

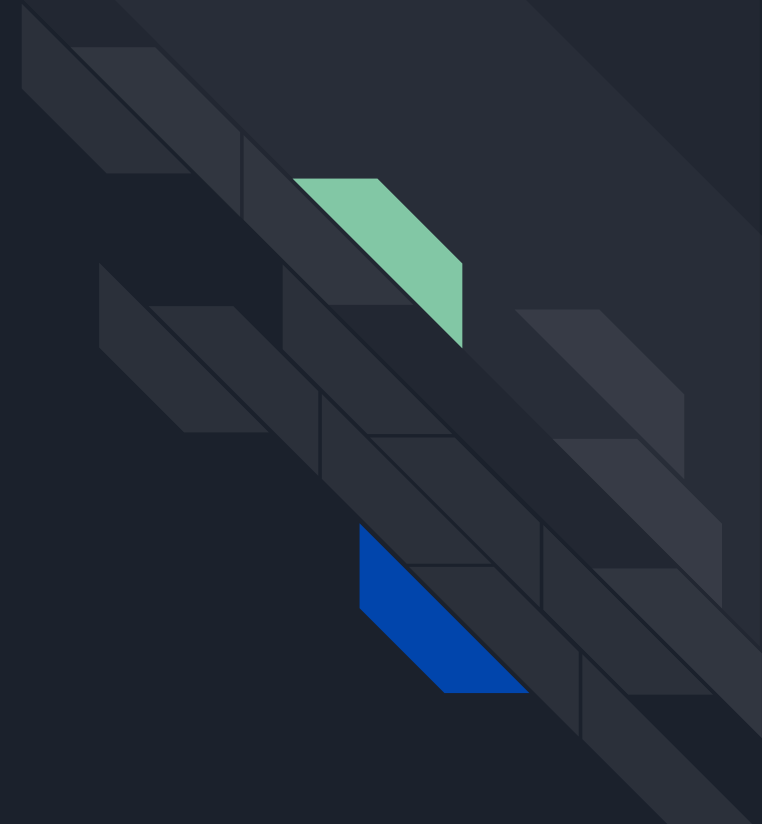
A decorative graphic on the left side of the slide consisting of two overlapping parallelograms. The front one is blue and the back one is a light green. They are positioned diagonally, with the blue one partially covering the green one.

Modeling the Human Skeleton

An exercise in Hierarchical Modeling

Table of Contents

1. Introduction
2. Concepts
3. Human Modeling
 - 3.1. Modeling the Skeleton
 - 3.2. Applying Motion Data
 - 3.3. Tools and Libraries
4. Conclusion
5. References



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.

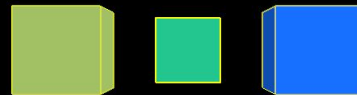
Concepts





Drawing in 3D

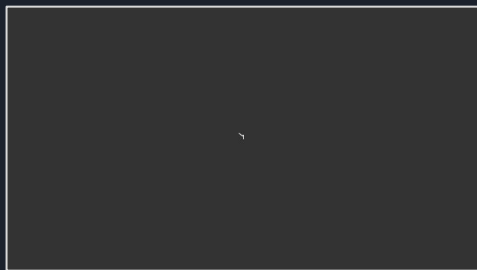
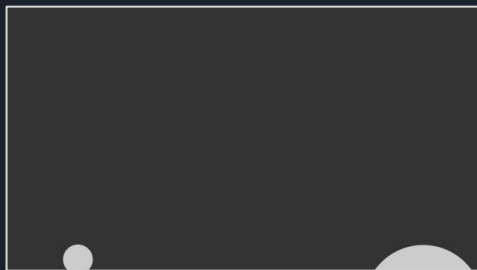
- Moving from programming in 2D to 3D
- Drawing in 3D space
- Translating in 3D space
- Rotating in 3D space
- Ray casting



