CMSC 635

Basics

3x3 Matrices

- Transformations: $v' = M\,v$
- 3x3: scale, rotate, reflect, shear
  - Columns of M = new axes
- Think of vectors as columns (contravariant)
- Think of normals as rows (covariant)
- $n \cdot v = n\,v = n_i\,v^i = n_x v^x + n_y v^y + n_z v^z$
- Normal • tangent: $n\,v = 0 = n\,M^{-1}\,M\,v = n'\,v'$

4x4 matrices

- : 3x3 + translate, perspective
  - Columns of M = axes + origin
  - P = [x y z 1] = [p 1] == k P
- Column vector = point
- Row vector = plane: $[n_x \; n_y \; n_z \; -n \cdot p_0]$
- $N \cdot P = 0 = n \cdot p - n \cdot p_0$
- $N' = N M^{-1}$

Inverse, Adjoint & Determinant

- Determinant |M|
- Adjoint M^*
- Inverse $M^{-1} = M^* / |M|$
- No inverse when $|M| = 0$
- Scale doesn't matter, can often use M^*!!!

Eigenvalues & Eigenvectors

- $M v = \lambda v$
  - Eigenvalue λ
  - Eigenvector v
- $(M - \lambda I) v = 0 \Rightarrow |M - \lambda I| = 0$
- SVD (Singular Value Decomposition)
  - $M = R_1 D R_2$

Separating Axes

- Do two convex polygonal objects intersect?
- Is there a plane separating the two objects?
  - Project onto plane normal (dot product)
  - Look for gap.
- Possible normals:
  - Faces of either object
  - Cross products of one edge from each

Bounding Boxes

- AABB: Axis-aligned bounding box
- OBB: Oriented bounding box