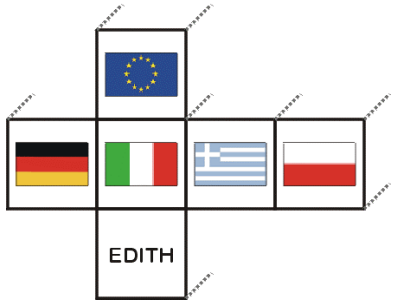


The BUB-Tree

(bounding UB-Tree)

dealing with dead space

Dipl. Inform. Robert Fenk

Knowledge Bases Research Group (Prof. Bayer),
Bavarian Research Center for
Knowledge-Based Systems (FORWISS)
Munich, Germany

Motivation

Objective: Multidimensional indexing

- real data is always skewed
  - data warehousing
  - spatial data

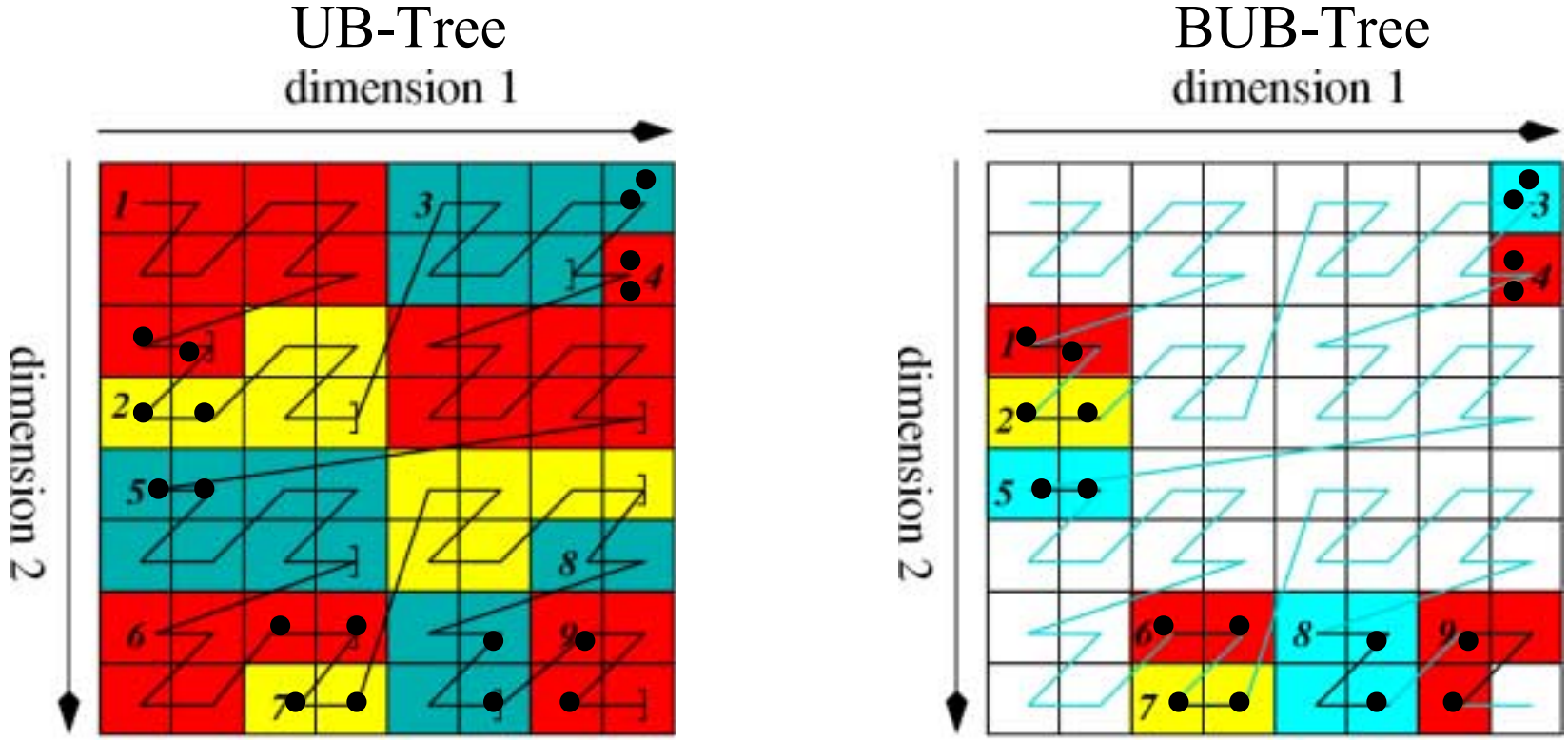
⇒ there is a lot of dead space

- UB-Tree partitions the whole universe

⇒ good performance in general, but queries on dead space suffer

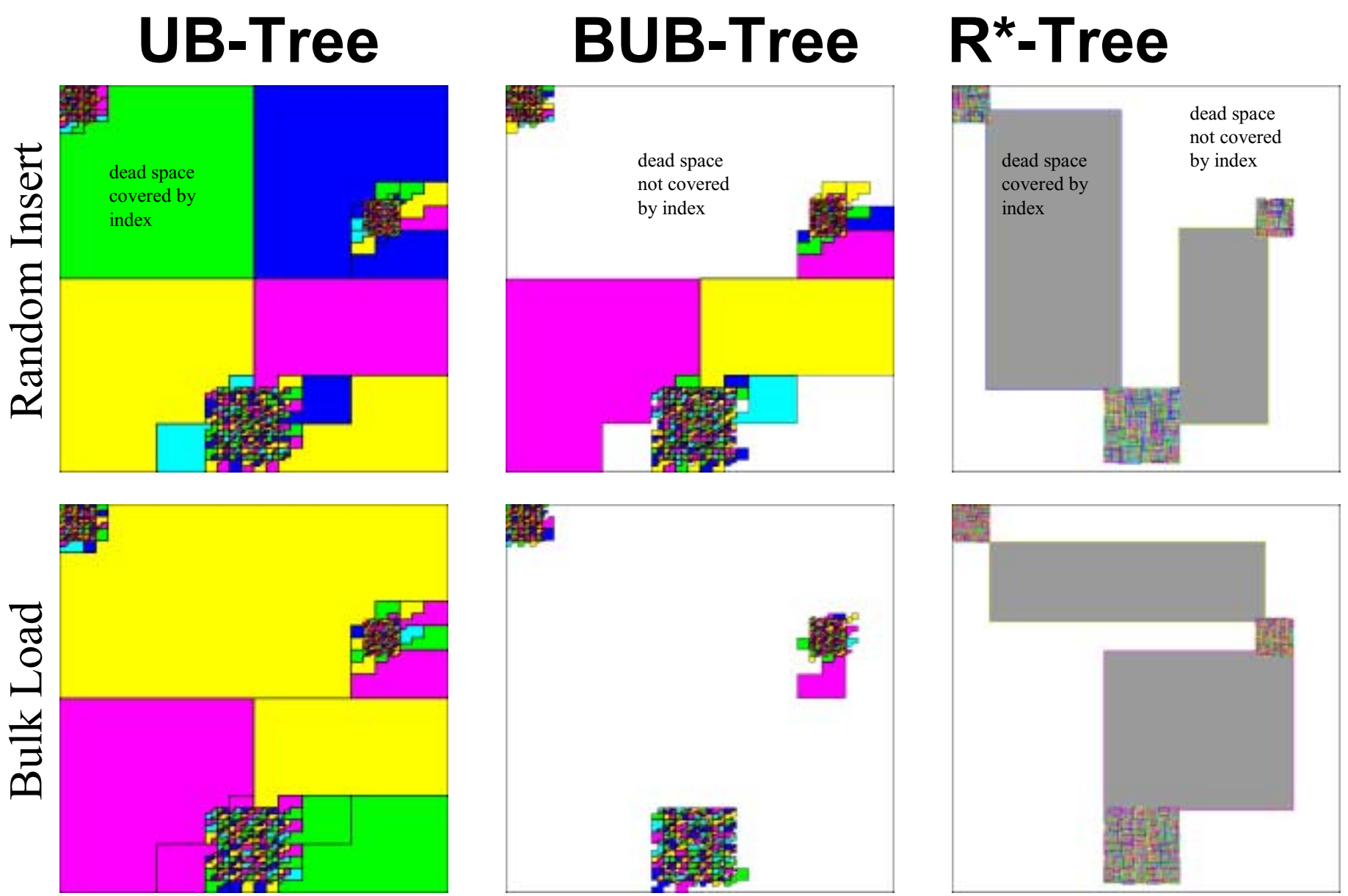
- has the R-Tree a “better” partitioning?

