

Composing Transformation

- Matrix multiplication is associative

$$M3 \times M2 \times M1 = (M3 \times M2) \times M1 = M3 \times (M2 \times M1)$$

- Transformation products may not be commutative $A \times B \neq B \times A$
- Some cases where $A \times B = B \times A$

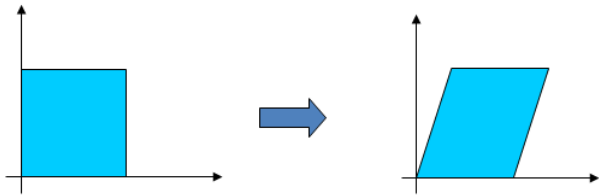
| A | B |
|-----------------|--------------------|
| translation | <u>translation</u> |
| scaling | <u>scaling</u> |
| rotation | <u>rotation</u> |
| uniform scaling | rotation |

$$(\underline{sx} = \underline{sy})$$

translation rotation?

Other Transformations

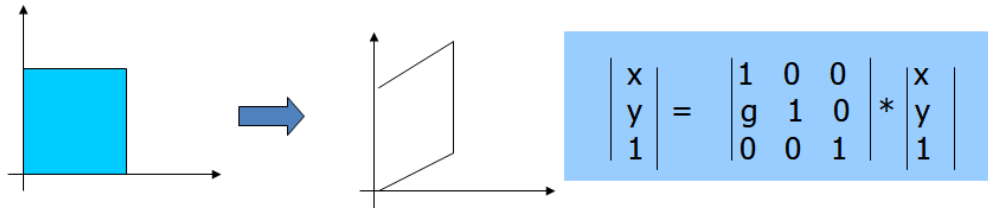
Shearing



- Y coordinates are unaffected, but x coordinates are translated linearly with y
- That is:
 - $y' = y$
 - $x' = x + y * h$

$$\begin{vmatrix} x \\ y \\ 1 \end{vmatrix} = \begin{vmatrix} 1 & h & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix} * \begin{vmatrix} x \\ y \\ 1 \end{vmatrix}$$

Shearing in Y



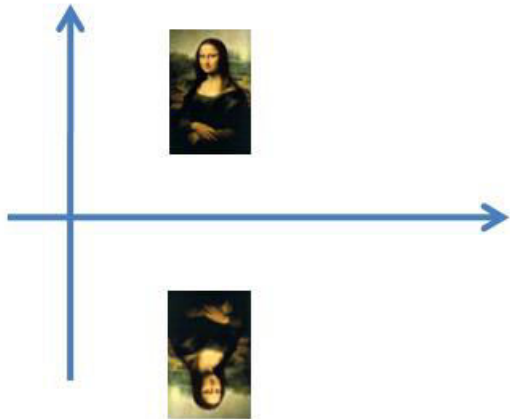
Interesting Facts:

- Shearing will not change the area of the object

Lecture No 24 Topic: Reflection



Reflection about X-axis



$$\begin{vmatrix} x \\ y \\ 1 \end{vmatrix} = \begin{vmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{vmatrix} * \begin{vmatrix} x \\ y \\ 1 \end{vmatrix}$$