Trigonometry and Derivatives and the Chain Rule and Maple

Maple can take derivatives for you:

```
> diff(sin(x), x);
```

$$\cos(x)$$

Here's a more complicated example:

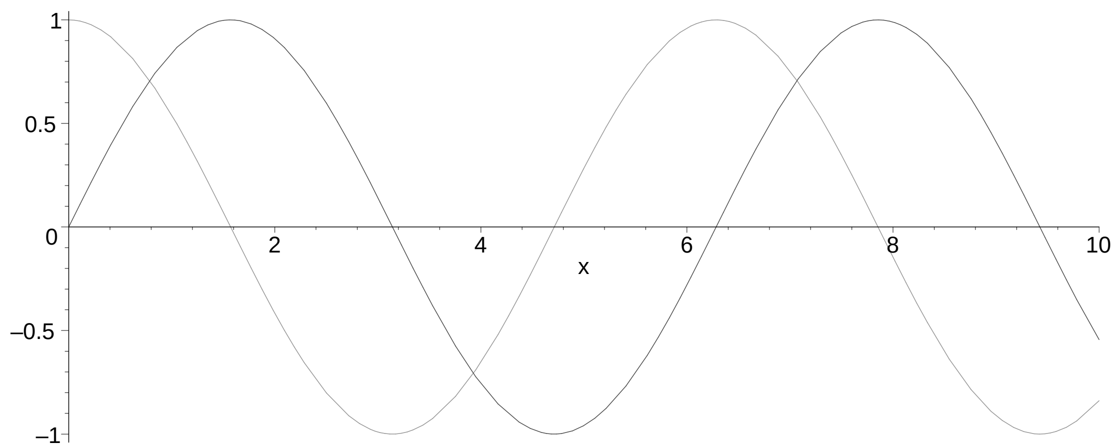
```
> diff( log( 2^x - 4*x + sin(17*x) ), x);
```

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

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

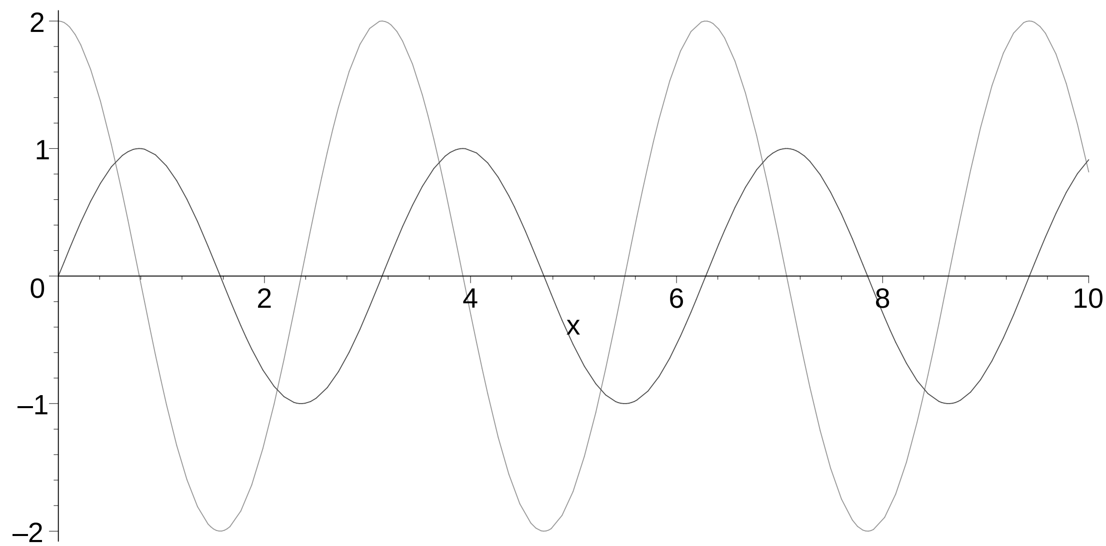
Ok. Let's look at some trig examples:

```
> plot( { sin(x), diff(sin(x), x) }, x=0..10);
```



As expected, the derivative of the sine function is the cosine function.

```
> plot( { sin(2*x), diff(sin(2*x), x) }, x=0..10);
```



sin(2x) is 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 sin(2x) is twice as large as the derivative of sin(x).

