Module 12 Character Rigging

Introduction

This term, the module extends and builds knowledge and practical skills about how to efficiently 'Rig' 3D characters. I will document my studies in the field of software rigging and research industry guidelines as well as study industry experts and existing techniques. I will also delve into the world of animation and learn about the history, and how animation in game is where it is today. I will achieve these aims by documenting weekly what I am doing in Maya and work towards preparing a human skeleton for animation, as well as using blend spaces to animate faces and pose my own model at the end of this project using Maya.

History of Animation

Experimentation with devices that would make pictures appear to move came with the spread of the Industrial Revolution in Europe and North America in the 18th and 19th centuries (History of Animation, 2021).

In 1603, the Magic Lantern used photographs on panes of glass to be a photo projector. Since certain sheets involve moving parts, it's considered the first example of projected animation (History of Animation, 2021).

In 1868 the first recorded flipbook was created, which inspired early animators. The start of cartoon theatre shows, especially in the United States and France, began at the start of the twentieth century from 1900-1930. Many animators established studios, the most popular of this period being Bray Studios in New York City. The cartoonists who produced Mighty Mouse, Betty Boop and Woody Woodpecker helped Bray Studios initiate their careers (History of Animation, 2021).

In 1906, the first exclusively animated film named 'Humorous Phases of Funny Faces' was created, using stop motion techniques. However, In 1908, 'Fantasmagorie' was released using hand-drawn animation, which film historians say is the first-ever animated cartoon film. These films were shortly followed by other films such as Gertie the Dinosaur' in 1914 and 'Felix the Cat' 1919 which is still a well-known name to this day (History of Animation, 2021).

In 1928, the infamous Steamboat Willie was the first-ever cartoon with sound created in 1928, and what launched Walt Disney Studios world-dominating company, which was founded in 1923, Los Angeles (History of Animation, 2021).

The ‘Golden Age’ of animation is considered to be between the 1930-1950s. This in my opinion was due to the vastly growing productions from Walt Disney, Warner Brothers and Fleischer. From infamous animations such as Looney Tunes, Betty Boop and Snow White (the first animated movie to use hand-drawn frames), these characters are still known and used in modern media almost one hundred years later (History of Animation, 2021).

The animation industry started adjusting itself to fit in with the rise of television as it became more popular for American families as a means of entertainment. Several TV cartoons with a "limited animation" style were made. By the mid-eighties, cartoons had become popular on TV with the aid of cable networks like the Disney Channel and Nickelodeon. In 1960, Hanna-Barbera, which is a studio I thoroughly enjoyed the productions of the old scooby doo films and shows, created The Flintstones, and Yogi Bear for mainstream television (History of Animation, 2021).

The 1980s is when the more recent animation techniques were introduced, CGI. The first film using completely CGI was ‘The Adventures of Andre & Wally B’ in 1984, which was created by The Graphics Group, which developed to Pixar in later years. After this in 1987, ‘The Simpsons’ was created by Matt Groening, produced by the Fox Broadcasting Company. ‘The Simpsons’ is the longest-running American Sitcom to run on television (History of Animation, 2021).

‘Toy Story’ was the first completely computer-animated feature film and a wide success globally (History of Animation, 2021).

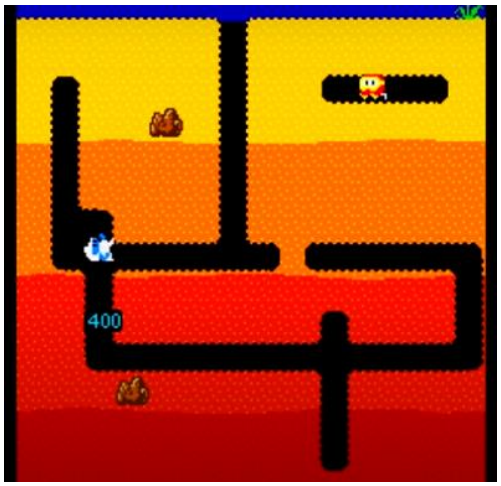
History of Video Game Animation

In 1958, an American Physicist named William Higinbotham, who also helped create the first nuclear bomb alongside J. Robert Oppenheimer, created an electronic tennis game known as ‘Tennis for Two’. Higinbotham used a cathode-ray tube (also known as an oscilloscope display) which was also used in early televisions to create the black and white display.

