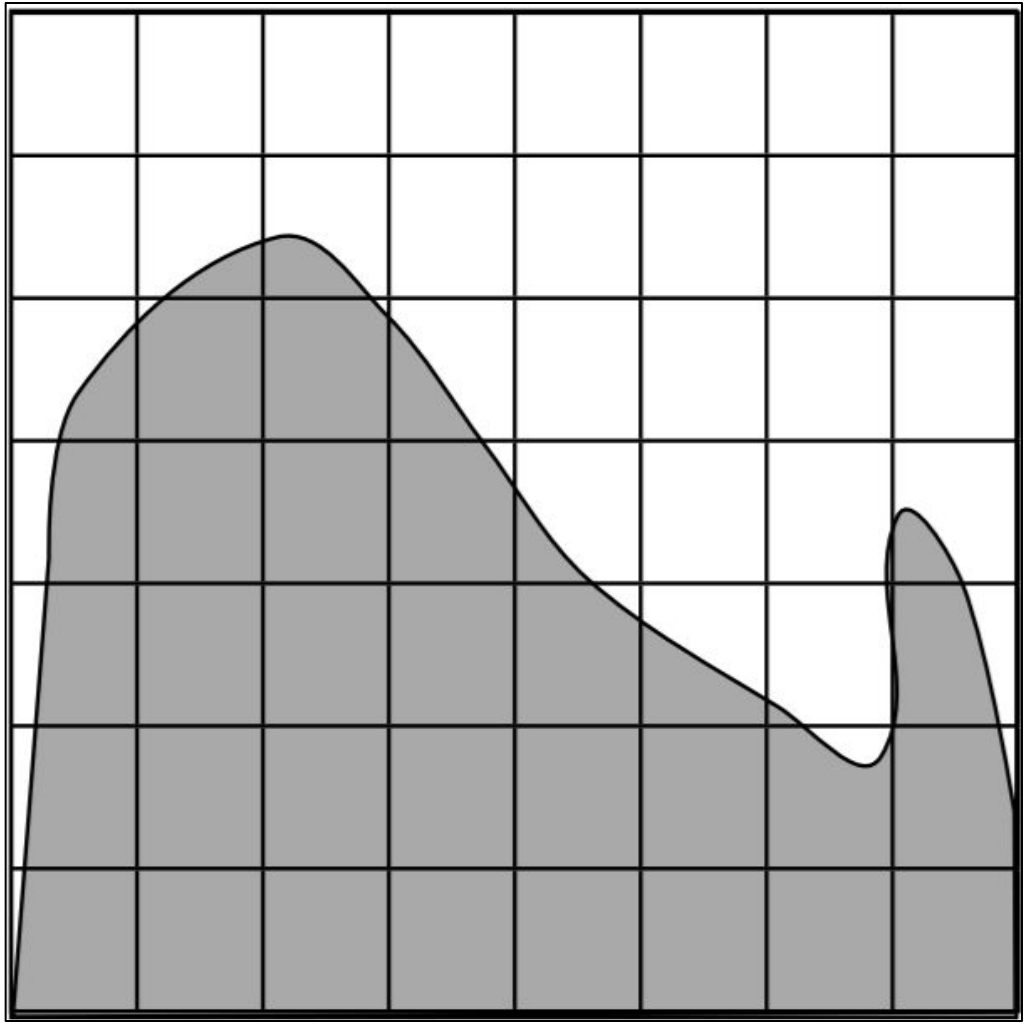
LIMITATIONS OF QUADTREE



- ➔ 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.

How does QuadTree Works?

