Chapter 5: Query Processing and Optimization

“Spatial Join Techniques”, EDWIN H. JACOX and HANAN SAMET, Institute for Advanced Computer Studies, University of Maryland

“Plane Sweep Algorithm”, JORDAN WOOD, SANGHO KIM, Department of Computer Science and Engineering, University of Minnesota
Motivation

- Plane Sweep Algorithm
  - Robotics, Computer Graphics
- Example Query
  - list all census blocks within 5 miles of an international airport
- Spatial Join operation is more complex than standard relational join
  - Multi-dimensional, No natural order, Memory limitations, Complex Join Condition
- Why use it?
  - Memory is getting cheaper, Existing index structures, Flexible to different geometries
Spatial Plane Sweep Algorithm

- Object Approximation (MBRs)
  - Reduces CPU computation
- Filter–and–Refine approach
- Plane Sweep Algorithm
  - Special case of intersections of minimum bounding rectangles
MBR’s are ordered by their left side
Vertical scan line is swept left to right
Rectangles are ‘active’ when scan line crosses them
    ◦ These are the rectangles that are tested for intersection

A1 is active
A1 and B1 are active
Every time the sweep line crosses a box, it is added to the relevant sweep structure. Once the box has been checked for intersections, it is removed from the sorted list.

A2 is checked for intersection with B1.
B2 is checked for intersection with A1 and A2.

Once the sweep line has passed a box, that box is removed from the sweep structure as it can no longer intersect any other box. In this case, B1 has been removed.

• Sweep structures should use a data structure that support the addition, removal, and intersection operations efficiently (e.g. Cartesian tree)
- Runs in $O(n \log(n))$, but worst case can run $O(n^2)$. Best case is $O(n)$.
References

- JORDAN WOOD, SANGHO KIM.: Plane Sweep Algorithm, Department of Computer Science and Engineering, University of Minnesota