**4/19/18 – Thursday**

**Numerical Methods - Spring '18**

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**Lab #5**

**Problem 1:**

Write a script that asks the user for a guess to the solution of $e^{-x} - x = 0$ and implements the fixed-point method of finding a root.

**My Solution:**

fixedpoint.m

```
%Problem 1 - A script implementing the fixed point method of finding a root
%for e^-x=x.

prompt='Hey hoss make an initial guess: ';
x0=input(prompt);
x1=exp(-x0);
vals=[x1];
prompt2='Cool hoss, how many iterations?'
counter=input(prompt2)

while counter>0
    x0=x1;
    x1=exp(-x0);
    vals=[vals x1]
    counter=counter-1;
end

disp(vals);
```

**Problem 2:**

When a cable is hung between two points it will sag due to gravity. The curve that results is called a catenary curve. The rate of drape is proportional to the distance from an end point. This can be formulated into a second order differential equation:

$$\frac{d^2y}{dx^2} = \frac{w}{T}\sqrt{1 + \left(\frac{dy}{dx}\right)^2}$$

Here, w is the density of the cable and T is the tension at the end points of the cable. This differential equation can be solved to obtain

$$y = \frac{T}{w}\cosh\left(\frac{w}{T}x\right) + y_0 - \frac{T}{w}$$

Here $y_0$ is the height above the ground at the lowest point. In this model, the cable is at its lowest point when x=0. Write a script to produce a graph of the cable given the following information.

a. The cable has density 10.
b. The lowest point is 5 meters above the ground.
c. When x= 50 meters, y=15 meters.
d. The cable is 200 meters long.

**My Solution:**

fixedpointfunction.m

```
%A function that returns the tension of a cable given an initial guess t0
%and an error. A helper function for graphcable
function y = fixedpointfunction(t0,err)
t1=t0.*cosh(500./t0)-100;
vals=[t1];
maxit=500;
j=1;

while abs(t1-t0)>err && j<maxit
    t0=t1;
    j=j+1;
    t1=t0.*cosh(500./t0)-100;
    vals=[vals t1];
end

y=vals(length(vals))
end
```

graphcable.m

```
%Problem 2 - A script that produces a group of the cable definied by the
%catenary curve given initial conditions.
disp('Okay... graphing now hoss...')
x=-200:1:200;
di
t=fixedpointfunction(1000,.0001);
dens=10;
y0=5;
y=(t./dens).*cosh((dens./t).*x)+y0-(t./dens);
disp('Almost done...')
plot(x,y)
title('A Hanging Cable');
xlabel('Legnth, meters');
ylabel('Height, meters');
%axis([-100,100,0,50]);
axis equal;
```