A Reactive Data Structure for Geographic Information Systems

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January 10, 1989

Abstract

We introduce a Reactive Data Structure, that is a spatial data structure with detail levels. The two properties, spatial organization and detail levels, are the basis for a Geographic Information System with a multi-scale database. A reactive data structure is a novel type of data structure cartering to S It is presented here as a modification of the binary space partioning tree that includes detail levels. This tree is one of the few spatial data structures that do not organize the space in a rectangular manner. An application of the reactive data structure in thematic mapping is given.

1 Introduction

In the past few years there has been a growing interest in Geographic Information Sys tems (GISs). There are many applications that use GIS technology, among them: Au tomated Mapping / Facility Management (AM/FM); Command, Control and Com munication Systems (C3S); War Gaming; and Car or Ship Navigation Systems. A major advantage of a GIS over the paper map is that the operator (end-user) can in teract with the system. To make this interaction both possible and efficient, the GIS has to be based on an appropriate data structure. However, most existing systems lack these data structures. We introduce the term Reactive Data Structure for a data structure with the following two properties:

Describe the context and motivation of your paper.

1.1 Spatial organization:

This is necessary for efficient implementation of operations such as: selection of all objects within a rectangle, picking an object from the display, map overlay computations, and so on [10]. Several spatial data structures are described in the literature and are implemented in existing GISs

1.2 Detail levels:

Too much details on the display will hamper the operator's per ception of the important information. Also, unnecessary details will slow down the drawing process. When the operator wants to take a closer look at a part Spatial organization: This is necessary for efficient implementation of operations such as: selection of all objects within a rectangle, picking an object from the display, map overlay computations, and so on [10]. Several spatial data structures are described in the literature and are implemented in existing GISs
This is a simple table:

Table 1: A caption.

1	2	3	4
a	b	c	d
e	f	g	h

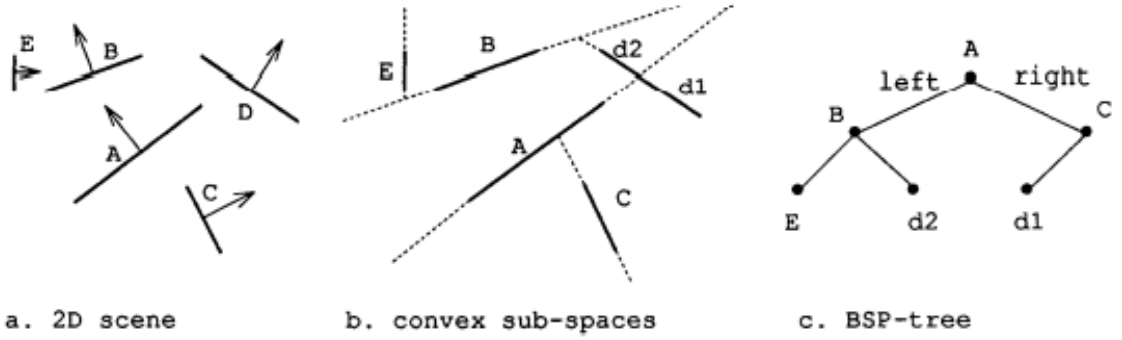

Figure 1:

[b]0.45

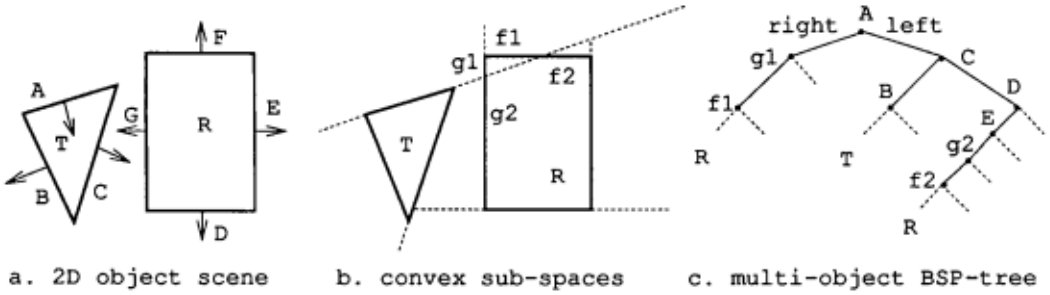

Figure 2:

2 The basic spatial operation

In this section we will explain how the (multi-object) BSP-tree is used in implementing two spatial operations: the pick and the rectangle search

2.1 The pick operation

A map is displayed on the screen. The user selects a point P = (x,y) with an input device such as a mouse or tablet. He wants to know which object he pointed at. To solve this problem we have to locate point P in the tree. This is done by descending.

2.2 Eqation

$$y^2 = 2x + 3 \tag{1}$$

3 Results and discussion

The data structure we presented is one of the few that combines the two difficult requirements: spatial organization and detail levels. The reactive BSP-tree fulfills, up to a certain extend, those requirements. The BSP-tree also introduces some problems, as we have seen in the previous sections. And we can think of more problems: How should a single unconnected point be stored in the BSP-tree? How can the BSPtree be balanced? How will the BSP-tree behave if we insert very large amounts of irregular geometric data? The BSP-tree is a static data structure. This is not really a problem, because the maps in most GIS applications are also static. In order to gain experience we are currently working on a prototype GIS that is based on a BSP-tree. We are interested in the size and the performance of the BSP-tree. We know that the BSP-tree is far from perfect, but we hope that is serves as a source of inspiration to generate

more ideas. A reactive data structure need not be based on a BSP-tree, other solutions are possible. We are also working on development of a reactive data structure based on an Object-Oriented approach to GIS.

References

Supplementary Files (optional)

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