

Class Notes 3-30 CS7491
Francisco Palop and Bas Schopman

The main topic of the class was on speeding up the detection of interfering balls. What we have is a set of ball with center and radius. We want to report all pair wise intersections. The naive approach is as follows:

```
For each ball A
  For each ball B (after A in the list)
    Check A AND B
```

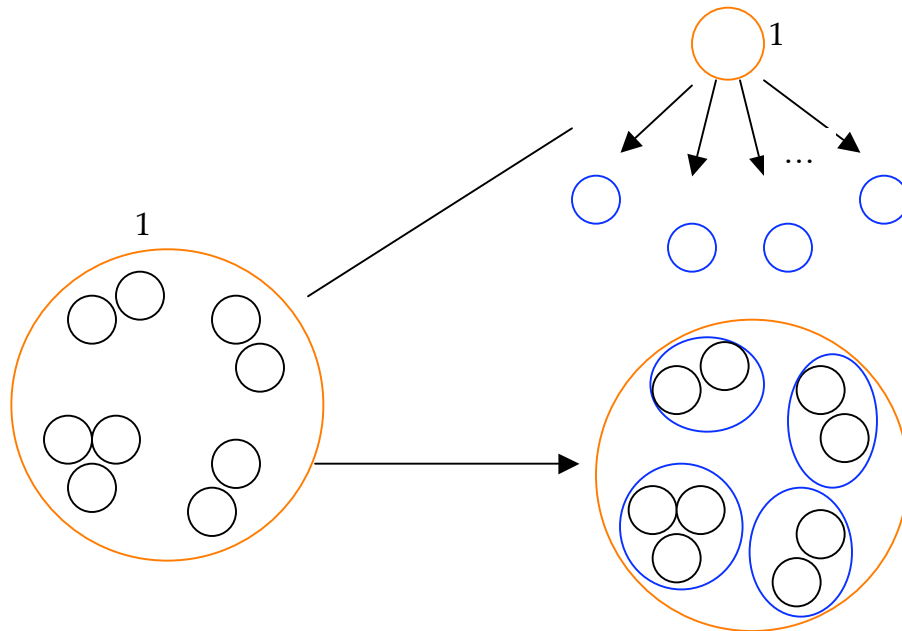
The ideas that were proposed in class were the following:

1. Make hierarchy of balls (wasted space?)
2. Use voxels
3. Binary Space Partition (BSP) } vs. Octrees?
4. Sort vs. Projections
5. Delaunay Tetrah. of space centers
6. Vertex spanning tree
7. Progressive vector quantization

1. Make hierarchy of balls

In the hierarchy approach the first question that arises is: "How do we make the hierarchy?" We have two approaches:

- a. Top down: build hierarchy
 - b. Bottom up: incremental insertion
- a. Top down



How do we get sphere 1?

Stupid and simple approach: minmax box, not optimal

A better approach is to cluster, we have 2 approaches:

- Divide the space in half, problem of overlap
- Use density

If we only want two clusters we can use caplets. We make a convex hull containing all the spheres and split it in half.



For the density approach we can use the k-means algorithm to get the seeds

k-means (k=2):

Random 2 centers

Assign sphere to closest center

Pick centered sphere as center and start over

Better is to use adaptive k-means. It uses 'machine learning' techniques:

Try several values of k

Measure inter cluster distances (smaller clusters)

The main disadvantage of the top down approach is that the initial partitioning decides if the clustering is good. Therefore it is best to use adaptive k-means algorithm.

(pic)

2. Use voxels

We're assuming that the spheres are smaller than the voxels.

Two main approaches:

- a. Record spheres with voxel containing their center
- b. Record spheres with voxels they intersect (replications)

How do we calculate the intersection of the voxel and the sphere?

Minimize circle to its center

Enlarge voxel with radius of center

If center of circle is in voxel then they intersect

This is a conservative approach, it will produce false positives.

Hierarchy of balls Vs. 2. Usage of voxels

Which of the two is better for:

- Cost of building
- Cost of finding all candidates
- No. of candidates that intersect

The last item is the most important one.