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approximation of rotation by skews

a rotation by a angle of less than 90° can be represented by a composition of two skews and a scaling matrix. let c, s be cosine and sine of angle of rotation. then:

$$\begin{bmatrix} c & s \\ -s & c \end{bmatrix} = \begin{bmatrix} \frac{1}{c} & 0 \\ 0 & c \end{bmatrix} \begin{bmatrix} 1 & sc \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ -\frac{s}{c} & 1 \end{bmatrix}$$

where $\begin{bmatrix} \frac{1}{c} & 0 \\ 0 & c \end{bmatrix}$ applies different scale factors in x and y directions

$\begin{bmatrix} 1 & sc \\ 0 & 1 \end{bmatrix}$ applies skew parallel to x-axis

$\begin{bmatrix} 1 & 0 \\ -\frac{s}{c} & 1 \end{bmatrix}$ applies skew parallel to y-axis

an approximate rotation can be obtained by omitting the scaling matrix. for angles up to 30° the scale error will be less than 14%, and the error in the ratio of x to y dimensions will be less than 25%.

normalization of sloping text (and italics)

if 'vertical' strokes have a slope v relative to the y-axis, and 'horizontal' strokes have a slope h relative to the x-axis, the the text can be normalized by:

$$\begin{bmatrix} 1 & \frac{-v}{1-hv} \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ -h & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$