UNIVERSITÉ Concordia UNIVERSITY

Animation for Computer Games
COMP 477/6311

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Collision Detection

Acknowledgements

- Some images were taken from the web for illustrations

http://web.cse.ohio-state.edu/~parent.1/classes/683/Lectures/Material/notesd1.pdf

Baraff, D. (1997). An introduction to physically based modeling: rigid body simulation I—unconstrained rigid body dynamics. *SIGGRAPH course notes*, 82.

Collision Detection and Handling

- 2 sides of the same coin
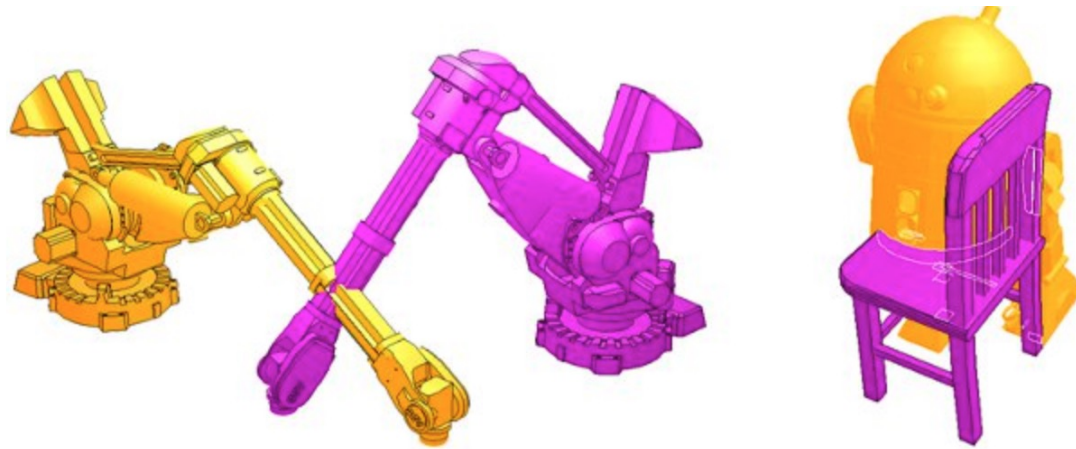
Collision Detection

- Geometric volumetric problem

- Predicate: ShapeA intersects ShapeB?
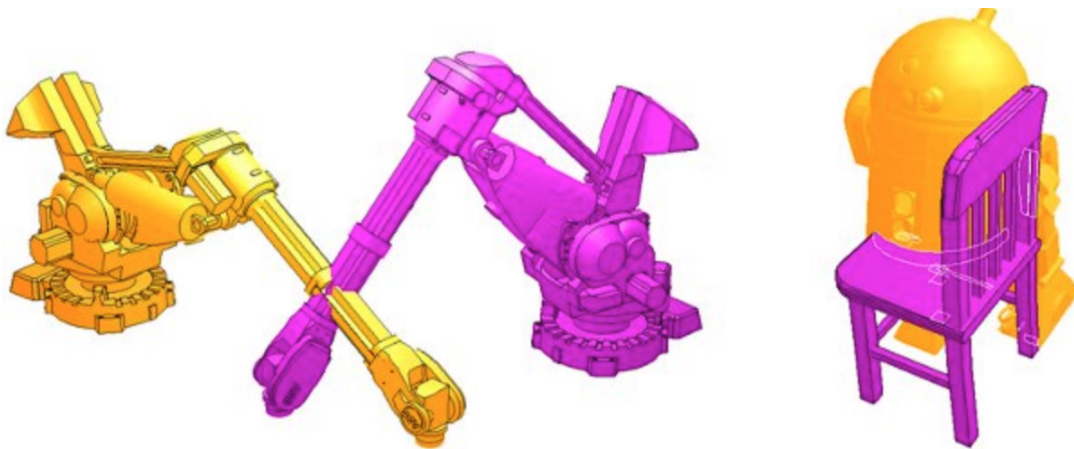
- Is it sufficient?

