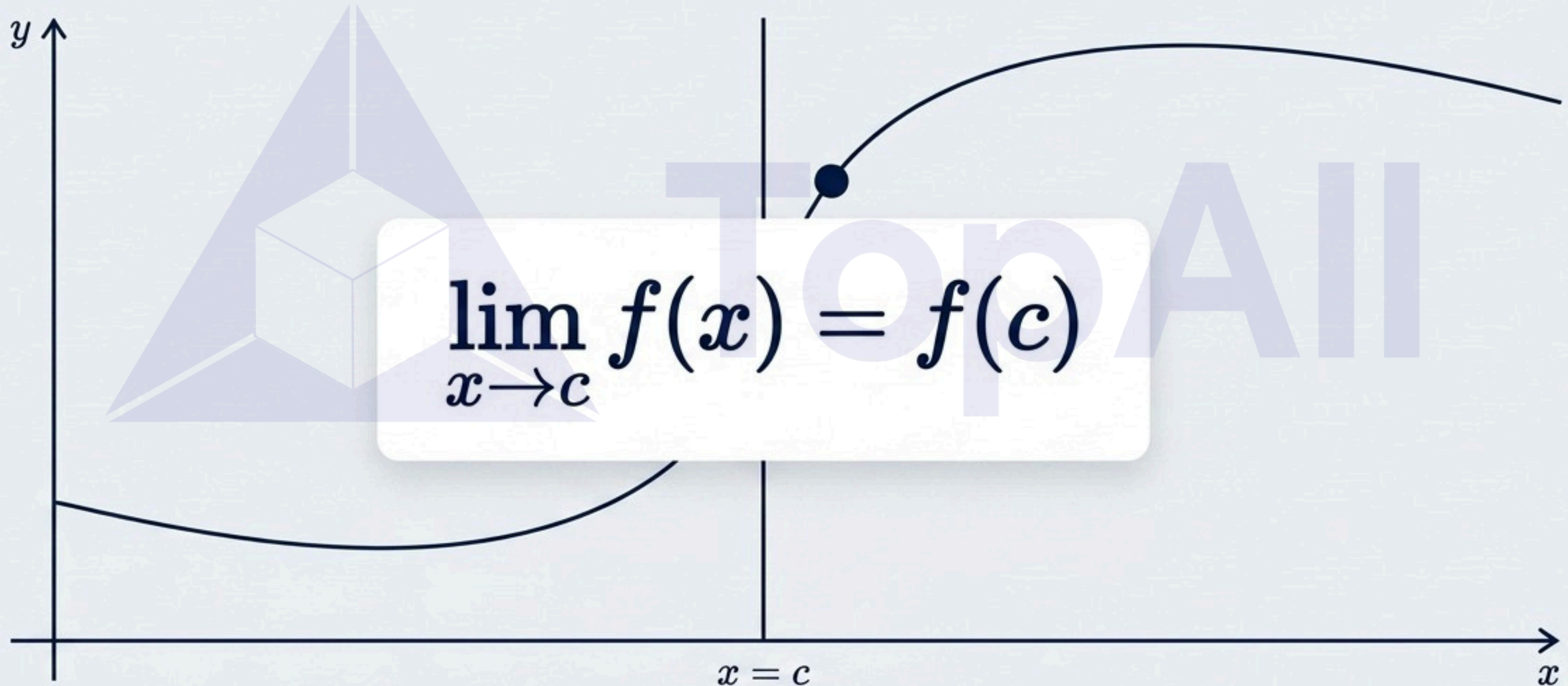


Continuity

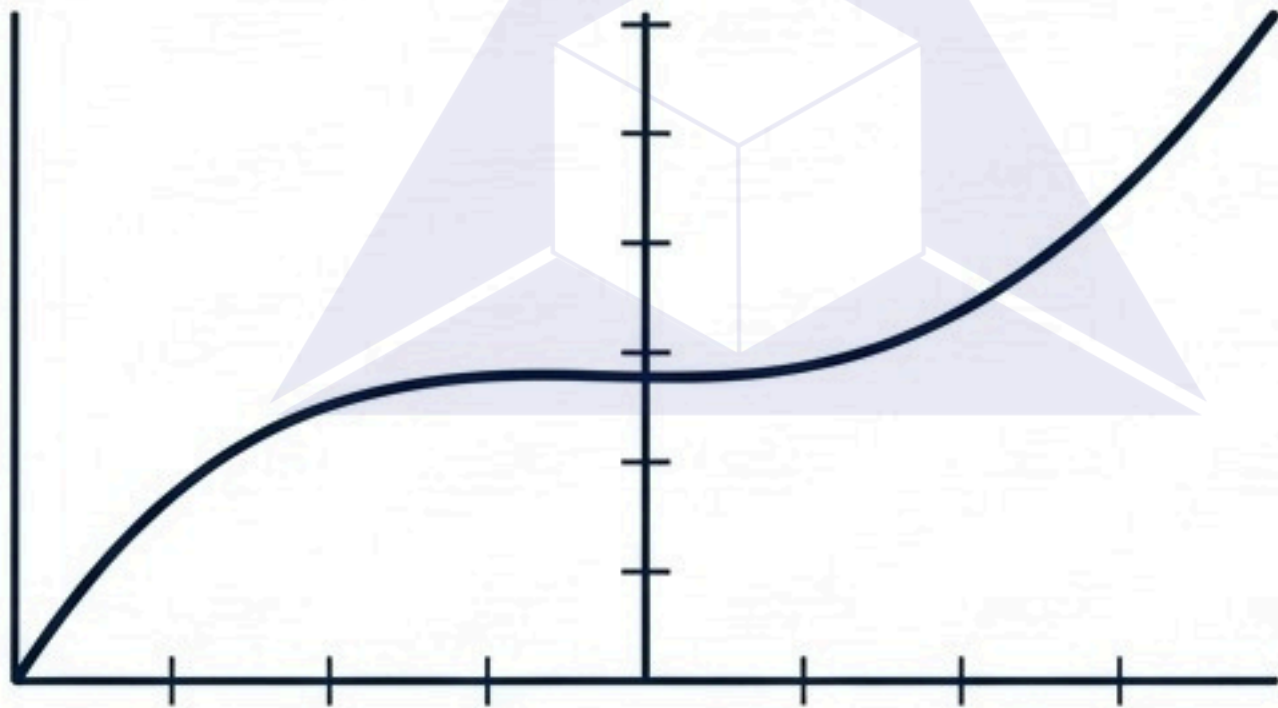
Does the function behave consistently at a point?



What Does “Continuous” Mean?

