CE305 Ltd, owns a large portion of land between the *Lake Newton* and the *Happynewyear Village* (see Figure 1). The company wants to build a large amusement park to this area for the children of the village. However, since the area is too close to the lake, the board of the company has serious concerns about the load capacity of the soil in the construction site and needs your consultancy about this subject.

Figure 1: The location of the land owned by *CE305 Ltd*

Your mission, should you choose to accept it, to model the behavior of soil and plot its strain stress relationship. To complete this task you are given the data obtained from the oedometer test. In your CE 363 class, you have learned how to interpret the results of oedometer test for a typical soil specimen. For those who has not taken the class yet or cannot remember the test, a typical test setup is shown in Figure 2.

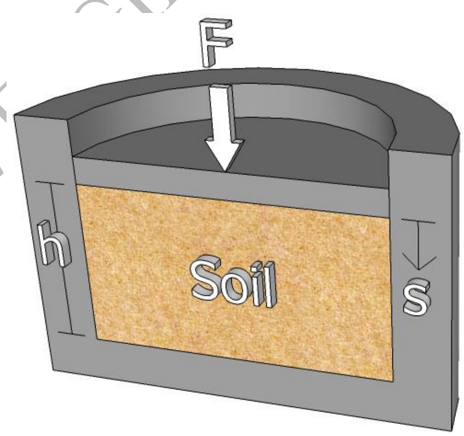

Figure 2: Confined Compression Test

The data obtained from the test results are given as σ (kPa) and ε (%) values in the “lab9_data.xls” document as an Excel file. Where;

$$\sigma = \frac{F}{A} \quad \text{(Eq. 1)}$$

$$\varepsilon = \frac{s}{h} \quad \text{(Eq. 2)}$$

The recent studies showed that the σ-ε relationship may be modeled with a differential equation in the form of:

$$\frac{d\sigma}{d\varepsilon} = \frac{1}{C_c}\sigma \quad \text{(Eq. 3)}$$

Where C_c is compression index and it is 0.2254 for this type of soil.

a) In this part you are expected to write a MATLAB script which uses Euler's formula to determine the σ-ε relationship by using Eq. 3.

Remark:
Euler's Formula:

$$\sigma_{i+1} = \sigma_i + f(\varepsilon_i, \sigma_i) \cdot h$$
$$f(\varepsilon, \sigma) = \frac{d\sigma}{d\varepsilon} \quad \text{(Eq. 4)}$$

Start from ε_0 = 0.1% and σ_0 =3.84 kPa and continue until ε=1.2%. Take h=0.0001.

b) Note that the exact σ-ε relationship satisfying the Eq. 3 is given below.

$$\sigma = e^{\frac{\varepsilon}{C_c}} \quad \text{(Eq. 5)}$$

Plot three σ-ε relationships obtained from the oedometer test, from part a) and from the exact σ-ε relationship.

CE305 Ltd is pretty sure that you do not need the following guidelines. But, in case you forget something you can benefit from these guidelines

```
clear all
close all

%% Initial condition:
epsilon_0=....;          %When the experiment started
sigma_0=....;
epsilon(1)=....;
sigma(1)=....;
epsilon_max=....; %yielding_criterion

%% Step size, number of steps
h=....;  %Step Size
N=....; %Number of Steps

%% Solve, storing the solution in array sigma(j)
for j=1:N
    sigma(....)=....; Euler Formula
    epsilon(....)=....; Update the epsilon
end

%% Plot vs time

%Read Data
data = xlsread(....);
epsilonLab = data(....); % Assign the first column of data to epsilonLab
sigmaLab= data(....); % Assign the second column of data to sigmaLab

plot(....); %plot the stress-strain relationships for Euler Method,
Exact Solution and Lab data
legend('Euler Method','Exact Solution', 'Laboratory Data')
```