Collision Detection

- Geometric volumetric problem

- Models = triangular meshes

- Triangle to triangle intersection
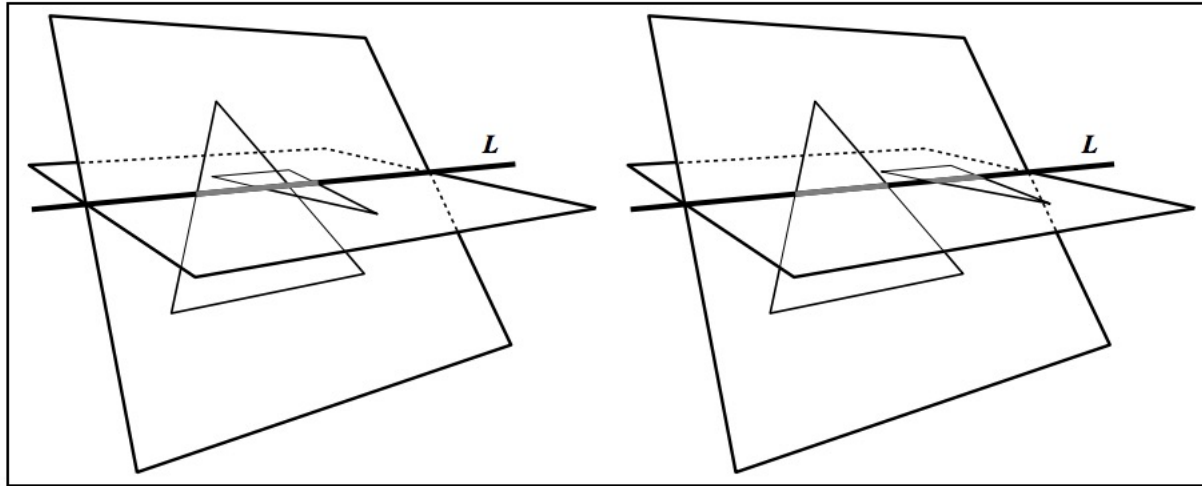
- Closed volume

- Is this sufficient?

Collision Detection

- Geometric volumetric problem
- Models = triangular meshes
- Triangle to triangle intersection
- Volume is closed
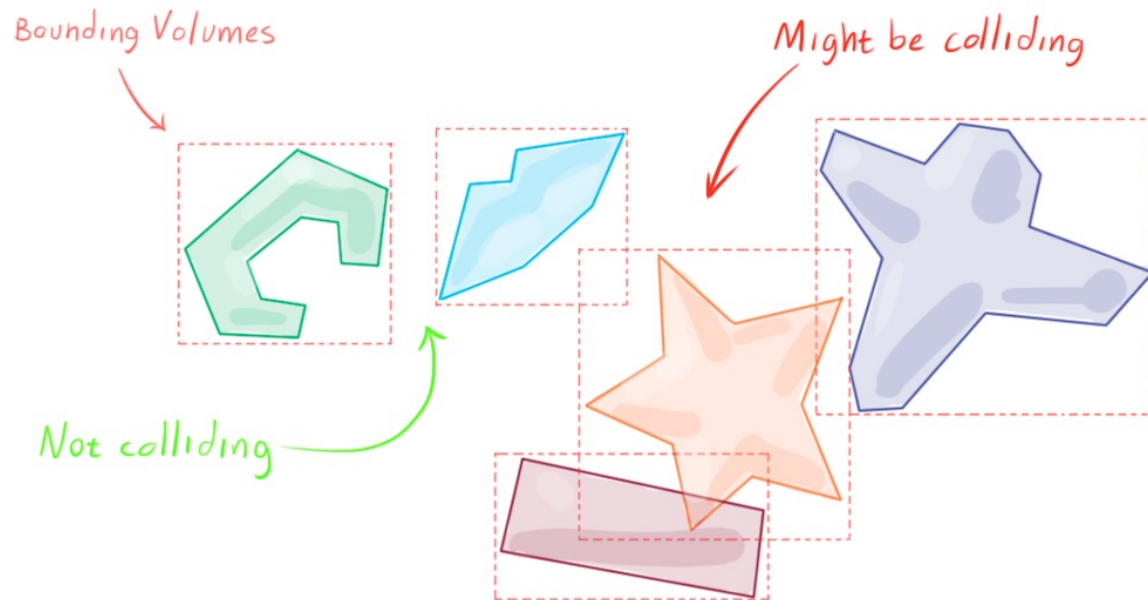- Is it enough?
- No (but practically yes)