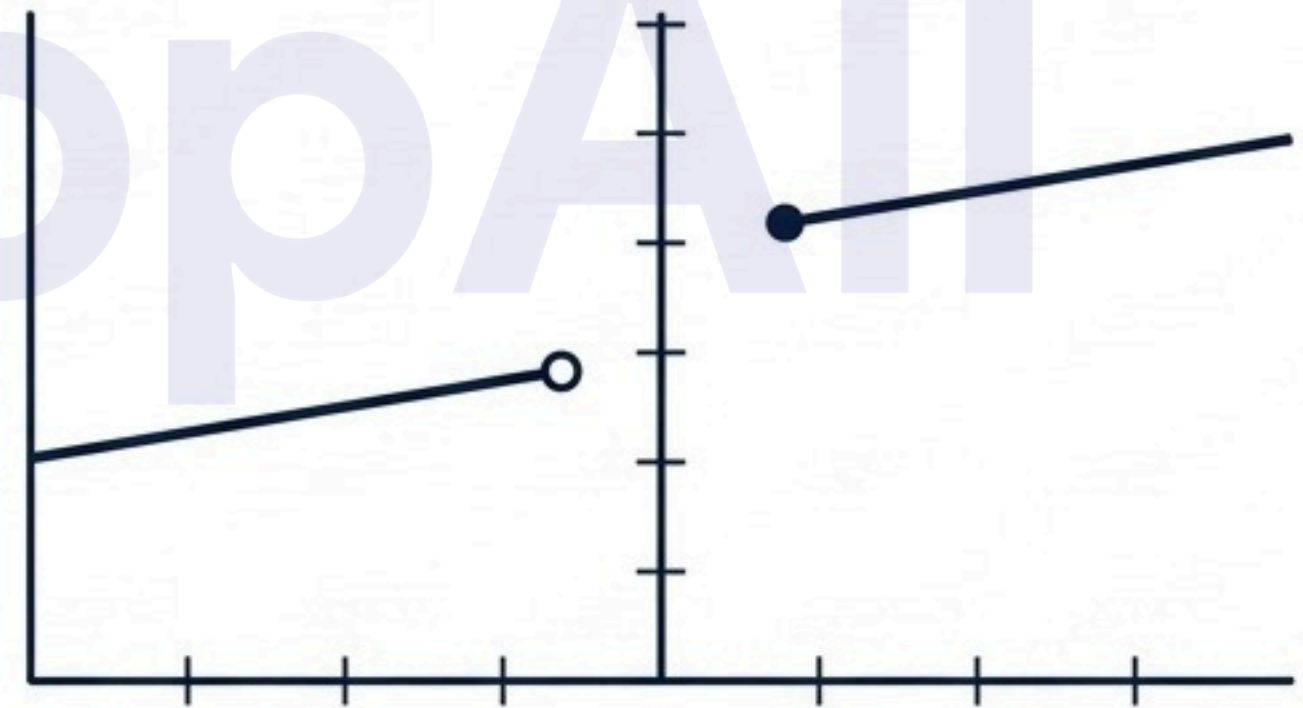
A function is continuous around a point when the nearby values of the function approach the value at that point.

