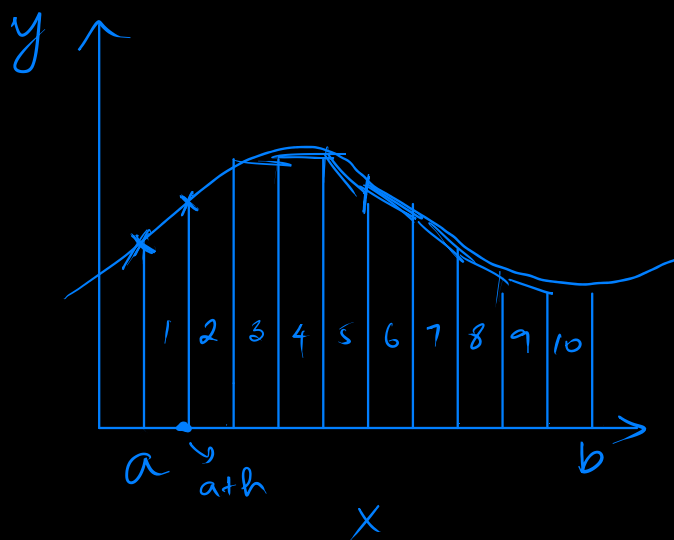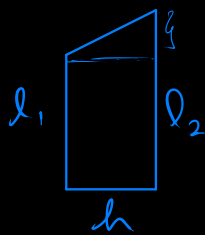# Trapezoidal Rule to Calculate area

$y = f(x)$

Find area under the curve from $x = a$ to $x = b$.

Divide x from a to b into subintervals of length h

$$\Rightarrow h = x_{i+1} - x_i$$

Each strip forms a trapezoid

Area of a trapezoid $= l_1 h + \frac{1}{2} \times (l_2 - l_1) h$

$$= \frac{h}{2}(l_1 + l_2)$$

Here $l_1 = f(x_i)$, $l_2 = f(x_{i+1})$

$\Rightarrow$ Area of one trapezoid $= \frac{h}{2}(f(x_i) + f(x_{i+1}))$

If we choose to divide $x = a$ to $x = b$ into n subintervals, then, $h = \dfrac{b-a}{n}$

Let $x_0 = a$, $x_1 = a+h$, $x_2 = a+2h$, $\ldots$, $x_{n-1} = a+(n-1)h$, $x_n = b$

Sum of trapezoid areas $= \frac{h}{2}(f(x_0) + f(x_1)) + \cdots + \frac{h}{2}(f(x_{n-1}) + f(x_n))$

$= \frac{h}{2}\left[f(x_0) + 2f(x_1) + \cdots + 2f(x_{n-1}) + f(x_n) \right]$

$= h\left[\frac{f(a) + f(b)}{2} + f(x_1) + \cdots + f(x_{n-1}) \right]$

For a, b, n as input,

$h = (b-a)/n$;

area $= (f(a) + f(b))/ 2.0$;

for $(i = 1;\ i <= n-1;\ i++)$

area $+= f(a + i * h)$;

area $=$ area $* h$;

//Output area

$\int_0^1 \frac{1}{1+x^2} dx = \left[\tan^{-1} x + c \right]_0^1 = \tan^{-1} 1 - \tan^{-1} 0$

$= \pi/4 - 0 = \pi/4$

$\Rightarrow 4 \int_0^1 \frac{1}{1+x^2} dx = \pi$

$\Rightarrow$ Numerically compute the integration

$$f(x) = \frac{4.0}{1+x^2}$$

num-steps = 10

i = 0 $\frac{0+0.5}{10} = 0.05$

$\frac{1.5}{10} = 0.15$

0.25

0.35

```c
int main()
{
    int i = 0;
    double x = 0.0, pi = 0.0, step = 0.0, sum = 0.0;
    long num_steps = 1000000;
    step = 1 / (double) num_steps;
    for ( i = 0; i < num_steps; i++)
    {
        x = (i + 0.5) * step;
        sum = sum + 4.0 / (1.0 + x * x);
    }
    pi = sum * step;
    printf(" %.f \n", pi);
}
```

Sieve of Eratosthenes

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 41, 43, 47, 53, 59

Find primes between 2 and n

1. Create a list of Natural numbers $2, 3, \ldots, n$, all of which are unmarked

2. $k \leftarrow 2$ (first unmarked number on the list)

3. Repeat

   Mark all multiples of k between k^2 and n

   Set $k \leftarrow$ Smallest number greater than k that is unmarked.

   until $k^2 > n$

4. Unmarked numbers are Prime.