

Bounding Volume Hierarchy

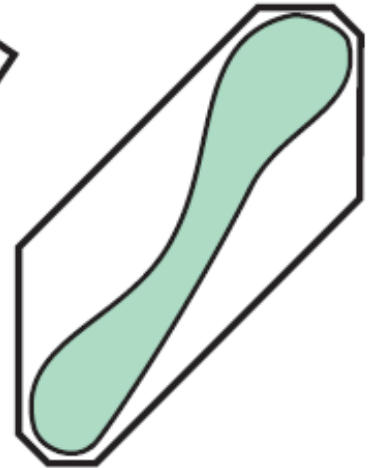
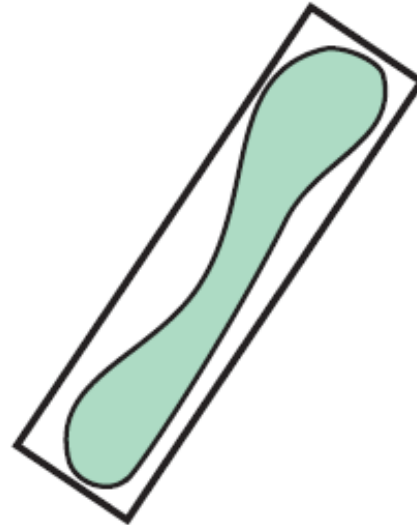
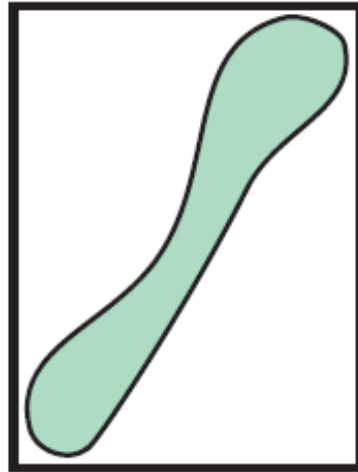
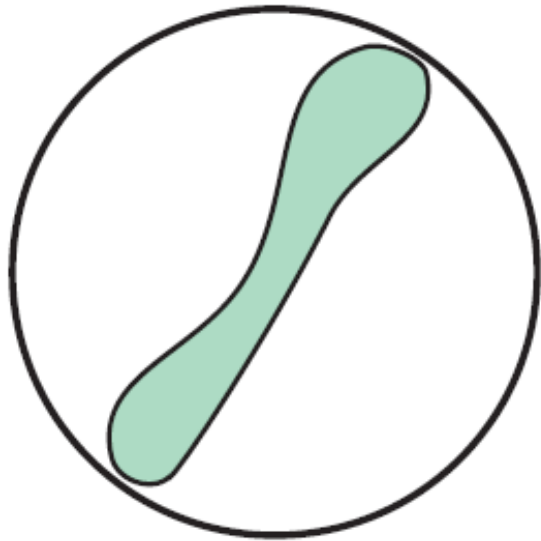
Myung-Soo Kim

Seoul National University

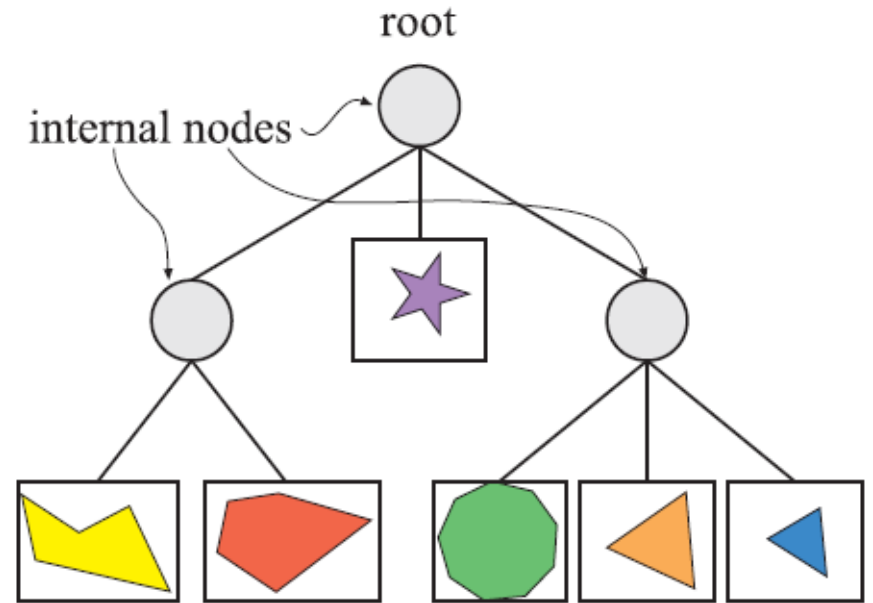
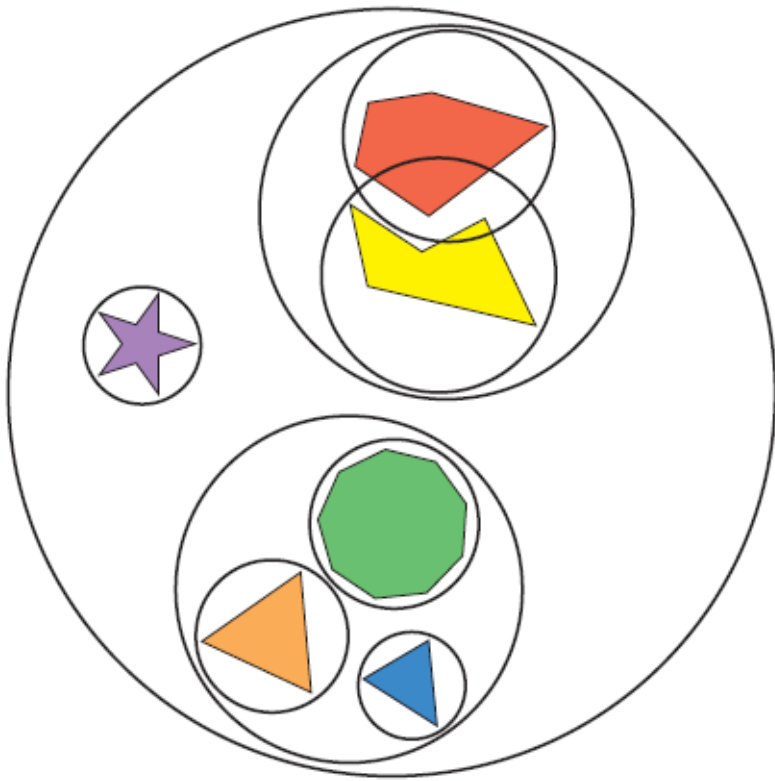
<http://cse.snu.ac.kr/mskim>

