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% C. Petersen, H. Werkle, Dynamik der Baukonstruktionen
% 2. Auflage, Springer Vieweg, Wiesbaden, 2018
%
% ML_27_1_Romberg_Verfahren: Numerische Integration mittels
% Romberg-Verfahren
%
% Version 1.0, April 2018
% Softwareentwicklung:
% Andrei Firus, M.Eng (andrei.firus@gmail.com)

% Aufbau Eingabedatei: Eingabedatei nicht notwendig

% Ausgabedateien:
% Outputdatei_1: Eingaben- und Ergebnisübersicht

%----- EINGABEBLOCK -----
% Funktionsdefinition: y(x)
y=@(x) ((1/((1-x^2)^2+(2*0.02*x)^2))*(1/0.5)*(exp(-(0.5+x)/...
(2*0.5)^2)+exp(-(0.5-x)/(2*0.5)^2)));

xa=0; % untere Integrationsgrenze
xe=2; % obere Integrationsgrenze

m=20; % Ordnung des Näherungswertes

dx=0.001; % Schrittweite (benötigt nur für
% die Darstellung)
%-----

%----- BERECHNUNGSBLOCK -----
% Schrittweitendefinition
h=zeros(m+1,1);
for i=1:1:m+1
    h(i)=(xe-xa)/2^(i-1);
end

% Rekursive Berechnung
I=zeros(m+1,m+1);
I(1,1)=(y(xa)+y(xe))/2;
summe=zeros(2^(i-2),1);
for i=2:1:m+1
    for jj=1:1:2^(i-2)
        summe(jj)=y(xa+h(i-1)/2+(jj-1)*h(i-1));
    end
    I(i,1)=0.5*I(i-1,1)+(h(i-1)/2)*sum(summe);
end

% Erstellung des Dreiecksschemas
for i=2:1:m+1
    for k=2:1:i
        I(i,k)=I(i,k-1)+(I(i,k-1)-I(i-1,k-1))/((4^(k-1))-1);
    end
end

% Integralwert
Integral=I(m+1,m+1);

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%----- DARSTELLUNGSBLOCK -----
% Grafische Darstellung der Ergebnisse
% Definition der Vektoren x_l und der dazugehörigen Funktionswerte y_l
x_l=xa:dx:xe;
y_l=zeros(length(x_l),1);
for i=1:1:length(x_l)
    y_l(i)=y(x_l(i));
end
name_fig1 = 'Funktionsverlauf';
fig1=figure('Name',name_fig1,'NumberTitle','off');
set(fig1,'Position',[500 350 700 500]);
plot(x_l,y_l); grid on;
title('Funktionsverlauf y(x)');
xlabel('x');
ylabel('y(x)');
grid on;
%-----

%----- AUSGABEBLOCK -----
% Ausgabe der Ergebnisse in eine Datei
fid = fopen('Outputdatei_1_Allgemein.txt', 'w');
fprintf(fid,...
    '%s\n','C. Petersen, H. Werkle, Dynamik der Baukonstruktionen');
fprintf(fid,...
    '%s\n','2. Auflage, Springer Vieweg, Wiesbaden, 2018');
fprintf(fid,...
    '%s\n','Softwareentwicklung: Andrei Firus (andrei.firus@gmail.com)');
fprintf(fid,'%s\n','Programm ML_27_1: Eingaben- und Ergebnisseübersicht');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,...
    '%s\n','-----');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,...
    '%s\n','EINGABEDATEN:');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,'%s\n','Zu integrierende Funktion:');
func_string=func2str(y);
fprintf(fid,'%s%s\n','y(x)=',func_string(5:end));
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,'%s\n','Funktionsverlauf: s. Dateiende');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,'%s\n','Untere Integrationsrenze[-:]');
fprintf(fid,'%d\n',xa);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,'%s\n','Obere Integrationsgrenze [-:]');
fprintf(fid,'%d\n',xe);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,'%s\n','Ordnung des Naeherungswertes:');
fprintf(fid,'%d\n',m);

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[illegible]