The chain rule is an algebraic way of seeing this:

```
> diff(sin(x), x);
```

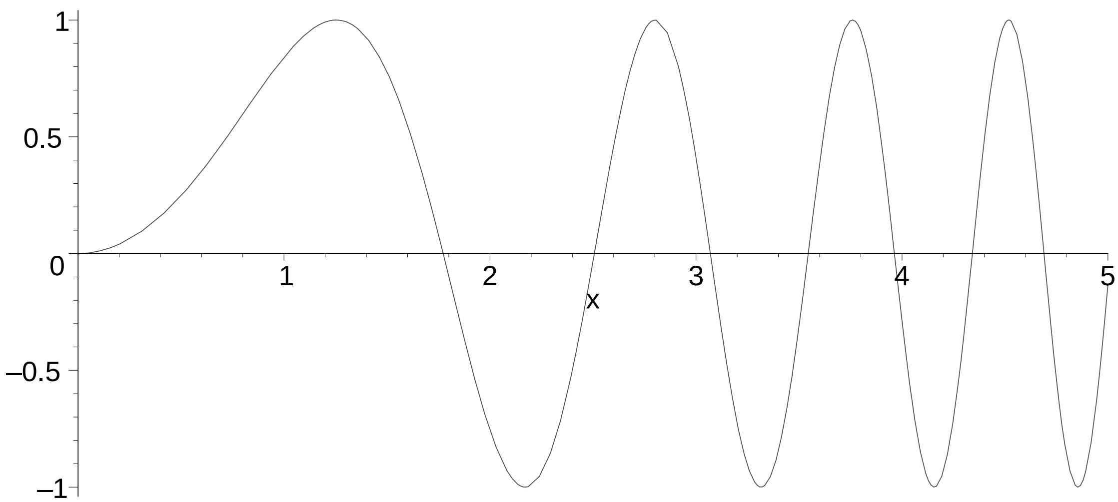
$$\cos(x)$$

```
> diff( sin(2*x), x);
```

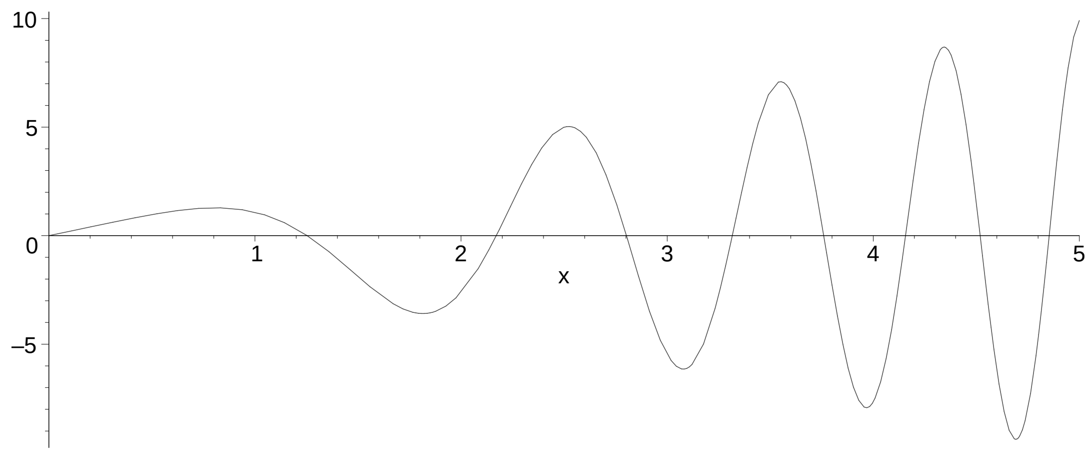
$$2 \cos(2 x)$$

Let’s try another graphical application of the chain rule.

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




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

$$2\cos(x^2)\,x$$

```
>
```