<http://3map.snu.ac.kr>

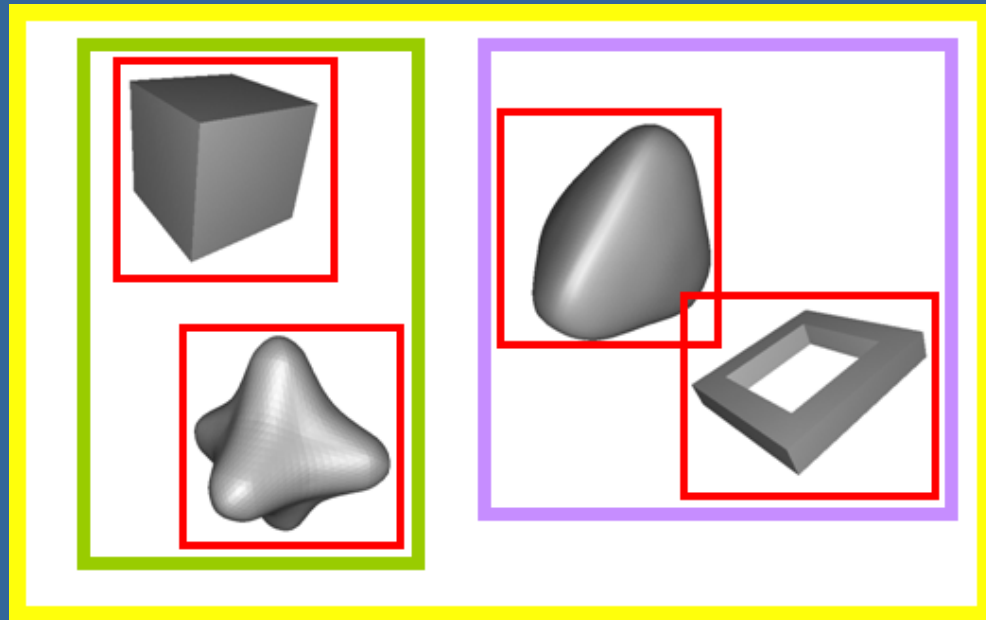
Bounding Volumes



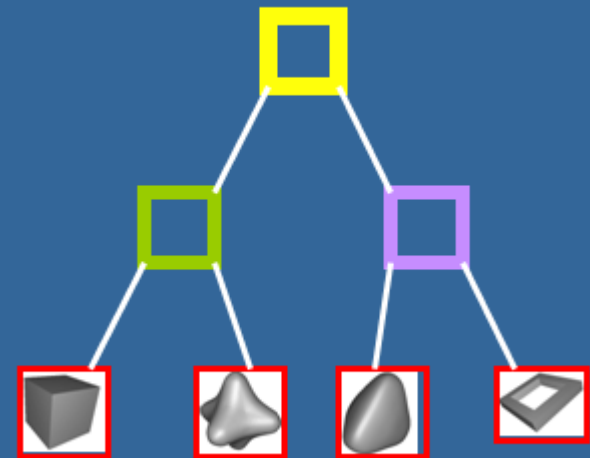
Bounding Volume Hierarchy



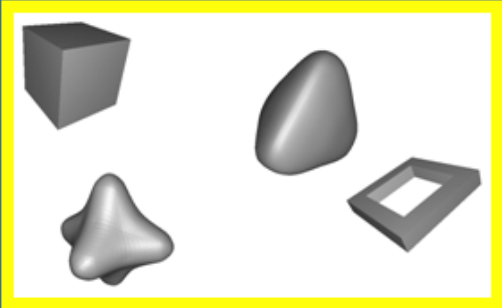
Bounding Volume Hierarchy



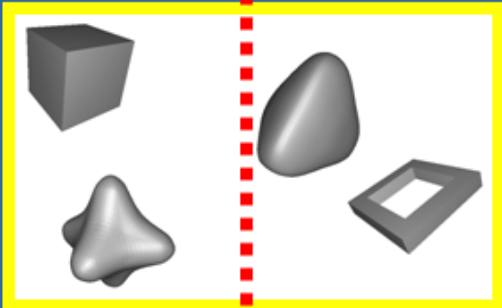
Data structure



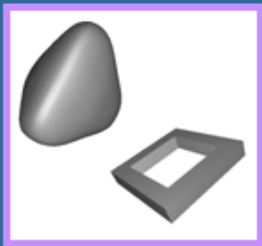
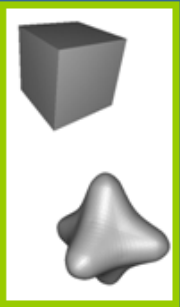
BVH Construction for AABB



