

u -substitution is backwards chain rule

Motivating example

	Example application of chain rule	Example application of u -substitution
1.	$f(x) = \sin\left(\underbrace{x^2 + 4x + 3}_u\right)$ "pretend x "	$f(x) = \sin(x^2 + 4x + 3) + C$
2.	$f(x) = \sin(u)$	$f(x) = \sin(u) + C$
3.	$f'(x) = \cos(u) \cdot \underline{\hspace{2cm}}$	$f(x) = \int \cos(u) du$
4.	$f'(x) = \cos\left(\underbrace{x^2 + 4x + 3}_u\right) \cdot \left(\underbrace{2x + 4}_{\frac{du}{dx}}\right)$ "pretend x "	$f(x) = \int \cos\left(\underbrace{x^2 + 4x + 3}_u\right) \cdot \left(\underbrace{2x + 4}_{\frac{du}{dx}}\right) dx$
5.		Let $u = x^2 + 4x + 3$ $\frac{du}{dx} = 2x + 4$
6.		$f(x) = \int \cos(x^2 + 4x + 3) \cdot (2x + 4) dx$

Steps

1. Identify a **portion of the integrand that has a derivative that looks like some other stuff in the integrand**. Let this expression be u .
2. Compute $du = u'(x)dx$.
3. Substitute u and du into the integral (replacing the bounds if the integral is definite).
4. Attempt to integrate the resulting integral.
5. If integration is successful, replace u with its expression in terms of x .