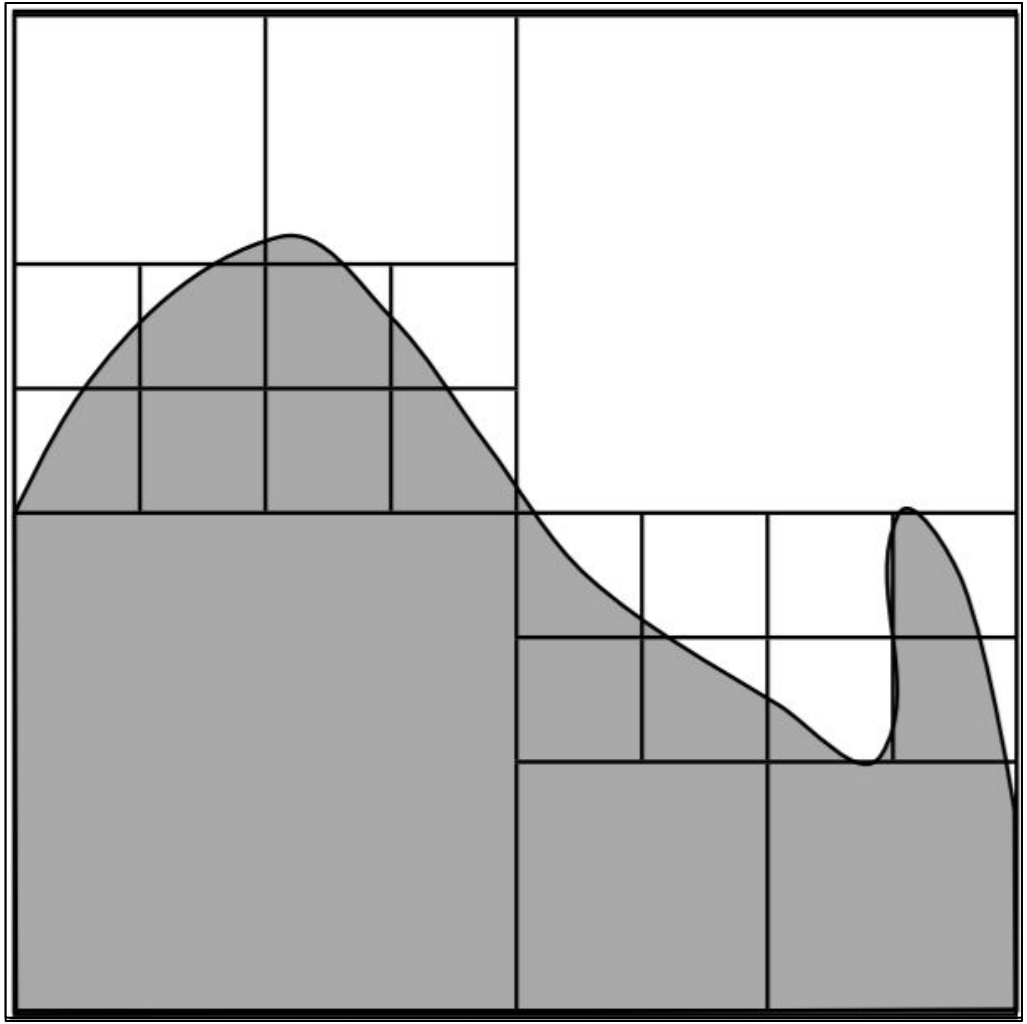
Subdivide into uniform blocks



How does QuadTree Works?

