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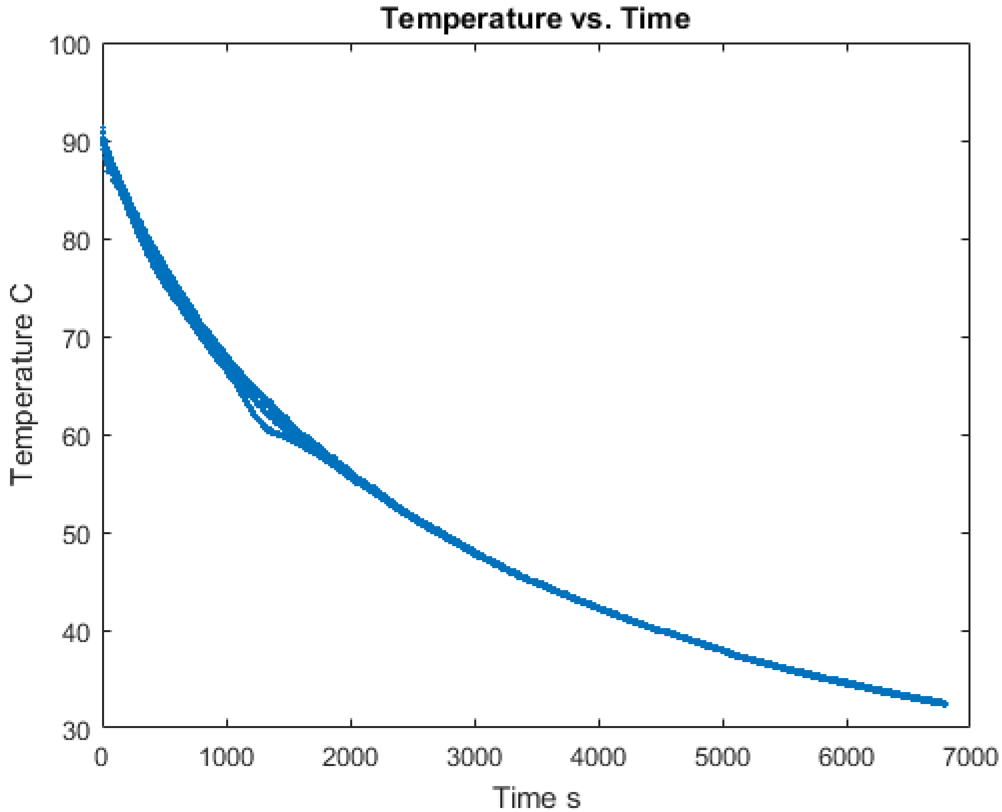
```
%HANWEN ZHAO
%MEID:650-703
```

MCEN 3030 PROJECT3

```
clc
close all
clear all
%NEWTON'S LAW OF COOLING
data = load('cooling.txt'); % load data from txt file
T = [data(:,2); data(:,3); data(:,4); data(:,5)]; % rearrange data
t = [data(:,1); data(:,1); data(:,1); data(:,1)]; % create a single
 corresponding time vector
plot(t,T,'*','markersize',1); % plot tghe data points
xlabel('Time s')
ylabel('Temperature C')
title('Temperature vs. Time')
hold on
height = 0.16; % the height of glass
width = 0.07; % the width of the glass
A = pi * (width/2)^2; % calcultate the surface area
vol = A * height; % calculte the volume of the glass
rho = 1000; % water density kg/m^3
c = 4186; % water heat capacity kj/kg*celsius
m = rho * vol; % calculate the mass of water
```



Problem 1

The equation from heat transfer qdot = -h*A*(T-T0) qdot = m*c(dT/dt) rewrite the eqn and take integral ln(T-T0) = -tau*t+C tau = (h*A/m*c) linearize the eqn Y = a1*x + a0 a0 = log(T-TO); a1 = -tau = -(h*A)/(m*c);

```
syms h T0
Ti = 26.5; % temperature of surrounding
X = t; % set up the linear eqn
Y = log(T-Ti);
nx = length(X);
ny = length(Y);
Sx = sum(X); % linear lease-squares regression
Sy = sum(Y);
Sxy = sum(X.*Y);
Sxx = sum(X.^2);
a1 = (nx*Sxy-Sx*Sy)/(nx*Sxx-Sx^2); % calculate a1
a0 = (Sxx*Sy-Sxy*Sx)/(nx*Sxx-Sx^2); % calculate a0
h = double(vpasolve(a1 == -((h*A)/(m*c)), h)); % calculate the value
 of h
T0 = double(vpasolve(a0 == log(T0 - Ti),T0)); % calculate the initial
 temperature
fprintf('The coefficients of linear equation are a1 = %4.6f, a0 =
 %4.6f.\n',a1,a0)
fprintf('The calculated coefficient h is %4.6f, the initial
 temperature T0 is %4.6f.\n',h,T0)
```

