CMSC425 Transformation notes

References:
Mount, Lecture 6: Affine Transformations and Rotations plus Rotation Matrix handout

Outline:

I. Representations
- We represent graphical objects using points, vectors, lines, polylines, patches.
- We transform them using homogeneous coordinates

II. Two-d transforms
- A. Representation using matrices and homogenous coordinates
  - Form: M*P, P column vector - left multiplication
- B. Basic affine transforms
  - i. Translation
  - ii. Scaling
  - iii. Rotation
  - iv. Shear
  - v. Reflection
- C. Inverse of a transform
- D. Composition of transforms
  - i. Rotation about an arbitrary pivot point
  - ii. Scaling and shearing about same
  - iii. Other examples
- E. Properties of affine transformations
  - i. Lines into lines, planes into planes
  - ii. Ratios are preserved
  - iii. Areas go by det M

II. Three-d transforms
- A. Elementary transforms
  - i. Translation
  - ii. Scaling
  - iii. Shearing
  - iv. Rotations
    - a. Euler angles: elementary rotations about x, y and z
      Roll, pitch, yaw
    - b. Rotations around an arbitrary axis – angle axis
    - c. Finding the rotation matrix from the new axes directly (Handout)
- B. Quaternions
  - i. Why use quaternions. Smooth interpolation, no gimbal lock
  - ii. Review of imaginary numbers a + bi
    Operations: product, conjugate a - bi
  - iii. Quaternions $\mathbf{q} = q0 + iq1 + jq2 + kq3$. i, j, k
    $\mathbf{q} = (s, \mathbf{u})$ s scalar, $\mathbf{u}$ vector
  - iv. Operations: conjugate (s, $-\mathbf{u}$), modulus, multiplication
  - v. Rotating vector by quaternion