Subdivide into uniform blocks

Merge Similar Brothers

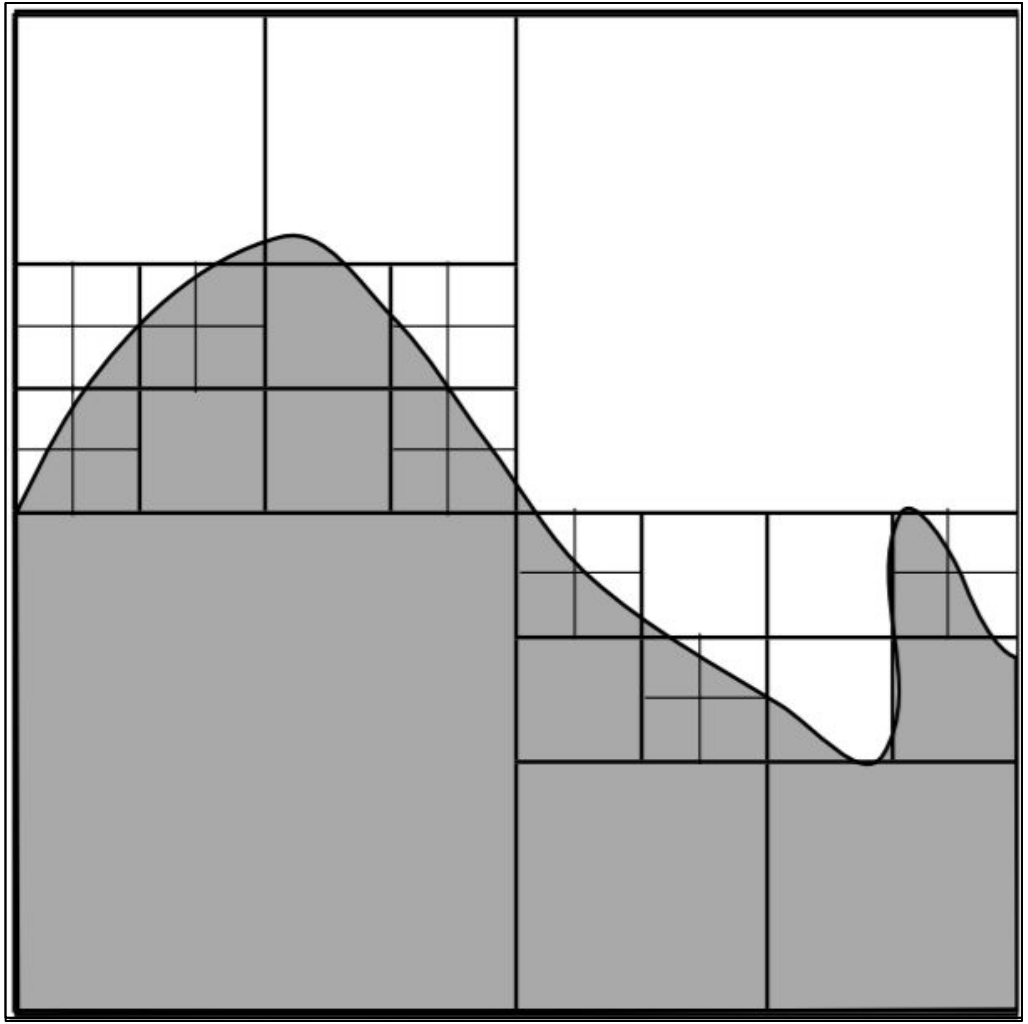


How does QuadTree Works?

Subdivide into uniform blocks

Merge Similar Brothers

Subdivide Non-homogenous Cells



How does QuadTree Works?

