Spatial Subdivision Techniques

SAMPL Group Presentation

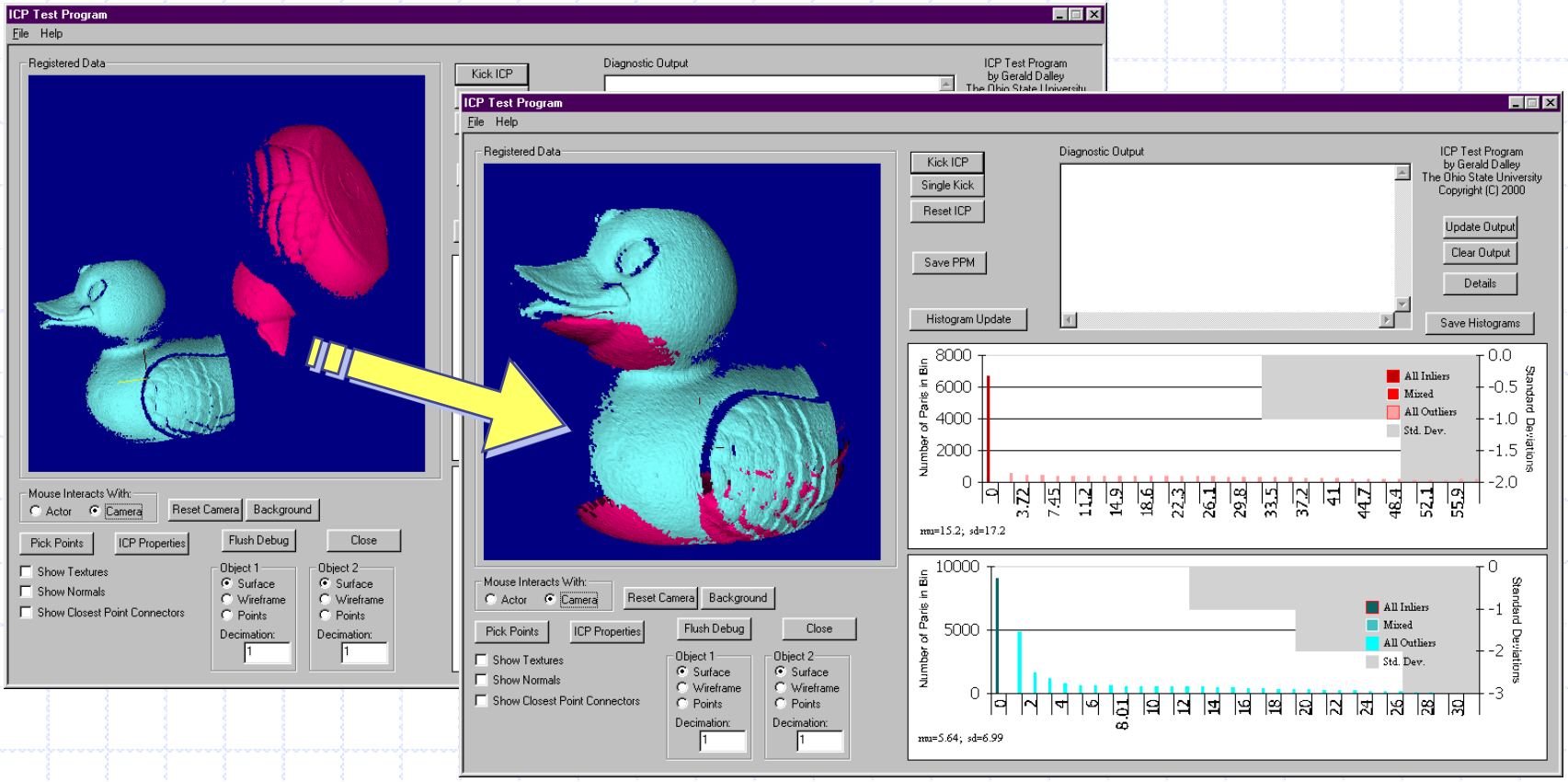
By Gerald Dalley

Presentation Overview

- Motivation
  - Correspondence Searching in Range Image Registration
  - Nearest-Neighbor Searches in Matching
  - What's Wrong with Brute Force?
- Spatial Subdivision Techniques
  - Uniform Subdivision -- *O(1) to O(N)*
  - Octrees -- *O(log N)*
  - k-D Trees -- *O(log N)*
  - BSP Trees -- *O(log N)*