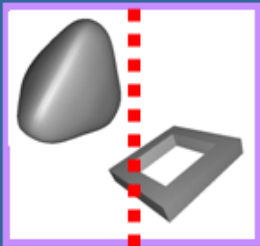
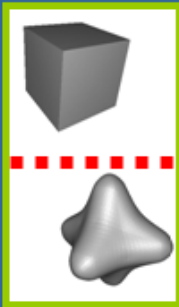
x is longest



Find minimal boxes



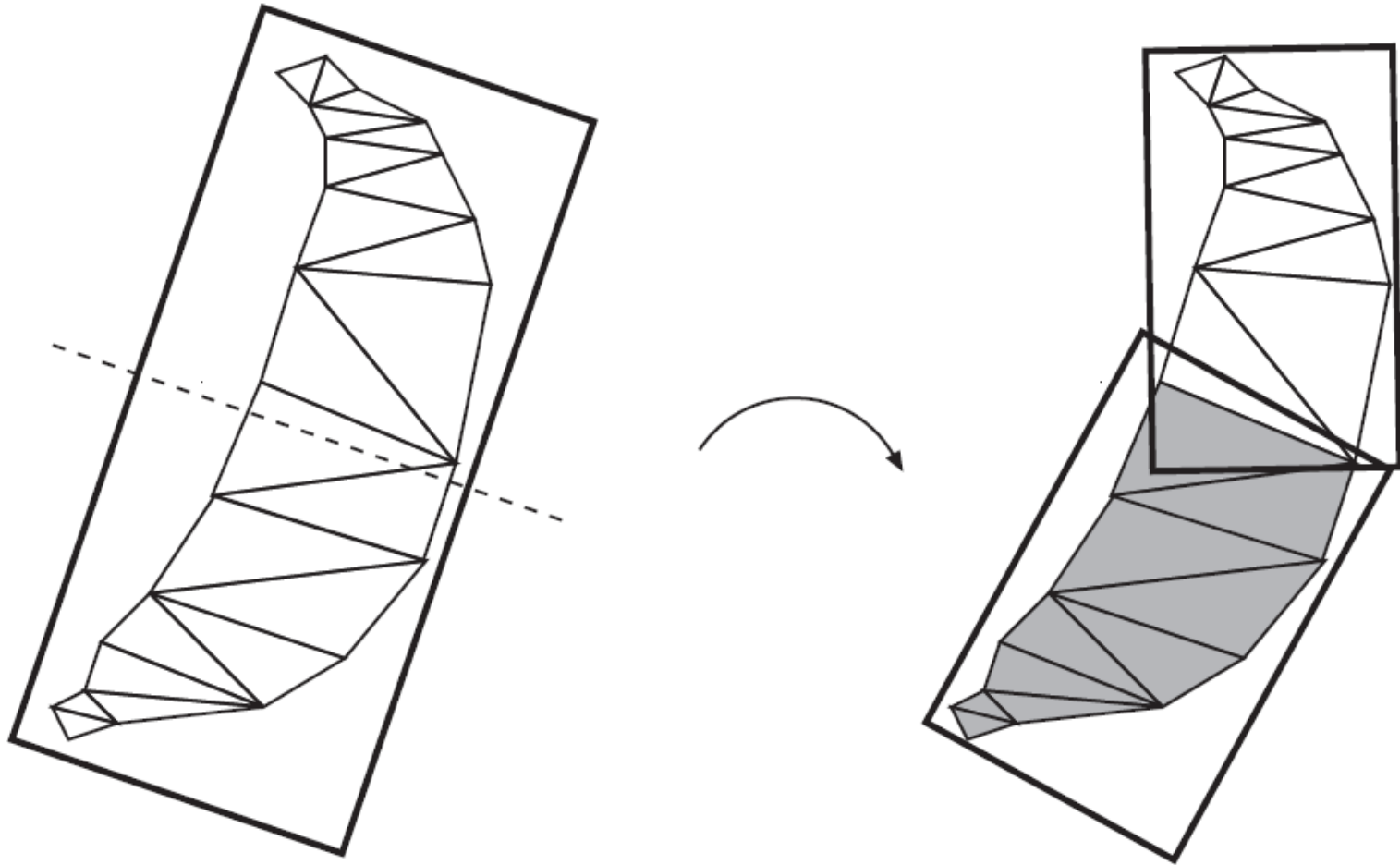
Split along longest axis



Find minimal boxes



OBB Construction

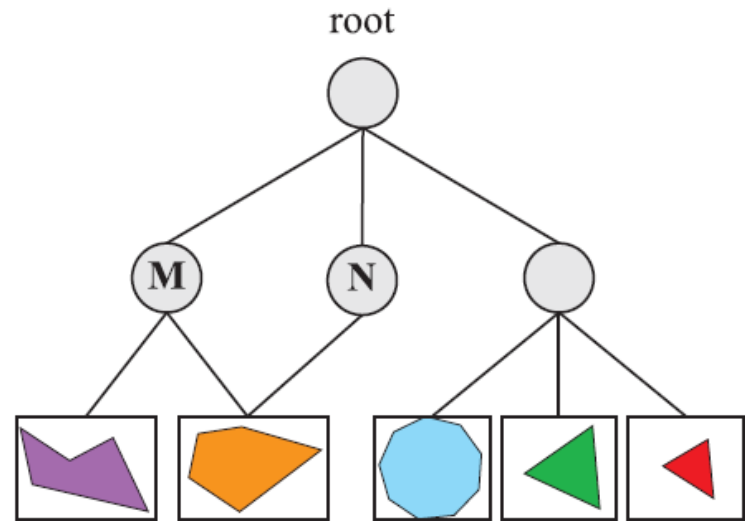
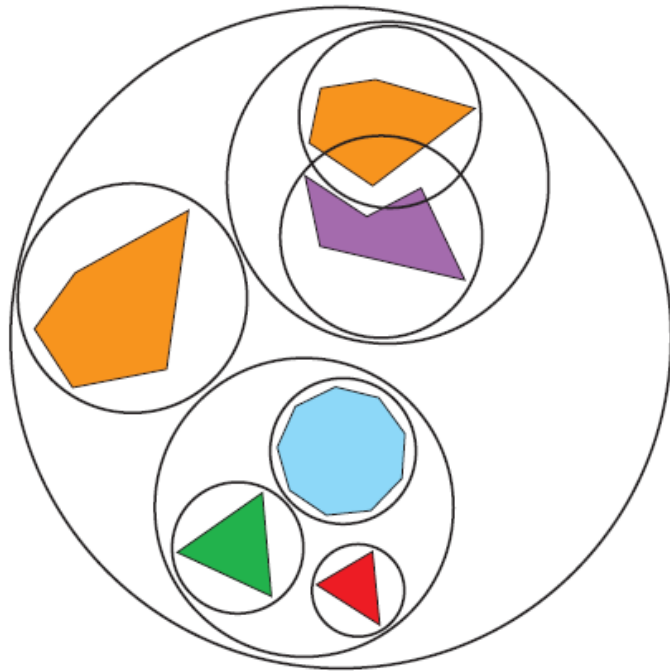


BVH Complexity