Continuous



(Drawn without lifting the pen)

Discontinuous



(Requires lifting the pen)

The Continuity Test at $x = c$

1

$f(c)$ exists

2

The limit exists
($LHL = RHL$)

3

Limit equals
function value
($\lim_{x \rightarrow c} f(x) = f(c)$)



$$LHL = RHL = f(c)$$



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$$E=mc^2$$



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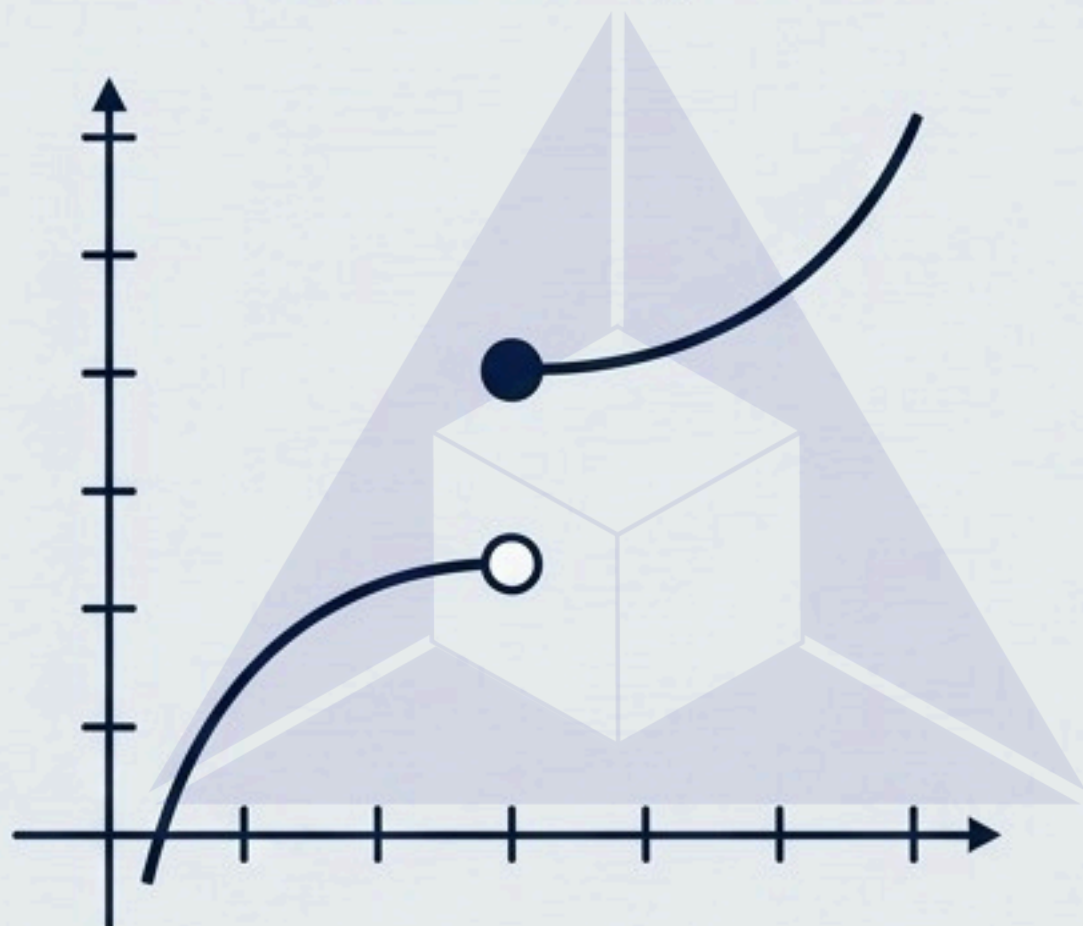
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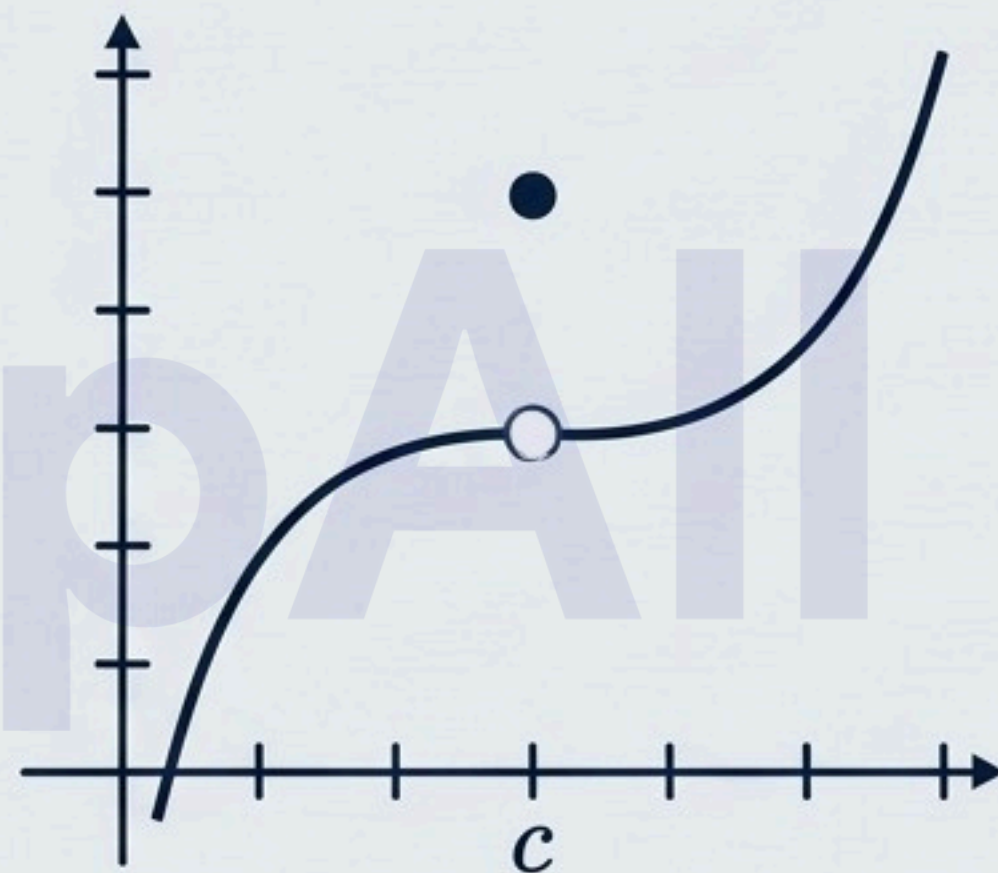
Recognise the Failure Type

