Transformations

3D scene lives in a coordinate system

- When it comes to defining shape, location, orientation and other properties of 3D scene elements we relay on using **points and vectors.**
- Points and vectors are represented with **three coordinates: (x,y,z)**
- These values are meaningless without a **coordinate system** that defines origin of the space and gives three linearly independent vectors that define x,y and z axis of a space.
- Origin and three vectors define a **frame** which defines coordinate systems.
- <IMAGE: 3D COORDINATE SYSTEM, POINTS, VECTORS, OBJECTS>
  - Point or vector in 3D space depend on its relationship to the frame – point can have same absolute position in space but its coordinates depend on frame.

3D scene requires a standard frame

- Note that coordinate system is defined with origin and three vectors.
- But point and vectors depend on coordinate system!
- Therefore, we define **world space** – a standard frame – with origin (0,0,0) and vectors (1,0,0), (0,1,0) and (0,0,1).
- All other frames will be defined with respect to this world coordinate system.

Note: coordinate system handedness

- Axis of x,z and z vectors defining coordinate system can face in one of two directions.
- Left coordinate system
- Right coordinate system
- <IMAGES>

Elements of 3D scene are described with vectors

- Points
- Vectors
- Normals
- Rays

Elements of 3D scene are moved using matrix operations

- TODO

Important matrices are transformation matrices

- Modeling elements, 3D scene and animations relies on transformations
  - Translation
  - Rotation
  - Scale
  - Look-at notation

Translation

Scaling

Rotation

Moving directed objects

- Camera movement using look-at notation

Matrix and coordinate system

- Relationship between matrix and coordinate system

Special care: transformations on normals

Other coordinate systems

Literature

- https://github.com/lorentzo/IntroductionToComputerGraphics/wiki/Foundations-of-3D-scene-modeling