Object Oriented Modeling and Programming in Engineering

Homework 1

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1. From an oscillating energy system, you've got the equation for the power:

$$P(t) = a_1 * t + \sin(2 * \boldsymbol{\pi} * \boldsymbol{f_1} * \boldsymbol{t})$$

Whereat:

$$a_1 = \frac{127138}{40000} W$$
$$f_1 = 2\ Hz$$

For this system you want to calculate the energy consumption E(t) for t=20 seconds.

$$E(t) = \int_0^t p(t) * dt$$
$$P(t) = \frac{127138}{40000} * t + \sin(2 * \boldsymbol{\pi} * \boldsymbol{2} * \boldsymbol{t})$$
$$E(t) = \int_0^{20} \left(\frac{127138}{40000} * t + \sin(2 * \boldsymbol{\pi} * \boldsymbol{2} * \boldsymbol{t})\right) * dt$$
$$E(t) = \int_0^{20} \left(\frac{63569}{20000} * t + \sin(4 * \boldsymbol{\pi} * \boldsymbol{t})\right) * dt$$
$$E(t) = \left(\frac{63569 * t^2}{40000} - \frac{\cos(4 * t * \pi)}{4 * \pi}\right)\Bigg|_0^{20}$$
$$E(t) = \left(\frac{63569 * 20^2}{40000} - \frac{\cos(4 * 20 * \pi)}{4 * \pi}\right) - \left(\frac{63569 * 0^2}{40000} - \frac{\cos(4 * 0 * \pi)}{4 * \pi}\right)$$
$$E(t) = \left(\frac{63569}{100} - \frac{1}{4 * \pi}\right) - \left(-\frac{1}{4 * \pi}\right)$$
$$E(t) = \left(\frac{63569}{100}\right) = 635.69$$

2. UML Diagram

The UML diagram presented in the Figure 1 is used to show and explain the class ***MainClass_Homework1*** and the methods used to calculate and graph the area of the function using 3 different numerical methods and the analytical function, the class. The C# is called MainClass_Homework1.

The UML diagram presented in the Figure 2 is used to show and explain the class ***TestFunction***, this class is used to test the class ***MainClass_Homework1***

