Computational Geometry

Summary

Basic problems

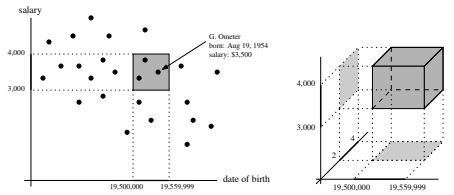
- Point location
- Line segment intersection
- Robustness and degeneracies
- Efficiency via data structure
- Geometric data structures: geometric search trees

Compiler Design

- Loop optimization
- View the set of all executions of a statement within *n* loops as a set of integer points on an *n*-dimensional polytope defined by loop constraints

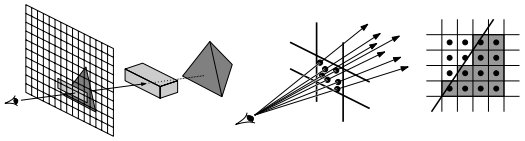
Orthogonal Range Searching

- Database queries and geometry?
  - report all points whose coordinates fall between certain ranges



Arrangements and Duality

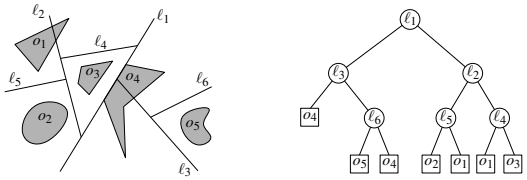
- Raytracing and super-sampling



- Discrepancy: The difference between the sampled set (hits) and the visible object within the pixel area

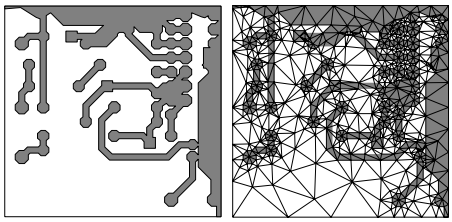
Binary Space Partitioning

- Visibility preprocessing
- Recursively splitting the plane with lines
  - binary tree
  - stops when only one object is in each region



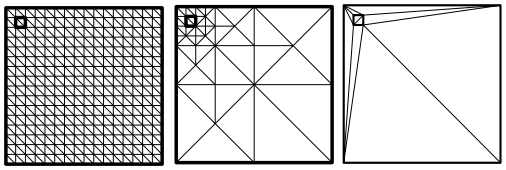
Mesh Generation

- Circuit board design



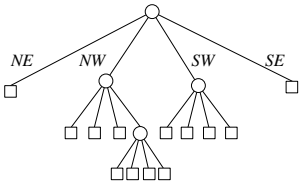
Non-Uniform

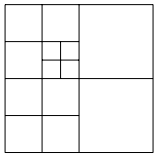
- Fine when necessary



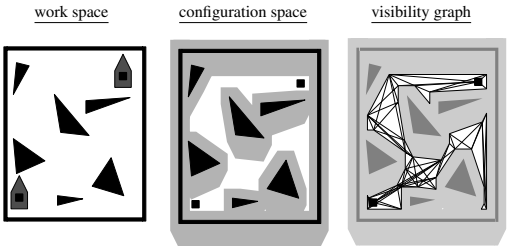
Quadtree

- Recursively subdivide into 4 squares
  - stop when each cell only contains one point





Visibility Graph



Manifold Learning

- The curse of dimensionality
- Distribution of natural/physical data is likely not uniform: concentrates around low-dimensional structures
- Machine learning: find a function that fits the data to some manifold
- Geometry: recover the manifold from sampled points