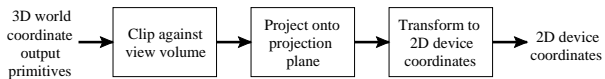


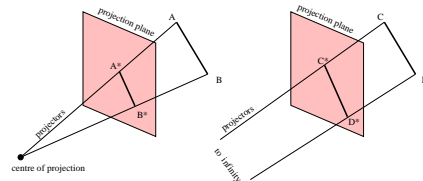
Projection

- Gets a bit mathematical (but not for a while).
- Central to computer graphics.



- Already dealt with transformation to device coordinates.

General Projections



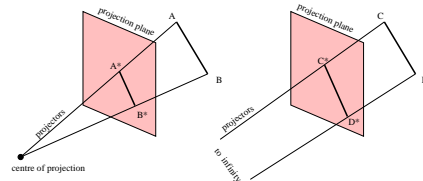
- Perspective foreshortening is important to **realism** but results in distortion of angles, distances and parallel lines.
- Parallel projections also distort angles, but **maintain parallelism and distances**.

General Projections

- Convert an nD coordinate system into a mD coordinate system: in computer graphics $n = 3$ and $m = 2$.
- We consider **planar geometric projections** – we project onto a plane.
- Projections can be visualised using projectors which emanate from the centre of the projection.
- The **centre of projection** is generally at a finite distance from the projection plane but is sometimes defined at infinity.
- Easy to implement (if not understand) using **homogeneous coordinates**.

Defining a Plane?

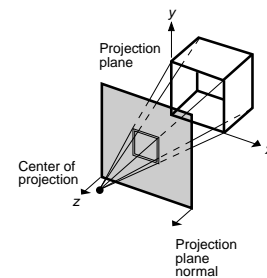
- We need to define the projection plane – **how can this be done?**



Defining a Plane?

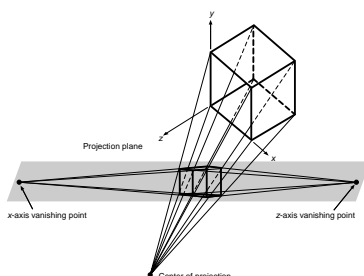
- Most simple is to define a point in the projection plane, and then two vectors, one for up and one for across.
- This allows us to define any (all) points in the plane.
- For computer graphics we normal give a point, a vector to define up and a **normal vector** to the plane (which is the cross product of the up and across vectors).
- Concept of **normal vectors** is very important in computer graphics.

Perspective projections



- In a perspective projection all parallel lines that are **not** parallel to the projection plane appear to go to a **vanishing point**.

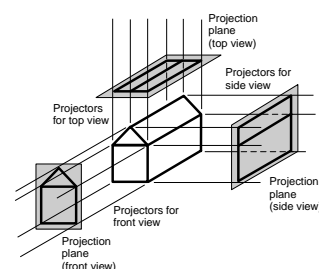
2 point perspective projections



- The number of axis vanishing points will depend on the number of axes cut by the projection plane – two point projections look realistic.

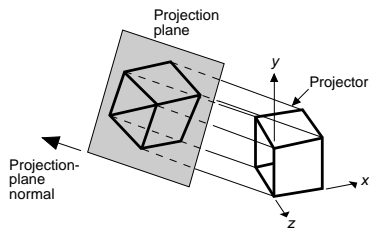
Parallel projections

- Parallel **orthographic** projections have the direction of the projection parallel to the normal to the projection plane:



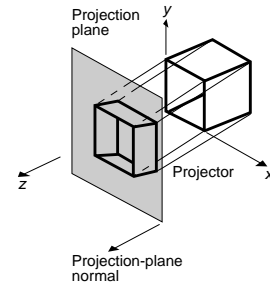
Parallel projections

- **Axometric orthographic** projections are parallel projections that use projection planes that are not normal to the principal axes.



Parallel projections

- In **oblique** projection the projection plane normal and direction of projection differ.



Summary

- Having finished this lecture you should:
 - understand what projection is in computer graphics;
 - compare perspective and parallel projections;
 - be able to work with planes, and normals;
 - understand the applications of the different types of projections.
- We will next look at how projection is handled mathematically!