$$\det(M) = \det \begin{pmatrix} a & b \\ c & d \end{pmatrix} = ad - bc$$

$$H(x,y) = \begin{bmatrix} f_{xx}(x,y) & f_{xy}(x,y) \\ f_{yx}(x,y) & f_{yy}(x,y) \end{bmatrix}$$

1. If $\det(H) > 0$ and $f_{xx}(a,b) > 0$, then $f(a,b)$ is a *local minimum.*
2. If $\det(H) > 0$ and $f_{xx}(a,b) < 0$, then $f(a,b)$ is a *local maximum.*
3. If $\det(H) < 0$, then (a,b) is a *saddle point.*
4. If $\det(H) = 0$, the test is *inconclusive.*

Curve/Surface	**Equation**
$y = f(x)$	$y = f'(a)(x-a) + f(a)$
$z = f(x,y)$	$z = c + \nabla f(a,b) \cdot \langle x-a, y-b \rangle$
$F(x,y,z) = D$	$\nabla F(a,b,c) \cdot \langle x-a, y-b, z-c \rangle = 0$

Suppose $D = \{(x,y,z) : a \leqslant x \leqslant b,\ g(x) \leqslant y \leqslant h(x),\ G(x,y) \leqslant z \leqslant H(x,y)\}$, where the bounds of y depend on x and the bounds of z depend on x and y.

Then

$$V = \iiint_D f(x,y,z)\, dV = \int_a^b \int_{g(x)}^{h(x)} \int_{G(x,y)}^{H(x,y)} f(x,y,z)\, dz\, dy\, dx$$