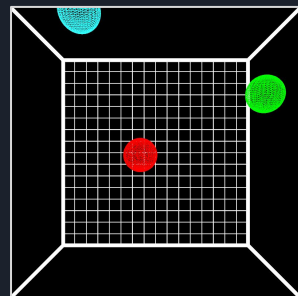
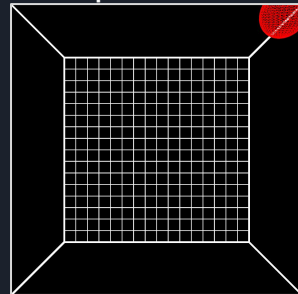
Motion Examples

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

2D Example



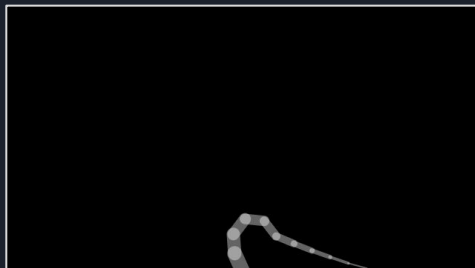
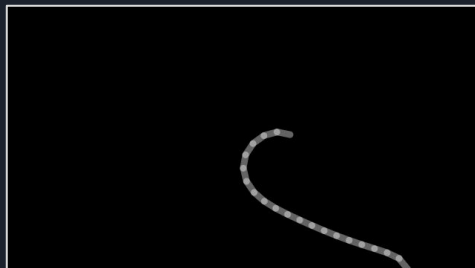
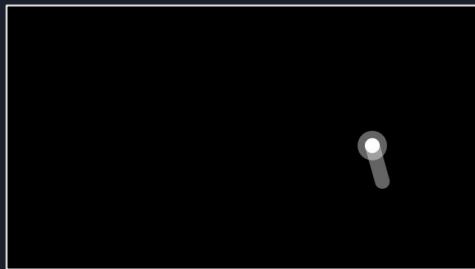
3D Implementation



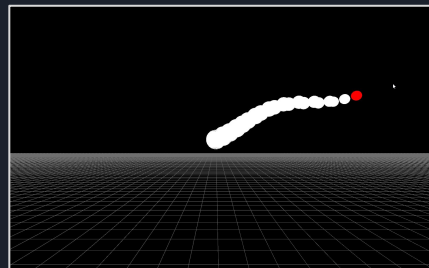
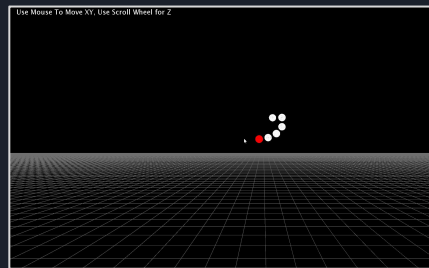
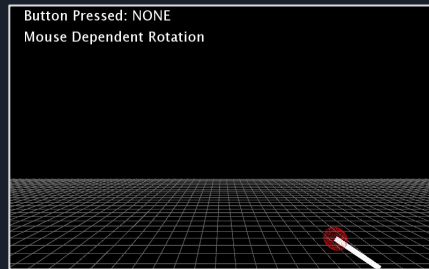
Interaction Examples

