Modeling the Human Skeleton

An exercise in Hierarchical Modeling

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Introduction

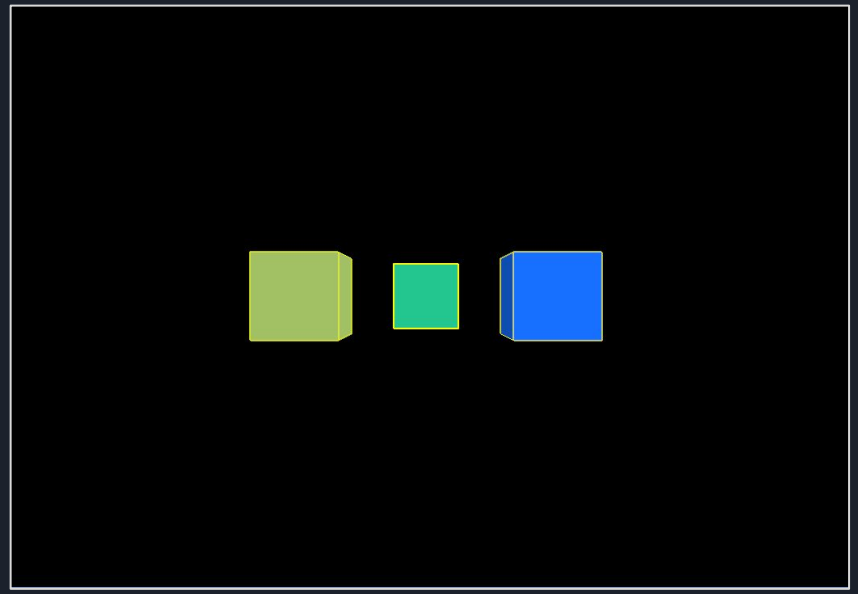
Goals:

- Explore 3D Processing concepts in regards to modeling a human skeleton.
- Concepts such as:
  - 3D Shapes, textures, lighting, perspective
  - Hierarchical modeling, scene graphs, parent and child nodes
  - Kinematic modeling
  - Motion data
- To develop a final project implementing these concepts to create a human skeleton.

Concepts

Drawing in 3D

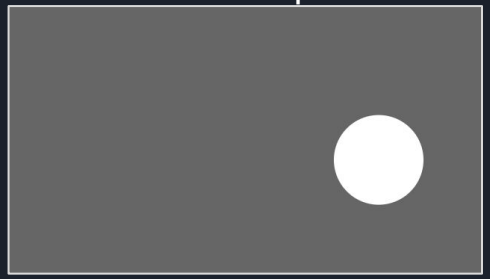
- Moving from programming in 2D to 3D
- Drawing in 3D space
- Translating in 3D space
- Rotating in 3D space
- Ray casting



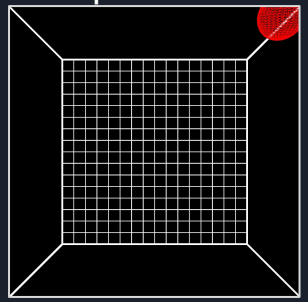
Motion Examples

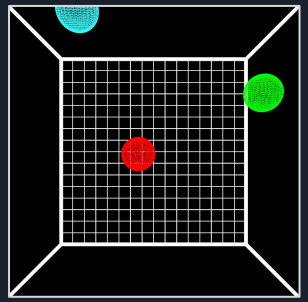
- Recreating 2D examples from Processing.org in 3D
- Focus on animating an objects and how they interact
- Bounce
- Collision
- Brownian

