

**Title:** First Steps

**Abstract:**

For my capstone project in CS1950U (Topics in 3D Game Development) I extended the culmination of our work thus far in the class to create a full 3D game. The game is coded completely from scratch in the Qt engine, and runs on C++. The basic functionality for the game, including the window screen, application, and game engine were written as the focus of the class over the course of the semester. My capstone project takes what we had developed: collisions, cameras, platforming, optimization, AI and pathfinding and adds unique new features and a gameplay experience.

The features I chose to implement were rigging, inverse kinematics, and procedural animation. To implement these features I created new classes and components which would handle the functionality of keeping track of game objects, constructing a rig, and correctly applying transformations and rotations.

I initialized a character with a custom model, broken into poseable parts. I assigned each part to a Joint struct, and parented items to each other in a rig from top to bottom over the y axis. This created a rig, to which I could apply rotations and transformations which would cascade down to lower Joints. I coded an Inverse Kinematics solver, which would properly rotate the limbs to reach for a input target position. With that done, I could raycast down from the body to the terrain and place the feet accordingly by passing in the collision point. When the body moved, if the raycast hit was a certain distance threshold away from the last hit, the target would be updated to the new hit to maintain balance. I added a check such that one foot would only move while the other was grounded, further ensuring balance for the character. I also added a bit of functionality which would subtly pick up and put down the feet as they traveled, giving the illusion of walking.

Using the AI system we had developed earlier in the class, I coded a hierarchy of conditions and actions which the character would take depending on its on-screen position and input from the player, such that the character acted as a sort of pet that could be led around to interact with the scene. With that, the project was a complete and playable game.

**Faculty Sponsor:**

Daniel Ritchie