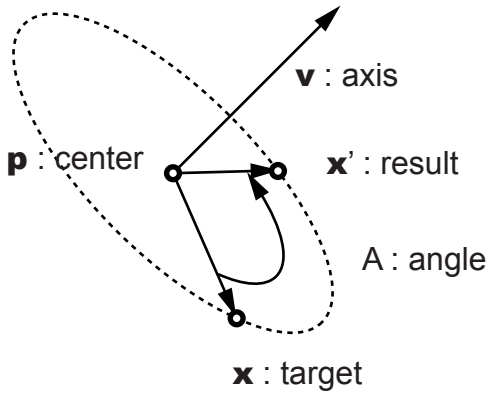
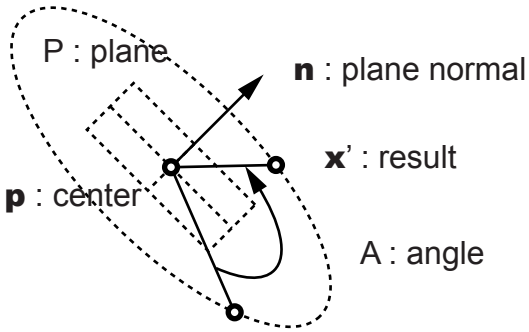
ROTATION AND CIRCLE