2D Example



3D Implementation

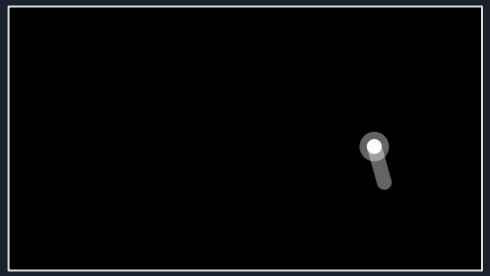


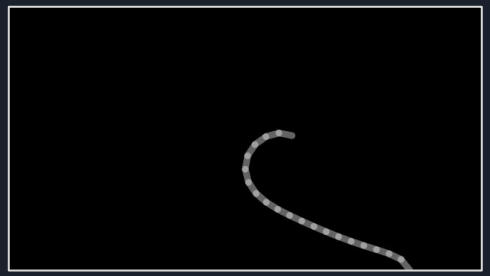


Interaction Examples

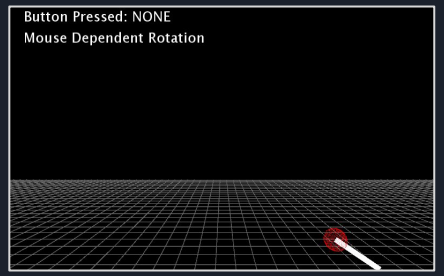
- Recreating 2D examples from Processing.org in 3D
- Focus on how the user can interact with the objects
- Follow1
- Follow3
- Reach2