This inspired the creation of ‘Pong’ in 1972, which used a black and white Hitachi television screen. The developers used ‘colour overlay’ which was a cellophane sheet placed over the tv to add colour to the game (Visual.ly, 2021). Magnavox was the first game to use the colour overlay technique, but the four-player edition of Pong included this. It was a limited solution, however, it was extremely cost-effective (The History of Video Game Animations, 2021).

Six years later the game 'Galaxian' was released and used RGB colours instead of the colour overlay technique. It was essentially a better-looking version of 'Space Invaders'. In the 80s, colour graphics were the standard, however, pixels were not. There were two principal paradigms for rendering an on-screen image; the vector, and the raster. Raster is derived from the word 'rastrum' (Latin) meaning 'rake' as they are lines on the display. The electron beam then slides back and forth along the rake lines and forms a grid, then finally a picture is created (The History of Video Game Animations, 2021). Vector graphics are a lot smoother, yet simpler, as raster images cant produce smooth lines. However, their rendering of more complex games and images is what pushed the pixel's dominance in the gaming industry (Visual.ly, 2021).

(Pixel Pioneers, 2021)



(Pixel Pioneers, 2021)

Possibly the most outstanding graphics of the beginning of the 80s was in the game 'Dragon's Lair'. It used laserdisc technology and was an interactive movie (The History of Video Game Animations, 2021).

Almost ten years later, as the 'Golden Age of Arcade' was coming to a close, SEGA Master System was released, containing thirty-two on-screen colours (The History of Video Game Animations, 2021).

A technique that was very popular for game developers in the early 80s was parallax scrolling; which separated the foreground from the background into separate layers which move at different times to add depth to the game (The History of Video Game Animations, 2021).

In 1989, Nintendo's Game Boy was released, and even though it was black and white, it dominated markets as the batteries lasted much longer than other systems. That same year, SEGA Genesis was released, now with 64 on-screen colours (The History of Video Game Animations, 2021). Animation is an extremely important factor in making movement in games believable, therefore before motion capture was widely used, game developers used rotoscoping. The animation in Prince of Persia used sprites (2D images overlaid) which were traced directly from a video (50 Underrated Sega Genesis Games | Den of Geek, 2021). It was time-consuming, however, it makes the movement in the game look natural.

The contest for coloured consoles was being pushed, and in 1991 Nintendo released the Super Nintendo (SNES) with 256 colours (16-bit) available on the screen. Mortal Kombat was an incredible leap in in-game animation (The History of Video Game Animations, 2021). The characters looked photo-realistic and the fighting combos and style was very unique. The realistic sprites were very influential for other developers. Compared to other systems at the time, the console offered sophisticated graphics and sound. In order to remain successful in the next decade, the device has been developed to accommodate the continual production of various improvement chips incorporated into game cartridges (The History of Video Game Animations, 2021).

In 1994, the Sony Playstation was released with 16.7 million colours (24 bit). Sony's growth in power in video games was signalled by the PlayStation. The release brought both critical praise and impressive sales (The History of Video Game Animations, 2021). In less than a decade, it was finally the first "computer entertainment platform" to sell over 100 million units. Donkey Kong Country was an incredibly animated game of 1994, with very smooth movements.

The Game Boy Colour was released in 1998 with a liquid crystal display, allowing batteries to last up to 10 hours (Visual.ly, 2021). Colours were overlaid to produce a coloured game.

