

Object-oriented Modelling and Programming in Engineering

Homework 1

- Integration by Hand: (Exact result of the integration) – Task 3.2

$$E(t) = \int_0^t p(t) dt$$

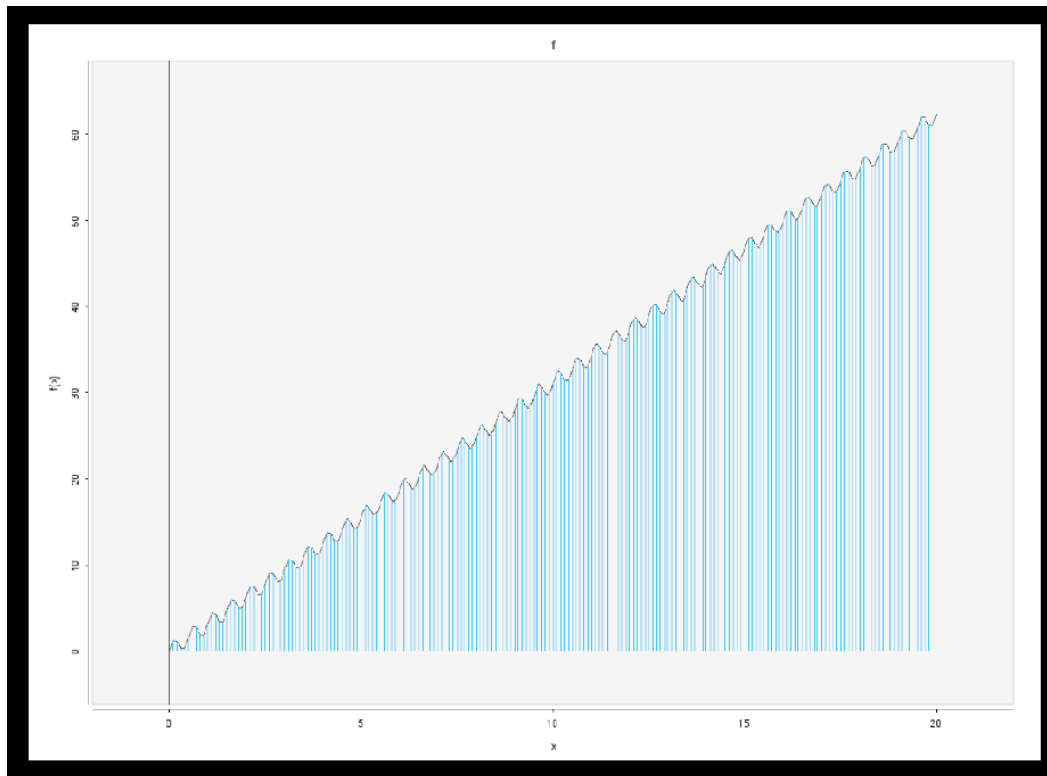
$$P(t) = a_1 * t + \sin(2 * \pi * f_1 * t)$$

$$a_1 = \frac{(\text{My Registration Number})}{40000} \text{ W} = \frac{124567}{40000} = 3.1141 \text{ W}$$

