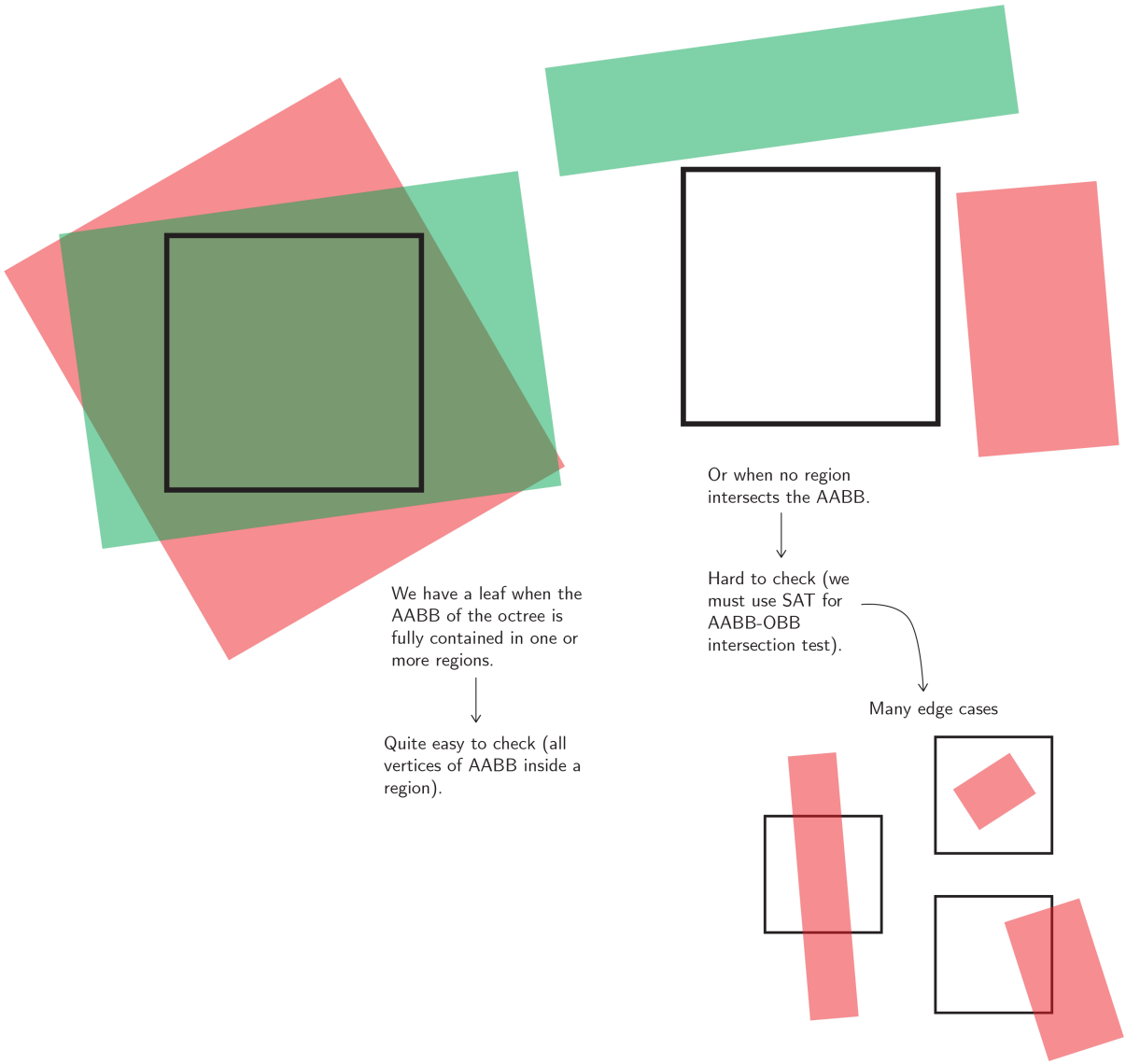
- $cmp_f \longrightarrow$ floating point comparison
- $add_f \longrightarrow$ floating point addition
- $mul_f \longrightarrow$ floating point multiplication
- $div_f \longrightarrow$ floating point division
- $abs_f \longrightarrow$ absolute value
- $dot_v \longrightarrow$ dot product (3D)
- $x_v \longrightarrow$ cross product
- $add_v \longrightarrow$ vector addition

Octree

Construction



- Check the relative position of the OBB representing a region with the AABB representing an octree cell:
  - AABB fully outside
  - Intersection
  - AABB fully inside (intersection)
- Do this for all the regions of the cell:
  - **AABB fully inside OR fully outside all regions**: cell is a leaf, save regions where the AABB is fully inside.
  - **At least one region intersects (not fully inside)**: recursively subdivide the cell (only consider the regions that intersect it).
- Do this until cells are too small or all cells are leaves.
- To check the relative position of an AABB and an OBB we must use the separating axis theorem (SAT), which is complex.

$$C_{construction}(root) = C_{intersection} + 8 \cdot C_{construction}(subtree)$$

$C_{intersection} = C_{SAT} + C_{fully\ inside}$ early out if SAT fails, but little gains (SAT is way the most complex part by far)

