LW06

Area Under The Curve

You would like to find the area under the curve

$$y = f(x)$$

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 areas 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 nonnegative over the interval $[a,b]$. The trapezoidal rule approximates this area T as

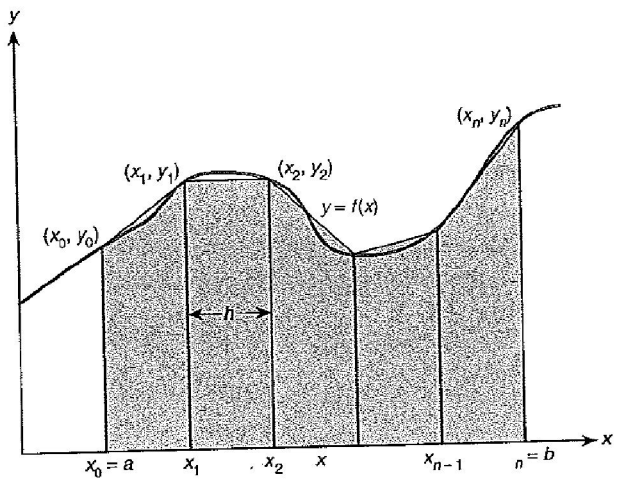
$$T = \frac{h}{2}\left(f(a) + f(b) + 2\sum_{i=1}^{n-1} f(x_i)\right)$$

for n subintervals of length h:

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

FIGURE 7.13

Approximating the Area Under a Curve with Trapezoids



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

$$g(x) = x^2 \sin x \qquad (a = 0, b = 3.14159)$$

and

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

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

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

$$\int_a^b f(x)dx$$

PART1[2Pts] Write a function to compute the area under a linear function f(x) = x + 5 and test it simply.
The prototype of your function is

double areaUnderTheCurve(int a, int b, int n);

Implement the function f as another user-defined function.

PART2[2Pts] Write a function to compute the area under a given function and test it simply.
The function can be one of the listed functions below:

LINEAR	f(x) = x + 5
QUADRATIC	g(x) = 2x^2 - 3x + 1
CUBIC	h(x) = x^3

The prototype of your function is

double areaUnderTheCurve(int a, int b, int n, double f(double x));

Define the types of functions as an enumarated type .
write a user-defined function **"select"** which reads the user choice from the keyboard and calls the areaUnderTheCurve function by using a switch statement.