# Differentiation and Tangent Lines

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## *Overview*

This week's lab will provide practice finding locally linear approximations to functions. That is, finding tangent lines to curves.

## *Maple Essentials*

- The *Tangents* tutor is started from the Maple 9.5 user interface under the Tools menu:

  **Tools → Tutors → Calculus - Single Variable → Tangents...**

- The *TangentLine* maplet is available from Texas A & M University at the URL:

  `http://calclabs.math.tamu.edu/maple/maplets/TangentLine.maplet`

- The Maple commands involved with finding and plotting the tangent line to the graph of a (differentiable) function are:

| Command | Description |
|---|---|
| `:=` | assignment |
| `diff` | differentiate an expression |
| `eval` | evaluate at a point |
| `plot` | plot one or more expressions |

## *Preparation*

Review the derivation of the general formula for the equation of the tangent line to the graph of a function, $f$, at a point $(a, f(a))$ where $f$ is differentiable (pp. 177–179 in Anton).

## *Activities*

1. Your TA will demonstrate two approaches to this problem:

   Find an equation for the line that is tangent to the curve $y = x^3 - 2x + 1$ at the point $(2, 5)$ and graph the curve and this tangent line on the same axes.

   - Launch the *Tangents* tutor.
     Enter the function as `x^3 - 2*x + 1` and the base point as `2`. Press the *Display* button.
   - Enter and execute (one-by-one) the following Maple commands:

```
> f := x^3 - 2*x + 1;                  # assign function to f
> Df := diff( f, x );                  # compute derivative, f'(x)
> m := eval(Df, x=2);                  # slope of curve at x = 2 is f'(2)
> L := m * (x-2) + eval(f, x=2);       # tangent line is y = f'(2)(x - 2) + f(2)
> plot( [ f, L ], x=-2..3 );           # plot of function and tangent line
```

2. Graph the curve $y = f(x)$ and the tangent line at $(a, f(a))$ for each of the following:
   (a) $f(x) = \sqrt{x}$, $a = 3$
   (b) $f(x) = \frac{5}{x} + 1$, $a = -2$
   (c) $f(x) = x^2$, $a = 1$
   (d) $f(x) = 2^x$, $a = 1$ (To enter $2^x$, type `2^x`. Note that this is very different from $x^2$.)
   (e) $f(x) = \sin(x)$, $a = \frac{\pi}{4}$ (Recall that, in Maple, $\pi$ is `Pi`.)

## *Assignment*

There is nothing due this week. The *TangentLine* maplet provides additional practice finding tangent lines.