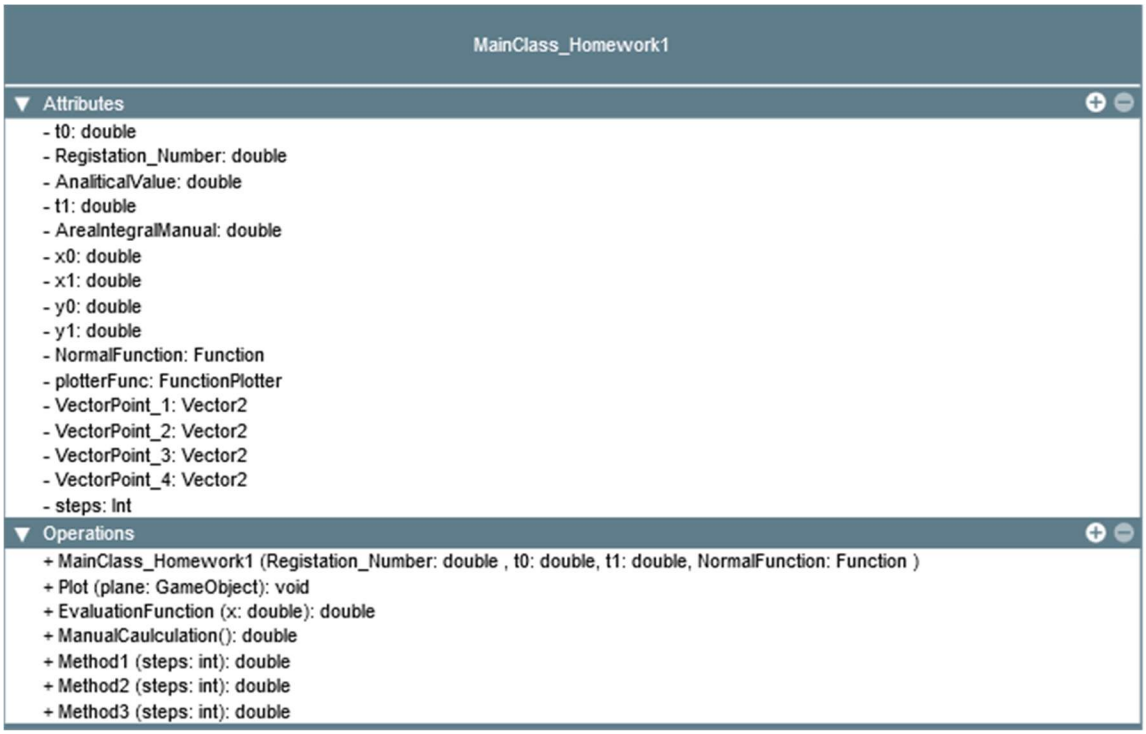

Figure 1 UML MainClass_Homework1

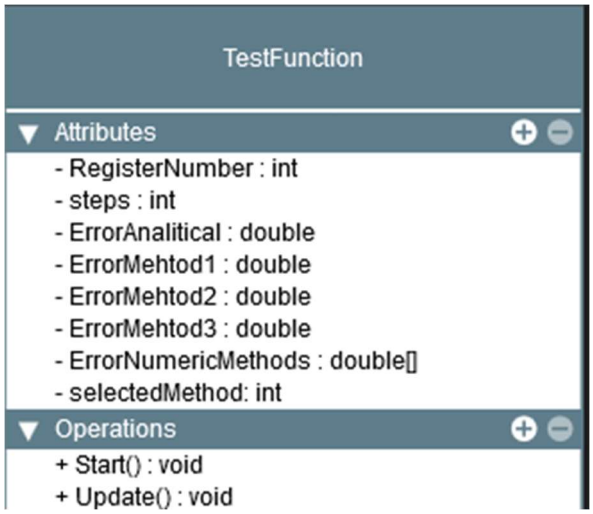

Figure 2 UML TestFunction

3. Function plots
    - Function plot.
    -

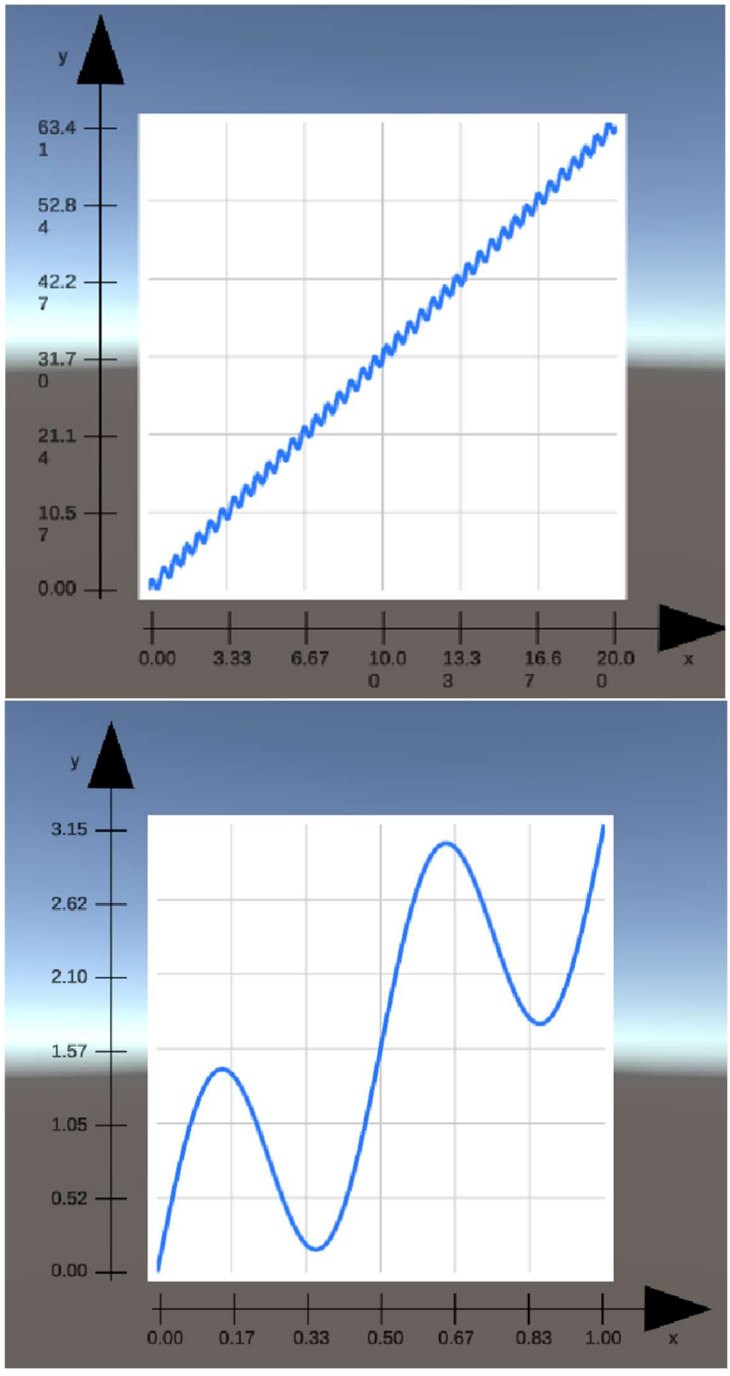

Figure 3 Function Plot

- Method 1.