ROTATION BY CENTER + AXIS + ANGLE

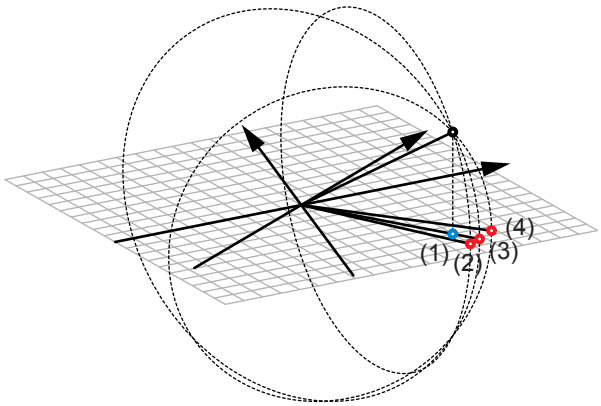


ROTATION BY CENTER + PLANE + ANGLE



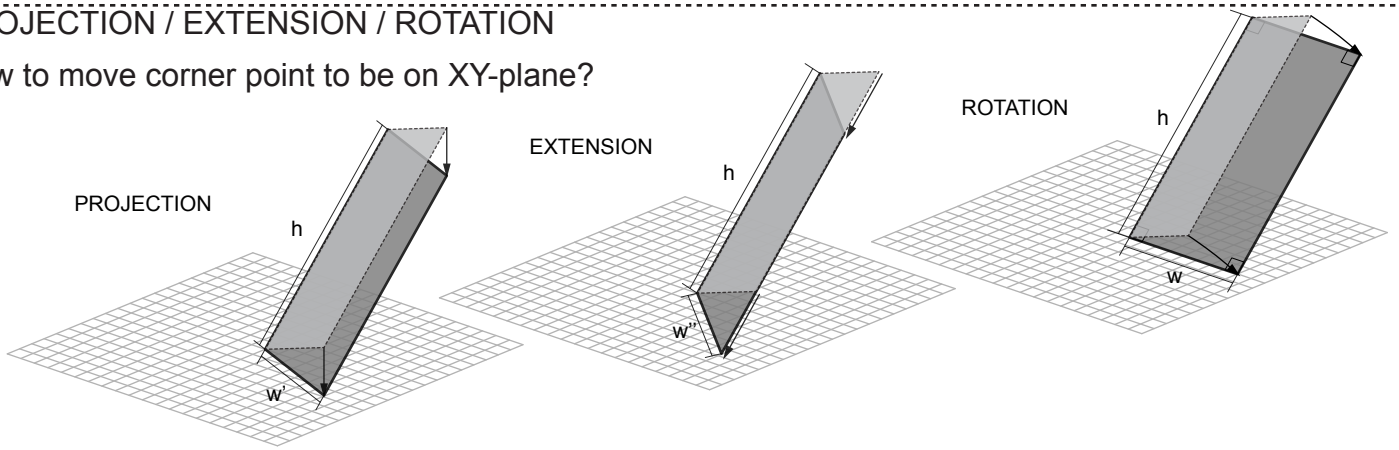
PROJECTION VS ROTATION

(1) Projection on XY plane
(2) Rotate around X-axis
(3) Rotate around axis on XY-plane perpendicular to a vector to the point
(4) Rotate around arbitrary axis on XY-plane



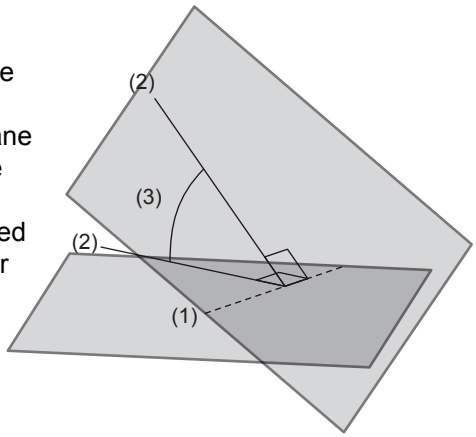
PROJECTION / EXTENSION / ROTATION

How to move corner point to be on XY-plane?



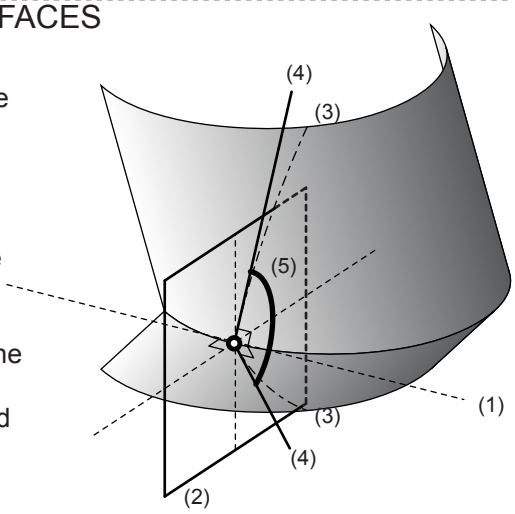
ANGLE OF PLANES

(1) Intersectional line of two planes
(2) Line on each plane perpendicular to the intersectional line
(3) Angle is measured by the perpendicular lines



ANGLE OF SURFACES

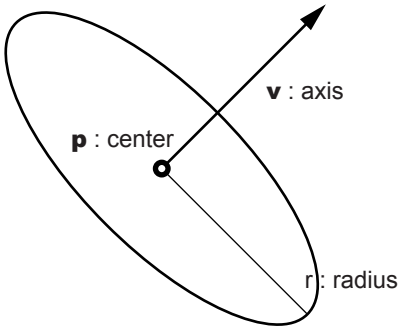
(1) Tangent line at the measurement point
(2) Perpendicular plane to the tangent line
(3) Intersection curve of the plane with the surfaces
(4) Tangent lines to the intersectional curve
(5) Angle is measured by the tangent lines



