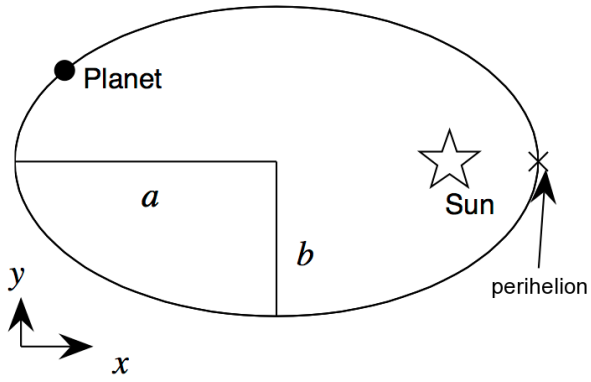
Tutorial 25-08-2016

Q1. Write a code to find the root of
f(x) = Exp(sqrt{5} x) - 13.5 cos(0.1x) + 25x^4

This equation has two roots. The code should automatically find both the roots.

Q2.



A planet is moving around the sun in an elliptic Kepler orbit with semi-major axis a, semi-minor axis b, and eccentricity $e = \sqrt{1 - b^2/a^2}$. The planet is orbiting the Sun and was last at its perihelion at $t = 0$. $\omega = 2\pi/T$ is its angular frequency and T is the duration of its orbit.

If we define a 2D coordinate system (x, y) with origin at the center of the ellipse, then the points on the ellipse are described by the equation

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \ . \tag{1}$$

The location of the planet in the (x, y) coordinate system is given by

$$\begin{aligned} x &= a\cos E \ , \\ y &= b\sin E \ , \\ E &= \omega t + e\sin E \ . \end{aligned} \tag{2}$$

Earth has an orbital period of 365.25635 days, a semi-major axis a = 1.496x10^{16} km, and its orbit has an eccentricity, e = 0.0167. Compute (x,y) for t = 91 days, t = 182 days and t = 273 days. Fractional error in E at the end of your computation should be less than 10^{-7}. How many iterations your program require?

Include the answer in the report

Now, suppose something happened to put earth in a heavily eccentric orbit with e = 0.99999. How many iterations does the code take now? See if you can accelerate the convergence.

Also, plot the orbit of the planet in both cases.