ISC 4220

Assignment 1

Due: January 21, 2016 in the Lab

Nonlinear Equations 1

1. Write a general purpose Matlab function [xst, erra, iter] = bisection(func, a, b, tol), which accepts any user-specified function, an interval $[a, b]$, and an error tolerance level. The function should output the solution, the approximate relative error, and the number of iterations required.

- Double check to ensure that $[a, b]$ is valid.
- Check the appendix at the end of this lab to find out how to pass function names as arguments to other functions.

Use it to find the solution to,

$$\tan x - \frac{1}{1+x^2} = 0,$$

with $a = 0$ and $b = 1$, upto 3 decimal digits.

2. Suppose I take out a $n = 15 \times 12 = 180$ month fixed-rate loan for $L = \$100,000$, at an annual interest rate of i_a. The fixed monthly payment P (in dollars) required to fully pay off the loan in n years is given by:

$$P = L\frac{i_m(1+i_m)^n}{(1+i_m)^n - 1}$$

where $i_m = i_a/12$ is the monthly interest rate. If my monthly budget only allows me to make payments of $P = \$800$, what is the maximum i_a that I can afford? Rewrite the equation above and use the bisection rule to figure out the answer to an accuracy of 10^{-6}.

What if my budget is $P = \$600, \$700, \$900$, or $\$1000$? What if it is $P = \$500$?

Appendix

In Matlab, we can write functions that accept names of other functions as input arguments. For example consider the simple functions myadd.m and mysub.m which add and subtract two numbers.

```
function sum = myadd(a, b)
  sum = a+b;
end

function sub = mysub(a, b)
  sub = a-b;
end
```

We can specify a general function myoperator.m which accepts the name of the function as a variable.

```
function result = myoperator(func, a, b);
  result = func(a, b);
end
```

In this example, we can ask myoperator to add numbers using the command:

```
>> x = myoperator(@myadd, 1, 2)
x = 3
>> x = myoperator(@mysub, 1, 2)
x = -1
```