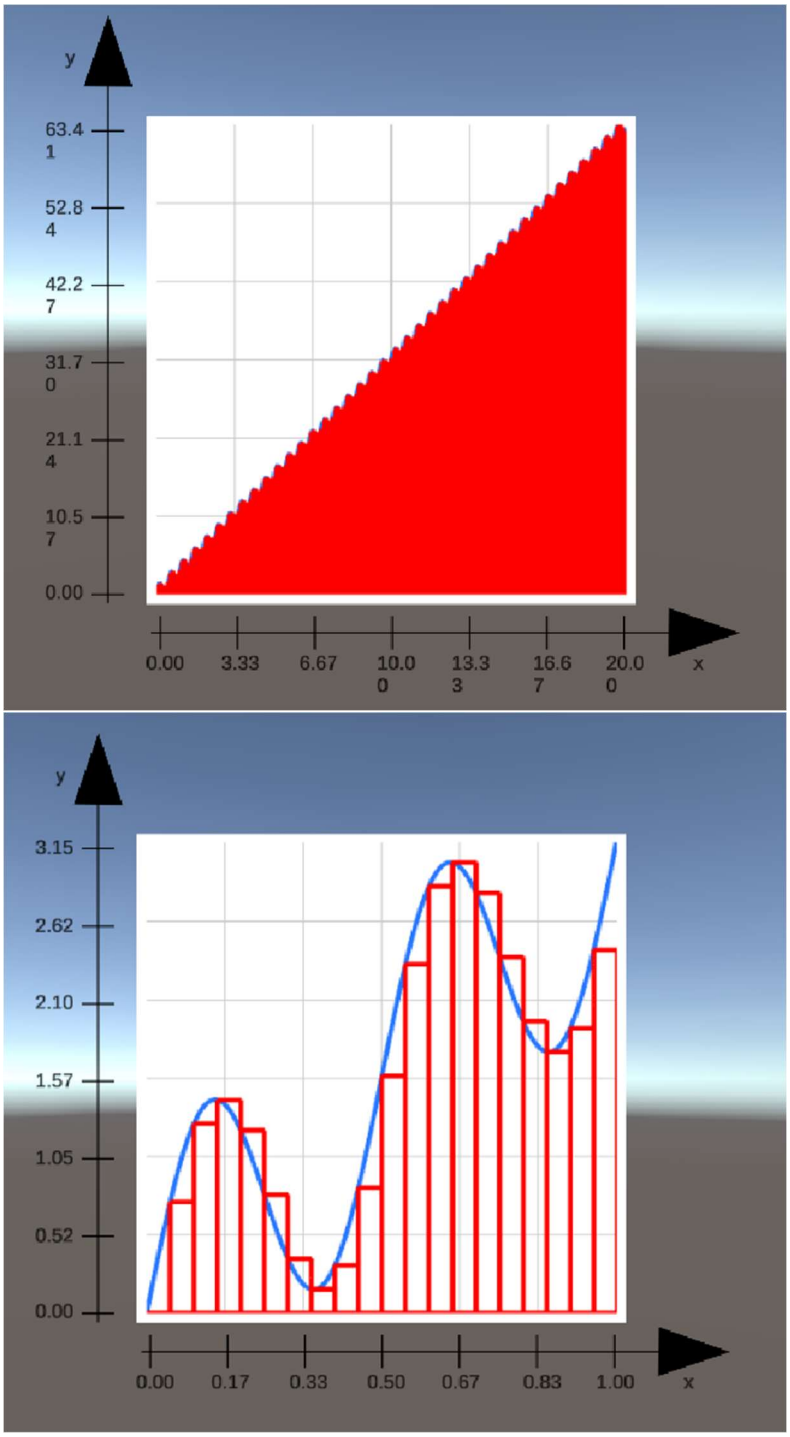

Figure 4 Graph method 1

- Method 2.

