

12.2 • Find limits algebraically

Last time: find limits numerically.

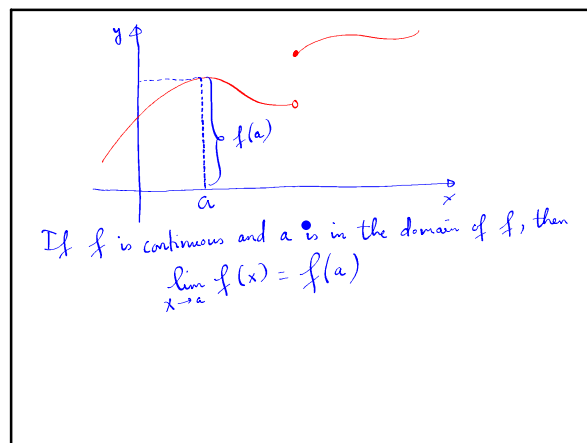
$$\lim_{x \rightarrow 3} \frac{x^2 - x - 6}{x^2 - 9}$$

Plug 3 into the function. $\frac{0}{0}$

x	f(x)	x	f(x)
3.5	2.05	2.9	2.6555
3.2	2.8	2.95	2.699
3.1	2.9	2.99	2.749
3.05	2.95	3.001	2.7501
3.001	2.7501		

Find limits algebraically

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$$\lim_{x \rightarrow 2} \frac{x^2 - x - 6}{x^2 - 9} = \frac{(2)^2 - 2 - 6}{(2)^2 - 9} = \frac{4 - 8}{4 - 9} = \frac{-4}{-5} = \boxed{\frac{4}{5}}$$

E.g.

$$\lim_{x \rightarrow 1} \frac{x}{\sqrt{1+2x} - 1} = \frac{1}{\sqrt{3} - 1}$$

$$\lim_{x \rightarrow 0} \frac{x}{\sqrt{1+2x} - 1} = \frac{0}{0} \rightarrow \text{we need to do something.}$$

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$\frac{0}{0}$ limits

E.g. $\lim_{x \rightarrow 7} \frac{x^2 - 6x - 7}{x - 7} = \frac{0}{0}$

$$\frac{(x+1)(x-7)}{x-7} = x+1$$

graph of $\frac{x^2 - 6x - 7}{x - 7}$

$$\frac{x^2 - 6x - 7}{x - 7} = x+1 \text{ provided that } x \neq 7$$

$$\lim_{x \rightarrow 7} \frac{x^2 - 6x - 7}{x - 7} = \lim_{x \rightarrow 7} (x+1) = \boxed{8}$$

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E.g. $\lim_{x \rightarrow 3} \frac{x^2 - 9}{x^2 - 5x + 6} = \frac{0}{0} = \lim_{x \rightarrow 3} \frac{(x-3)(x+3)}{(x-3)(x-2)} = \lim_{x \rightarrow 3} \frac{x+3}{x-2} = 6$

E.g. $\lim_{h \rightarrow 0} \frac{(h+3)^2 - 9}{h} = \frac{0}{0} = \lim_{h \rightarrow 0} \frac{h^2 + 6h + 9 - 9}{h} = \lim_{h \rightarrow 0} \frac{h^2 + 6h}{h} = \lim_{h \rightarrow 0} \frac{h(h+6)}{h} = \lim_{h \rightarrow 0} (h+6) = 6$

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E.g. $\lim_{h \rightarrow 0} \frac{(2-h)^3 - 8}{h}$

$$\lim_{h \rightarrow 0} \frac{8 - 12h + 6h^2 - h^3 - 8}{h} = \lim_{h \rightarrow 0} \frac{-12h + 6h^2 - h^3}{h} = \lim_{h \rightarrow 0} (-12 + 6h - h^2) = \boxed{-12}$$

Evaluate limit algebraically by finding the LCD.

E.g. $\lim_{x \rightarrow 5} \frac{\frac{1}{x-5} - \frac{1}{5}}{x-5}$

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