'Ultima Underworld: The Stygian Abyss' was a game that heavily influenced first-person shooter games today, and created the first 3D space. 'Wolfenstein' used 3D levels, which were built on a squared grid (Visual.ly, 2021). Everything was texture mapped on the screen. This was followed by Doom which built upon the existing engine of Wolfenstein. It removed the grid map and added more realistic lighting. It was the first game that portrayed a great 3D atmosphere (The History of Video Game Animations, 2021). The game developers used plenty of techniques to make the game look 3D as they had limited access to geometry and a lack of power within the processors. These 3D games only started to be produced after the mid-1990s (The History of Video Game Animations, 2021). A very influential 3D game was Super Mario 64 which was released in 1996, one of the most successful early 3D games in history. It had complete freedom when it came down to movement and a great camera system. Games such as Crash Bandicoot were

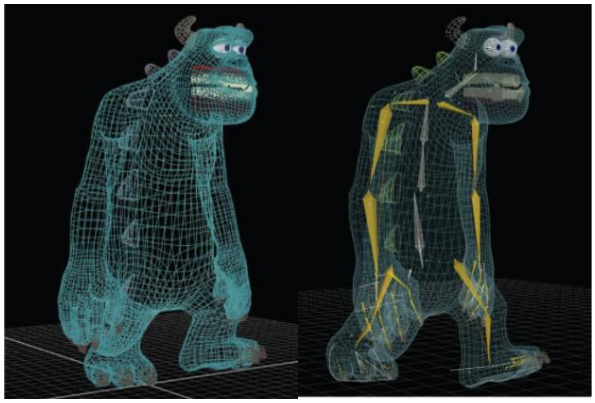
created alongside this, and it was the beginning of 3D animation (The History of Video Game Animations, 2021).

Another example of a great 3D game was Quake. It contained no sprites and had polygonal mobs and weapons (The History of Video Game Animations, 2021).

Rigging

Virtual bones, joints, and muscles that require meshes to move are called digital rigs. It's a lot like the cords on a puppet. There is just the right amount of versatility in a decent rig. The animators can't create the poses they need without the proper controls. Too much versatility makes it far too time-consuming to display the model.

Riggers begin with a character's generated 3D model. Based on the background and purpose of the character, they research how the character needs to move. As an example, Randall, from Monsters Inc, runs like a chameleon, but he stands on his hind feet. Animators break down the movements into individual components and create the hundreds of control points that would be used by animators to create stationary positions.

 (Pixar, 2021)

Parent-Child Relationships

Comprehension of relationships is fundamental when it comes to rigging. When a rig is broken down, there are many different factors that all have to work together for the rig to be successful. A rig that looks perfect on the surface will often begin to fall apart later on if not properly rigged (Autodesk, 2021).

In Autodesk Maya, the basic relationship which needs to be created is the parent-child one. The technique of 'parenting' is to choose the child object initially, and then shift-

click to select its parent (Autodesk, 2021). To make this change I used the keyboard shortcut 'P'. If the parent object is transformed, the child will be influenced too. In the channel Box', it is necessary to change the rotation values to nought for the child object which makes the parent object the child's new 'centre of the world' (Autodesk, 2021).

As this process is continued, and more objects are parented, this creates what is called a ***hierarchy***. Whichever object is at the very top of the hierarchy is the most influential on all of the other objects. To remove any particular object from the hierarchy, I can use the keyboard shortcut 'Shift-P '(Autodesk, 2021).

Constraints

Constraints are a very important part of rigging in Maya. Constraints let the rigger build relationships within the rig without messing with the hierarchical structure; the constraints are also smaller and don't affect all of the transformations, as opposed to the parenting method (Building skeletons | Maya 2020 | Autodesk Knowledge Network, 2021). When a constraint is used upon an object, the channels are not as easily played with. Instead, keys are used on the object which creates a 'pairBlend node' which lets the rigger decide if the keys or constraints are active. In the channel box, the translated channels are blue, which tells the rigger if a constraint is active (Building skeletons | Maya 2020 | Autodesk Knowledge Network, 2021).