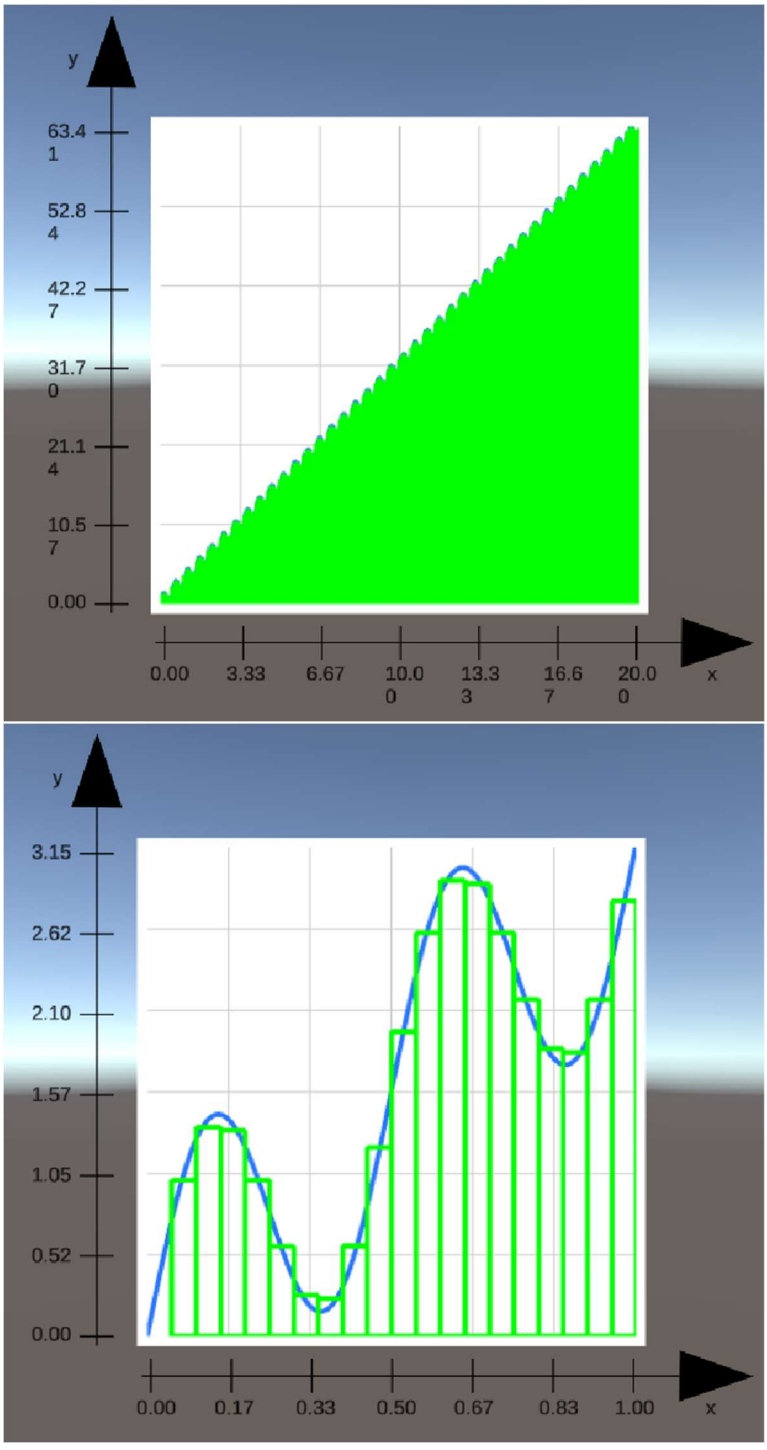

Figure 5 Graph method 2

- Method 3.