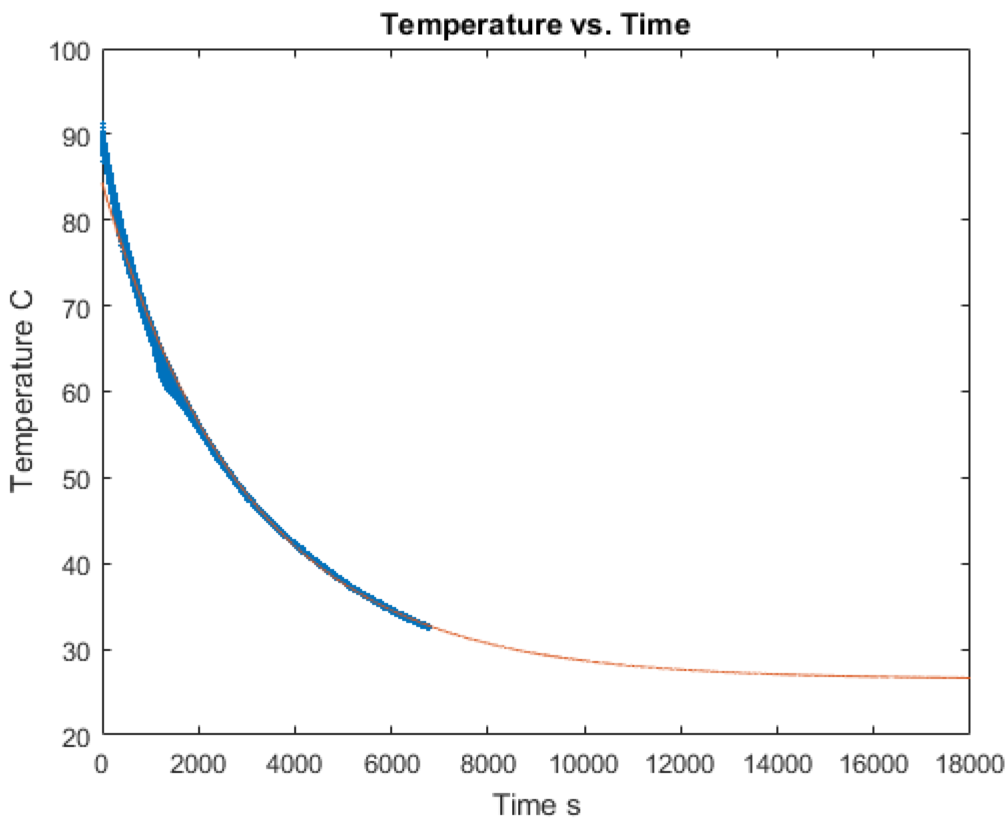
```
The coefficients of linear equation are a1 = -0.000329, a0 = 4.057925.
The calculated coefficient h is 220.120559, the initial temperature T0
 is 84.354136.
```

Problem 2

rewrite our equation

```
t2 = 1:5*60*60; % time for 5 hours
tau = (h*A)/(m*c); % calculate tau
T2 = exp(-tau*t2+a0)+Ti; % calculate temp regreting to the eqn we have
plot(t2,T2) % plot data
t3 = 10000;
T3 = double(exp(-tau*t3+a0)+Ti); % calculate temp at t = 10000s
fprintf('The estimate temperature at 10000s is %4.6f.\n',T3)
```

```
The estimate temperature at 10000s is 28.662719.
```



Problem 3

```
t4 = t(1:25); % obtain first 25 data
T4 = (T(1:25))';
Xint = 1.5; % the time to be interpolated
n = length(t4);
for i = 1:n % calculte the product terms Li
```

```
    L(i) = 1;
    for j = 1:n
        if j ~= i
            L(i) = L(i)*(Xint-t4(j))/(t4(i)-t4(j));
        end
    end
end
lagrange = double(sum(T4.*L)); % calculate the temp via Lagrange
 interpolating ploynomial
fprintf('The predict temperature at t=1.5s via Lagrange interpolating
 polynomial is %4.6f.\n',lagrange)
fprintf('The prediction is not working because the temperate at t=1 is
 89.5, at t=2 is 90.4.\n')
fprintf('The main reason of the method failure is that we have very
 noisy data at first 25 data points.\n')
fprintf('The polynomial is trying to fit all the nosiy data at
 interger time instant, thus it gave us a extreme high value at
 t=1.5s.\n')
fprintf('However the Nwtons polynimial will give us the similar high
 value due to the same reason.\n')
fprintf('The linear spline interpolation should give us a reasonable
 value since it only use two points to calculate.\n')
```

```
The predict temperature at t=1.5s via Lagrange interpolating
 polynomial is 1645.459011.
The prediction is not working because the temperate at t=1 is 89.5, at
 t=2 is 90.4.
The main reason of the method failure is that we have very noisy data
 at first 25 data points.
The polynomial is trying to fit all the nosiy data at interger time
 instant, thus it gave us a extreme high value at t=1.5s.
However the Nwtons polynimial will give us the similar high value due
 to the same reason.
The linear spline interpolation should give us a reasonable value
 since it only use two points to calculate.
```

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