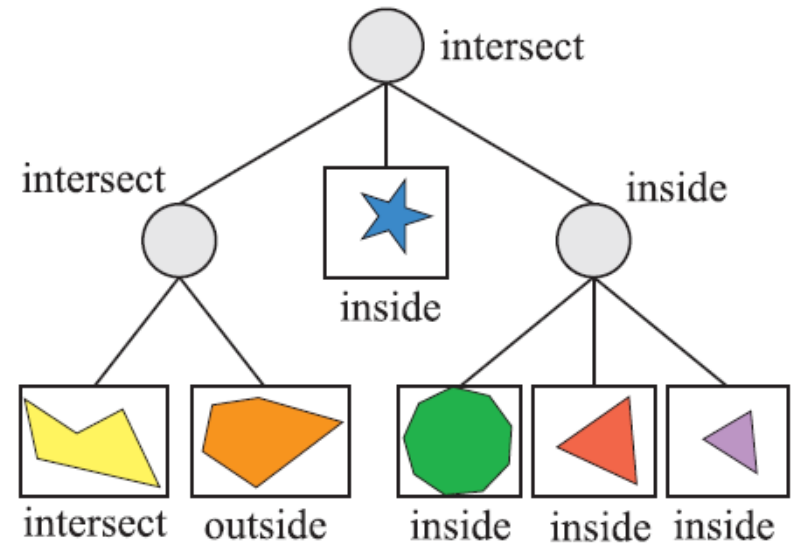
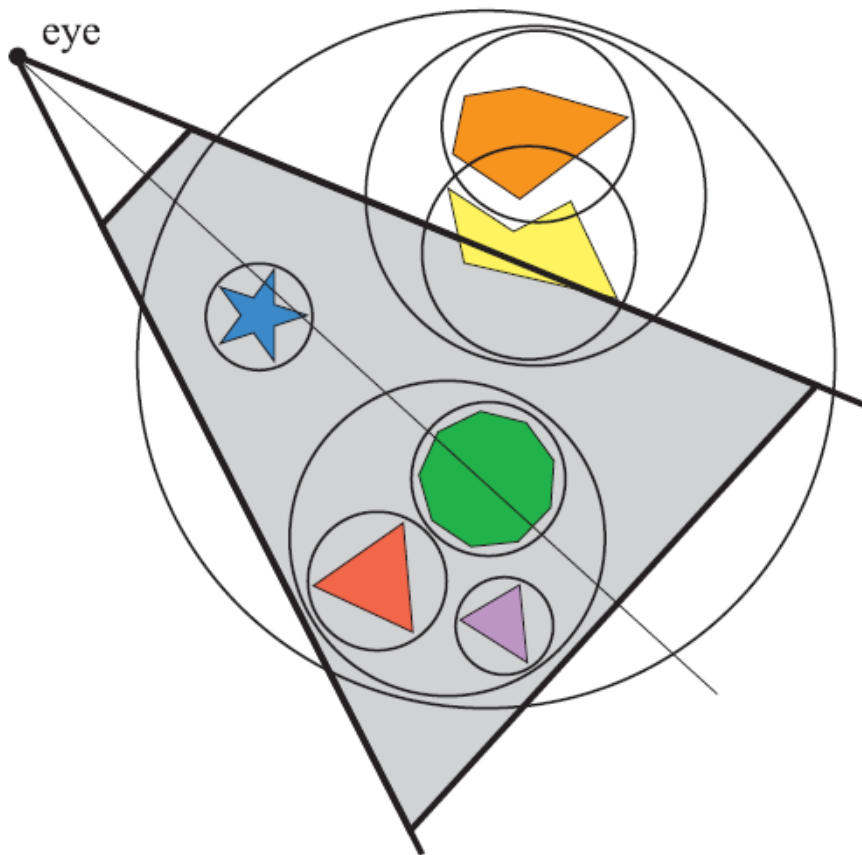
Model	Triangles (M)	Size of BVH (MB)	Mean and std of depth of leaves	Comp. time (min)
Hugo	0.02	2	16, 1.7	0.03
Bunny	0.07	8	17, 0.8	0.26
Dragon	0.8	108	21, 1.6	3
1M power plant	1.1	139	23, 2.9	6
Turbine	1.7	220	22, 0.7	8
Lucy	28	4,811	37, 3.4	34