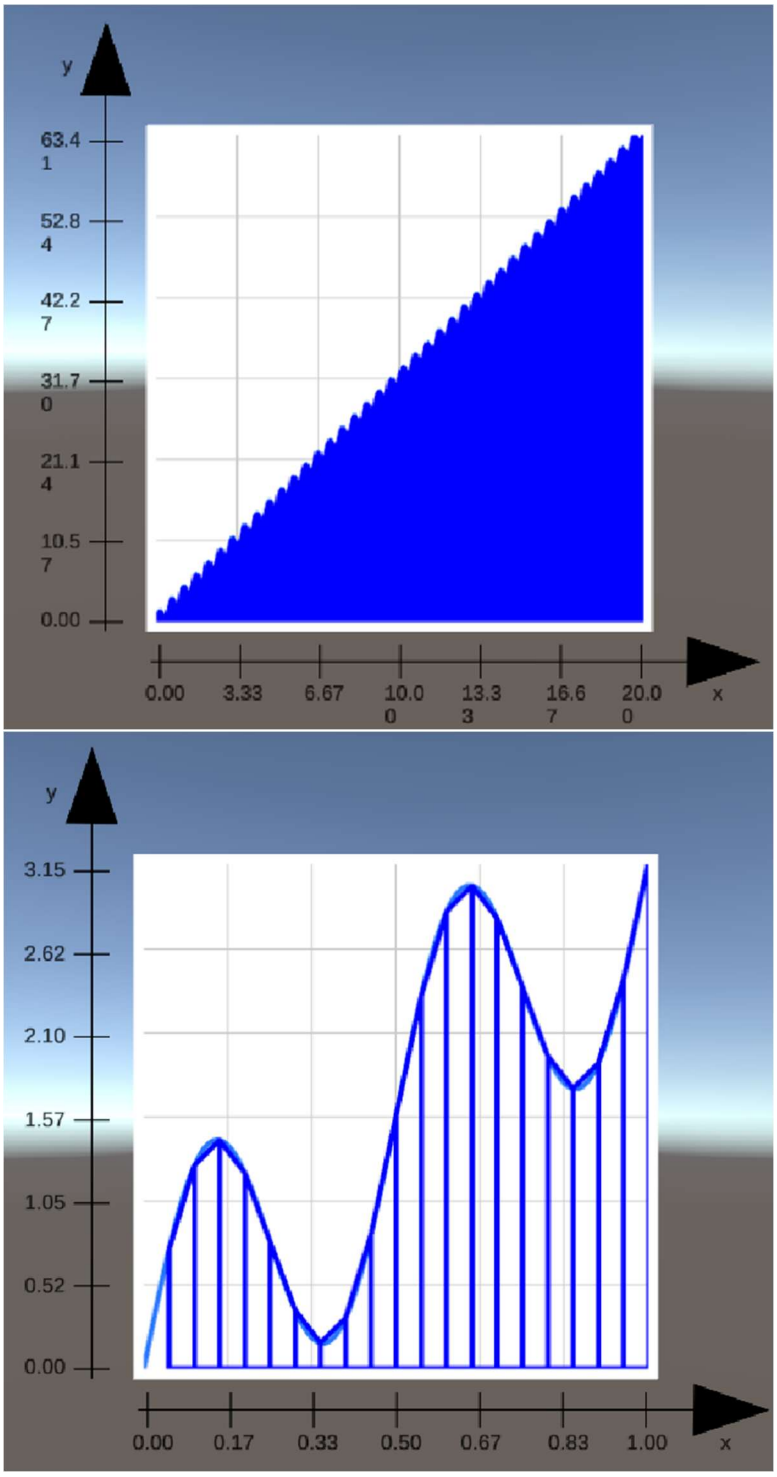

Figure 6 Graph method 3

4. Nassi – Schneiderman Diagrams

   <u>Method 1.</u>

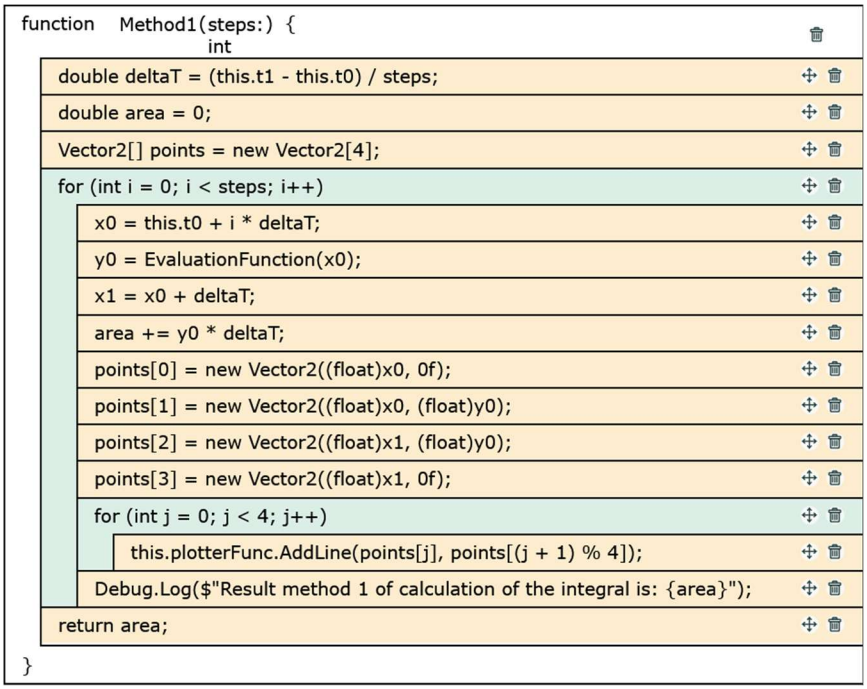