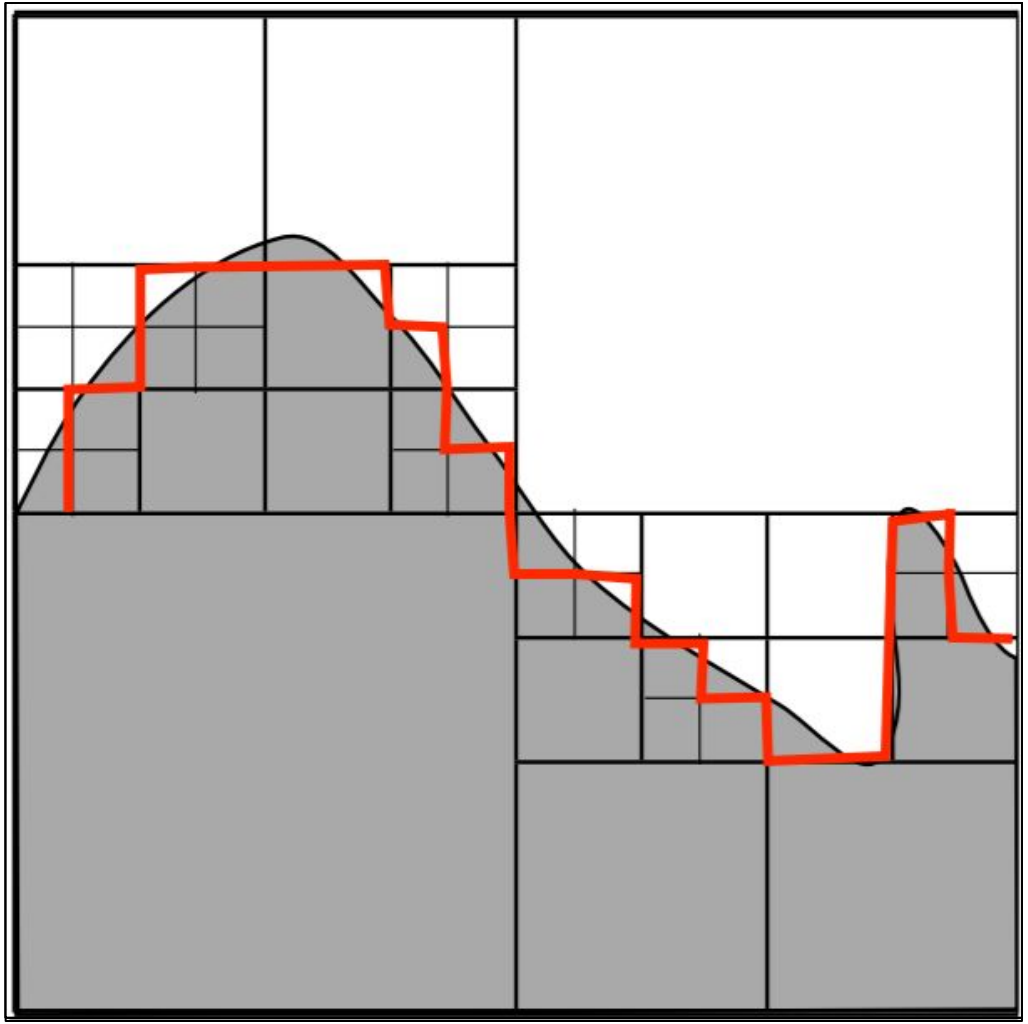
Subdivide into uniform blocks

Merge Similar Brothers

Subdivide Non-homogenous Cells

Group Identical Blocks

to get regions



USE CASES OF QUADTREE

- Use Cases of QuadTree includes:

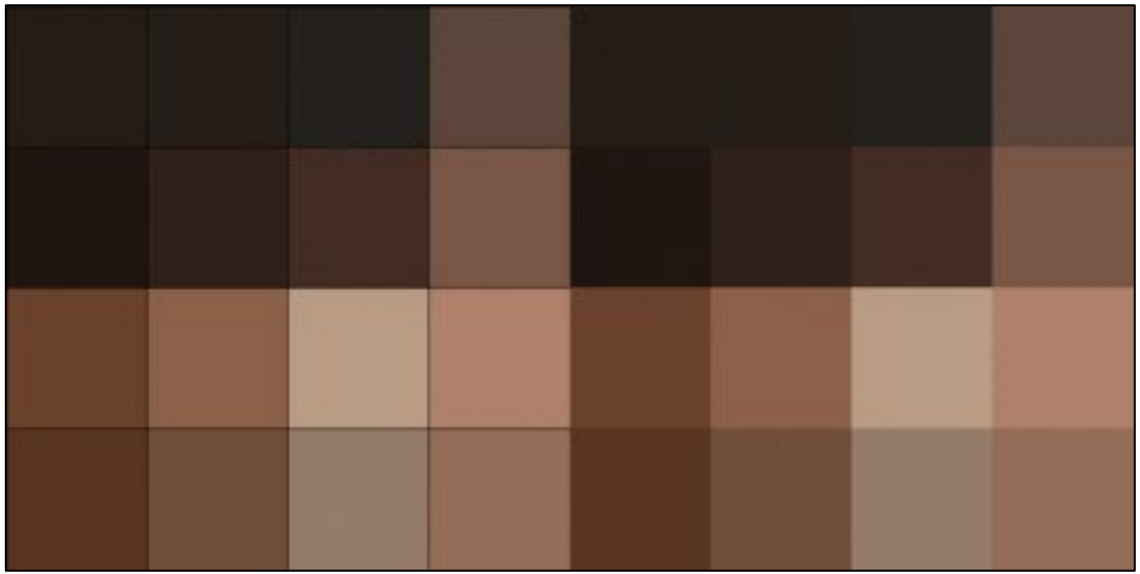
  ➔ Image Processing

  ➔ Sparse Data Storage

  ➔ Spatial Indexing

USE CASE - 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.