Table 1: *Benchmark Models: Model complexity, sizes of BVHs, mean and standard deviation(std) of depth of leaf nodes, and computation time to compute cache-oblivious layouts are shown.*

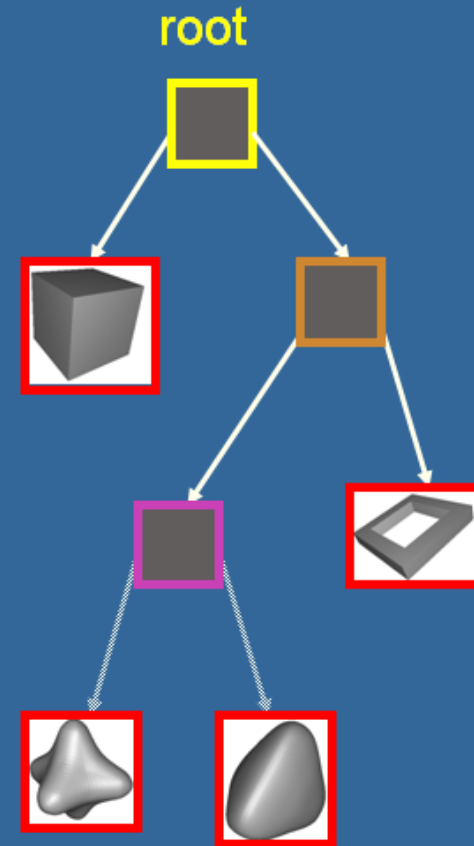
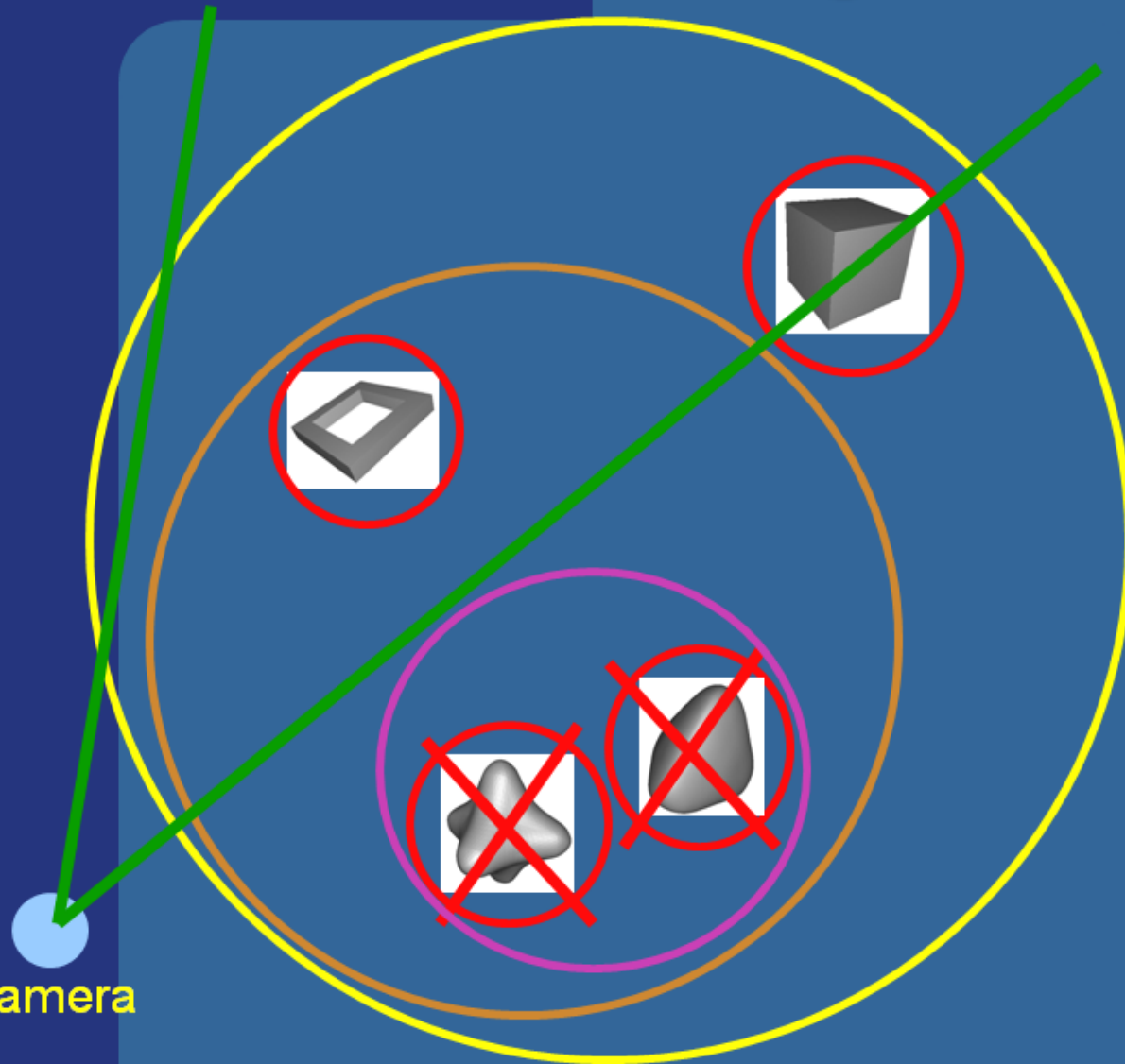
Scene Graph