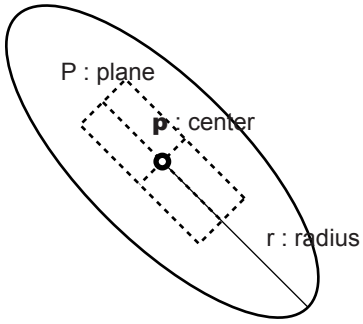
ROTATION AND CIRCLE

DEFINITION OF CIRCLE

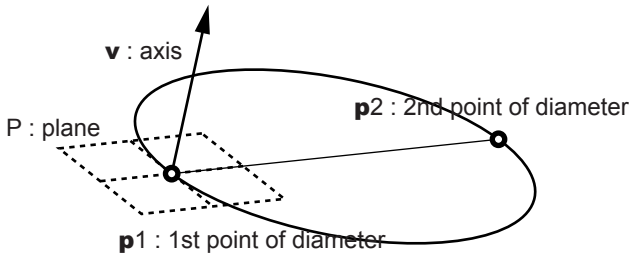
CENTER + AXIS + RADIUS



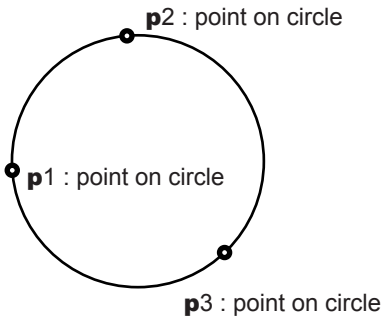
CENTER + PLANE + RADIUS



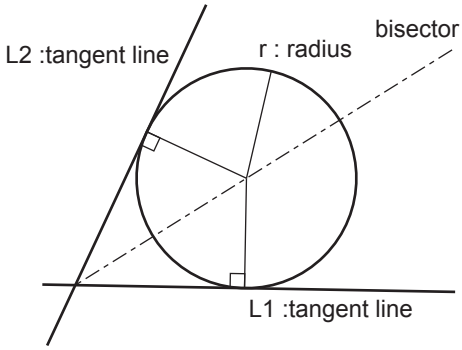
PLANE (OR AXIS) + DIAMETER



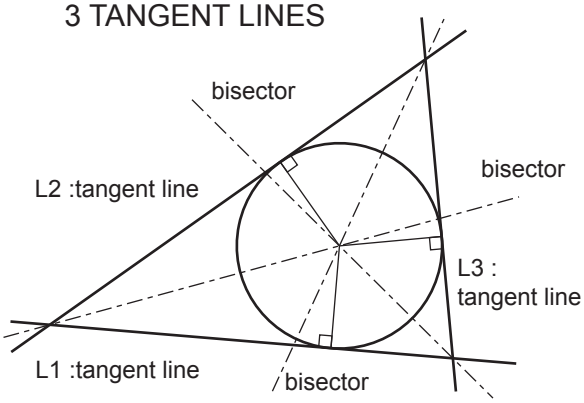
3 POINTS



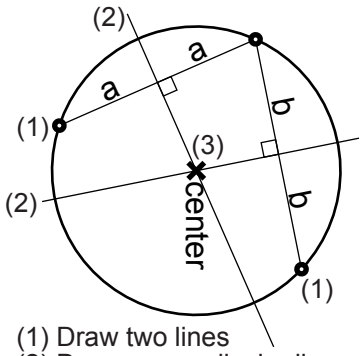
2 TANGENT LINES + RADIUS



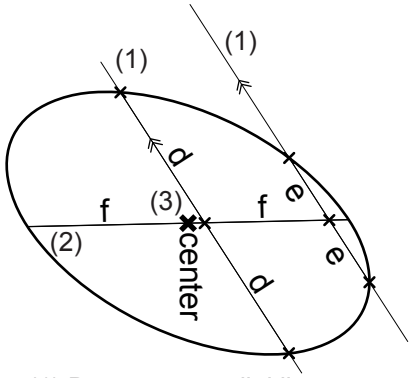
3 TANGENT LINES



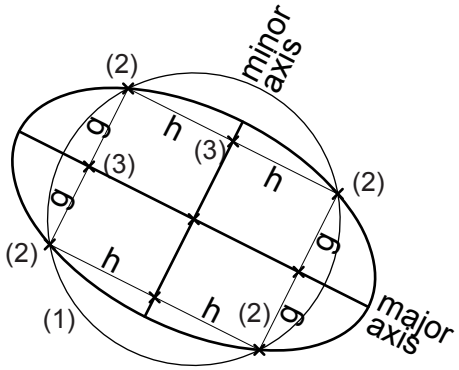
FINDING CENTER



(1) Draw two lines
(2) Draw perpendicular line on midpoint
(3) Take intersection

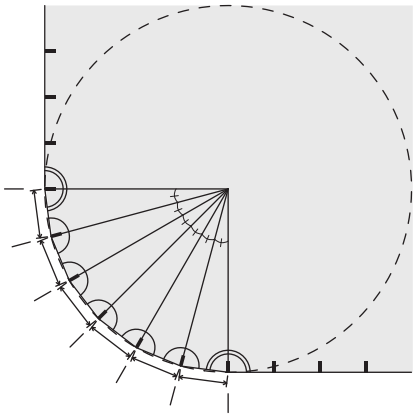


(1) Draw two parallel lines
(2) Connect midpoints and extend until intersecting with ellipse
(3) Take midpoint