Basic Idea

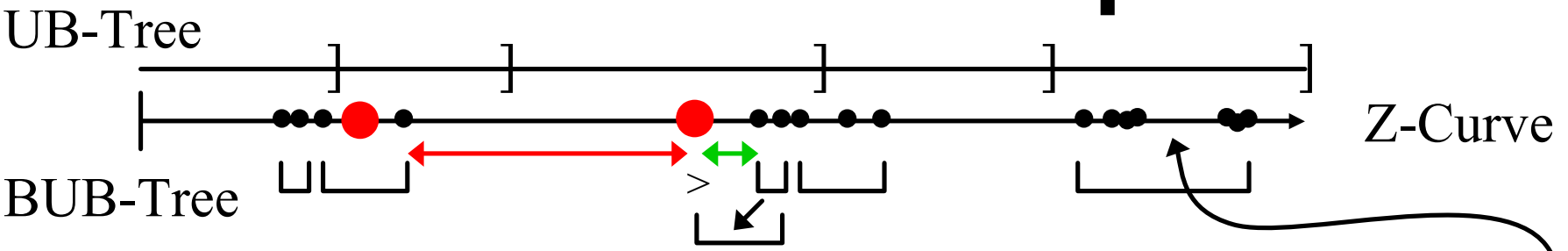


- use Z-intervals instead of Z-separators
- store (zstart,zend) in a B-Tree

⇒ higher index levels reflect Z-intervals of lower ones


UB-Tree
BUB-Tree
R*-Tree
Random Insert
Bulk Load
dead space
covered by
index
dead space
not covered
by index
dead space
covered by
index
dead space
not covered
by index

Insertion and Split



- find nearest Z-Region w.r.to Z-order and insert there

  cost: *height* page reads, 1 page write, binary search on pages

- fix region boundaries if inserting at start/end

  worst case cost: *height* page reads & writes

- split between tuples with biggest Z-distance

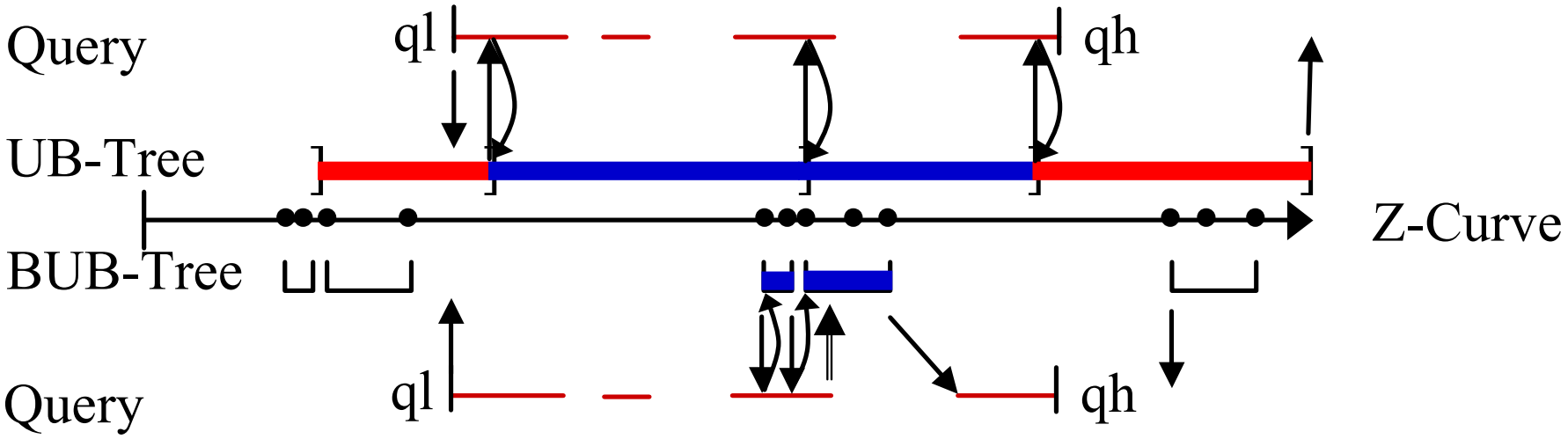
  the goal: minimize the space covered by the index!!!

  – honor minimum fill rate

  – split only when Z-gap volume exceeds a given % of Z-region volume

  – split only when Z-gap volume exceeds a given volume

Range Query



- we need two algorithms developed for UB-Trees
  - NextJumpIn(*z*): calculates next intersection point greater than *z* of the Z-curve with the query box
  - NextJumpOut(*z*): calculates the point greater than *z* (where Z is within the query box) on the Z-curve where it leaves the query box again

Summary

- “twice” the space requirements for index part
  - reduced index fanout,
  - + but high potential for compression due to prefixes
- + „only“ populated parts of the universe are indexed
- + UB-Tree basic algorithms can be reused
- + still a disjoint space partitioning
- + logarithmic cost for basic operations, i.e. it is a dynamic index structure which is not true for the R*-Tree!
- + query performance equal or better to R*-Tree
  - + also with dual space approach for GIS data