LITERATURE SURVEY

Author's Name	Title and Year of Publication	Findings
Qing Cai, Yimin Zhou	A quadtree-based hierarchical clustering method for visualizing large point dataset, 2016	This paper introduces a new clustering method with quadtree spatial indexing. It explains a grid-based, partitioning, hierarchical clustering method on quadtree file system storage.
Clifford A.Shaffer, Hanan Samet	Optimal quadtree construction algorithms, 1987	In this paper, an algorithm is for constructing a quadtree in time proportionate to the number of blocks in a given picture is described.
Irene Gargantini	An effective way to represent quadtrees, 1982	This paper proposes a new structure very similar to quadtree, called as "linear quadtree" and different algorithms used to represent that structure. The linear quadtree saves 66% of the computer storage required by regular quadtrees.

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 visualizer to visualize data more easily for any programmers.

OBJECTIVES

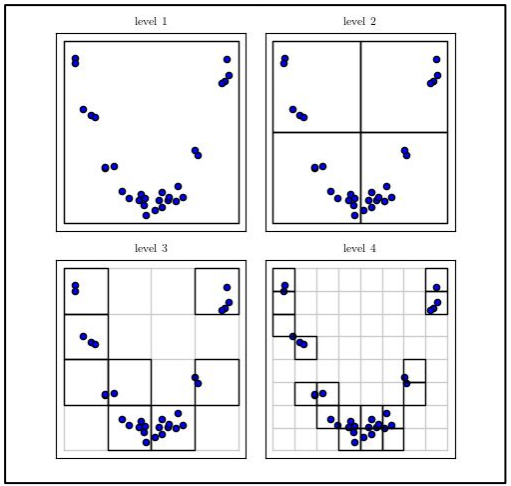
This project's objective is to implement a quadtree visualizer that can be helpful in understanding working of QuadTree.

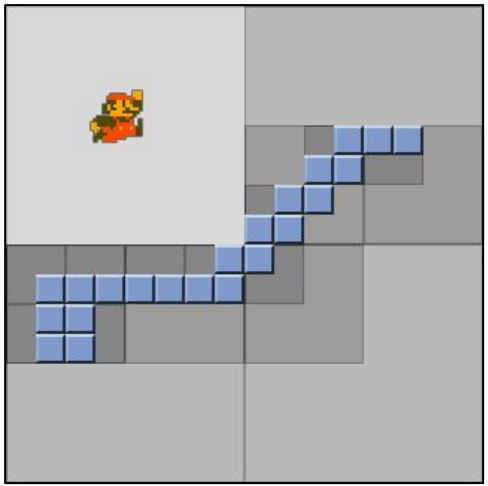
QuadTree aims to be:

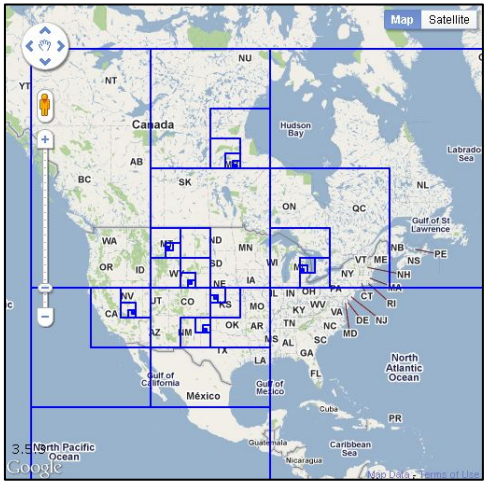
- ➔ Versatile (can be used in dynamic and static contexts)
- ➔ Simple
- ➔ Lightweight
- ➔ Easy to use
- ➔ Fast

