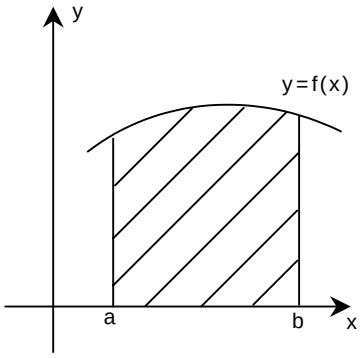
56 Integration

"Whoever digs a pit for others will fall into it."

The basic problem of integral calculus is actually a problem of areas. We calculate the area of graph between the points x = a and x = b.

In order to find out the area, the definition of Integration suggests us to divide the entire area into pieces of rectangles. When the width dx of the rectangle becomes smaller and smaller, we get the area of a graph with good accuracy.



In general, we use the notation

$$\int_a^b F(x)\,dx$$

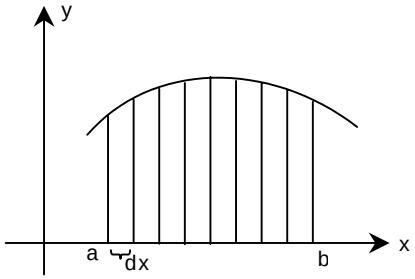
56.1 Program

The following program finds out the integration of $y = 4 - x^2$

```
#include <math.h>

#define EQUATION( x )   ( 4 - (x)*(x) )    /* to be integrated */

#define b         ( 2 ) /* Upper limit */
#define a         ( -2 )      /* Lower limit */
#define dx        ( 0.00001 ) /* interval */

int main( void )
{
   double result = 0, x;
   for ( x = a ; x<=b ; x += dx )
      result += EQUATION( x ) * dx;
   printf( "Result of Integral( 4-x*x ) over -2 to 2 is %lf \n",
            result );
   return(0);
}
```

56.2 Numerical Analysis

Numerical Analysis is another widespread area in Mathematics. The main idea behind Numerical Analysis is to reduce the number of iterations. Thus when you solve the above problem with Numerical Analysis methods like Simpson's method, you can save many iterations and your precious time!



All rectangles are all of same width dx and the height f(x) is different at different x