Figure 7 Nassi – Schneiderman Diagrams - Method 1

Method 2.

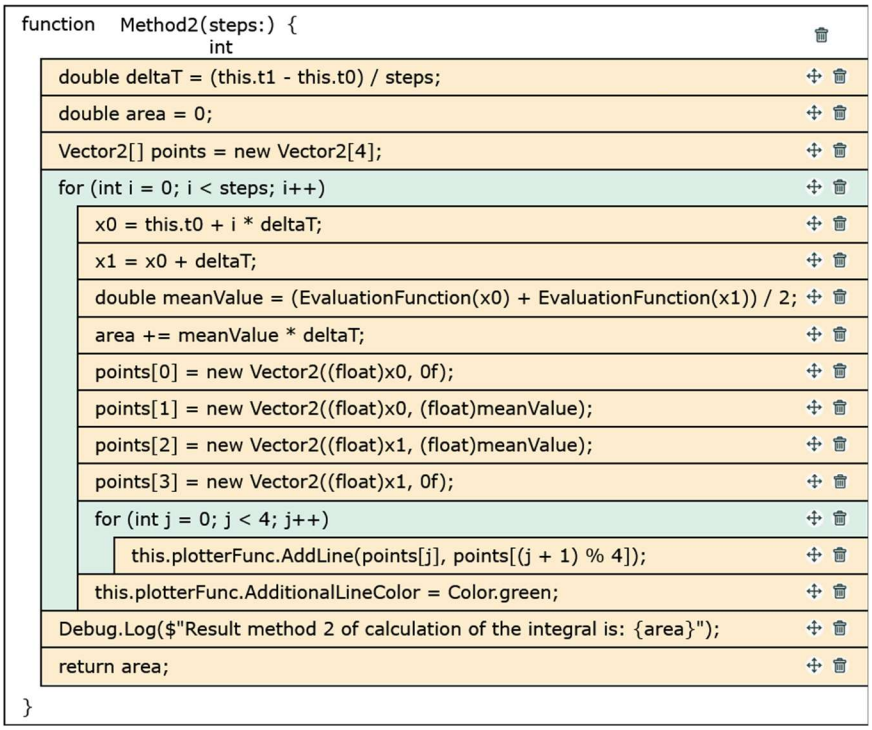

Figure 8 Nassi – Schneiderman Diagrams - Method 2

Method 3.