Jump at the point



$$\text{LHL} \neq \text{RHL}$$

Limit exists but wrong function value



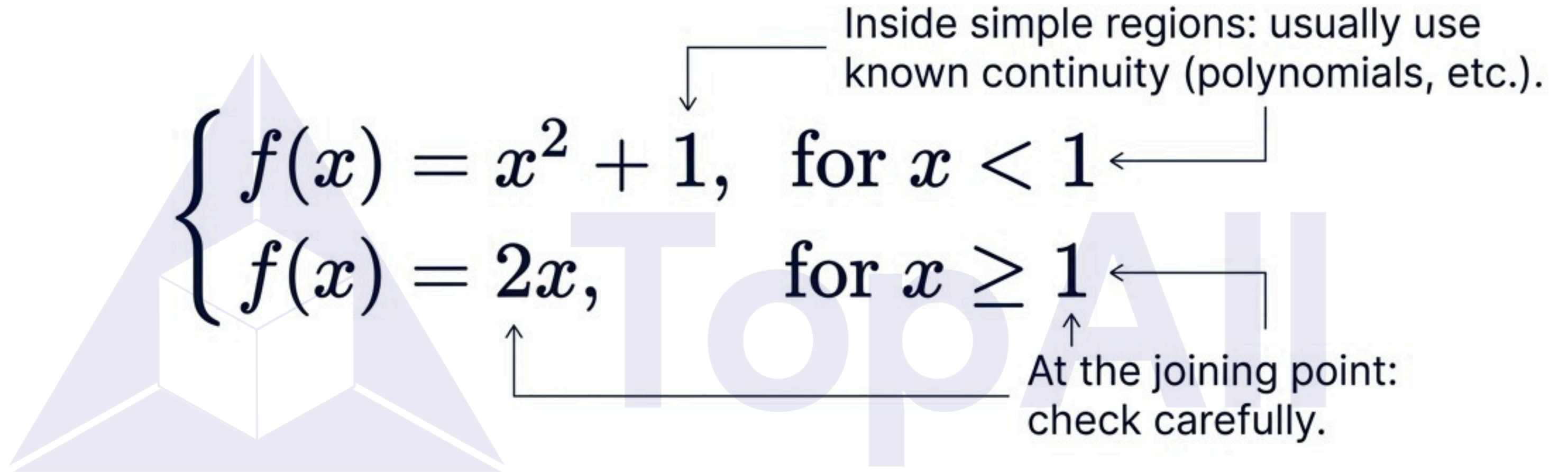
$$\text{LHL} = \text{RHL}, \text{ but } \lim_{x \rightarrow c} f(x) \neq f(c)$$

