```
(* Here's another example showing that the unit normal always points
   to the concave side of the curve. Consider the graph of the cubic y=
  x^3 thought of as a parametrized curve with x=t and y=t^3. *)
```

In[8]:= `r[t_] := {t, t^3}`

`(* The unit tangent is: *)`

In[39]:= $T = \left\{\frac{1}{\sqrt{1+9t^4}}, \frac{3t^2}{\sqrt{1+9t^4}}\right\};$

`(* The derivative of the unit tangent is: *)`

In[31]:= $N1 = \partial_t T$

Out[31]= $\left\{-\frac{18t^3}{(1+9t^4)^{3/2}}, -\frac{54t^5}{(1+9t^4)^{3/2}} + \frac{6t}{\sqrt{1+9t^4}}\right\}$

`(* Evaluating at t=1 gives: *)`

In[37]:= $\left\{-\frac{18t^3}{(1+9t^4)^{3/2}}, -\frac{54t^5}{(1+9t^4)^{3/2}} + \frac{6t}{\sqrt{1+9t^4}}\right\}$ `//. t → 1`

In[38]:= $N\left[\left\{-\frac{9}{5\sqrt{10}}, 3\sqrt{\frac{2}{5}} - \frac{27}{5\sqrt{10}}\right\}\right]$

Out[38]= `{-0.56921, 0.189737}`

```
(* So at (1,1) the unit normal, which has the same direction as the unit tangent,
 has negative x-component and positive y-component. *)
```

`(* Evaluating at t=-1 gives: *)`

In[33]:= $\left\{-\frac{18t^3}{(1+9t^4)^{3/2}}, -\frac{54t^5}{(1+9t^4)^{3/2}} + \frac{6t}{\sqrt{1+9t^4}}\right\}$ `//. t → -1`

In[35]:= $N\left[\left\{\frac{9}{5\sqrt{10}}, -3\sqrt{\frac{2}{5}} + \frac{27}{5\sqrt{10}}\right\}\right]$

Out[35]= `{0.56921, -0.189737}`

```
(* So at (-1,-1) the unit normal has positive x-component and negative y-component.

   In either case, the unit normal points to the concave side of the curve. *)
```