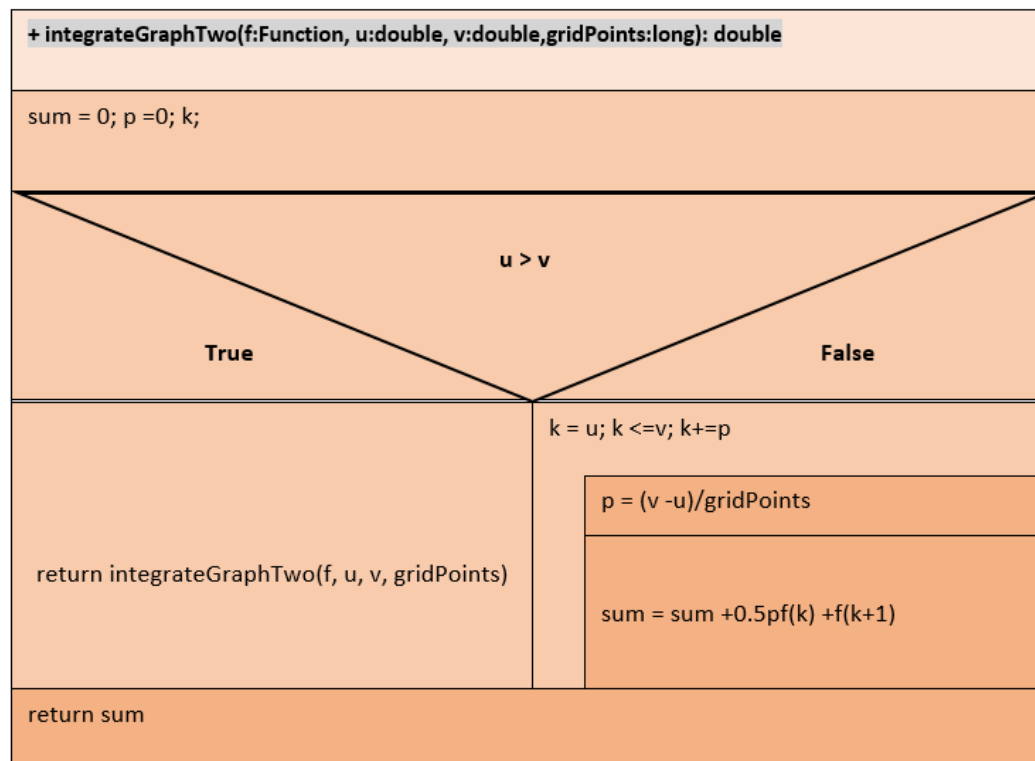
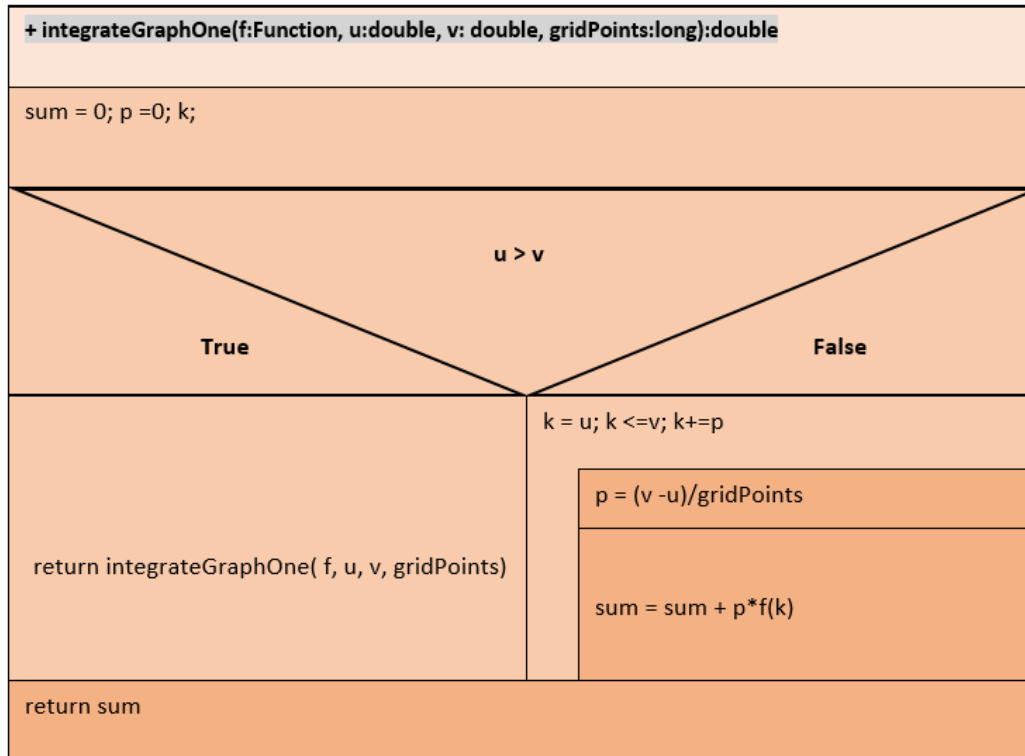
$$f_1 = 2 \text{ Hz}, t = 20 \text{ s}$$

