1 3.5: Chain Rule

From 3.4: we know $\frac{d}{dx}(\sin x) = \cos x$. Does $\frac{d}{dx}(\sin 2x) = \cos 2x$?

**Recall**: The composition of 2 functions $f$ and $g$ is defined by

Define $f$ and $g$ for the above function.

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**The Chain Rule**: If $f$ and $g$ are differentiable functions, $y = f(u)$ and $u = g(x)$, then

$$\frac{dy}{dx} =$$

An alternate version of the Chain Rule states that $\frac{d}{dx} f(g(x)) =$

**Examples:**

Find the derivatives of the following:

$f(x) = \sin(x^2) - \sin^3 x$  
$y = \sqrt{\cos^2(3x) + 1}$
Differentiate the following:
\[ f(x) = x^2 \tan(3x) \quad \quad \quad y = \frac{2x + 1}{\sin^2 x} \]

(On Your Own) Given \( f(1) = 2, f(2) = 2\sqrt{2}, f'(1) = 1, f'(2) = \frac{1}{2}, g(1) = 2, g(2) = \frac{5}{2}, g'(1) = \frac{3}{4}, g'(2) = 0, \) and \( u(x) = f(g(x)) \), find \( u'(1) \)