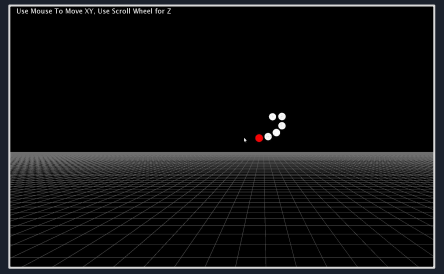
2D Example

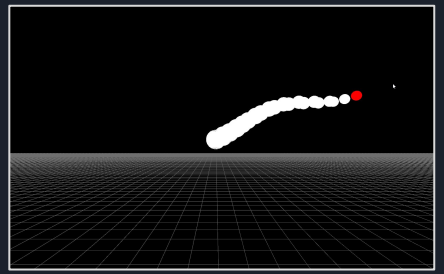




3D Implementation

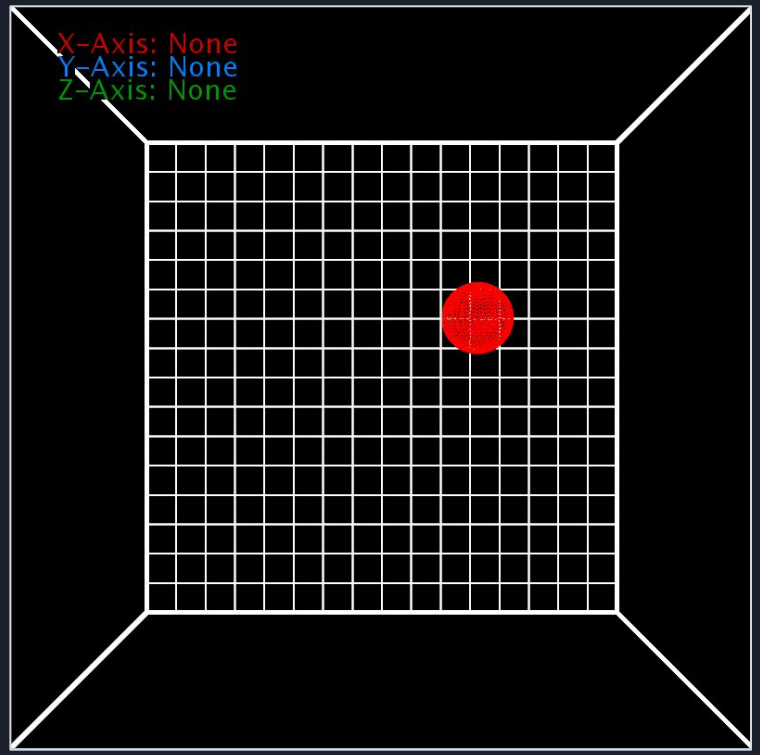






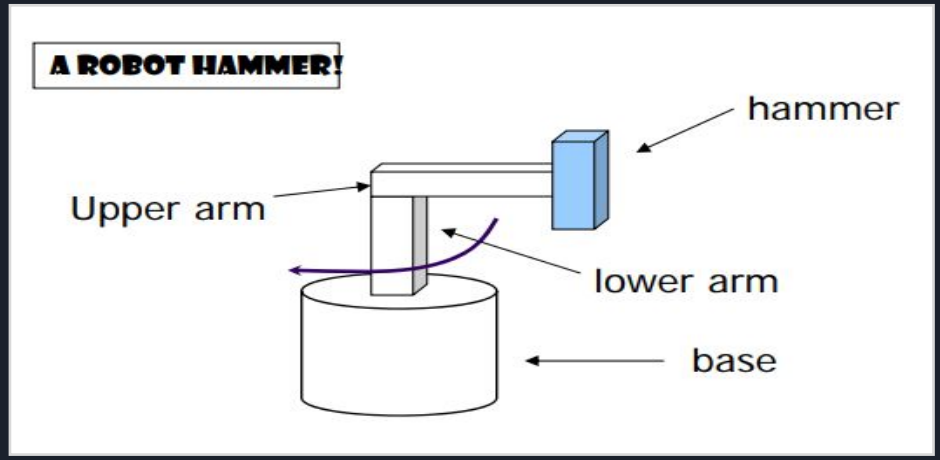
External Forces

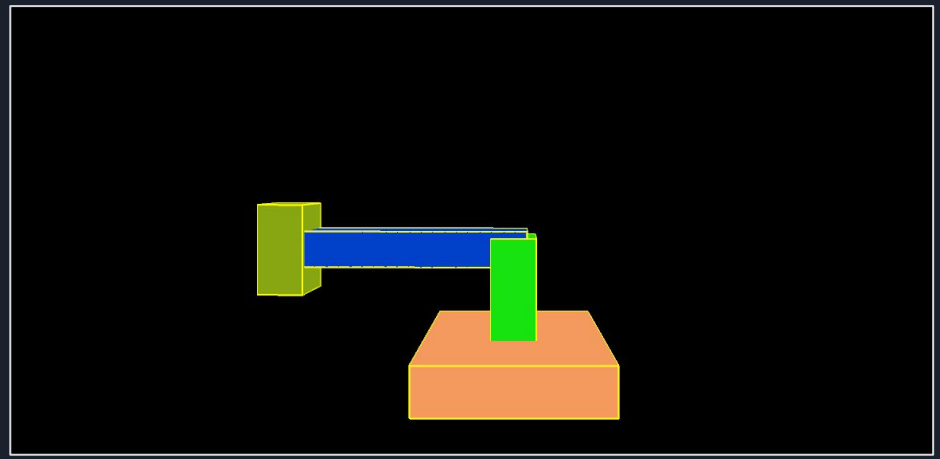
- How do objects react when external forces are applied
- Apply an external force on one or more axis
- Ex. changing the direction of gravity acting on a ball



