

# Practice 2: Hierarchical Modeling and Transformations

This document outlines the scene graph, transformations, and primitives used in the application.

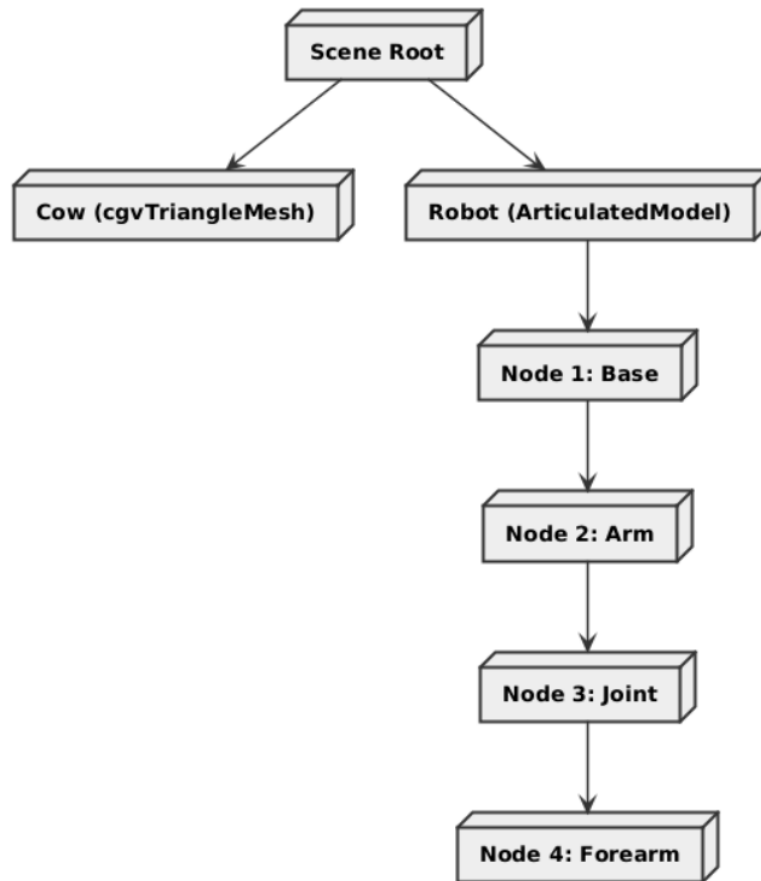
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## 1. Scene Graph Overview

The scene contains two root-level objects:

- Cow (cgvTriangleMesh): A non-articulated mesh loaded from an OBJ file.
- Robot (ArticulatedModel): An articulated model composed of several primitive shapes.

The transformation order for all objects is Translate -> Rotate -> Scale, as the `rstMode` is set to false by default in the `Object3D` constructor, meaning transformations are applied sequentially as they are called.



## 2. Object Details

### 2.1. Cow (cgvTriangleMesh)

- Parent: Scene Root
- Initial Transformations:
  - Translate(-5, 0, 0)
- Primitives:
  - A mesh of triangles loaded from objFiles/cow.obj.

### 2.2. Robot (ArticulatedModel)

- Parent: Scene Root
- Initial Transformations:
  - Translate(5, 0, 0)

- Hierarchy and Transformations: The robot is composed of several parts in a hierarchical structure. The transformations are applied in order from parent to child.
  - Node 1: Base
    - Parent: Robot Root
    - Transformations:
      - Rotate(dof[0], 0, 1, 0) (Yaw rotation around its Y-axis)
      - Scale(1.5, 1.0, 1.5)
    - Primitive: glutSolidCube(1.0)
  - Node 2: Arm
    - Parent: Base
    - Transformations:
      - Translate(0, 0.5, 0) (Positioned on top of the base)
      - Rotate(dof[1], 1, 0, 0) (Pitch rotation on its X-axis)
    - Primitives:
      - Joint: glutSolidSphere(0.4, 20, 20)
      - Arm: A cylinder created by draw\_cylinder(0.25, 2.0, 20), which is internally transformed by Rotate(-90, 1, 0, 0) to orient it along the Y-axis.
  - Node 3: Joint
    - Parent: Arm
    - Transformations:
      - Translate(0, 2.0, 0) (Positioned at the end of Arm)
      - Rotate(dof[2], 1, 0, 0) (Pitch rotation on its X-axis)
    - Primitives:
      - Joint: glutSolidSphere(0.3, 20, 20)
      - Arm: A cylinder created by draw\_cylinder(0.2, 2.0, 20), also internally rotated by Rotate(-90, 1, 0, 0).
  - Node 4: Forearm

- Parent: Joint
- Transformations:
  - Translate(0, 2.0, 0) (Positioned at the end of Joint)
- Primitive: glutSolidSphere(0.5, 20, 20)

### 3. Degrees of freedom (DoF)

The articulated robot has 3 Degrees of Freedom, which correspond to the rotations of its joints:

- dof[0]: Controls the Y-axis rotation of the Base.
- dof[1]: Controls the X-axis rotation of Arm .
- dof[2]: Controls the X-axis rotation of Joint .

These DoFs can be manipulated via keyboard controls or mouse picking, which targets the specific joint to modify its corresponding DoF value.

### 4. Explanation video

[Link to video on youtube](#)