SCOPE

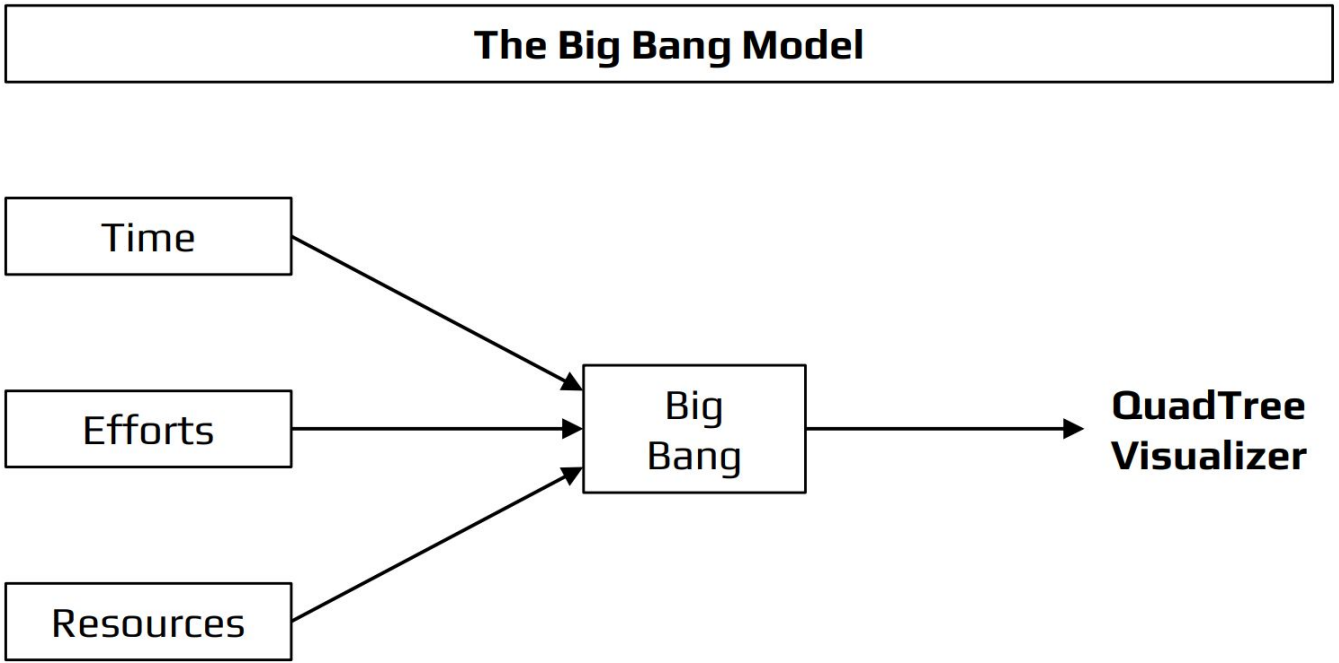
- ➔ Computer Graphics, Games, Movies
- ➔ Computer Vision, CAD, Street Maps (Google Maps/Google Earth)
- ➔ Visualization (Graphing Complex Functions)







THE BIG BANG MODEL



THE BIG BANG MODEL

- There is no planning required for this.
- Suitable for small projects.
- Very few resources are required.
- As there is no proper planning hence it does not require managerial staffs.
- Easy to implement.
- It develops the skills of the newcomers.
- Very much flexible for the developers working on it.

REQUIREMENTS, TOOLS & TECHNOLOGIES

SOFTWARE REQUIREMENTS

- ➔ GitHub
- ➔ VSCode
- ➔ Web Browser

HARDWARE REQUIREMENTS

- ➔ 4 GB RAM
- ➔ Any Operating System

TOOLS USED

- ➔ NPM Dependencies
- ➔ CMD/Terminal

TECHNOLOGIES USED

- ➔ HTML 5.0
- ➔ CSS 3.0
- ➔ JavaScript, v. ES13
- ➔ TypeScript, v.4.6.3
- ➔ Node.js, v17.9.0
- ➔ Next.js, v10.0.5
- ➔ React, v17.0.1