Hierarchical Modeling

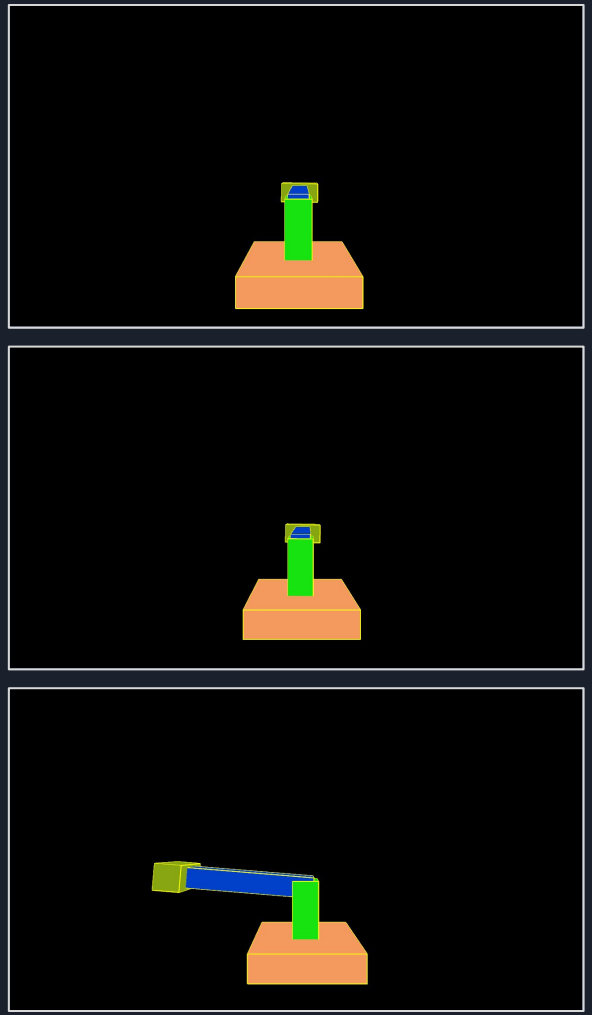
- Scene graphs
- Matrix stack
- PushMatrix()
- PopMatrix()
- Absolute and Relative transformations
- Child shapes/nodes dependent on movement with parent nodes





Joints and Constraints

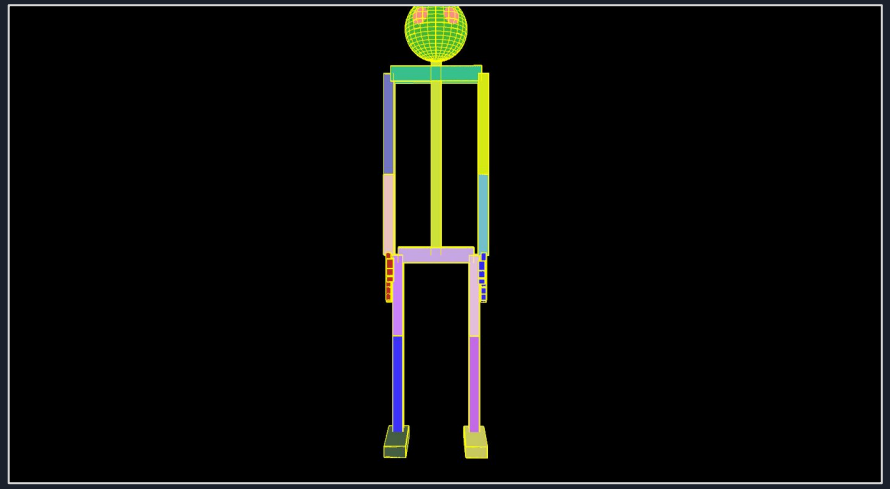
- Translation constraints limit range of movement
- Joint constraints limit the angles of the joints
- Hinge Joints seen here
- Ball and Socket Joints seen later

