Numerical Methods 35006
Computer Lab 2: Taylor series, Zero finding

Go through each of the tasks in order. If you're stuck then ask the person sitting next to you - if you're both stuck then put your hand up and someone will come and help.

1. Find (in whatever way you see fit) the n^{th} term of the Taylor series of

$$f(x) = \sin(x) \ ,$$

expanded about the point $x_0 = \pi/3$. Write python code that, given a number N, will plot the N^{th} order Taylor series approximation to $f(x)$ in the range $x \in [-\pi/2, 3\pi/2]$.

2. Use Newton's method to determine a solution accurate to within 0.00001 for the equation

$$\cos x = x$$

using the initial estimate $x = 0.5$.

3. a) Write a bisection routine for an arbitrary function. The function should be called in the following way:

```
x = bisection(f,a,b,tol)
```

where `f` is a function that returns a real number, `a` and `b` are the endpoints of the initial search interval, and `tol` is the accuracy to which the zero should be known. The routine should print out an error if the bisection routine fails.

b) Save your routine into a new file (call it `mysearch.py`), then test it using the following script:

```
import numpy as np
import mysearch as mys
def f(x):
       f = x - np.cos(x)
       return f
a = 0
b = 1
tol = 0.0001
x = mys.bisection(f,a,b,tol)
print('Zero found at',x)
```

4. a) Write a bracketing procedure that returns a list of brackets of the roots of

$$f(x) = x^4 - x - 1$$

in the range $x \in [-2, 2]$.

b) Use the secant method to find all of the roots of f to within 10^{-4}.

5. Use the false position method to find all solutions to the equation

$$3x^2 = e^x$$

to within 10^{-5}.

6. Take each of your search routines and incorporate them into your `mysearch.py` module.