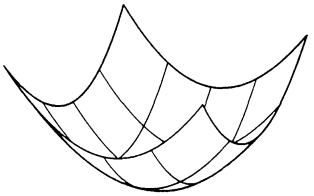
Definitely ~ Positively the Pits

$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ positive definite

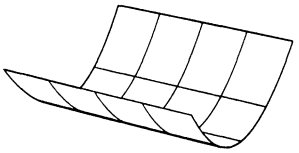
$$z = [x, y]\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = x^2 + y^2$$



pit

$\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$ positive semidefinite

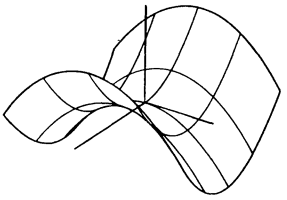
$$z = [x, y]\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = x^2 + 0$$



valley

$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ indefinite

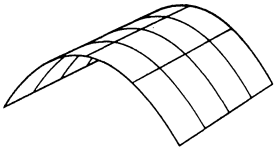
$$z = [x, y]\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = x^2 - y^2$$



pass

$\begin{bmatrix} 0 & 0 \\ 0 & -1 \end{bmatrix}$ negative semidefinite

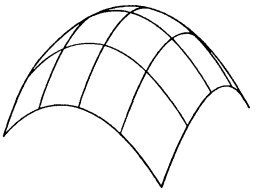
$$z = [x, y]\begin{bmatrix} 0 & 0 \\ 0 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = 0 - y^2$$



ridge

$\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$ negative definite

$$z = [x, y]\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = -x^2 - y^2$$

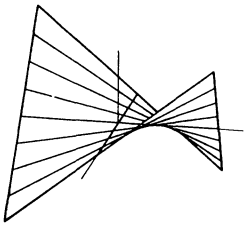


peak

Rotate to Saddle-up

$$z = 2xy = [x, y]\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = [x, y]\begin{bmatrix} a & -a \\ a & +a \end{bmatrix}\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}\begin{bmatrix} -a & a \\ -a & a \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = s^2 - t^2;$$

where $a = \sqrt{2}/2$



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