EXERCISE 9

1. Bounding Volumes

(a) Discuss the advantages and disadvantages of the bounding volume types

- sphere,
- AABB,
- OBB, and
- k-DOP

with regard to how well they are suited for

- translation and
- rotation.

(b) Sketch one algorithm each for constructing a

- bounding sphere,
- AABB, and
- OBB

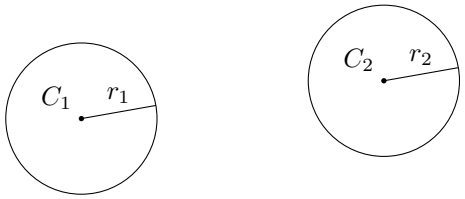
for objects that are represented as triangle meshes.

Sphere: allows for trans and rot, interference detection is cheap and easy, updates are cheap not tightly bound, so not a good approximation
AABB: comparatively cheap, tighter than sphere, low-dim approximation for interference det, does not allow for rotation as axes are fixed
OBB: suited for both trans and rot, axes orientations can be changed, updates are cheap in hierarchical mode, overlap test is expensive separating plane needs to be found. 2F+E^2 possible candidates = 15 for OBB
k-DOP: not suited for rotation as directions are fixed, overlap tests and updates are both expensive, but viable choice for deformable bodies and it gives a good fit

2. Overlap Test

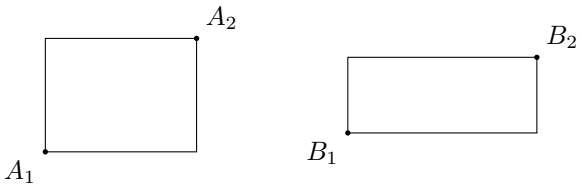
Sketch an algorithm that checks whether the two bounding volumes overlap.

(a) Bounding spheres:



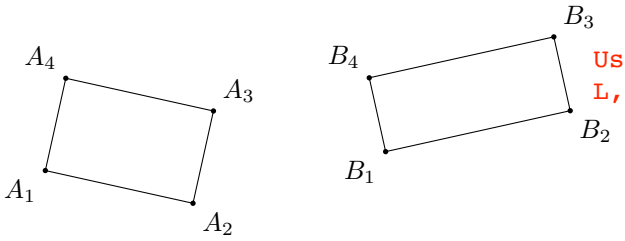
|c1 - c2| > r1 + r2, then no overlap

(b) AABB:



Must overlap along each 1D axes

(c) OBB:

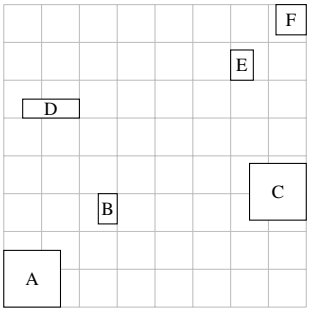


Using separating plane theorem, must exist L, s.t. T.L > pa + pb

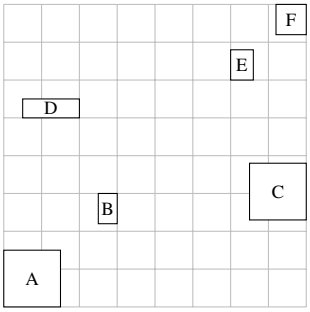
3. Accelerating Structures

Construct an acceleration structure for the following objects that are already organized in separate AABBs.

(a) Create a *sensible* BVH consisting of AABBs using a binary tree.



(b) Create a Quadtree with each leaf node containing at most one of the AABBs.



4. Computational Costs

Consider the following ways of organizing multiple objects, i.e., triangle meshes, in a scene:

- one single array of individual triangles,
- one AABB per object, and
- AABBs organized in a BVH, one AABB per object as the leafs.

Discuss briefly their impact on the computational cost for collision detection. Do not consider update costs.