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# PointCloud.py
""" Some basic operations on a cloud of points in
the plane are used to illustate various list-processing
basics."""

from random import normalvariate as randn
from math import sqrt
from SimpleGraphics import *

def MakeCloud(n,sigma):
    """ Returns lists of floats x and y that define a cloud
    of n points in the plane.

    The x and y values are randomly generated using the normal
    distribution with mean zero and standard deviation sigma.

    PreC: n is a positive integer greater than 1 and sigma is a positive float.
    """
    # Build up x and y via repreated appending.
    x=[]
    y=[]
    for k in range(n):
        r = randn(0,sigma)
        x.append(r)
        r = randn(0,sigma)
        y.append(r)
    return (x,y)

def Diameter(x,y):
    """ Returns (d,imax,jmax) where d is a float that is the diameter of a cloud
    of points defined by lists x and y. imax and jmax are ints that are
    the indices of the diameter points.

    The diameter of a cloud of points is the maximum distance between any
    two points in the cloud. The two points for which this occurs are called
    diameter points.

    PreC: x and y are lists of floats with the same length.
    """
    # d is the maximum separation between all pairs of points that have
    # so far been checked.
    d = 0
    n = len(x)
    for i in range(n):
        # Examine distances to the point (x[i],y[i])
        for j in range(n):
            dij = sqrt((x[i]-x[j])**2 + (y[i]-y[j])**2)
            if dij>d:
                # The distance between the ith and jth points is
                # a new maximum. Update d and save the values of i and j.
                d = dij
                imax = i
                jmax = j
    return (d,imax,jmax)

def ShowCloud(x,y):
    """ Displays a point cloud defined by x and y and highlights
    the two points  that define its diameter.
    PreC: x and y are lists of floats with the same length.
    """
    # Figure out how big to make the window.
    xMax = max(map(abs,x))
    yMax = max(map(abs,y))
    M = max(xMax,yMax)
    MakeWindow(1.1*M,bgcolor=BLACK,labels=False)
    # Determine the radius of each displayed point.
    r = M/50;
    # Determine the indices of the points that define the diameter.
    d,i,j = Diameter(x,y)
    for k in range(len(x)):
        # Display the kth point in the cloud.
        if k==i or k==j:
            # This will highlight the diameter points.
            DrawDisk(x[k],y[k],2*r,FillColor=CYAN)
        DrawDisk(x[k],y[k],r,FillColor=YELLOW)
    s = 'Diameter Points: (%5.2f,%5.2f) and (%5.2f,%5.2f)' % (x[0],y[0],x[1],y[1])
    Title(s,FontSize=20)
    ShowWindow()

# Application Script
if __name__ == '__main__':
    (x,y) = MakeCloud(500,3)
    ShowCloud(x,y)
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