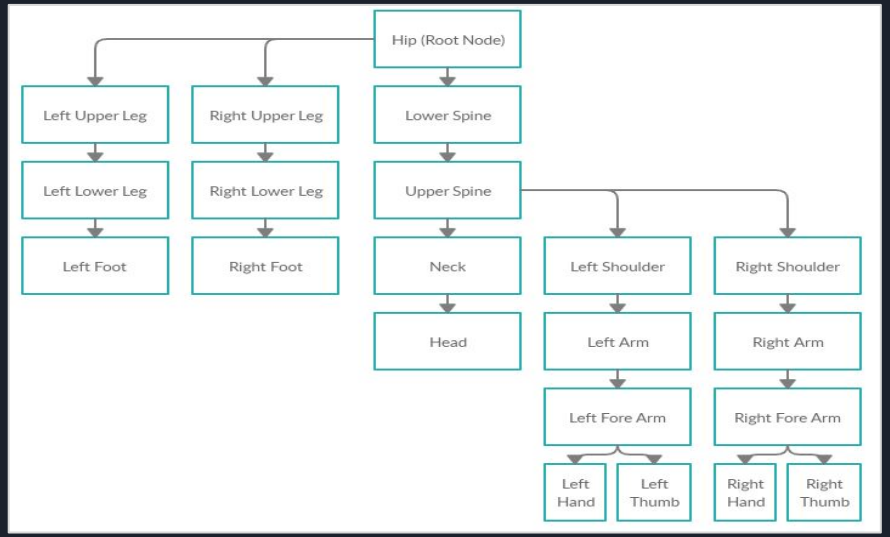


Human Modeling

Modeling a Human Skeleton

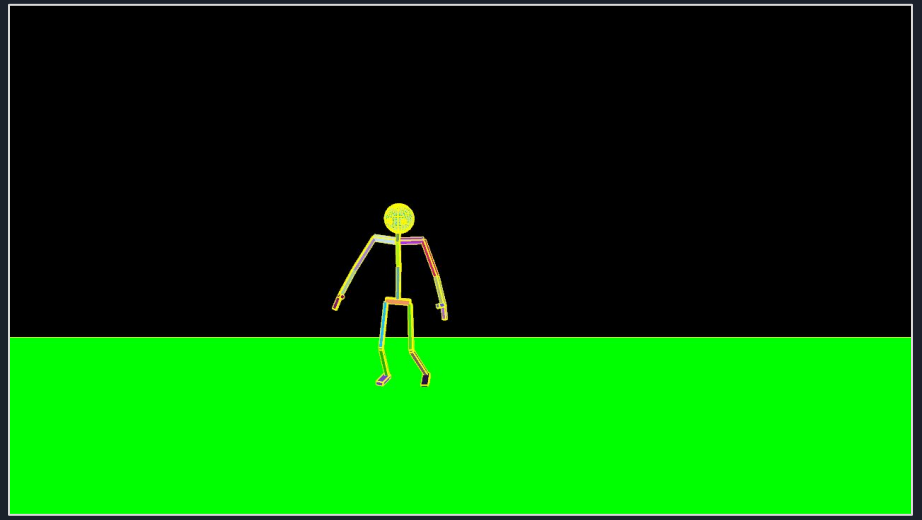
- Applied all concepts talked about previously
- Raycasting allows the user to select the bone to move
- Motion and Interaction concepts allow for manipulation
- Child nodes(hands) dependent on parents(arms)
- Hinge, Ball and Socket and similar joints

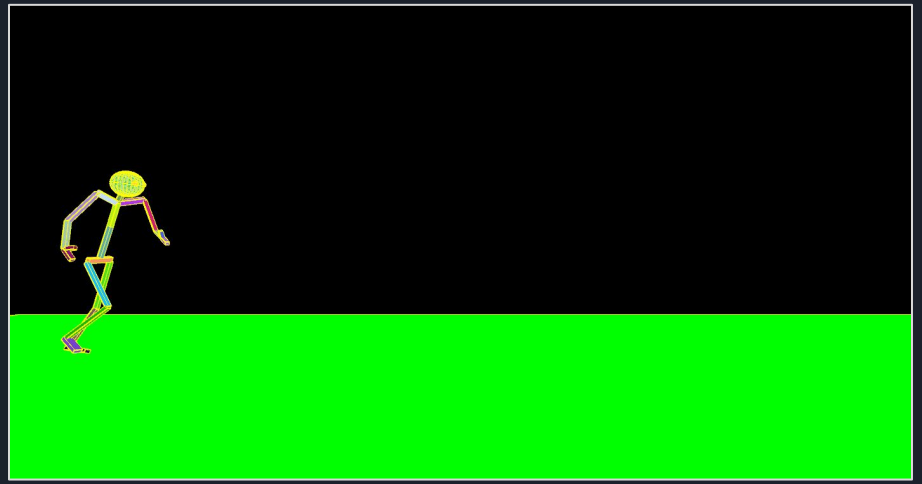




Applying Motion Capture Data

- Parsing Biovision Hierarchy (BVH) files
- Contains information on how to translate/rotate each joint
- Apply the parsed data to a compatible skeleton
- Data obtained from the NUS Motion Capture Database





