Homework Exercises for Lecture 3

3-1 Describe and analyze a KDS to detect collision for n unit disks moving continuously. If disks have different sizes, give an example showing that a disk must be involved in $\Theta(n)$ certificates. Try to design a kinetic collision detection which is compact and responsive for arbitrarily sized disks.

3-2 Describe and analyze a kinetic data structure to maintain the median of a set of n linearly continuously changing real values. The difficult part will be analyzing the number of events. You can assume the following bounds for any set of n lines in the plane and any integer $k \leqslant n/2$.

- The number of intersection points with exactly k lines below them is $O(nk^{1/3})$. In particular if the numbers are changing linearly, their median change $O(n^{4/3})$ times.
- The number of intersection points with at most k below them is $O(nk)$.