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

2D Example

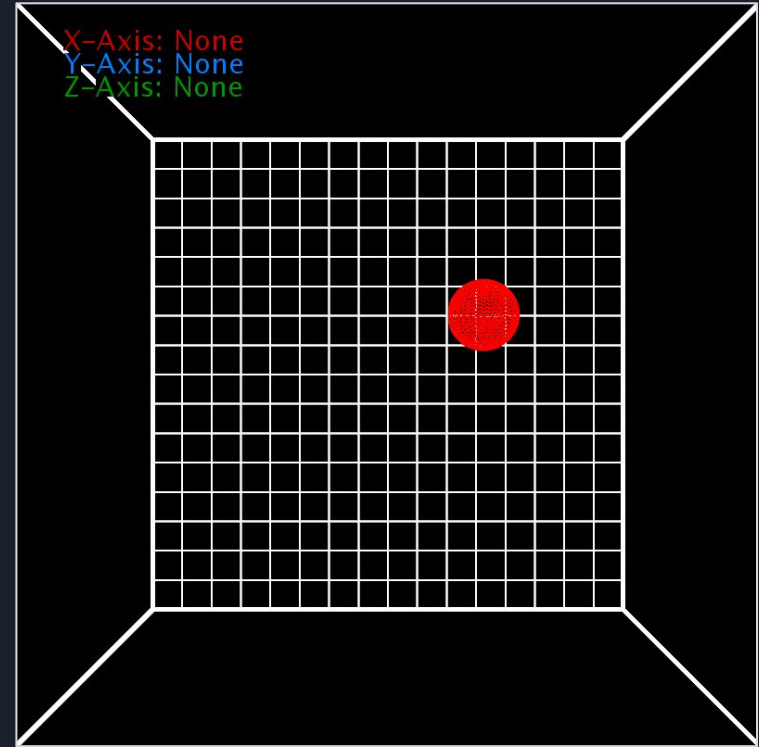


3D Implementation



External Forces

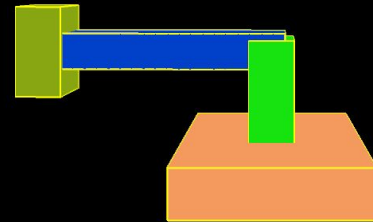
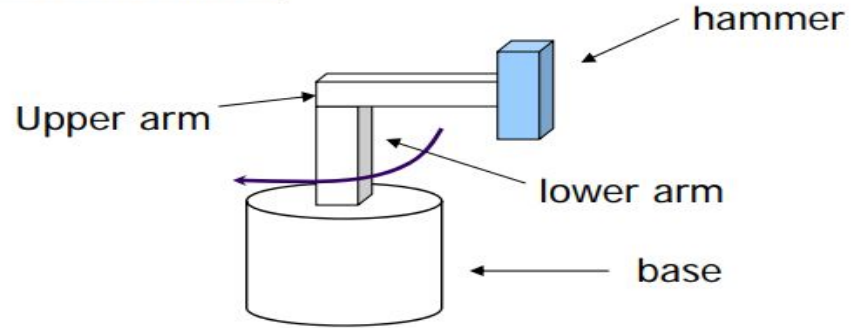
- How do objects react when external forces are applied
- Apply an external force on one or more axis
- Ex. changing the direction of gravity acting on a ball



Hierarchical Modeling

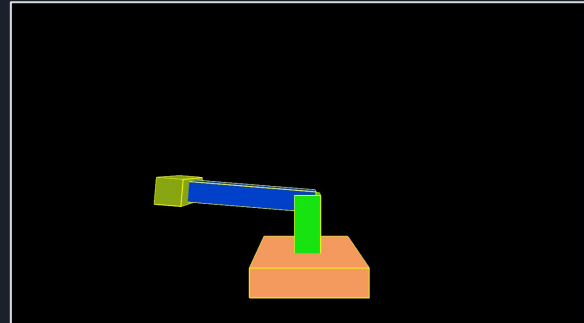
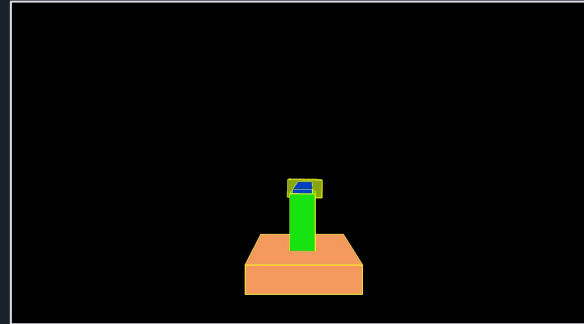
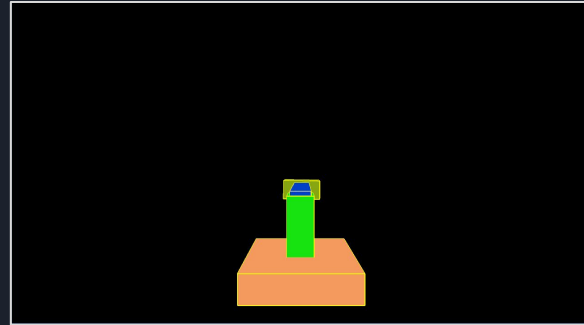
- Scene graphs
- Matrix stack
- PushMatrix()
- PopMatrix()
- Absolute and Relative transformations
- Child shapes/nodes dependent on movement with parent nodes