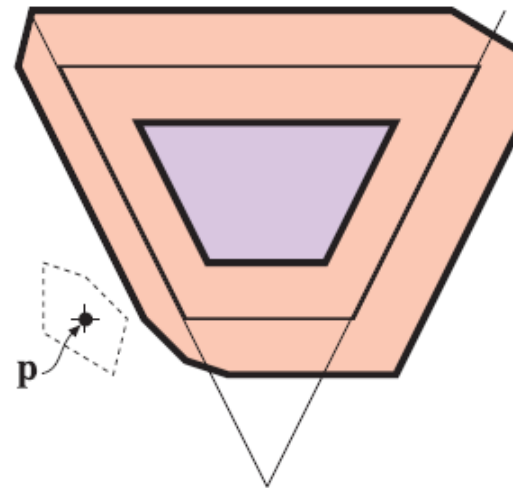
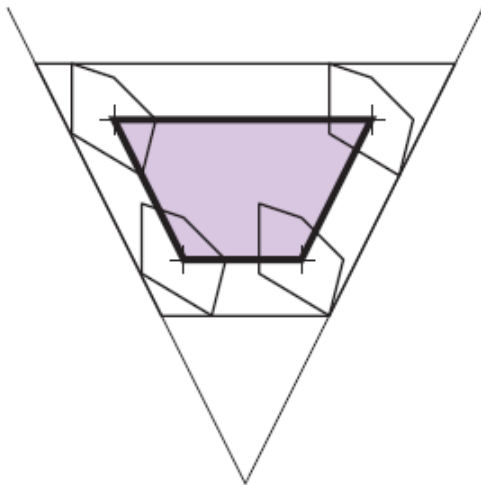
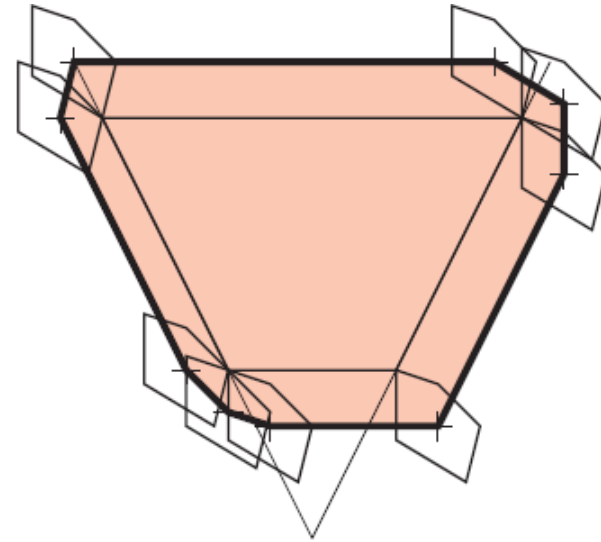
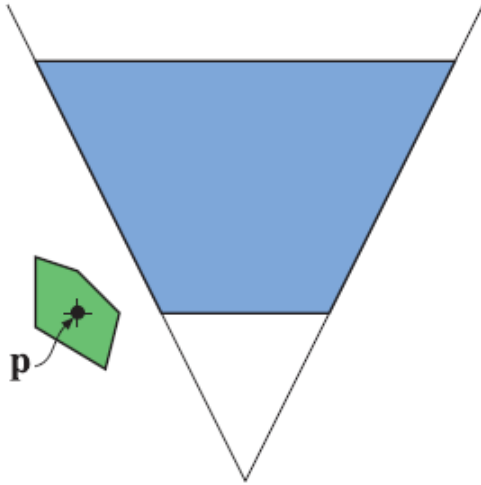
View Frustum Culling



