## Discriminant

$$D(x,y) = f_{xx}(x,y)f_{yy}(x,y) - f_{xy}(x,y)f_{yx}(x,y)$$

## Selected Vector Formulas

$$\begin{aligned}
\|\mathbf{v}\times\mathbf{w}\|^2 &= \|\mathbf{v}\|^2\|\mathbf{w}\|^2 - (\mathbf{v}\cdot\mathbf{w})^2\\
\|\mathbf{v}+\mathbf{w}\| &\le \|\mathbf{v}\| + \|\mathbf{w}\|\\
\mathrm{proj}_{\mathbf{v}}(\mathbf{u}) &= \frac{\mathbf{u}\cdot\mathbf{v}}{\|\mathbf{v}\|^2}\mathbf{v}\\
V &= |\mathbf{u}\cdot(\mathbf{v}\times\mathbf{w})|\\
A &= |\mathbf{v}\cdot\mathbf{u}|
\end{aligned}$$

## Spherical Coordinates

$$\begin{aligned}
x &= \rho\cos(\theta)\sin(\phi) & \rho &= \sqrt{x^2+y^2+z^2}\\
y &= \rho\sin(\theta)\sin(\phi) & \tan(\theta) &= \frac{y}{x}\\
z &= \rho\cos(\phi) & \cos(\phi) &= \frac{z}{\sqrt{x^2+y^2+z^2}}
\end{aligned}$$

## Cylindrical Coordinates

$$\begin{aligned}
x &= r\cos(\theta) & r &= \sqrt{x^2+y^2}\\
y &= r\sin(\theta) & \tan(\theta) &= \frac{y}{x}\\
z &= z & z &= z
\end{aligned}$$

## Implicit Differentiation

$$F(z,y,z) = 0$$

$$\frac{\partial z}{\partial x} = -\frac{F_x}{F_z} \qquad \frac{\partial z}{\partial y} = -\frac{F_y}{F_z}$$

## Trigonometic Identities

$$\begin{aligned}
\sin(2x) &= 2\sin(x)\cos(x)\\
\sin^2(x) &= \frac{1-\cos(2x)}{2}\\
\cos^2(x) &= \frac{1+\cos(2x)}{2}
\end{aligned}$$