Tools and Libraries

Processing Java
A flexible software sketchbook

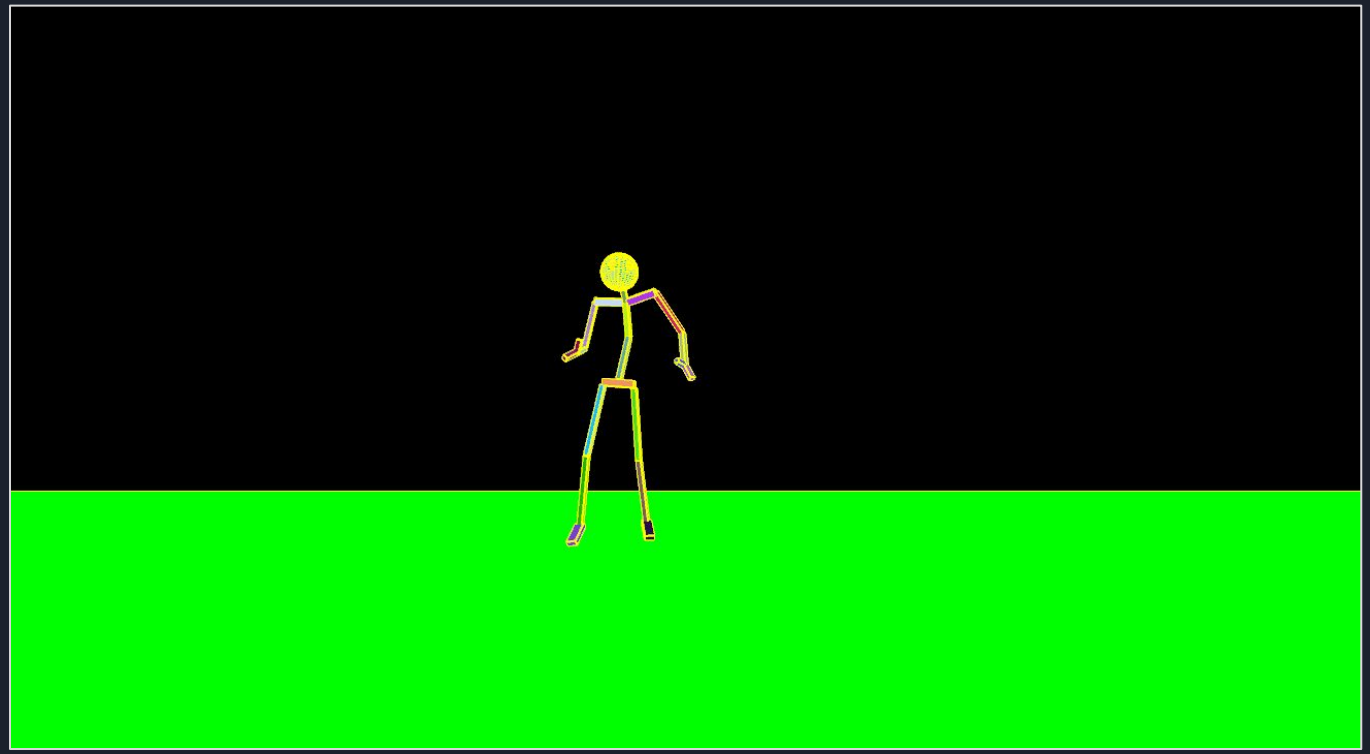
shapes3D
A library to aid modeling in 3D

NUS
National University of Singapore
Information Technology

NUS Motion Capture Database
A database of .bvh mocap files

Conclusion

Final Product



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