Programming Project 6

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1 Assignment

You would like to find the area under the curve

$$y = f(x) \tag{1}$$

between the lines $x = a$ and $x = b$. One way to approximate this area is to use line segments as approximations of small pieces of the curve and then to sum the area of trapezoids created by drawing perpendiculars from the line segment endpoints to the x-axis, as shown in Fig. 7.13. We will assume that $f(x)$ is non-negative over the interval $[a, b]$. The trapezoidal rule approximates this area T as

$$T = \frac{h}{2}\left(f(a) + f(b) + 2\sum_{i=1}^{n-1} f(x_i)\right) \tag{2}$$

for n subintervals of length h:

$$h = \frac{b-a}{n} \tag{3}$$

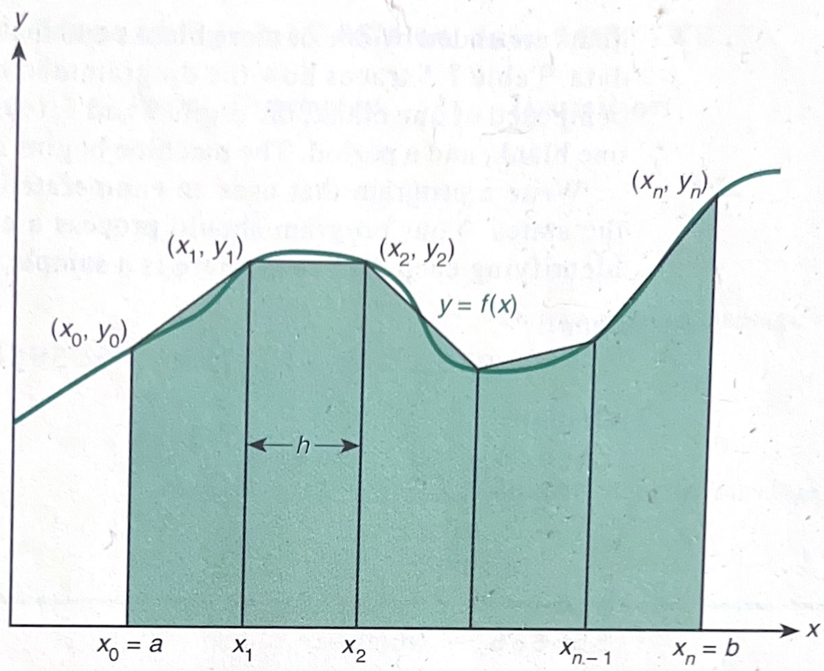
Write a function `trap` with input parameters `a`, `b`, `n`, and `f` that implements the trapezoidal rule. Call `trap` with values for `n` of 2, 4, 8, 16, 32, 64, and 128 on functions

$$g(x) = x^2 sinx \qquad (a = 0, b = 3.14159) \tag{4}$$

and

$$h(x) = \sqrt{4 - x^2} \qquad (a = -2, b = 2) \tag{5}$$

Figure 7.13 Approximating the Area Under a Curve with Trapezoids



Function h defines a half-circle of radius 2. Compare your approximations to the actual area of this half circle.

Note: If you have studied calculus, you will observe that the trapezoidal rule is approximating

$$\int_a^b f(x)dx \tag{6}$$