A ROBOT HAMMER!



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

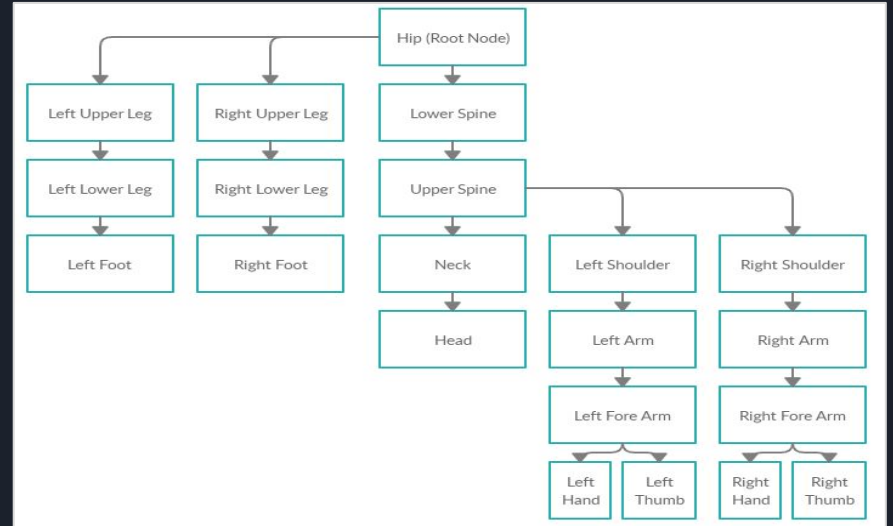
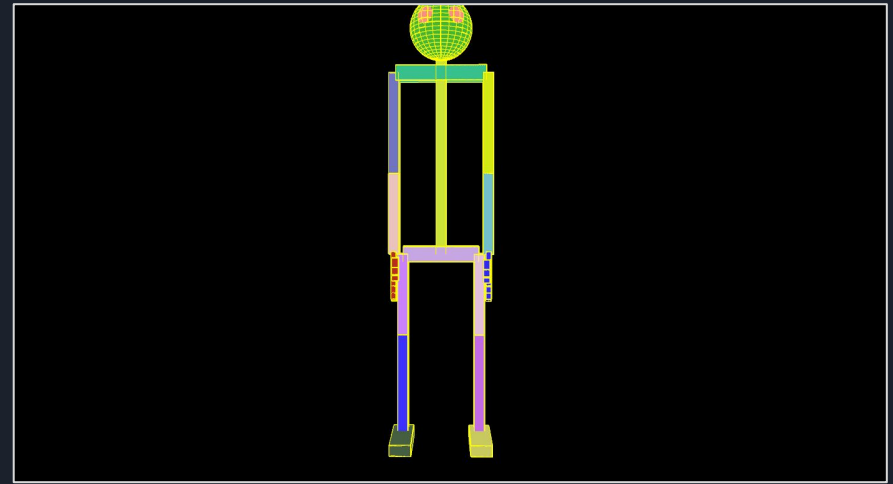