Collision Detection

Intersect the planes
2D segment intersection
Is it efficient?
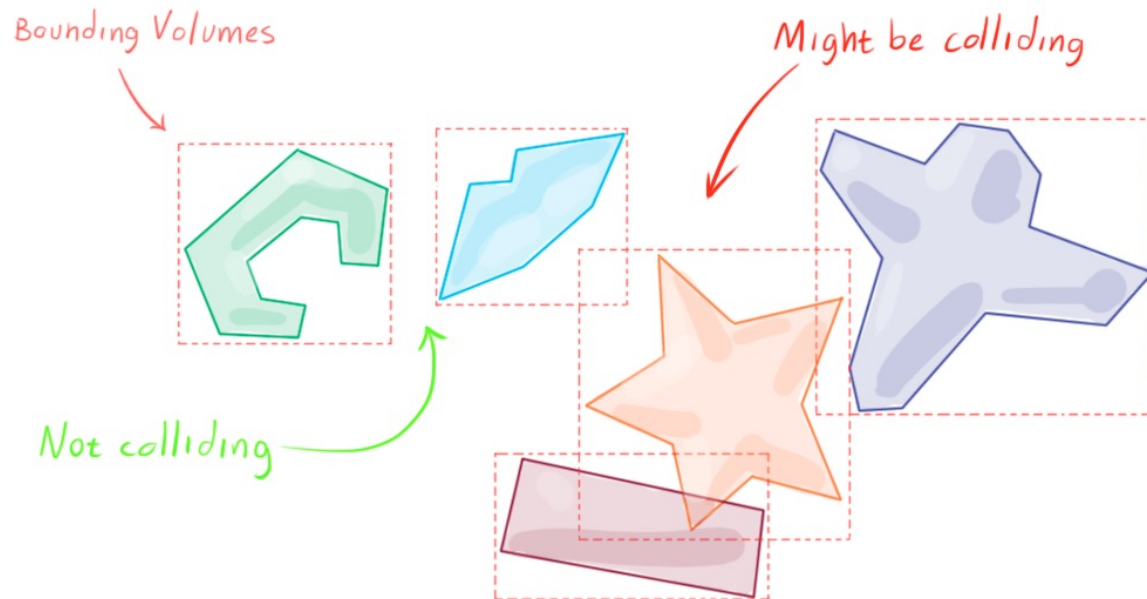How do we improve?

Broad phase

- Split the process into two phases
  - Broad phase (cheap but not as accurate)
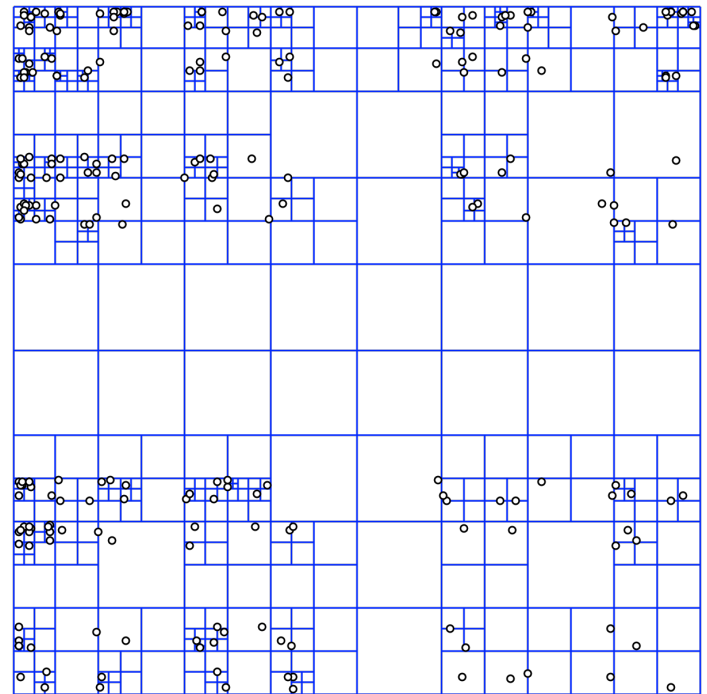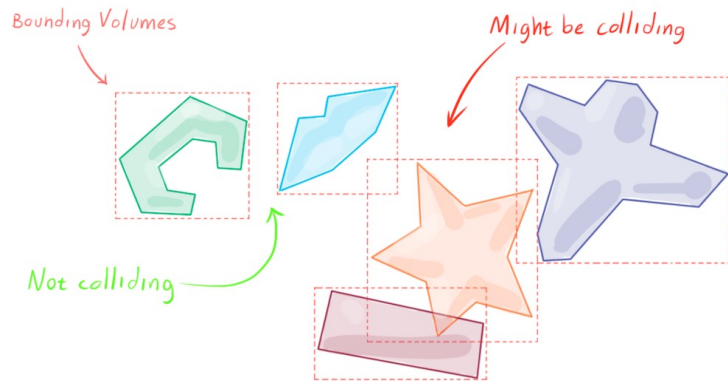 - Narrow phase (same as before)