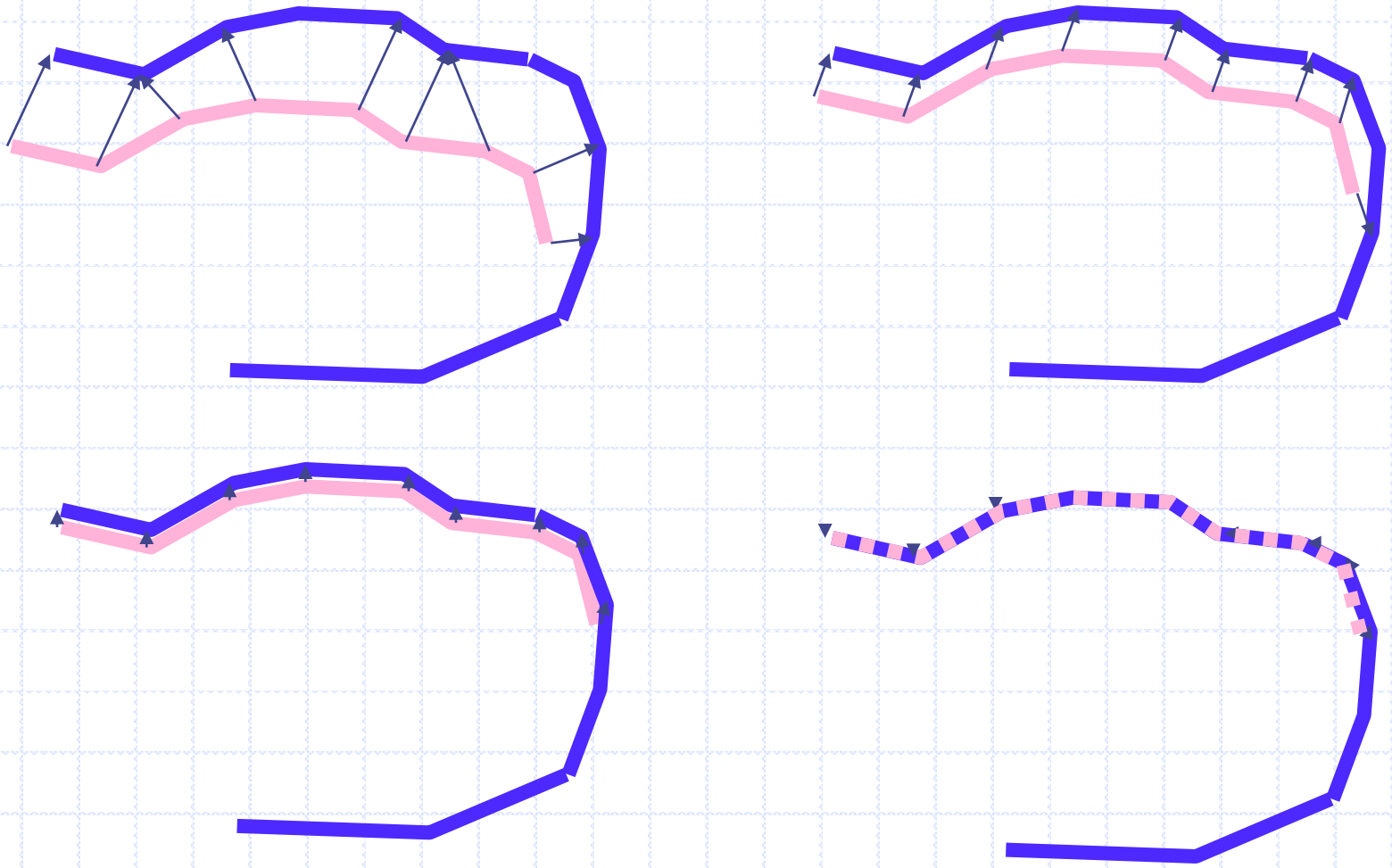
Correspondence Searching in Range Image Registration:

Range Image Registration



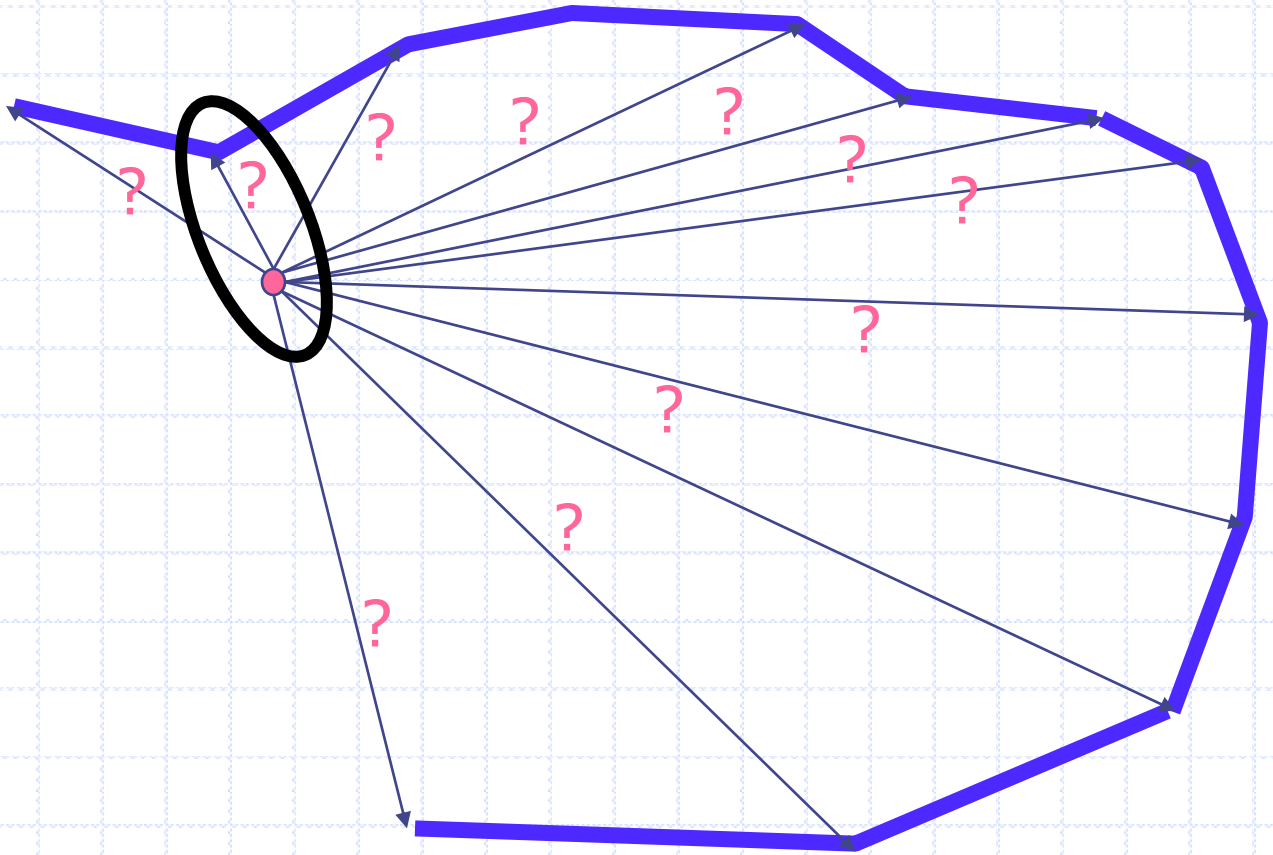
Correspondence Searching in Range Image Registration:

Range Image Registration (cont.)

