**Lab (5):** **Numerical Integration: Implementing Trapezoidal Rule in Matlab**

* The trapezoidal rule as discussed in class is given as



* The following file trapezoidal.m implements the trapezoidal rule in Matlab

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function [integral] = trapezoidal(index\_f,a,b,n)

% function to calculate the integral using trapezoidal rule

% input parameters:

% index\_f: parameter for the integrand

% a: lower limit

% b: upper limit

% n: Number of intervals must be positive integer greater than or equal

% to 1

%

% output parameter: integral

% sum the endpoints

sumend =( f(a,index\_f) + f(b,index\_f))/2; % f is a function which contains

% multiple integrands

h = (b-a)/n; % size of interval

sum = 0;

if ( n > 1)

for j = 1:1:n-1

xj = a + j\*h;

sum = sum + f(xj,index\_f);

end

end

integral = h\*(sumend + sum);

function f\_value = f(x,index)

% this function defines the integrand

switch index

case 1

f\_value = exp(-x.^2);

case 2

f\_value = 1./(1+x.^2);

end

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* Read the **m** file carefully and make sure you understand all the Matlab commands
* Run this function by writing a script file (e.g. main.m). A sample script file is as follows:

clear all

a = 0;

b = 1;

n = 1;

index\_f = 1

integral = trapezoidal(index\_f,a,b,n)

* Run this script file to calculate the integral of , as given on page 193 of your textbook and fill in the following table



* Modify your script file to generate the table 5.1, page 194 of your textbook. A sample script file is as follows.

clear all

a = 0;

b = 1;

n = 1;

index\_f = 1

n1 = [ 2 4 8 16 32 64 128];

for q = 1:length(n1)

n = n1(q);

integral(q) = trapezoidal(index\_f,a,b,n);

end

trueval = 0.746824132812427;

err = trueval - integral

y = [n1; err];

fprintf(1,'%6.2f %12.8f\n',y);

* Plot the error versus n, i.e., plot(n1,err,’-o’)
* Repeat the above exercises for the integrals given on page 193 of your textbook.