IT523 Digital Image Processing
Assignment - 0: The Ferris Wheel.

1. Read the help files and try out some of the following commands:
   `help, plot, subplot, figure, sin, cos, pi, exp, zeros, ones, size, stem, abs, round, axis, hold on, function, .*, for.`

2. Assume that the radius of a Ferris wheel is R (in some units) whose center is situated at the point $(R+H, 0)$ (we are interested in coordinates in the plane in which the wheel rotates, H is the offset from the ground level). The wheel rotates for T minutes, completing one revolution in P seconds. Determine the formulae for the horizontal and vertical coordinates for the position of a particular point on the rim of the wheel. Find the Nyquist sampling rate $f_s Hz$ for these functions. Plot the sequence for x coordinate versus time, y coordinate versus time, and x versus the y coordinate, by assuming values for R, H, T & P and obtained by sampling with rate (a)$4f_s Hz$ (b) $f_s Hz$ and (c) $\frac{f_s}{3} Hz$.

3. Assume there are several smaller Ferris wheels each of radius R_1 ($R_1 < H$ and $R_1 < R$) attached to the rim of the original wheel. Refer Figure 1 for a real world example. Each smaller wheel completes a revolution in P_1 seconds. Determine the formulae for the horizontal and vertical coordinates for position of a point on the rim of this smaller Ferris wheel. Find the Nyquist sampling rate $f_s Hz$ for these functions. Plot the sequence for x coordinate versus time, y coordinate versus time, and x versus the y coordinate, by assuming values for R, H, T, P, R_1 & P_1 and obtained by sampling with rate (a)$4f_s Hz$ (b) $f_s Hz$ and (c) $\frac{f_s}{3} Hz$.

Figure 1: A double Ferris wheel. Image source - `www.rollercoastermodels.com`

4. Next, assume that there are J nested Ferris wheels. Write a MATLAB function `myferris.m` that takes in a vector R containing the radii of the J Ferris wheels, a vector P containing the time in seconds it takes to complete a revolution by the corresponding Ferris wheel, total time for which the wheel rotates T and the offset H. The function should automatically compute the Nyquist sampling rate $f_s Hz$. The function should also plot the sequence for x coordinate versus time, y coordinate versus time, and x versus the y coordinate for a point on the rim of the last Ferris wheel obtained by sampling with rate (a)$4f_s Hz$ (b) $f_s Hz$ and (c) $\frac{f_s}{3} Hz$.