# Mathematics 1 -Limits and Continuity 

## Topics: Computer engineering <br> Written on March 13, 2024

## 1. Limits:

- A limit describes the behavior of a function as its input approaches a certain value.
- The limit of a function $f(x)$ as $x$ approaches a is denoted by $\lim (x \rightarrow a) f(x)$ and represents the value that $f(x)$ approaches as $x$ gets closer to a (but not necessarily equal to a).
- If the limit exists and is equal to a finite value, the function is said to be continuous at that point.


## 2. Types of Limits:

- Left-hand Limit: $\lim (x \rightarrow a-) f(x)$ represents the behavior of $f(x)$ as $x$ approaches a from the left side (values less than a).
- Right-hand Limit: $\lim (x \rightarrow a+) f(x)$ represents the behavior of $f(x)$ as $x$ approaches a from the right side (values greater than a).
- Infinite Limits: If the limit of a function approaches positive or negative infinity as x approaches a certain value, it's called an infinite limit.


## 3. Continuity:

- A function is continuous at a point a if three conditions are met:

1. The function is defined at a.
2. The limit of the function as $x$ approaches a exists.
3. The limit of the function as $x$ approaches a is equal to the value of the function at a.

- If a function is continuous at every point in its domain, it's called a continuous function.


## 4. Types of Discontinuity:

- Removable Discontinuity: A point where a function is not defined or has a hole, but it can be filled in to make the function continuous at that point.
- Jump Discontinuity: A point where the function has a sudden jump from one value to another.
- Infinite Discontinuity: A point where the function approaches positive or negative infinity.
- Asymptotic Discontinuity: A point where the function approaches a vertical asymptote.


## 5. Properties of Continuous Functions:

- Continuous functions satisfy several important properties, such as the intermediate
value theorem, the extreme value theorem, and the composition of continuous functions is continuous.
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