Broad phase

– Broad phase (cheap but not as accurate)
  - If intersect in broad phase then
    - Narrow phase
  - What if we do not intersect in broad phase?

Bounding Volumes
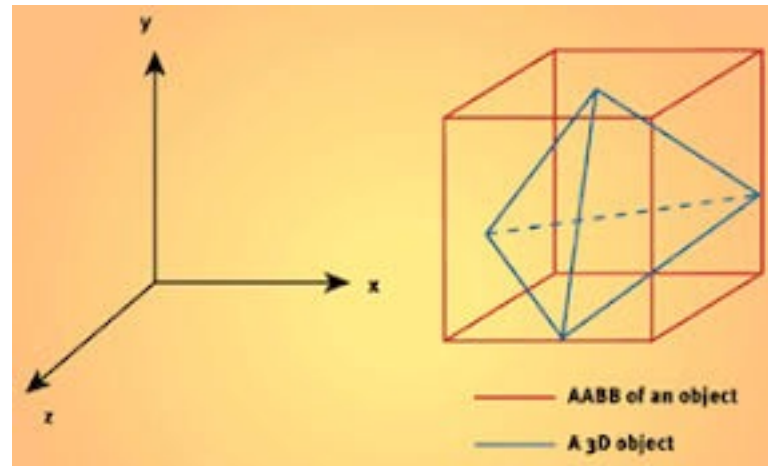
Might be colliding

Not colliding

Broad phase

– Strategies
  • Bounding volumes
  • Space partitioning

Bounding volumes

– Axis align bounding boxes (AABB)

• Embed objects using smallest axis aligned bounding box

• How?

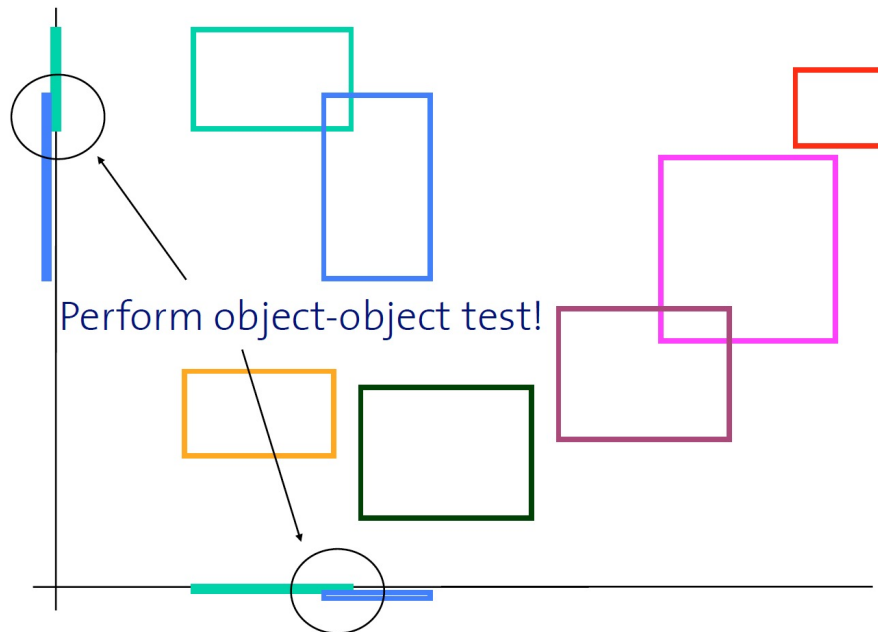• Pros?

