For this assignment you have to write 2D game which will simulate the trajectory of a (particle) point under a ”Brownian motion” when the particle is restricted inside a triangular box.

You will start with the particle at a random position (point $P$) inside the box, and then as long as the particle is in the box, you will

- chose a vector, $d$, a unit vector pointing in a random direction.
- scale $d$ so it has length $1/50$ of the length of the shortest side of the triangle.
- The new location of the particle is $P = P + d$

Repeat the above procedure for updating $P$ until the point $P$ gets outside the triangle.

The image that you would show is the complete trajectory of the particle, from the starting position (mark this one with some different color than that of the trajectory, and a bigger point size), to the final position inside the box (mark this one as well.)

You should use 2D graphics for this assignment. The box will be modelled simply as the boundary of the triangle. The inside should be white. Draw the trajectory in blue.

The program should work for any triangle (not just equilateral), use the math we studied, do not get hooked on particular coordinate values!

Important math concepts you have to resolve are given below:

- Given a triangle, i.e. the three vertices, choose an initial interior point
- Given a triangle, how to choose at random a point in the interior (i.e. what will be the affine convex combination in term of the three vertices).
- Choose a random unit vector $d$
- Given a triangle, find the length of the shortest side.
- Given a point $P$, how to decide if the point is inside or outside the triangle. Here are some suggestions.
  - Assume that $M$ is a fixed point inside the triangle (for example the center of mass).
  - $P$ is inside the triangle if and only if, for each side of the triangle, $P$ and $M$ are in the same half-plane (on the same side) with respect to the side.
  - One way to resolve the question if $P$ and $M$ are on the same side of, for example, side $AB$, is to check if the dot products of vectors $P - A$ and $M - A$ with a vector $n$ orthogonal to $AB$ have the same signs:
    $$(M - A)n \ast (P - A)n \geq 0$$
    $(M - A)n$ denotes the dot product of vectors $M - A$ and $n$, and $\ast$ denotes scalar multiplication of two real numbers.
– And of course, to resolve the previous step, you need to be able to find the vector \( n \). That is, given two points, for example \( A \) and \( B \), find a vector \( n \) orthogonal to the vector \( B - A \).

As usual, for a programming assignment, submit hardcopy of the source code and a one page report stating: what you did; how you did it; any particular features you want to draw attention to; or any problems with the program you know about.

Submit a hard copy in class, and e-mail the source to: csc171a@yahoo.com.