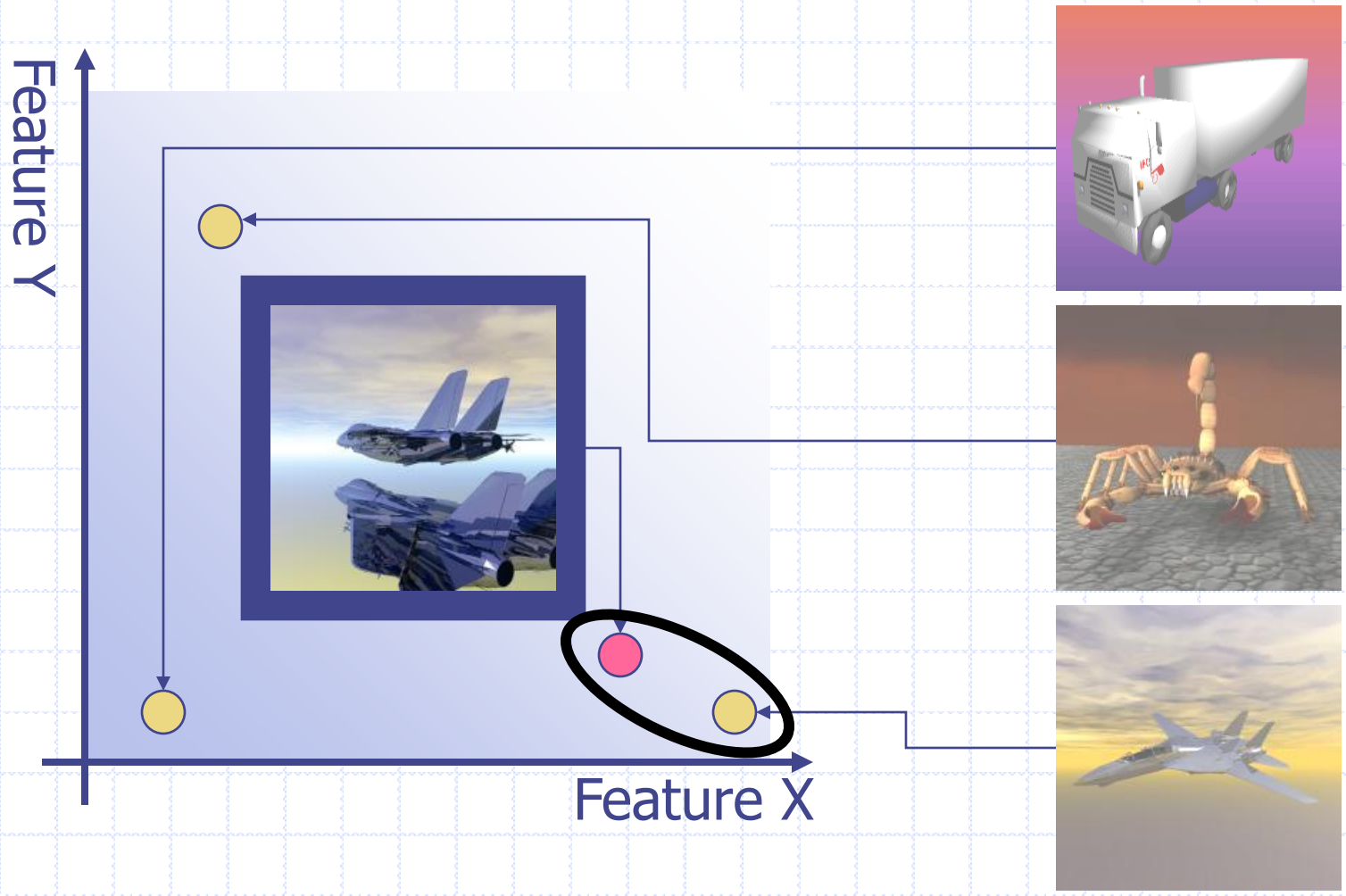


Correspondence Searching in Range Image Registration:

Correspondence Search



Nearest-Neighbor Searches in Matching



Images from http://avalon.viewpoint.com/

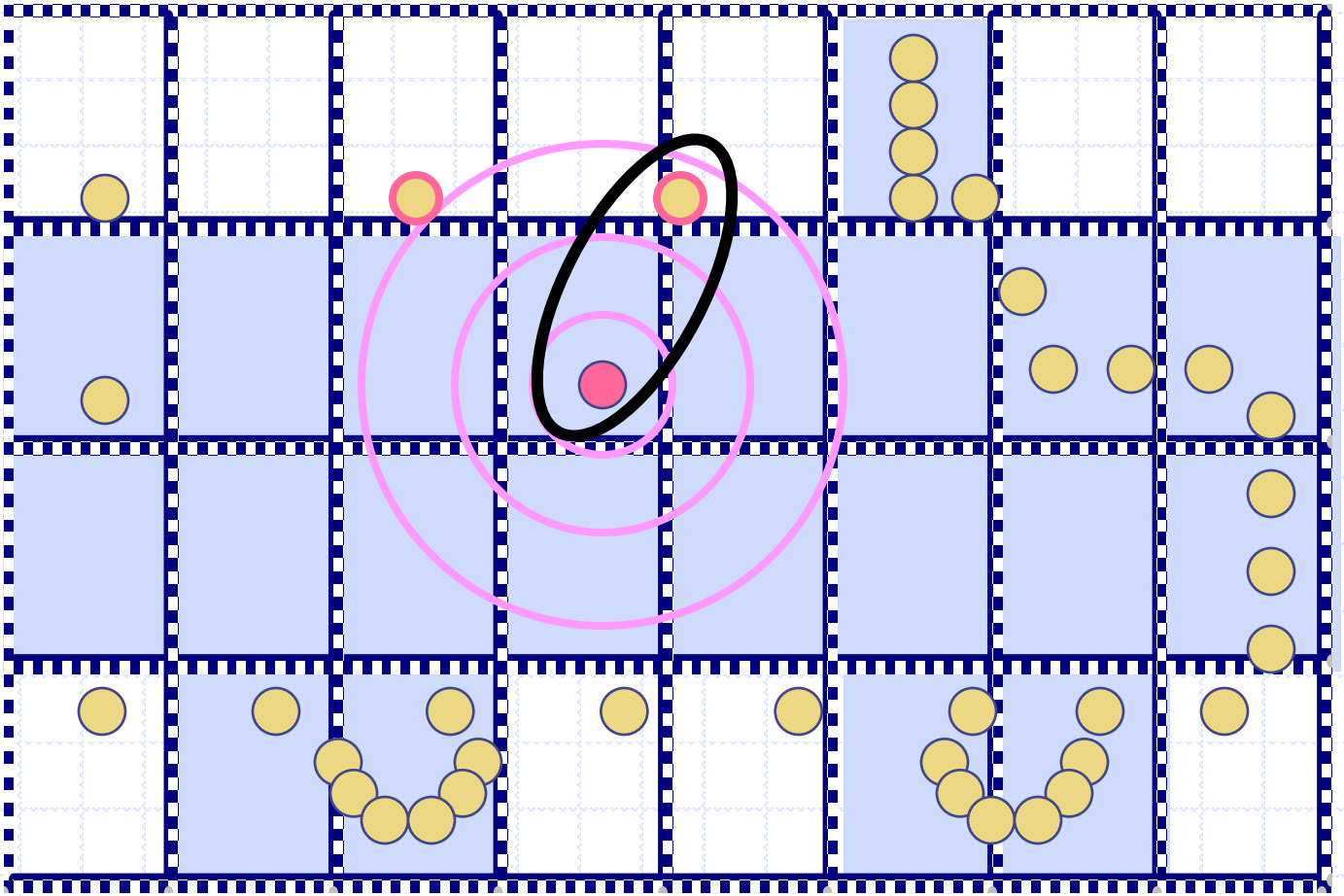
Spatial Subdivision Techniques:

Why Bother?