Human Modeling



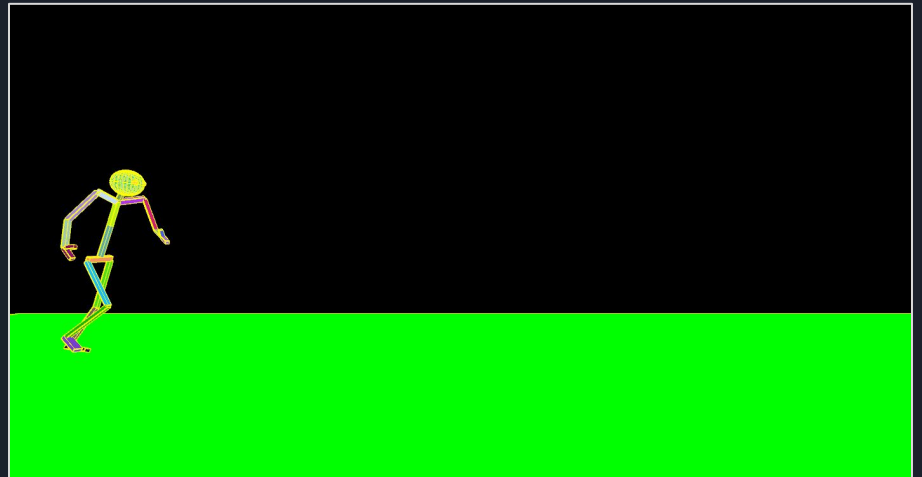
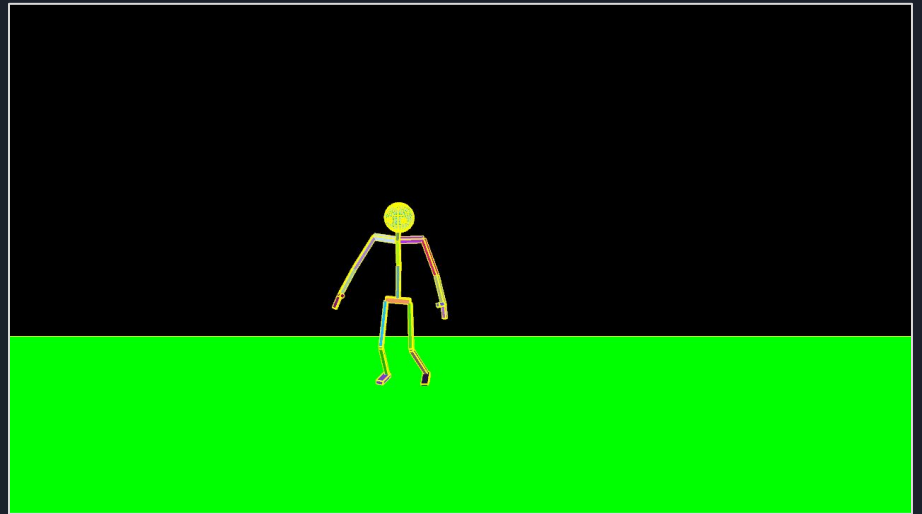
Modeling a Human Skeleton

- 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 SFU Motion Capture Database