PROJECT PLAN

QuadTree Visualizer

By Amey Thakur, Hasan Rizvi, Mega Satish & Ajay Davare

Project Start: Wed, 9-15-2021

Display Week: 22

TASK	PROGRESS	START	END
Research Paper			
Conceptual understanding	100%	9-15-21	9-30-21
Literature Survey	100%	10-1-21	10-22-21
High-level analysis of algorithm	100%	10-23-21	11-12-21
Problem Statement			
Comprehensive Study of Core Concepts and Terminologies	100%	11-13-21	11-28-21
Design			
Define Wokflow	100%	11-29-21	12-13-21
Design Architecture	100%	12-14-21	12-28-21
Selection of Necessary Tools and Technologies	100%	12-15-21	12-29-21
Implementation			
Selection of Server Hosting	100%	12-30-21	1-14-22
Server Configuration	100%	1-15-22	1-30-22
Deployment of Core Module	100%	1-31-22	2-21-22
Deployment of Supporting Modules	100%	2-22-22	3-9-22
Final Deployment	100%	3-10-22	3-25-22

GANTT CHART

Display Week: 18

TASK	PROGRESS	START	END
Research Paper			
Conceptual understanding	100%	9-15-21	9-30-21
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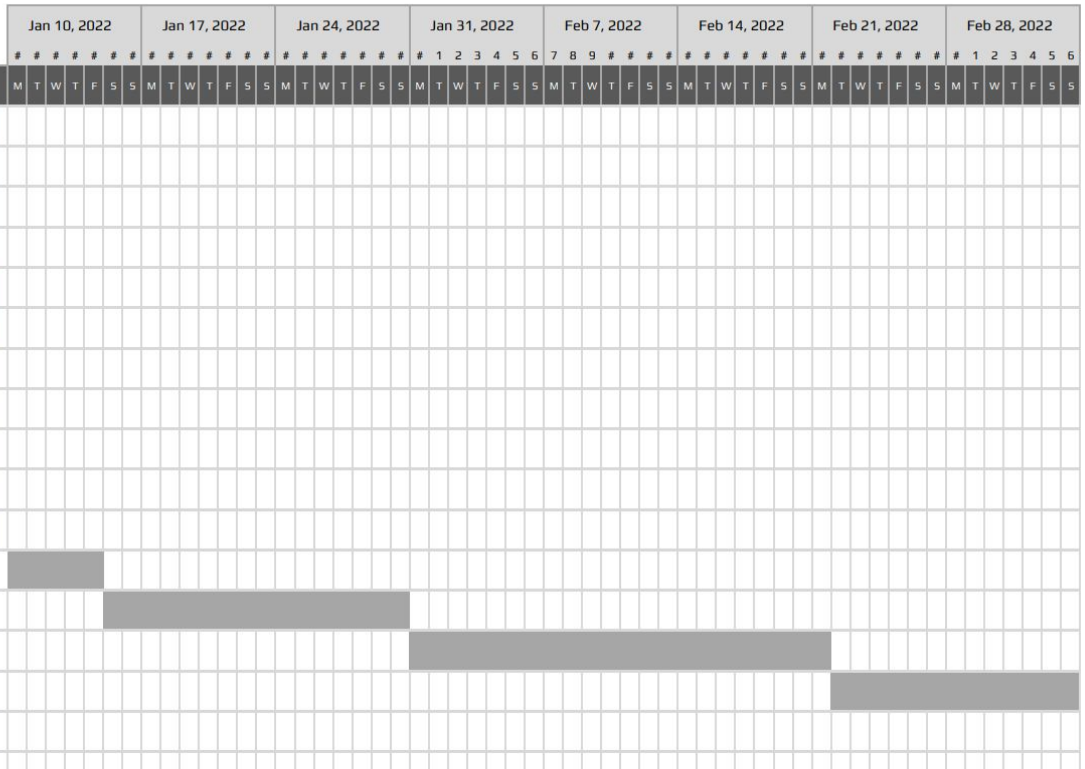

EXPECTED OUTCOMES

- A generic Quadtree Visualizer Web App, which can be used by anyone to visualize a quadtree.

- The application should be easy to use and the visualisation must be simple yet functional.

- Users should be able to manipulate the quadtree by adding, deleting the data points.

CONCLUSION

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

REFERENCES

[1] 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.

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

[3] “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