Differentiability Implies Continuity Proof

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The statement stated that if $f'(c)$ exists at $x = c$, then $f(x)$ is continuous at $x = c$. In order to proof so, we realize that
$0 = 0 * f'(c)$
$= 0 * \lim\limits_{x \to c} \frac{f(x)-f(c)}{x-c}$
$= \lim\limits_{x \to c}(x - c) * \lim\limits_{x \to c} \frac{f(x)-f(c)}{x-c}$
$= \lim\limits_{x \to c} \frac{(f(x)-f(c))(x-c)}{x-c}$
$= \lim\limits_{x \to c}(f(x) - f(c))$
$= -f(c) + \lim\limits_{x \to c} f(x)$
Therefore
$\lim\limits_{x \to c} f(x) = f(c)$ (which is the limit definition of continuity)
QED