The Chain Rule

Example 1
Find the derivative of $f(x) = (x + 3)^2$.

Squaring it out first  
Using power rule as is

Find the derivative of $f(x) = (2x + 3)^2$.

Squaring it out first  
Using power rule as is

What's wrong?
**Chain Rule**

\[
\frac{d}{dx} f(u(x)) = f'(u(x))u'(x)
\]

**Example 2**
Find the derivative of \( f(x) = (2x + 3)^2 \) without squaring it out first.
Make sure to use the chain rule.

**Example 3**
Find the derivative of \( f(x) = (2x + 3)^{17} \).
Example 4
Find the derivative of \( f(x) = \cos(5x^2 - 7) \).

Example 5
Find the derivative of \( f(x) = \sqrt{\sin x - 3x} \).
**Example 6**
Find the derivative of $f(x) = (4x - \tan(3x) + e^{-2x})^{17}$.

**Example 7**
Find the derivative of $h(x) = \left(\frac{1}{3x - 1}\right)^\pi$ at $x = 1$. 
Example 8
Find the derivative of $h(x) = \sin(e^{4x}) - x^5 \cos(3x)$.

Example 9
Find the equation of the line tangent to the curve $y = \sin(5x) + \cos(2x)$ at $x = \frac{\pi}{6}$. 
Example 10
A table of values for $f, g, f', g'$ is given below:

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
<th>$g(x)$</th>
<th>$f'(x)$</th>
<th>$g'(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>8</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>2</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

(a) If $F(x) = f(f(x))$, find $F'(2)$.

(b) If $G(x) = g(g(x))$, find $G'(3)$.

(c) Find the derivative of $f(g(x))$ at $x = 1$.

(d) Find the derivative of $g(f(x))$ at $x = 1$.  

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