We can use definite integral $\int_a^b f(x) \, dx$ to calculate area of region under the graph of a **positive** function $f(x)$ and above the $x$-axis.

Now, we use integral to calculate area of region that lies between the graphs of two continuous functions $f(x)$ and $g(x)$. If $f(x) \geq g(x)$ in the interval $[a, b]$, we can use the following formula to calculate the area.

If $f(x) \geq g(x)$ in the interval $[a, b]$, the **area** $A$ of the region bounded by the curves $f(x)$, $g(x)$ and the lines $x = a$, $x = b$ can be computed by

$$A = \int_a^b (f(x) - g(x)) \, dx$$
If we don’t have the assumption \( f(x) \geq g(x) \), how should we do?

The area \( A \) of the region bounded by the curves \( f(x) \), \( g(x) \) and the lines \( x = a \), \( x = b \) can be computed by

\[
A = \int_{a}^{b} |f(x) - g(x)| \, dx
\]

Here \( |f(x) - g(x)| \) is the absolute value defined by

\[
|f(x) - g(x)| = \begin{cases} 
  f(x) - g(x) & \text{when } f(x) \geq g(x) \\
  g(x) - f(x) & \text{when } f(x) \leq g(x)
\end{cases}
\]
Regarding $x$ as a function of $y$

Same principle holds for finding areas between $x = f(y)$ and $y = g(y)$.

**Areas Between Curves**

If $f(y) \geq g(y)$ in the interval $[c, d]$, the area $A$ of the region bounded by the curves $f(y)$, $g(y)$ and the lines $y = c$, $y = d$ can be computed by

$$A = \int_c^d [f(y) - g(y)] \, dy$$