- A **limit** is a value toward which an expression converges as one or more variables approach certain values. It is denoted as:

$$L = \lim_{x \to a} f(x)$$

- A **left-hand limit** means the limit of a function as it approaches from the left-hand side. It is denoted as:

$$LHL = \lim_{x \to a^-} f(x)$$

- On the other hand, a **right-hand limit** means the limit of a function as it approaches from the right-hand side.
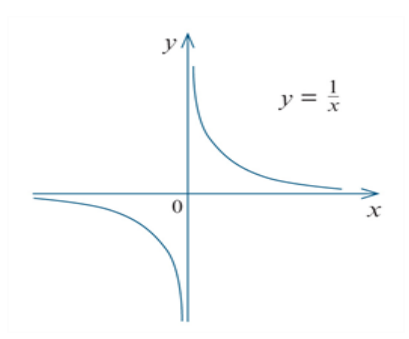
$$RHL = \lim_{x \to a+} f(x)$$

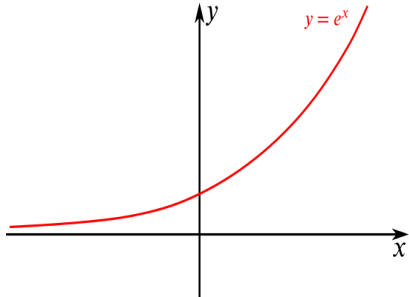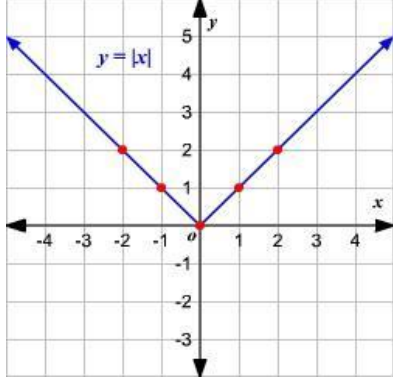- A **Function** is a relationship between inputs and outputs where each input is related to exactly one output.
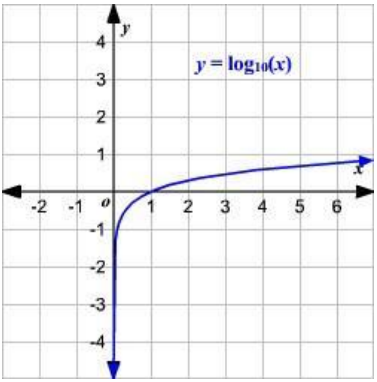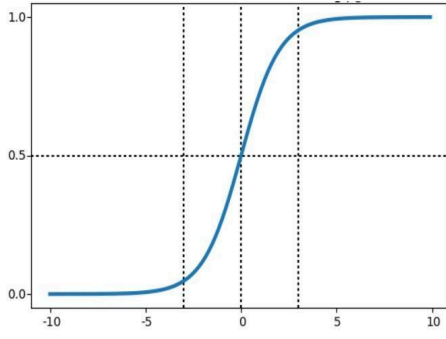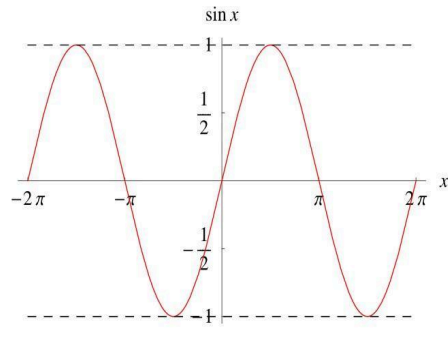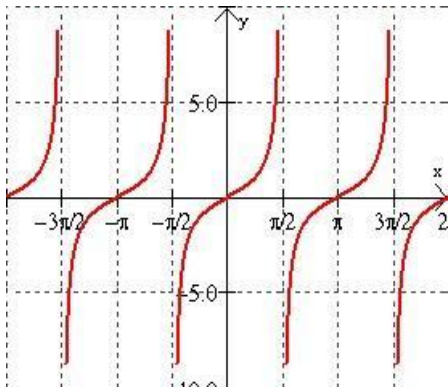
$$y = f(x)$$

| Output | Name of Function | Input |

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  - The **domain** of a function is the set of input values for f, in which the function is real and defined.
  - The set of all the outputs of a function is known as the **range** of the function.

- **Some important functions for Machine Learning:**

Function	Name	Domain	Range	Plot
$f(x) = \dfrac{1}{x}$	Hyperbola	R	R	$y = \frac{1}{x}$

$f(x) = e^x$	Exponent	R	R+	
$f(x) = |x|$	Modulus	R	R+	

$f(x) = log(x)$	Exponential	R+	R	
$f(x) = \dfrac{1}{1 + e^{-x}}$	Sigmoid	R	(-1, 1)	

$f(x) = sin(x)$	sine	R	[-1, 1]	
$f(x) = tan(x)$	tangent	$R - (2n+1)\dfrac{\pi}{2}$	R	

- f(x) is **continuous** at a point x = a,

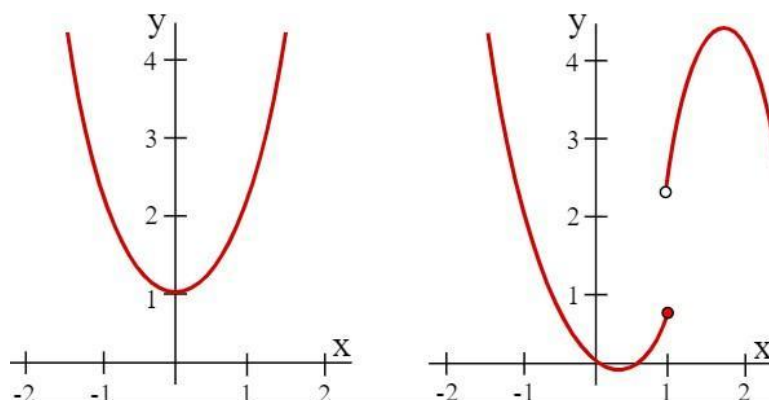$$\text{if } \lim_{x \to a^+} f(x) = \lim_{x \to a^-} f(x) = \lim_{x \to a} f(x)$$
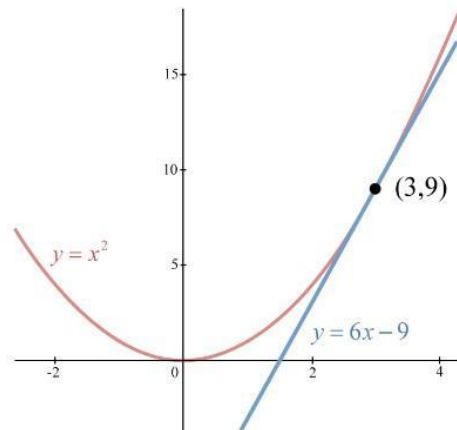
Example:

Figure 1

Figure 2

1. Figure 1 is continuous everywhere in its domain.

2. In Figure 2, at x=1, $\lim\limits_{x \to 1^-} f(x) \neq \lim\limits_{x \to 1^+} f(x)$

   Therefore, the function given in Figure 2 is not continuous at x=1.

3

- **A Tangent** is a straight line that touches a graph only at one point.
  Example:

In the above-given graph, line y = 6x - 9 is a tangent line to the curve at the point (3,9).