Trigonometry and Derivatives and the Chain Rule and Maple

Maple can take derivatives for you:

\[ \text{diff}(\sin(x), x); \]

\[ \cos(x) \]

Here’s a more complicated example:

\[ \text{diff}(\log(2^x - 4x + \sin(17x)), x); \]

\[ \frac{2^x \ln(2) - 4 + 17 \cos(17x)}{2^x - 4x + \sin(17x)} \]

Your little graphing calculator would wimper at the thought of doing such a thing. Maple does it in less than a second, and with no whining.

Ok. Let’s look at some trig examples:

\[ \text{plot}(\{\sin(x), \text{diff}(\sin(x), x)\}, x=0..10); \]

As expected, the derivative of the sine function is the cosine function.
\begin{verbatim}
> plot( { sin(2*x), diff(sin(2*x), x) }, x=0..10);

\text{\texttt{sin}(2x) is \texttt{sin}(x) scrunched in by a factor of 2. This means that the function is steeper, because it’s getting scrunched. So the derivative of \texttt{sin}(2x) is twice as large as the derivative of \texttt{sin}(x).}

\text{The chain rule is an algebraic way of seeing this:}

\texttt{diff(sin(x), x)};
\texttt{diff( sin(2*x), x)};
\texttt{diff( sin(2*x), x);} \quad \text{cos}(x)
\texttt{2 \cos(2 \, x)}
\end{verbatim}
Let’s try another graphical application of the chain rule.

> plot( sin(x^2), x=0..5);

Note that the derivative is getting larger as the function is getting scrunched more and more. (The two plots have different scales.) Algebraically:

> diff(sin(x^2), x);

> diff(sin(x^2), x);

2 \cos(x^2) x