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AMSC 460 - HW21

```
clear all; format compact; close all; syms f(x) x y z
```

Problem 1

If using the composite trapezoid rule, how many subintervals are needed to approximate the integral to within an absolute error of 10^{-8} ?

```
img = imread('amsc460p1.jpg'); imshow(img)
syms n
vpasolve(9*exp(3)/(12*n^2)== 10^(-8))
```

```
ans =
-38812.565867758281377226918861775
38812.565867758281377226918861775
```

Handwritten mathematical derivation for Problem 1:

$$a) \int_0^1 e^{3x} dx$$
$$f(x) = e^{3x} \quad f'(x) = 3e^{3x} \quad f''(x) = 9e^{3x}$$

The absolute error is $\left| \frac{h^2}{2} (b-a) f''(\xi) \right|$, $h = \frac{b-a}{n}$

$$\text{so } \left| \frac{h^2}{2} (b-a) f''(\xi) \right| = \frac{1}{12n^2} |f''(\xi)| \leq \frac{9e^3}{12n^2}$$
$$\text{so } \frac{9e^3}{12n^2} \leq 10^{-8} \quad \text{solve for } n \Rightarrow \begin{cases} n_1 = -38812.57 \\ n_2 = 38812.57 \end{cases}$$
$$\text{so } n \geq 38812.57$$

see matlab

Problem 2

Implement the composite trapezoid rule in MATLAB. For $n = 10^p$, with $p = 1, 2, 3, 4$, keep track of the error $E_T(n) = |I - T(f, n)|$, where $T(f, n)$ denotes the trapezoid rule with n subintervals. Plot

E_T for the given values of n on the same plot (use logarithmic axes for better scaling). Does your plot agree with the analysis performed in part (a)? \\\

```
I = int(f,0,1)
p=1:4;
for i=1:length(p)
    n(i)=10^p(i);
    T = trapz(f,n(i));
    E(i) = abs(I - T);
    fprintf('\n 10^%g T = %f, the error is %.9f',p(i),T,E(i));
end
```

```
I =
int(f(x), x, 0, 1)
```

Error using trapz (line 47)

Dimension argument must be a positive integer scalar within indexing range.

Error in hw21 (line 22)

```
T = trapz(f,n(i));
```

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