• Cons?

— AABB of an object
— A 3D object

Bounding volumes

– Axis align bounding boxes (AABB)

- How?

- Consider multiple objects?
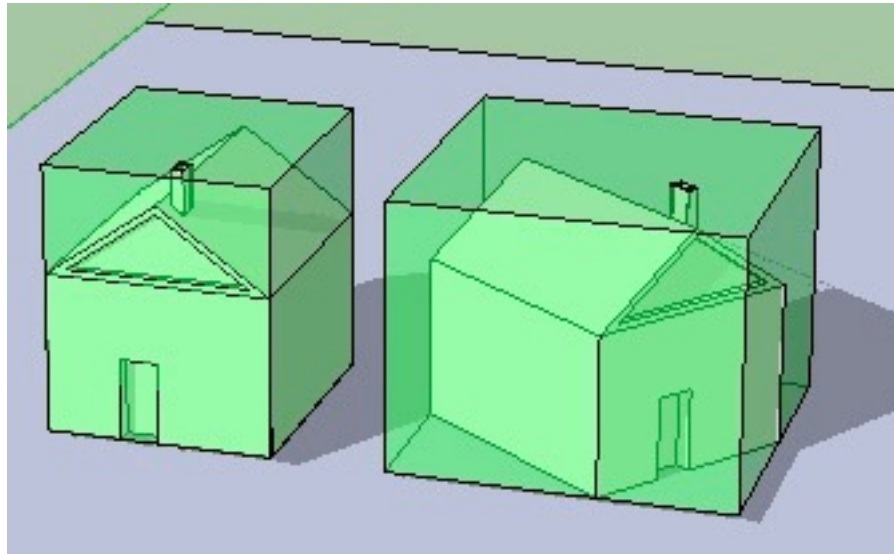
- Complexity?
  - $O(n2)$

- Can we do better?

Bounding volumes

– Axis align bounding boxes (AABB)

Perform object-object test!

Bounding volumes

– Axis align bounding boxes (AABB)

– O(nlogn + k)

– Pros?

  • efficient

– Cons?

Bounding volumes

– Sphere
  - Pros?
  - Cons?

Bounding volumes
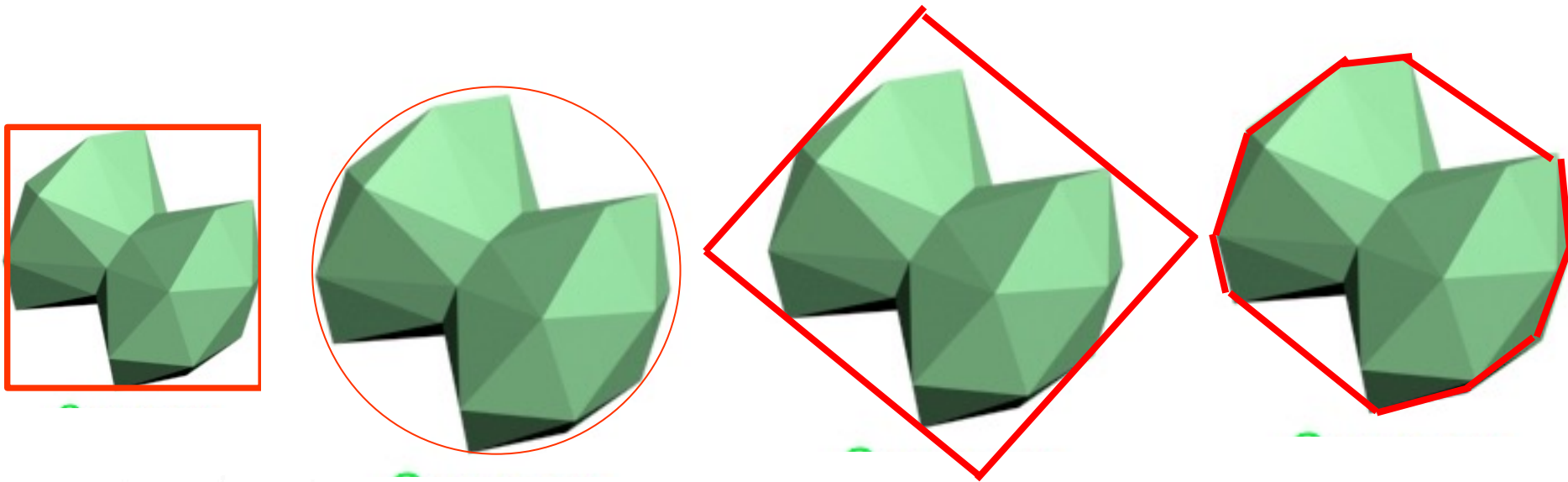
- Object aligned bounding box (OBB)
  - Pros?
  - Cons?