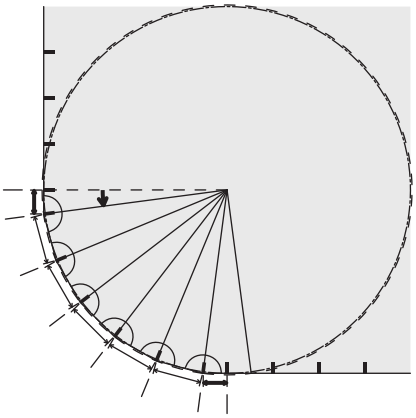


(1) Draw a circle at the ellipse center
(2) Take intersection and connect them to form a rectangle
(3) Connect each midpoint of edges

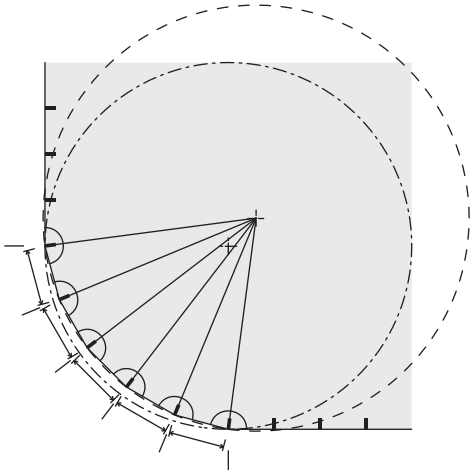
DIVIDING ARC



EQUAL EDGE LENGTHS
UNIQUE END ANGLES



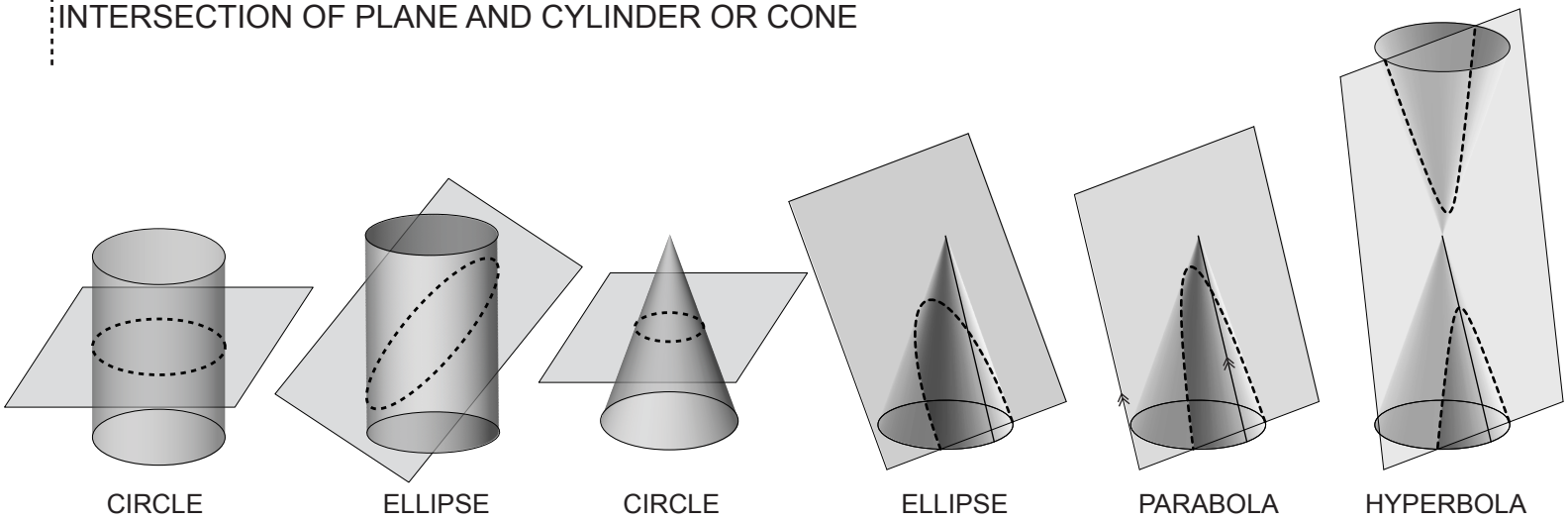
EQUAL ANGLES
UNIQUE END EDGE LENGTHS



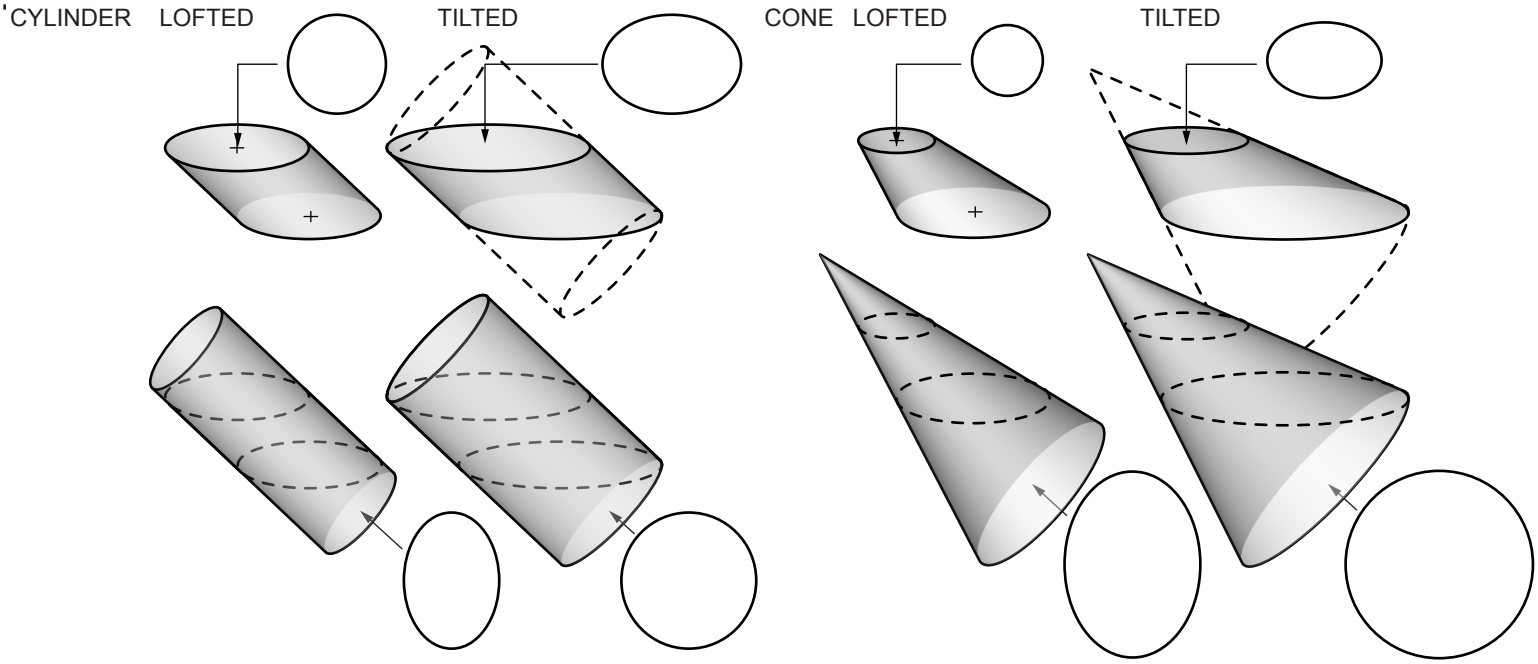
EQUAL ANGLES
EQUAL EDGE LENGTHS

ROTATION AND CIRCLE

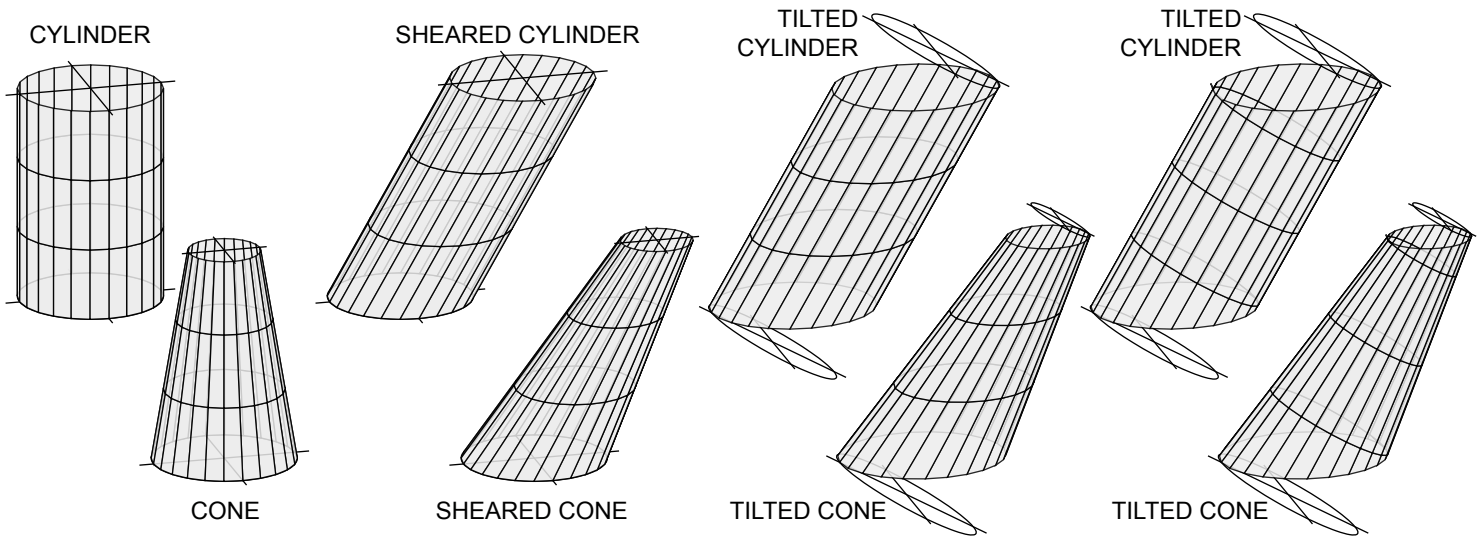
INTERSECTION OF PLANE AND CYLINDER OR CONE



LOFTED SURFACE BETWEEN CIRCLES VS TILTED CYLINDER AND CONE

