

# ECS 279 - Computer Animation

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## 1 BLENDER

### 1.1 Modeling a Low-Poly Humanoid

I chose the practical route for the Homework assignment and modeled a 3D character in Blender using a YouTube tutorial by Grant Abbitt[1]. The most challenging task there was setting up the reference image to follow. I achieved this by searching for a pose image for a female humanoid on Google, importing it into blender, duplicating the image and aligning one to the x-axis centered around the side pose and one to the y-axis centered around the front pose. This made for an easy reference to follow, switching between the two axes I added simple cube meshes and edited them in the "editor view" to fit the reference image accordingly. Figures 1 shows the model and how different limbs of the humanoid were constructed from the reference image.

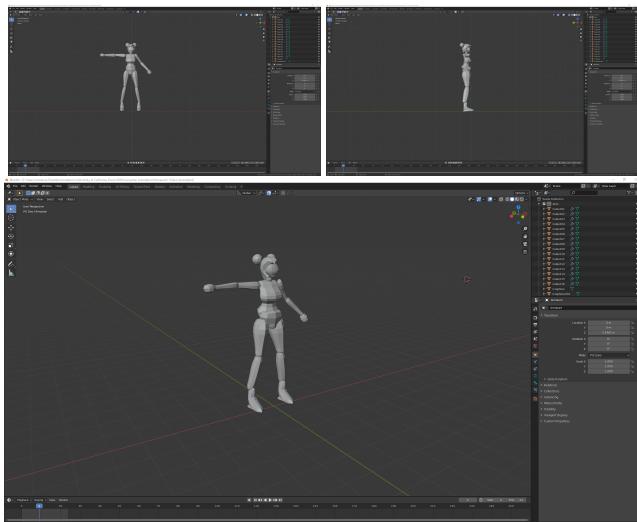


Fig. 1. Figures above show the front, side and 3D view of the model created within Blender.

### 1.2 Rigging a Model

Once again for rigging, I used Blender and another tutorial by Grant Abbitt[2] on Rigging. Rigging process was a bit tedious, I added bones to every limb I created within my humanoid and named it accordingly. One lesson I learned after the fact was that I could've used replication/duplication and only modeled and rigged half of the model and just duplicated it to the other half to achieve symmetry. But since I had already gone ahead and rigged the whole thing manually, I chose to stick with it for this project.

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### 1.3 Animating a Model & Inverse Kinematics

The most challenging part within animation was in-fact implementing Inverse Kinematics (IK) to the bones. My initial attempt was using Blender's "Auto IK" feature, which automatically figures out the appropriate IK settings for a given model and adds them accordingly. But to be able to actually add animated sequences and poses, I had to stray away from the Auto IK and manually implement it myself. I soon realized while adding IK constraints to each bone was that I needed more than just the bones of the skeleton to avoid problems such as singularity and odd motions. I added target and controller bones *outside* the mesh of the humanoid and set those as the target and controller constraints within my IK implementation. With that, I added IK to arms, legs and torso, with copy rotation constraints on the head and hands matching the controller. This made for an interesting structure which I could then manipulate for more complicated animations such as walking.



Fig. 2. Figures above show the 3D view of the rigged bones structure along with the controller and target bones for neck, hands and feet.

**1.3.1 Inverse Kinematics (IK).** Inverse Kinematics is essentially movement of bones/joints such that when the end point of a structure is moved (for example hands), the entire structure adjusts accordingly to reach a target position (structure being arms and shoulder in this example). IK within the bones uses a **Jacobian pseudoinverse**, which is essentially considering a small change in the joint position and rotation that eventually leads to a state where position is equal to the end-effector. If joint configuration change is defined by  $\delta q$ , and we want the end-effector to move from position  $x$  to  $x_d$ ,  $q_{next} = q + \alpha J^+(x_d - x(q))$ , where  $J^+ = J^T (JJ^T)^{-1}$ .

I implemented a 24 frames walking sequence. I used yet another reference image for this and keyed frames for different walking poses. And manually added the key frames for each of the steps.

My model's movement was 4 frames a part and made for a semi-realistic walking simulation. Figure 3 shows the Blender timeline and keyframes for the walking animation of my model.



Fig. 3. Shows the keyframes and a single frame of both 2D and 3D view of the 24FPS walking animation.

## 2 UNREAL ENGINE 4

I managed to successfully import the model into Unreal Engine 4, but whenever I tried working on it my UE4 crashed with an error of Illegal Memory Access at index 0 for Array core file, which turned out to be a bug in UE4. I had a scene set up in UE4 where I have a top-down 3D environment and I can click a button to spawn trees, therefore, constructing an "ecosystem". But due to the crash, right now, I am only able to use the existing model and not the new animated one I created. (I have included both projects in the submission).

## REFERENCES

- [1] G. Abbott, "Create a low poly person | blender 2.8 | beginners & intermediate."
- [2] G. Abbott, "Rigging a low poly person | blender 2.8 | beginners."