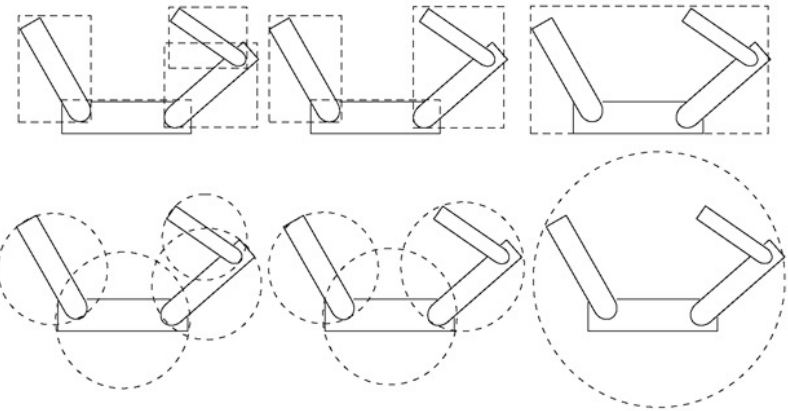# Bounding volumes

– Convex hull
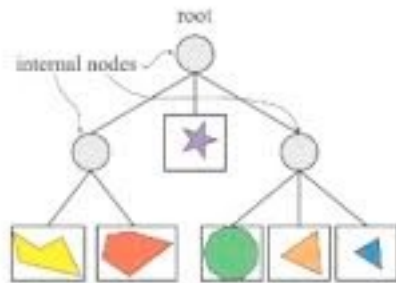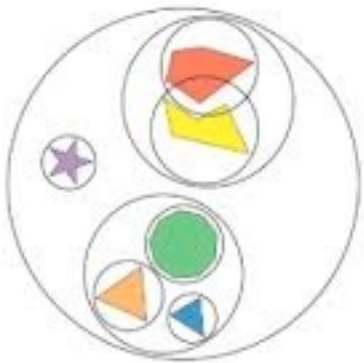 - Pros?
  - Cons?

Bounding volumes
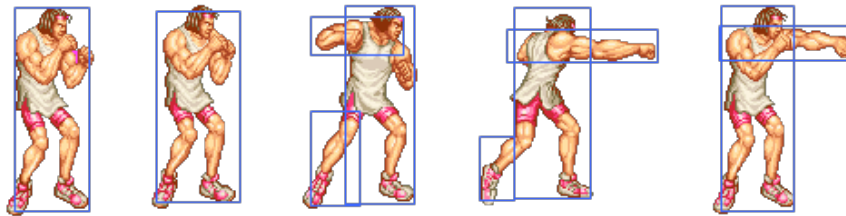

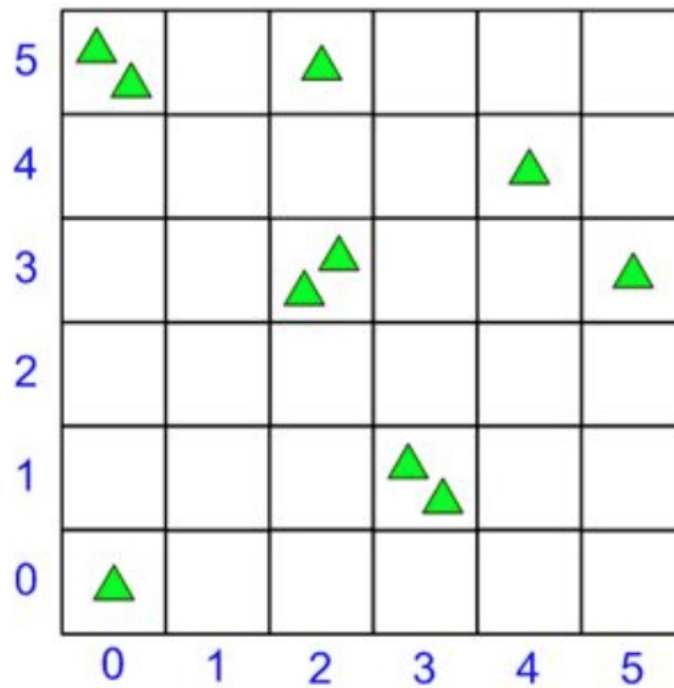Less type 1 error (false positives)

