> restart;

Maple Worksheet to facilitate the visualization of a family of surfaces.

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WWW URL: http://www.math.sc.edu/~meade/math524/exam/ex1-4.ms

The function to be analyzed/viewed

> f := x^4-4*a*x*y+y^4;

$$f := x^4 - 4\,a\,x\,y + y^4$$

A basic 3D plot can be done with the basic routines in Maple. The 3D animation requires loading some extra plotting routines (the plots package).

> with(plots):

Let's begin with a single plot. Feel free to change the value of a or the domain. You should also select better shading, styles, labels, etc. from the pull-down menus on the plot window header.

> plot3d(subs(a=1, f), x=-4..4, y=-4..4);
>

Another way to visualize this function is to create an animation from a sequence of 3D plots, with different values of a.

> animate3d(f, x=-4..4, y=-4..4, a=-2..2,
frames=20, view=[-4..4,-4..4,-10..10],
axes=BOXED, shading=ZHUE, style=PATCHCONTOUR);
>

Maple is also able to compute the gradient and Hessian (and other quantities) of this function.

> with(linalg):
> Gf := grad(f, [x,y]);

$$Gf := [\,4\,x^3 - 4\,a\,y \quad -4\,a\,x + 4\,y^3\,]$$

> Hf := hessian(f, [x,y]);

$$Hf := \begin{bmatrix} 12\,x^2 & -4\,a \\ -4\,a & 12\,y^2 \end{bmatrix}$$

In principle, Maple can also find the critical points. However, in practice, this is not so simple. The real problem is that Maple assumes a is a complex valued parameter, and tries to find all nine complex-valued solutions to Gf=0.
>

End of worksheet