

GLG490/598 Numerical methods

Homework #5

Due 11:59pm, 2/25/2021

(100 points)

Question: write a C code to use the Simpson's method to determine the double integration of:

$$\int_{x=0}^{x=2} \int_{y=0}^{y=1} e^{xy} dy dx$$

Formular for Simpson's method for double integration:

$$\int_{x=a}^{x=b} \int_{y=c}^{y=d} f(x,y) dy dx = \int_a^b g(x) dx = \frac{h}{6} \sum_{i=1}^{n-1} \left[g(x_i) + 4g\left(x_i + \frac{h}{2}\right) + g(x_i + h) \right]$$

where, n is the number of nodes in x -direction, $h = (b - a) / (n - 1)$ is the width for each column in x -direction, and

$$g(x) = \int_{y=c}^{y=d} f(x,y) dy$$

Using Simpson's method, we have

$$g(x_i) = \frac{l}{6} \sum_{j=1}^{m-1} \left[f(x_i, y_j) + 4f\left(x_i, y_j + \frac{l}{2}\right) + f(x_i, y_j + l) \right]$$

$$g\left(x_i + \frac{h}{2}\right) = \frac{l}{6} \sum_{j=1}^{m-1} \left[f\left(x_i + \frac{h}{2}, y_j\right) + 4f\left(x_i + \frac{h}{2}, y_j + \frac{l}{2}\right) + f\left(x_i + \frac{h}{2}, y_j + l\right) \right]$$

$$g(x_i + h) = \frac{l}{6} \sum_{j=1}^{m-1} \left[f(x_i + h, y_j) + 4f\left(x_i + h, y_j + \frac{l}{2}\right) + f(x_i + h, y_j + l) \right]$$

where, m is the number of nodes in y -direction, $l = (d - c) / (m - 1)$ is the width for each column in y -direction.

Requirements:

1. You need to write **ONE** single code for this homework.
2. Use $n=20$ and $m=20$ in your code. You should get the following outputs on the screen:

```
$ ./a.exe
n=20 m=20 integration=3.683872
```

To help you a little bit, I have created a temporally code named "Homework-05-Li-StartCode.c" in the homework folder. There is some guidance in this code. You can work on this code, or you can simply write your own code from scratch. It is not an easy homework. Please work on it asap, and feel free to

ask me for help. You need to use $n=20$ and $m=20$ to get the same results as above, but feel free to test how the result changes with n and m for your own interests.

How to submit your homework

1. Name your C code as 'FirstName-LastName-HW05.c'.
2. Send your code file to Mingming.Li@asu.edu and enter the email subject title as "Numerical Methods Homework 05".