- O(N) vs. O(log N)
- Nearest-neighbor searches
  - Range Image Registration
  - DAGSI and Billion-Point Data
  - High-dimensional feature-based object/image matching
- Ray-object intersections
  - Range Image Registration
  - Ray tracing
- Volumetric object representations

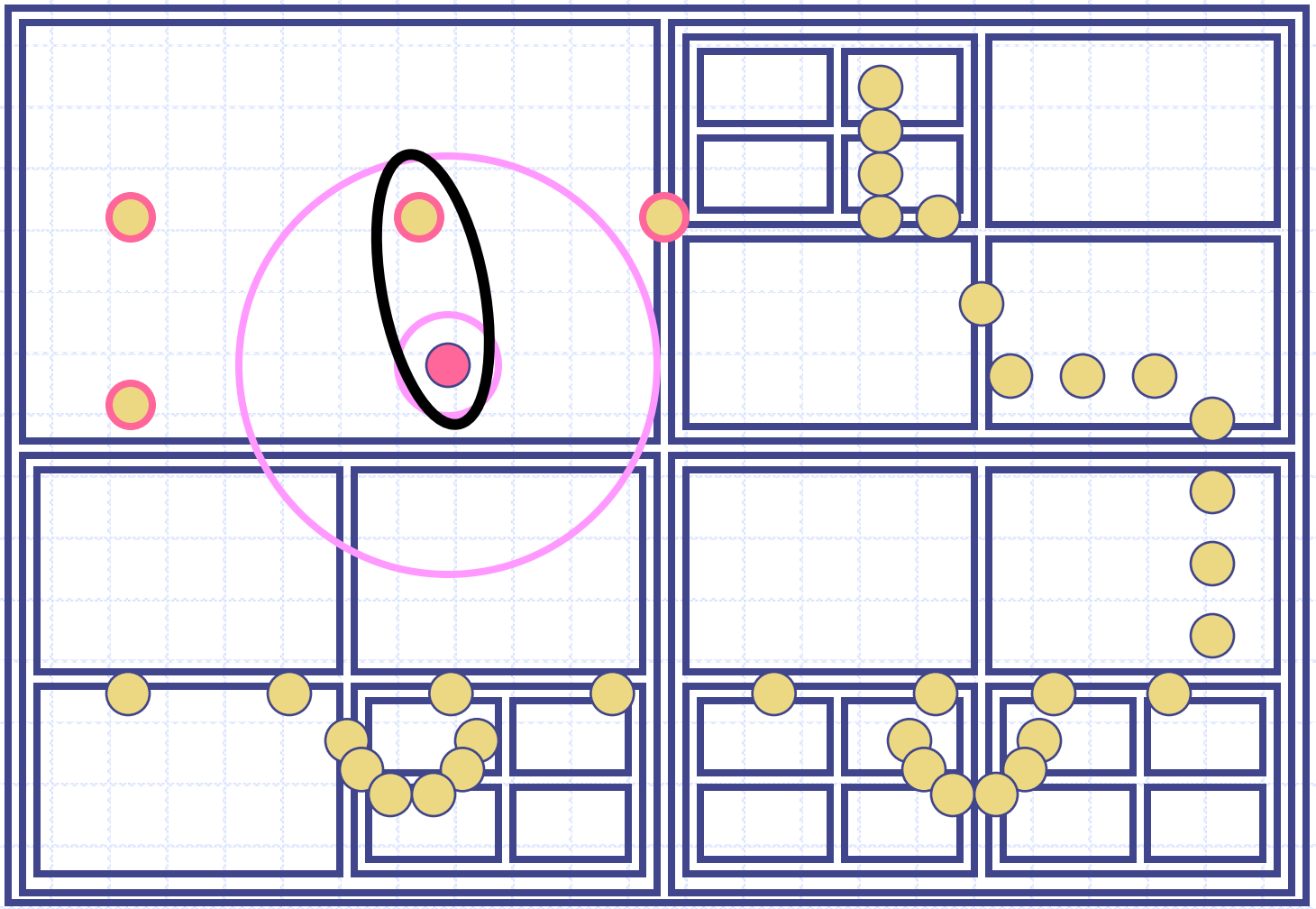
Spatial Subdivision Techniques:

Uniform Subdivision



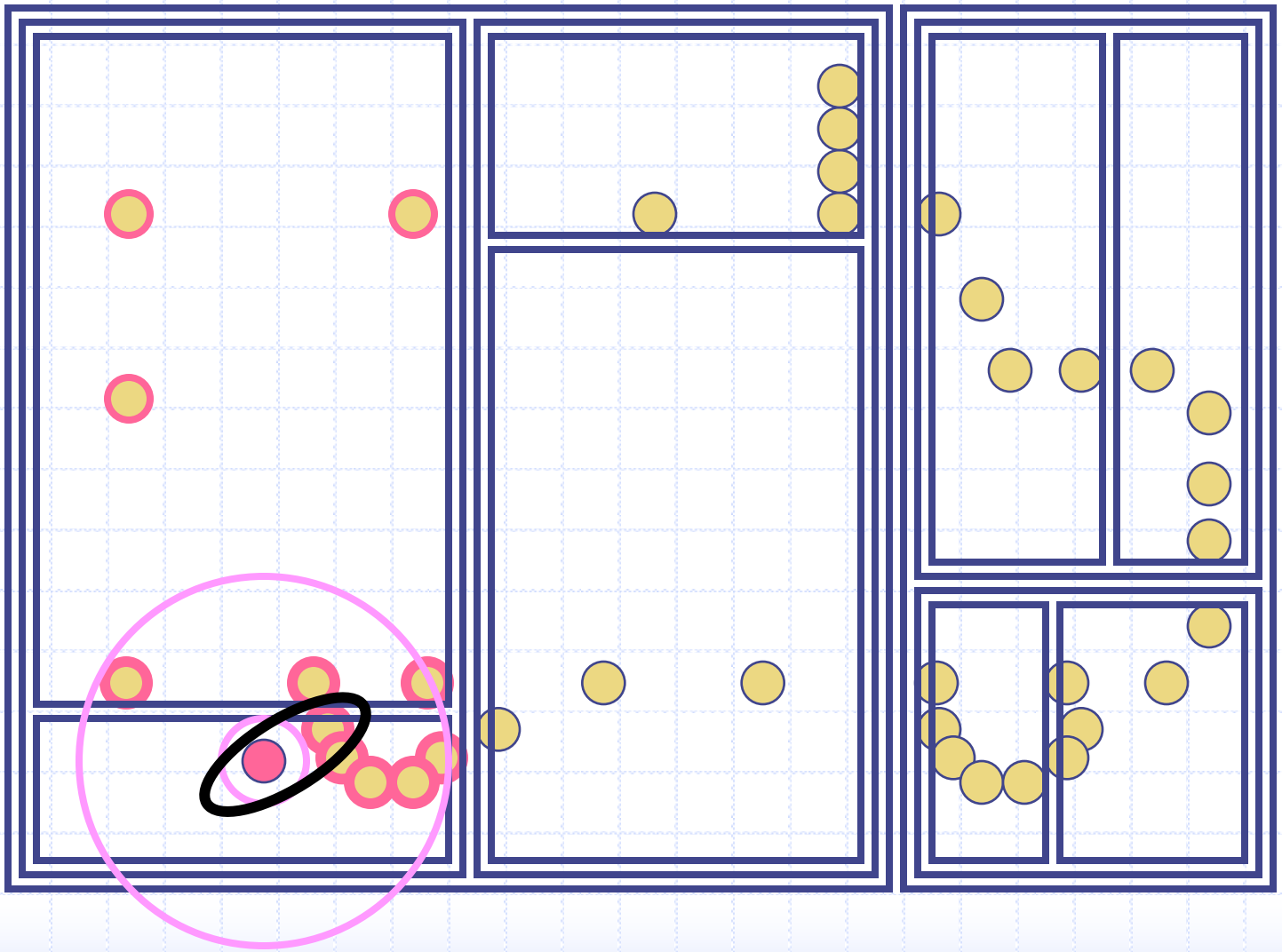
Spatial Subdivision Techniques:

Octrees (shown as a Quadtree)



