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Level Intended:	Bachelor	**Project Type:**	Thesis (12 weeks)
Collaborative Theme:	Spatial data structures; structure, algorithm visualization		
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Visualizing R-Tree Variants with Generic Designs in Java 6.0

Preamble

A good and proper R-Tree visualizer is one that helps to expedite the designing and debugging process of a test algorithm, which is primarily based on a spatial-indexing data structure. That is, we should be able to see the actual primitive positioning of the minimum bounding regions (MBRs) on the spatial-plane, as well as their relations to the various nodes represented by the underlying R-Tree, on top of any other arrangements affected by the governing algorithm. In other words, we should be able to immediately realize the distribution and grouping of the MBRs in both the spatial and nodal planes without the time-consuming need to decipher a string of letters and numbers from an output text console, and then tediously use the pencil and paper to draw out the messy relations between them, which may still contain errors.

On the other hand, a better and more versatile visualizer will not only be able to show the spatial and nodal relations on one R-Tree, but it should also be able to visualize *any* variant of the basic R-Tree that adheres to the five main properties given by Guttman [1].

Thesis Description

Presently, our group's library of Java codes contains an extensive collection of classes that cater to a series of R-Tree variants. This work shall concentrate in extracting the abstract commonalities between the unique R-Tree-related packages and design a generic visualizer that is capable of displaying both the spatial and nodal representations of a set of n hyper-rectangles (for d=2). We shall take advantage of the generic compiler in Java 6.0 [2] to achieve this, in tandem with the preexisting packages from JEDAS [3].

This work is directly related to two other projects in our research group where IP-lookup are being studied – specifically, the conflict detection problem. In retrospect, we shall use the rigorous environments provided by the two twin-projects in testing the correctness, robustness, and efficiency of the visualizer conceived. Furthermore, we shall also base and compare/contrast the findings for this to an earlier completed work by Heinzmann [4].

In addition to the basic user-interface, we will also allow for interactivity on both the spatial and nodal panels to affect primitive operations such as insertions, deletions, and queries (both range and stabbing).

References

1. A. Guttman. R-trees: A dynamic index structure for spatial searching. In *Proceedings of the International Conference on Management of Data (ACM SIGMOD)*, pages 47-57, 1984. ACM Press.
2. G. Bracha. Generics in the Java programming language. In *Sun Microsystems Inc.* [online] http://java.sun.com/j2se/1.5/pdf/generics-tutorial.pdf, Jul 2004.
3. T. Lauer, R. Adelmann, R. Müller, M. Danielsson, M. Helmert, and S. Moedersheim. JEDAS 2. In *Java EDucational Animation System (JEDAS)* [online] http://ad.informatik.uni-freiburg.de/jedas/, May 2004.
4. M. Heinzmann. Analysing R-tree variants as solutions for IP-lookup. *Bachelor Thesis, Albert-Ludwigs-Universität Freiburg*, May 2007.