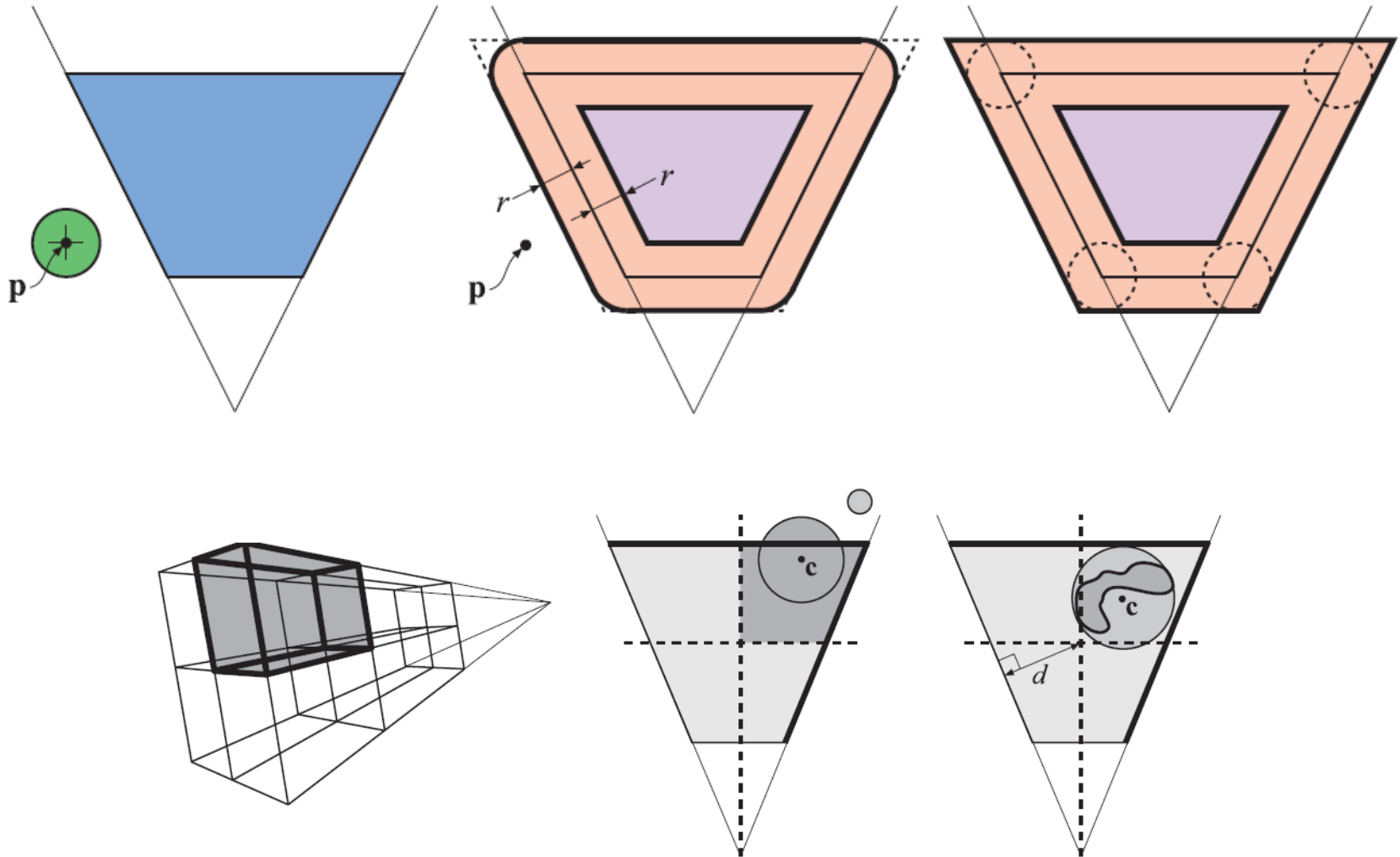
Example of Hierarchical View Frustum Culling