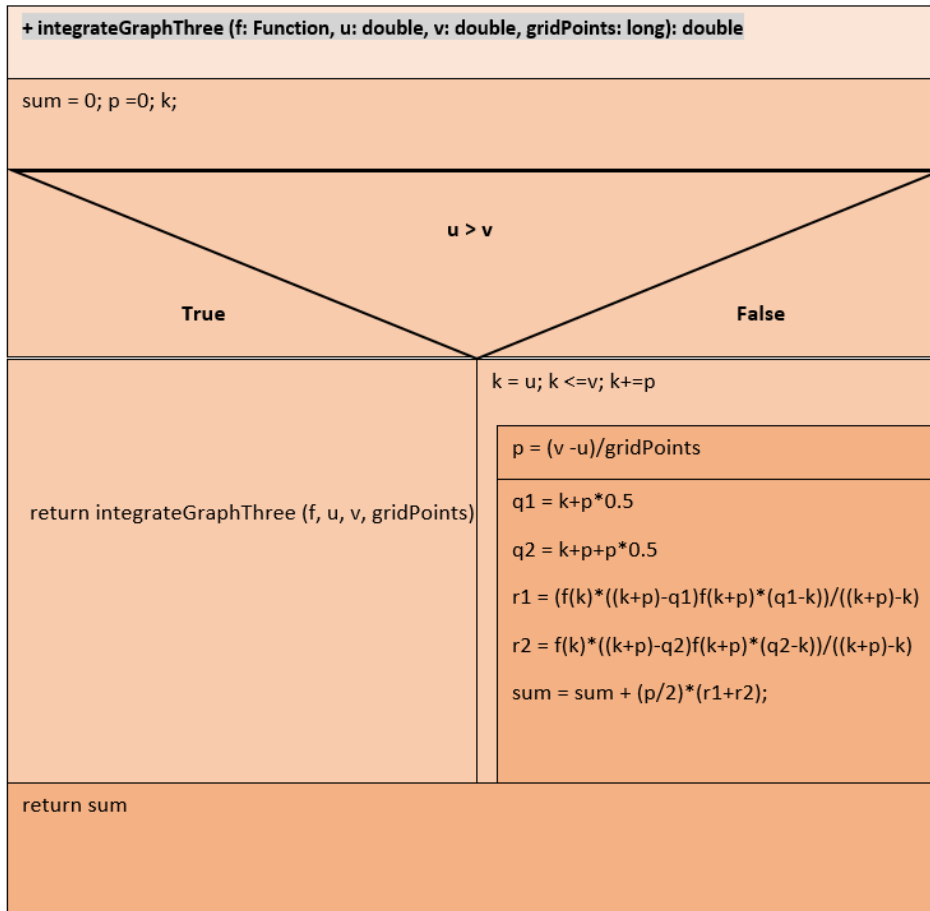
$$\begin{aligned} \int_0^t p(t) &= \int_0^{20} a_1 * t + \sin(2 * \pi * 2 * t) \\ &= \left[a_1 * \frac{(20)^2}{2} + (-\cos(4 * \pi * 20)) \right] \\ &= 628.520 \end{aligned}$$