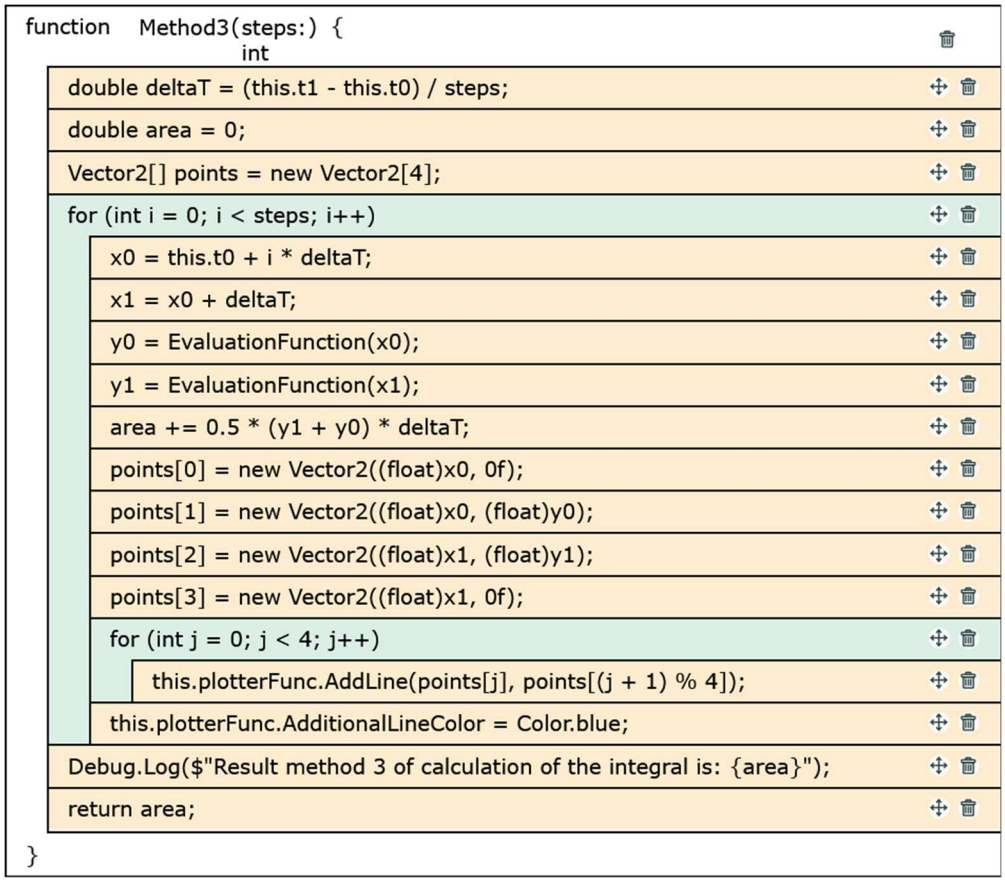

Figure 9 Nassi – Schneiderman Diagrams - Method 3

5. Results of the numerical and analytical methods.

   the manual calculation of this integral is: 635.69
   Result method 1 of calculation of the integral is: 632.51155
   Result method 2 of calculation of the integral is: 635.626554924185
   Result method 3 of calculation of the integral is: 635.626554924185

6. Result absolute error and relative error.

   Absolute Error for Method 1 : 3.17844999999977
   Relative Error for Method 1 : 0.00502512562814034
   Absolute Error for Method 2 : 0.0634450758145704
   Relative Error for Method 2 : 9.98150176751785E-05
   Absolute Error for Method 3 : 0.0634450758145704
   Relative Error for Method 3 : 9.98150176751785E-05