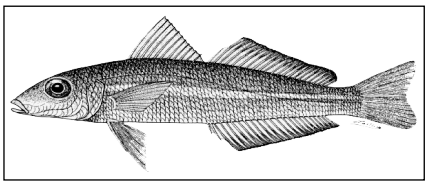


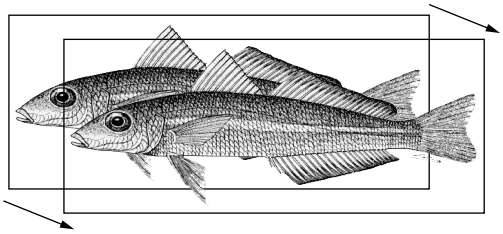
PANELIZATION OF CYLINDER AND CONE



ROTATION AND CIRCLE

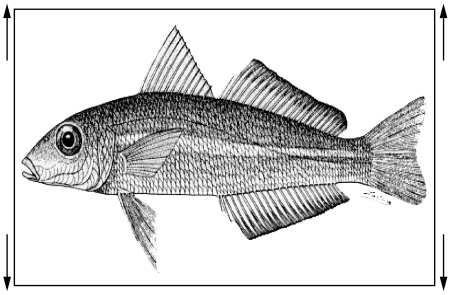
AFFINE TRANSFORMATION





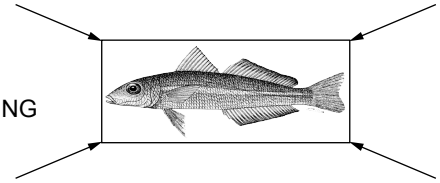
$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} t_x \\ t_y \end{pmatrix}$$

TRANSLATION



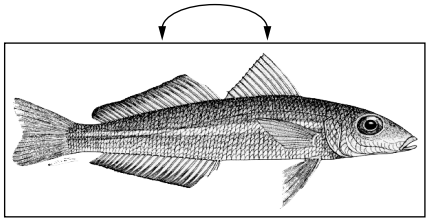
$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} s_x & 0 \\ 0 & s_y \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

NON-UNIFORM SCALING



$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} s & 0 \\ 0 & s \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

