UNIVERSITY OF SUSSEX
Scientific Computing
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Problem Sheet 4 (Problem 2 will be assessed)
Deadline: 12pm on Monday, November 21st, 2016.
Penalties will be imposed for submissions beyond this date.
Final submission date: Tuesday, November 22nd, 2016.
No submissions will be accepted beyond this date.

1. **Root finding:** Consider the equation $\sin(x) + 3\cos(x) - 2 = 0$ in the interval $(-2, 2)$.

   (a) Find the number and approximate bracketing values of the roots of that equation in this interval, using e.g. plotting.

   (b) Use Ridder's method and the results in (a) to find the the roots with eight significant digits.

   (c) Use Newton-Raphson's method and the results in (a) to find the the roots with eight significant digits.

   (d) Do the same using the in-build function `scipy.optimize.fsolve`.

2. **(Assessed) Systems of equations:** The trajectory of a satellite orbiting the Earth is:

$$R = \frac{C}{1 + e\sin(\theta + \alpha)} \tag{1}$$

   where (R, θ) are the polar coordinates of the satellite, and C, e, and α are constants (e is known as the eccentricity of the orbit, $C = a(1-e^2)$, where a is the orbit's semi-major axis, and α is the phase). If the satellite was observed at the three positions listed in the table, determine the smallest R of the

θ	-30°	0°	30°
R (km)	6870	6728	6615

   trajectory (this is called pericentre of the orbit) and the corresponding value of θ. To solve the equations use both the provided code `newtonRaphson2.py` and the in-build routine `scipy.optimize.fsolve`. [30]