

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]);  
}
```

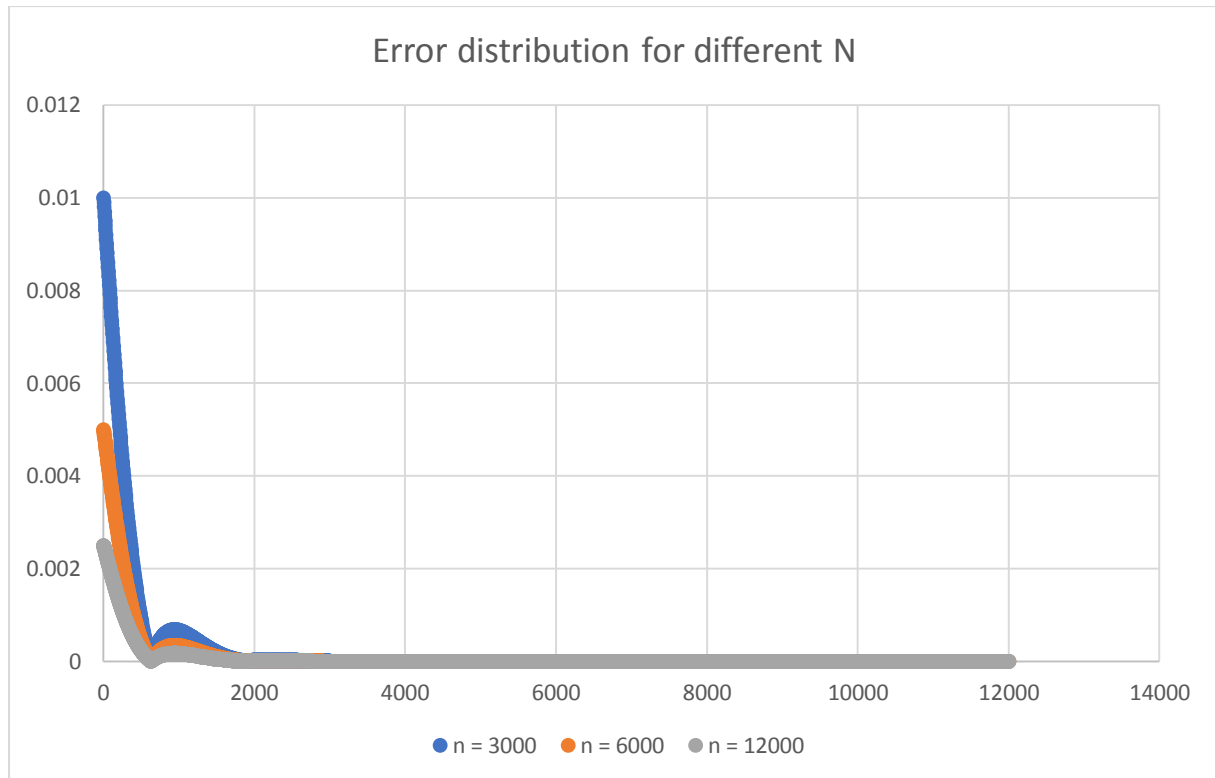
```

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.