Trapezoidal Rule for Discrete Functions with Unequal Segments

For a general case of a function given at n data points $\left(x_1, f\left(x_1\right)\right)$, $\left(x_2, f\left(x_2\right)\right)$, $\left(x_3, f\left(x_3\right)\right)$, …..,$\left(x_n, f\left(x_n\right)\right)$, where, $x_1, x_2, \ldots, x_n$ are in an ascending order, the approximate value of the integral $\int_{x_1}^{x_n} f(x)dx$ is given by

$$\int_{x_1}^{x_n} f(x)dx = \int_{x_1}^{x_2} f(x)dx + \int_{x_2}^{x_3} f(x)dx + \ldots\ldots + \int_{x_{n-1}}^{x_n} f(x)dx$$

$$\approx \left(x_2 - x_1\right)\frac{f\left(x_1\right) + f\left(x_2\right)}{2} + \left(x_3 - x_2\right)\frac{f\left(x_2\right) + f\left(x_3\right)}{2} + \ldots\ldots$$

$$\ldots\ldots + \left(x_n - x_{n-1}\right)\frac{f\left(x_{n-1}\right) + f\left(x_n\right)}{2}$$

This approach uses the trapezoidal rule in the intervals $\left[x_1, x_2\right]$, $\left[x_2, x_3\right]$, ….., $\left[x_{n-1}, x_n\right]$ and then adds the obtained values.