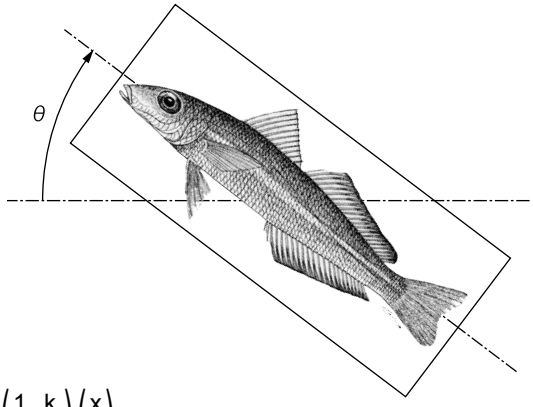
UNIFORM SCALING



$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} r_x & 0 \\ 0 & r_y \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

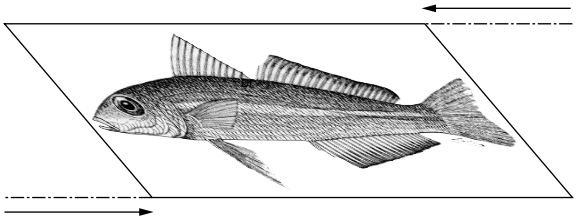
r_x, r_y = -1 or 1

REFLECTION



$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

ROTATION



$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} 1 & k \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \text{ (on x-axis)}$$

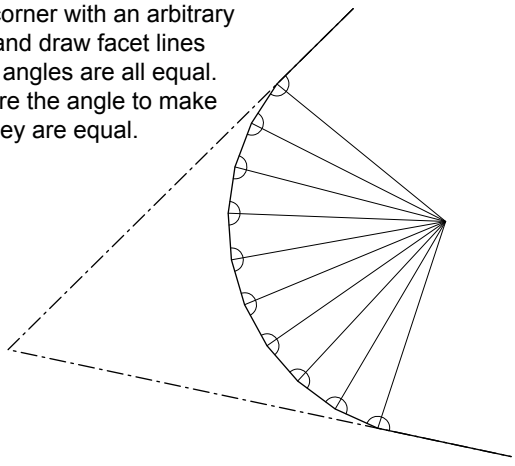
$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ k & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \text{ (on y-axis)}$$

SHEARING

EXERCISE

TASK1. BASIC

Draw corner with an arbitrary angle and draw facet lines whose angles are all equal. Measure the angle to make sure they are equal.



TASK2. ADVANCED

Model tilted faces with the facet lines drawn in task 1 whose unfolded shapes are identical and the angles of faces are all equal. Measure the angles of faces to check if they are equal and unfold the faces to check if the shapes are identical.

* The angle of tilted faces in 3D is different from the angle on the plan.