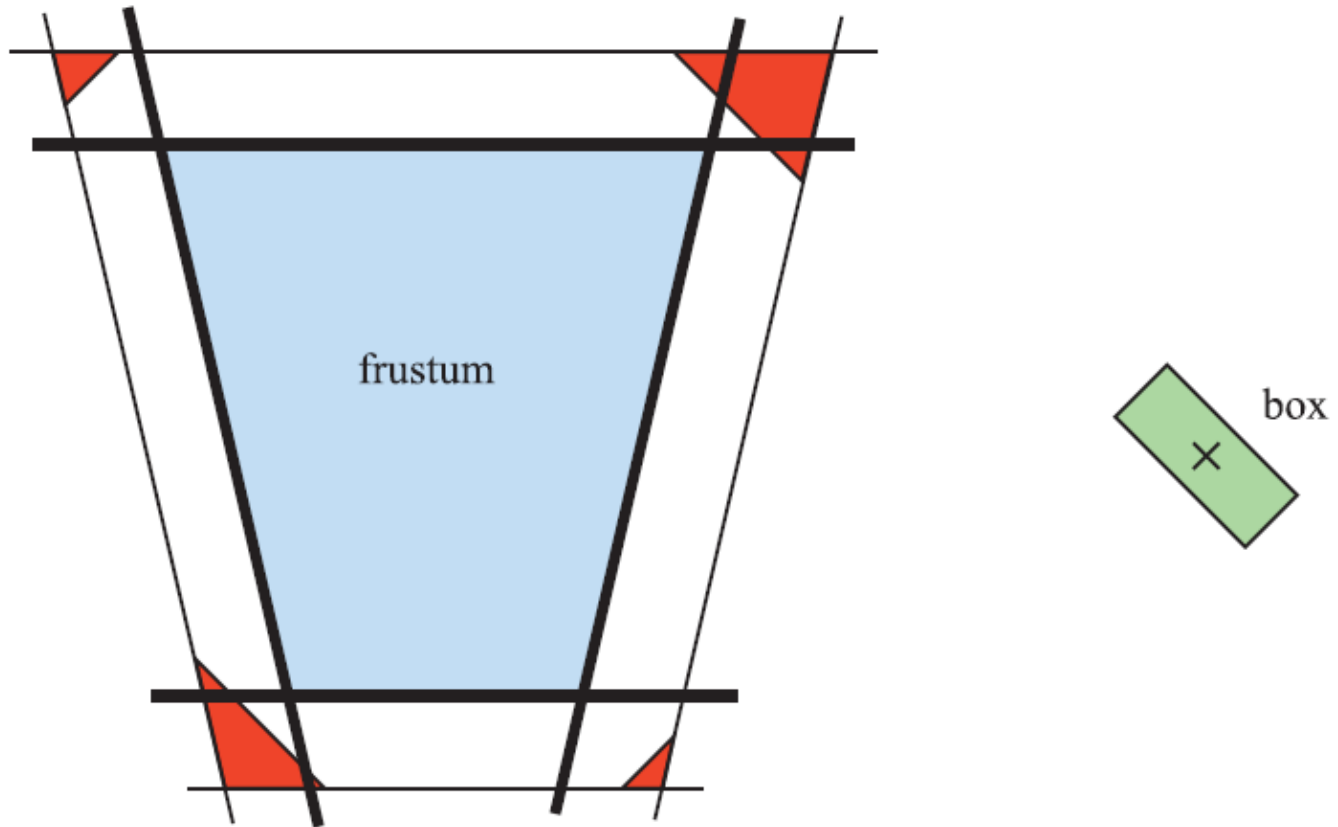
View Frustum Intersection



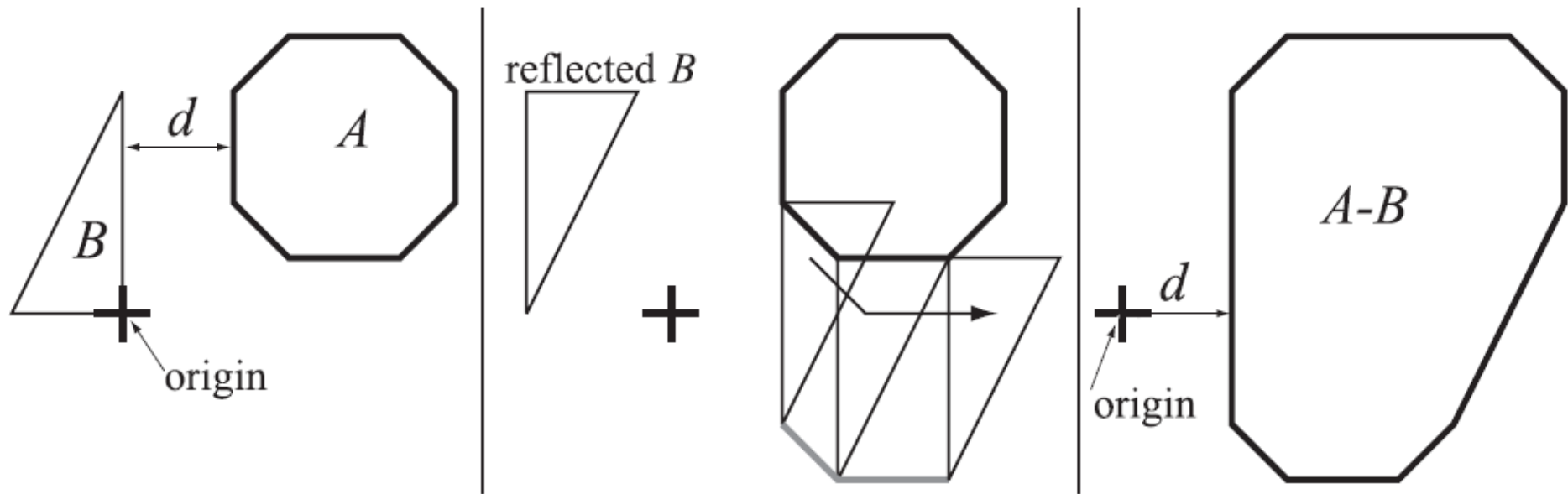
View Frustum Intersection



Frustum/Box Intersection



Distance Queries



$$A-B = \{a-b \mid a \in A, b \in B\}$$

Minkowski Sum/Difference

$$A + B = \{a + b \mid a \in A, b \in B\}$$

$$A - B = \{a - b \mid a \in A, b \in B\}$$

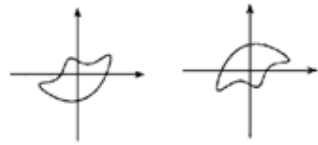
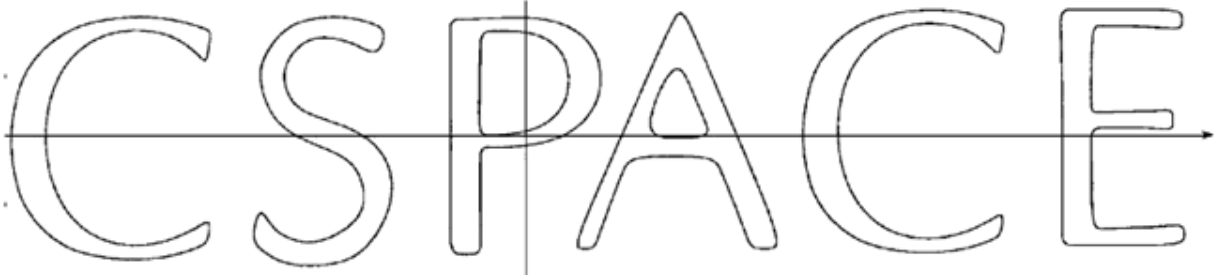
$$A \cap (B + p) \neq \emptyset$$

$$a = b + p$$

$$p = a - b$$

$$p \in A - B$$

Collision-Avoidance Motion Planning



GJK Algorithm for Convex Obj.

