EECE.2160: ECE Application Programming

Programming Assignment #5: Integral Approximation with Functions

Figures

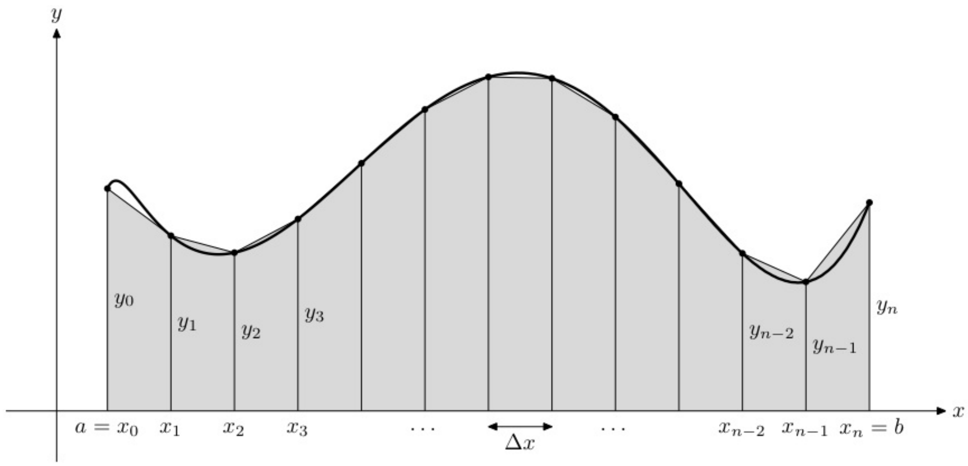

Figure 1: Demonstration of trapezoidal method

In the figure, the range $[a, b]$ has been divided into *n* different trapezoids, each of which has the same base, $\Delta x = (b - a)/n$. Recall that a trapezoid with base b and sides $h1$ and $h2$ has area:

$$0.5 \times b \times (h1 + h2)$$

Therefore, the area of trapezoid number *k* (1 ≤ *k* ≤ *n*) from the figure above is:

$$0.5 \times \Delta x \times (y_{k-1} + y_k) = 0.5 \times \Delta x \times (f(x_{k-1}) + f(x_k))$$

To find the total area under the curve—and therefore the approximate integral—sum the areas of all trapezoids:

$$\begin{aligned} Area &= 0.5 \times \Delta x \times (y_0 + y_1) + 0.5 \times \Delta x \times (y_1 + y_2) + \cdots + 0.5 \times \Delta x \times (y_{n-1} + y_n) \\ &= 0.5 \times \Delta x \times (y_0 + y_1 + y_1 + y_2 + \cdots + y_{n-1} + y_n) \\ &= 0.5 \times \Delta x \times (y_0 + 2y_1 + 2y_2 + \cdots + 2y_{n-1} + y_n) \\ &= \mathbf{0.5} \times \boldsymbol{\Delta x} \times \left(\boldsymbol{y_0} + \mathbf{2} \sum_{\boldsymbol{k=1}}^{\boldsymbol{n-1}} \boldsymbol{y_k} + \boldsymbol{y_n} \right) \approx \int_a^b f(x)dx \end{aligned}$$

Your integral function will use the equation shown in bold above to approximate the integral, given the endpoints of the interval $[a, b]$ and the number of trapezoids, n.