Numerical Analysis 4315/5315, Assignment 1

0- It is necessary to have a usb/thumb/flash drive to store your files. If you don't have
one write down or print your final versions.

00- You may need to add the directory where your files reside to the list of directories
Matlab is aware of, namely its `path`. Type `>>help path` to see more detail. Check the
example at the bottom of the help file, under Windows.

1- In class we defined generalized averages for a set of three positive numbers.
$y_1 = (x_1 + x_2 + x_3)/3$
$y_2 = \sqrt{(x_1 x_2 + x_2 x_3 + x_3 x_1)/3}$
$y_3 = \sqrt[3]{x_1 x_2 x_3}$
Define a similar set of formulas for four numbers and write a program to calculate them.
Optional advanced project: Write a program that works for any number of input variables.

2a- Write a program to solve $f(x) = 0$ using Newton method. For exit criterion use
$maxiter$ = maximum number of iteration. Solve $\cos x = x$. What is a reasonable starting
guess? Get answer to the maximum number of digits supported by Matlab. (Hint: at the
prompt type $>>$ `format   long` and observe the effect.)

2b- Add a second exit criterion, $xtol$, the improvement or movement in x_n, or the size of
the final interval containing the root. For this you need `abs`, the absolute value function,
and the syntax of conditionals in Matlab. The basic syntax is

```
if relation
expression
end
```

Implying that if the `relation` is satisfied then the `expression` will be carried out, other-
wise it will be ignored. The only relation we need now is $a < b$ which you type as you see.
So for example if y is the new improved value of x then you may want to use

```
if abs(x − y) < 10⁻¹³ % Why is abs needed here?
% the successive approximation to the root are within 10⁻¹³
root = y
end
```

You also need to know how to terminate an ongoing loop prematurely. The idea is that
perhaps long before your program exhausts the prescribed number of maximum iterations
you may want to stop. The command for that is `break`, it stops the loop. So the above
program fragment becomes

```
if abs(x − y) < 10⁻¹³
root = y
break
end
```

Try your program again by setting the maximum iteration at the unreasonably high
$maxiter = 100$ and a reasonable $xtol$, e.g., $xtol = 10^{-13}$. Control parameters such as
$maxiter$, $xtol$, etc, better be defined at the top of the program and then used.
Test your program with several different equations.

2c- Add a third exit criterion to your program $ytol$. You want $y = f(x)$ to become zero.
Well, in the real world it will never be zero, and you want to stop when y is small enough.
To do this you want to add another conditional, or perhaps combine the two conditionals.
In the latter case the syntax for *or* is `relation one | relation two`. The syntax for *and*
is `relation one & relation two`.