Tools and Libraries



Processing Java

A flexible software sketchbook



shapes3D

A library to aid modeling in 3D



Information Technology

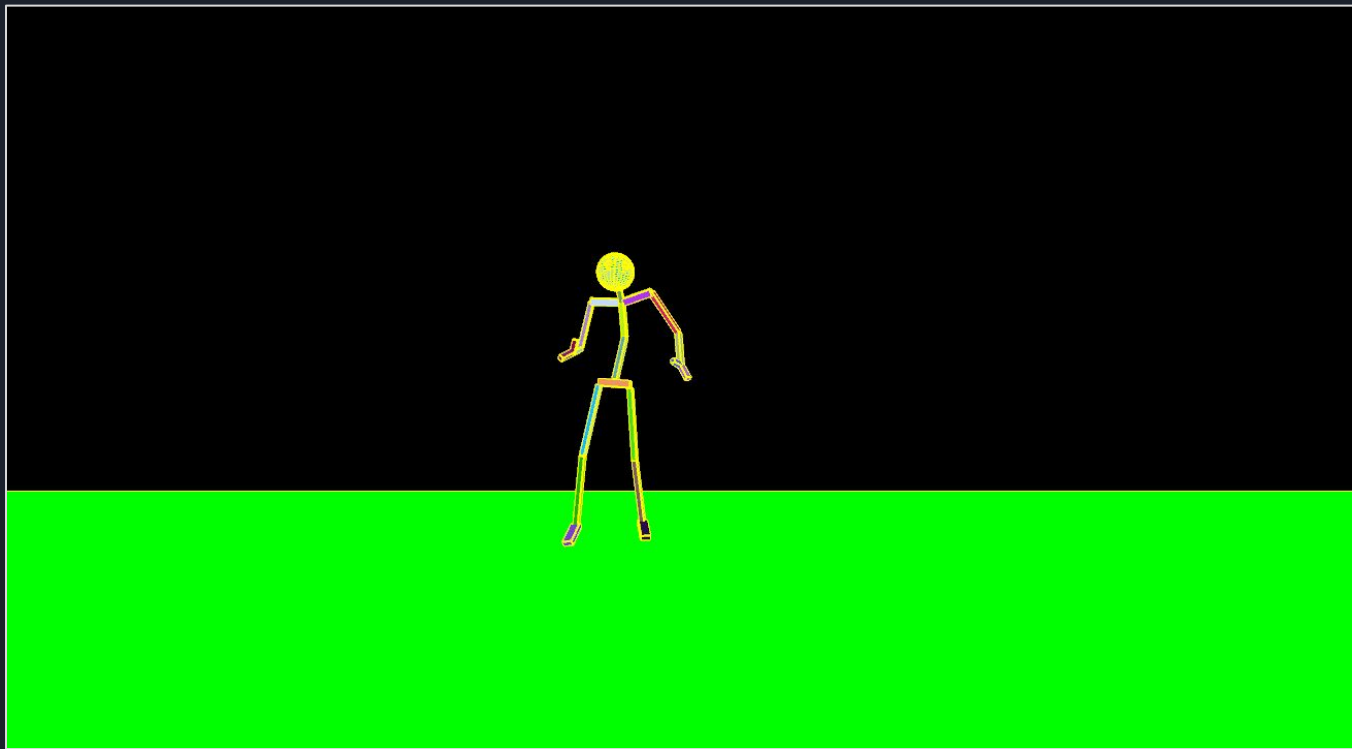
NUS Motion Capture Database

A database of .bvh mocap files

Conclusion



Final Product





References

1. Foundation P Examples. Short, prototypical programs exploring the basics of programming with Processing. In: Back to the Processing cover. <https://processing.org/examples/>. Accessed 27 Feb 2020
2. Foundation P Bounce \ Examples \ Processing.org. In: Back to the Processing cover. <https://processing.org/examples/bounce.html>. Accessed 27 Feb 2020
3. Foundation P Brownian \ Examples \ Processing.org. In: Back to the Processing cover. <https://processing.org/examples/brownian.html>. Accessed 27 Feb 2020
4. Foundation P CircleCollision \ Examples \ Processing.org. In: Back to the Processing cover. <https://processing.org/examples/circlecollision.html>. Accessed 27 Feb 2020
5. Foundation P Follow1 \ Examples \ Processing.org. In: Back to the Processing cover. <https://processing.org/examples/follow1.html>. Accessed 27 Feb 2020
6. Foundation P Follow2 \ Examples \ Processing.org. In: Back to the Processing cover. <https://processing.org/examples/follow2.html>. Accessed 27 Feb 2020
7. Foundation P Reach3 \ Examples \ Processing.org. In: Back to the Processing cover. <https://processing.org/examples/reach3.html>. Accessed 27 Feb 2020
8. Agu, E., 2020. *Lecture 5 (Part 3): Hierarchical 3D Models*. Accessed 12 Mar 2020
9. SFU Motion Capture Database. In: SFU MOCAP. <http://mocap.cs.sfu.ca/>. Accessed 20 Apr 2020