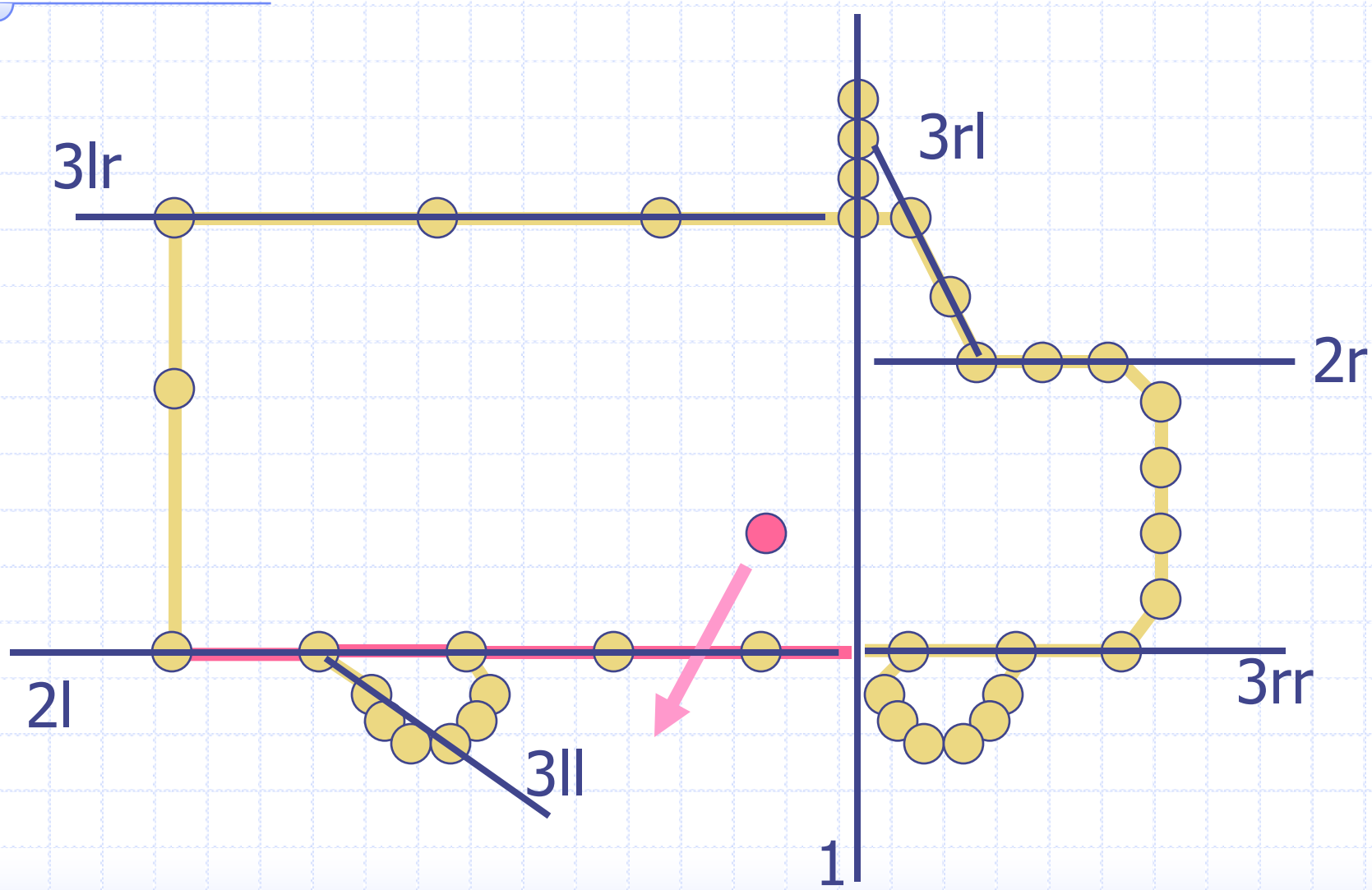
Spatial Subdivision Techniques:

k-D Trees



Spatial Subdivision Techniques:

Binary Space Partitioning (BSP) Trees



For Further Information…

- Foley, van Dam, Feiner, Hughes. *Computer Graphics: Principles and Practice*. Addison-Wesley. 2nd Ed. 1992. *(newer edition available too)*
  - Uniform Subdivision
  - Octrees
  - BSP Trees
  - Intersection tests
- Jerome H. Friedman, Jon Louis Bentley, and Raphael Ari Finkel. "An Algorithm for Finding Best Matches in Logarithmic Expected Time." *ACM Transaction on Mathematical Software*, 3(3):209–226, September 1977.
  - k-D Trees
- Michael Abrash. *Michael Abrash's Graphics Programming Black Book.*
  - BSP Trees