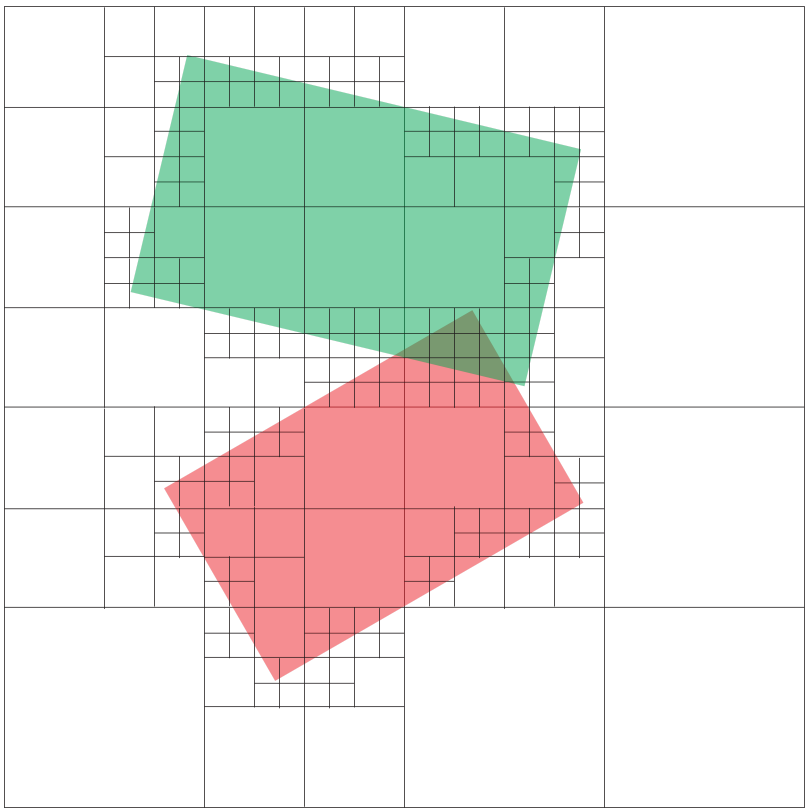
$C_{fully\ inside} = 8 \cdot C_{OBB}$ check *AABB for OBB*: we check if all the vertices of the AABB are inside the OBB of the region

$C_{SAT} = 9 \cdot x_v + (6 + 6 + 9) \cdot [(8 + 8) \cdot (dot_v + 2 \cdot cmp_f)]$ approximate cost and many early outs

Traversal

- Find the octree cell of the point and look up the regions.
- The search in the octree is linear w.r.t. the max number of levels allowed for the octree.

$C_{lookup} = levels \cdot [3 \cdot (mul_f + cmp_f)]$ for each axis we have to get if the component is before or after the half point



AABB for OBB

Construction

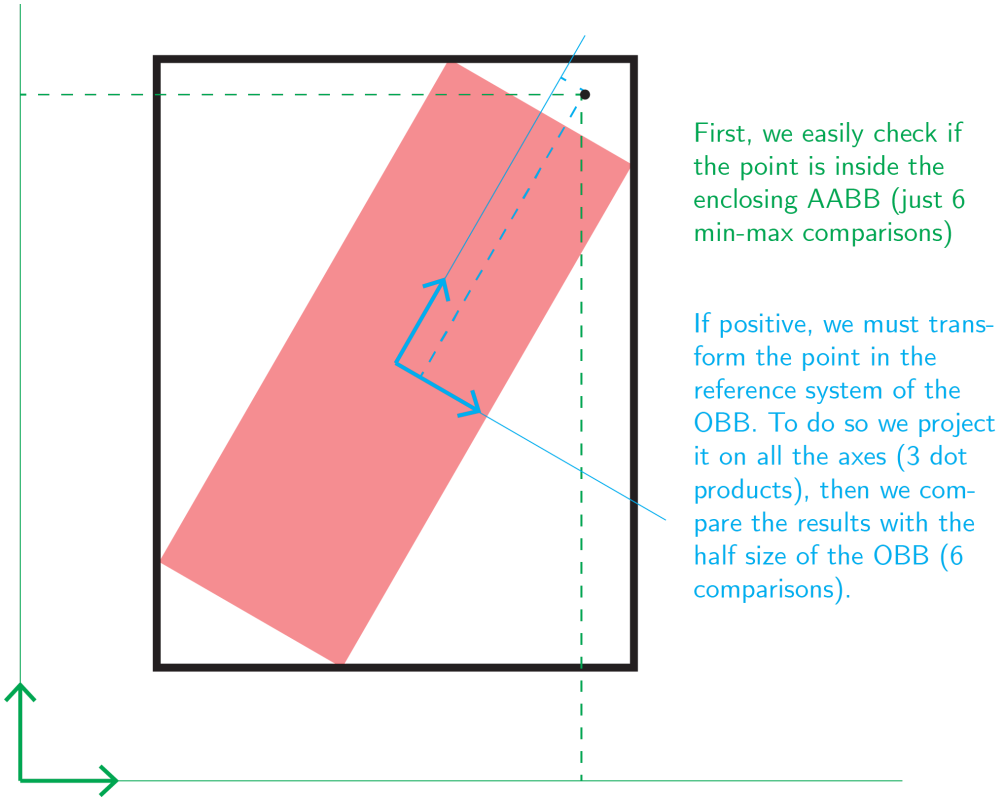
- For each vertex of each triangle, test if it is inside each BVH region.
- To check if it is inside:
    1. Check if a point is inside the AABB.
    2. Check if a point is inside the OBB:
        - To do so, we basically have to transform the point in the coordinate system of the OBB.

$C_{construction} = (3 \cdot V \cdot BVHs) \cdot C_{inside}$

$C_{inside} = C_{AABB} + C_{OBB}$ early out if the AABB part fails

$C_{AABB} = 6 \cdot cmp_f$ *early out when one component doesn't satisfy the comparison (outside AABB)*

$C_{OBB} = add_v + 3 \cdot (abs_v + dot_v + cmp_f)$ *there may be an early out if the first (or second) coordinate is already out of the OOBB*



Traversal

- For each BVH region, we have to check if the point is inside.

$C_{traversal} = BVHs \cdot C_{inside}$

Simplify to AABBs