Efficiency

Bounding volumes

Hierarchical bounding volumes
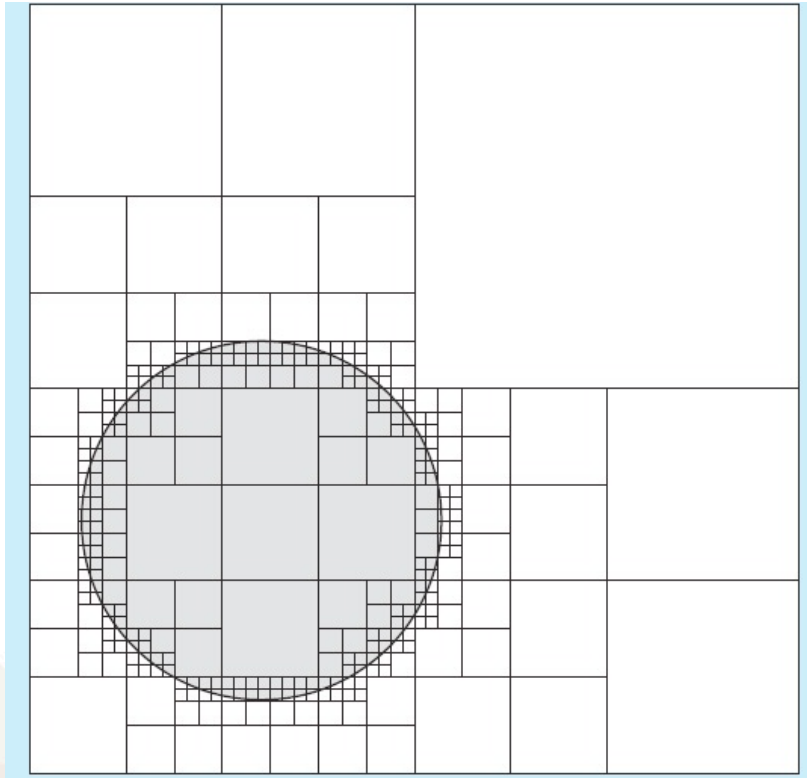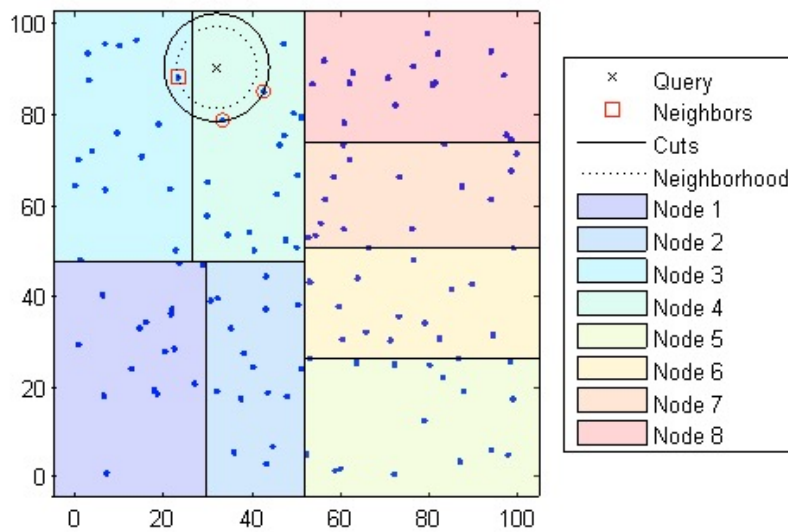
Space Partitioning

Did we see this before?
Regular grid

Space Partitioning

Quad-tree/Oct-tree

Space Partitioning

Kd-tree

Space Partitioning

Kd-tree