- Plot of the function P(t) – Task 3.1

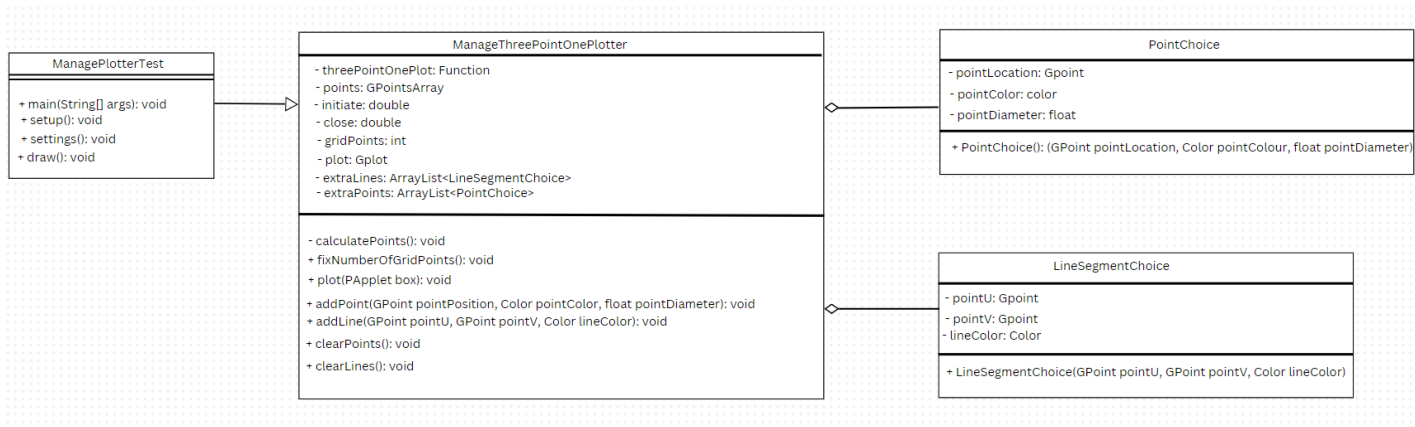


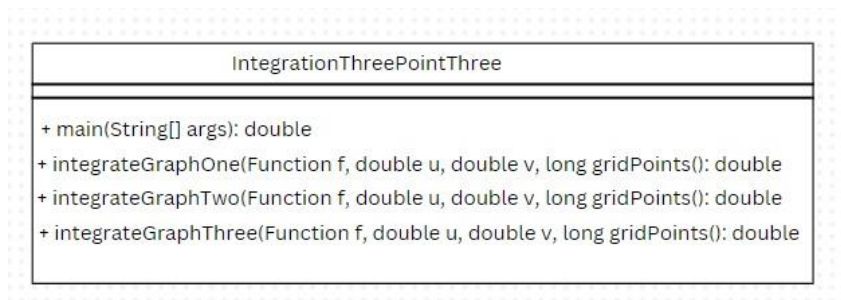
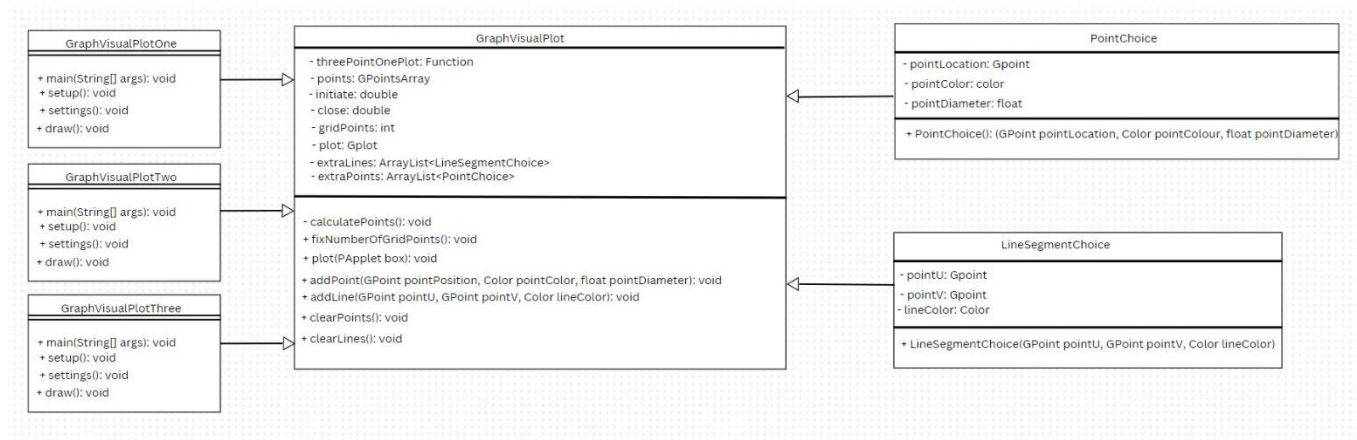
- Nassi-Schneiderman diagrams for all algorithms – Task 3.3





- UML-diagram(s) for the software structure





- **Result of Numerical Integration and Absolute and Relative Errors:**

```

Problems @ Javadoc Declaration Console ×
<terminated> IntegrationThreePointThree [Java Application]
Calculated Area One: 619.0
Absolute Error One: 9.519999999999982
Relative Error One: 1.5146693820403458

Calculated Area Two: 622.0
Absolute Error Two: 6.519999999999982
Relative Error Two: 1.037357601985614

Calculated Area Three: 625.0
Absolute Error Three: 3.519999999999982
Relative Error Three: 0.5600458219308824
  
```

The screenshot shows the output of the Java application in the IDE's console. The output displays the calculated areas and the absolute and relative errors for each of the three integration methods. The results are as follows:

Method	Calculated Area	Absolute Error	Relative Error
One	619.0	9.519999999999982	1.5146693820403458
Two	622.0	6.519999999999982	1.037357601985614
Three	625.0	3.519999999999982	0.5600458219308824

- Visualization of the integral according to figure 1, 2, and 3 (blue area)

