Kacper Pawłowski CS 2 lab 4

As during this lab I need advanced mathematical operations I included math.h library

Question 1

I created following function:

double derivative(double t, double y){

return(- y + exp(-t)\*cos(t));

}

Question 2

I created following function:

double solution(double t, double y){

return(exp(-t)\*sin(t));

}

Question 3

I created a file to which I will write error of Euler’s method.

I declared variables H, NS, e which represents error and list y[NS].

Then I calculated value of integral and error in the following way:

double y[NS];

y[0] = 0;

for(int i = 1; i <= NS; i++ ){

y[i] = y[i-1] + H \* derivative((i - 1)\*H, y[i-1]);

e = fabs(solution((i-1)\*H, y[i]) - y[i]);

double tk = (i-1)\*H;

fprintf(gh,"%lf\t%lf\t%lf\t%lf\n",tk, y[i-1], solution((i - 1)\*H,y[i]), e);

}

Question 4

Question 5

I prepared the following function:

double rk4(double x0, double y0, double h, double (\*fun)(double, double))

{

double y1;

double k1,k2,k3,k4;

k1 = h\*fun(x0 ,y0 );

k2 = h\*fun(x0+h/2.,y0+k1/2.);

k3 = h\*fun(x0+h/2.,y0+k2/2.);

k4 = h\*fun(x0+h ,y0+k3 );

y1 = y0 + (k1+2.\*k2+2.\*k3+k4)/6.;

return y1;

}

Later I created new file to which I printed results for new method and created new array to store values of Y. I implemented previously prepared function in the following way:

double y\_rk4[NS];

y\_rk4[0] = 0;

for(int i = 1; i <= NS; i++){

y\_rk4[i] = rk4( (i-1)\*H, y\_rk4[i-1], H, derivative);

e\_rk4 = fabs(solution((i-1)\*H, y\_rk4[i]) - y\_rk4[i]);

fprintf(fp,"%lf\n",e\_rk4);

}

Question 6

I ran the full program for H 0,025 , 0,001, 0,0001 and constant value of NS 6000. As I had two files to which I printed all the results, could easily compare the errors. In all cases the Euler method provided slightly more accurate results.