Where Should You Actually Check?

Inside simple regions: usually use known continuity (polynomials, etc.).

$$\begin{cases} f(x) = x^2 + 1, & \text{for } x < 1 \\ f(x) = 2x, & \text{for } x \geq 1 \end{cases}$$

At the joining point: check carefully.

A diagram showing a piecewise function. The function is defined as f(x) = x^2 + 1 for x < 1 and f(x) = 2x for x ≥ 1. Arrows point from the text 'Inside simple regions: usually use known continuity (polynomials, etc.)' to the two regions of the function. Another arrow points from the text 'At the joining point: check carefully.' to the point x = 1, which is the boundary between the two regions.

Find junction



Find LHL



Find RHL



Compare
with $f(c)$

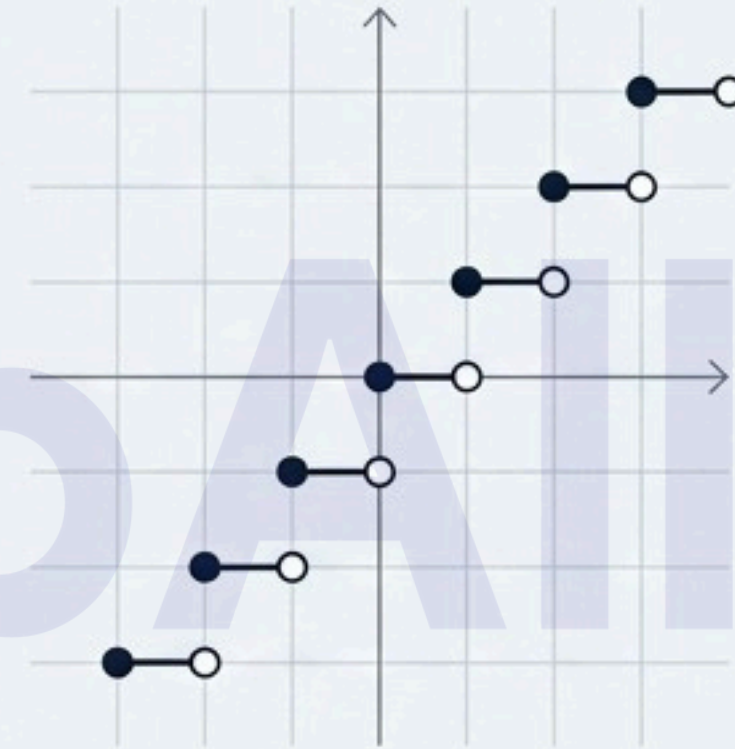
Two Important Details

Closed interval $[a, b]$

At a : $\lim_{x \rightarrow a^+} f(x) = f(a)$

At b : $\lim_{x \rightarrow b^-} f(x) = f(b)$

Greatest integer function $[x]$



At integer c :
 $\text{LHL} = c - 1$
 $\text{RHL} = c$

Therefore discontinuous at integers.

Continuity in One Frame

$$\text{LHL} = \text{RHL} = f(c)$$

- ✓ Function value exists
- ✓ Both sides agree
- ✓ Their common value equals $f(c)$

 **Caution:** At interval endpoints, use only the relevant one-sided limit.



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