Pole Vectors

A pole vector is a type of constraint used in Maya. They are useful as they are meant to constrict an IK chain by connecting it to a control object, so that it can move and follow the position of the connected object (Pole Vector constraints | Maya | Autodesk Knowledge Network, 2021). In a character rig, these pole vectors are most commonly constrained to objects behind the mesh (Pole Vector constraints | Maya | Autodesk Knowledge Network, 2021). This allows control of IK joints which are flipping when the joint angles are temperamental. It is almost like creating a handle for the different IK splines in the models (Pole Vector constraints | Maya | Autodesk Knowledge Network, 2021).

Blend Shape Deformers

Blend shapes are an amazing tool which brings emotion and life to a static mesh. A goal shape can be created which the static mesh can blend into, or out of to create a realistic animation (Create blend shape deformers | Maya | Autodesk Knowledge Network, 2021). I

have had a small amount of experience with blend shapes in Unreal Engine 4, however I have never animated them myself (Create blend shape deformers | Maya | Autodesk Knowledge Network, 2021). In Maya, blend shape deformers are used for meshes that animators need to be altered by different shapes. Multiple different deformers can be used for different parts of the mesh (Create blend shape deformers | Maya | Autodesk Knowledge Network, 2021). For example when adding blend shape deformers to a face, there can be multiple different shapes for the eyes and mouth. Blend shape deformers can be a long process, and the animator has to be careful not to have overlapping vertex movements (Create blend shape deformers | Maya | Autodesk Knowledge Network, 2021). All the movements need to blend together well, otherwise the model can end up looking strange.

Joint Hierarchy

Joints are a transform node in Maya, and only joints have an orientation that can be altered. The parent joint should be directed at the child's joints. When a chain of joints is created by using the left mouse click, with the tool active, the key 'Enter' is used to exit the joint tool (Building skeletons | Maya 2020 | Autodesk Knowledge Network, 2021). When the outliner is opened, it displays the ***joint hierarchy*** which has been automatically created, as well as the root joint. Under the 'Attribute Editor' tab, is the 'jointOrient' option, which demonstrates how the joint is automatically set to direct its focal point towards the child's joint using the 'X-Axis' which is also known as the 'Aim Axis' which tells us the length of the parent joint, great for stretching and squashing in the rigging (Building skeletons | Maya 2020 | Autodesk Knowledge Network, 2021).

These joints should then be placed into the mesh using the side view. The strict placement of the joints is extremely important within the rig, as it dictates exactly where the character will bend and move (Building skeletons | Maya 2020 | Autodesk Knowledge Network, 2021). The only joint in the hierarchy can have translations on the X-axis, Y-axis and Z-axis, however, child joints only have translations on the X-axis with the rotation values remaining at zero (Building skeletons | Maya 2020 | Autodesk Knowledge Network, 2021).

Painting Weights

Painting the skin weights in Maya is an extremely important tool in Maya, and is crucial when rigging 3D models. This tool allows the rigger to directly paint the intensity of the weights directly onto the mesh (Skeleton hierarchy | Maya 2016 | Autodesk Knowledge Network, 2021). For example, if the character's arm is moved, and some of the mesh from the hip area moves too, it means that the joint has too much influence. In this scenario,

I can select the joint that has too much influence and manually paint away on what looks like a heat map to remove the influence (Skeleton hierarchy | Maya 2016 | Autodesk Knowledge Network, 2021). The colours of the paint can be changed from gray scale to colour however I prefer a colour. When the joint is selected I receive instant colour feedback from the mesh and can decide on what tools I need (Skeleton hierarchy | Maya 2016 | Autodesk Knowledge Network, 2021). I can change the values of the paint to change the intensity of influence, as well as use the smooth tool to blend out the paint so it isn't a harsh cut off, as that would not be realistic to real movement (Skeleton hierarchy | Maya 2016 | Autodesk Knowledge Network, 2021).

Driven Keys

When using keyframes in animation, setting driven keys can make animation more efficient, however more complex. With this technique there is an attribute which is driven, and an attribute which is the driver (Driven keys | Maya | Autodesk Knowledge Network, 2021). When the driver attribute is linked to the driven attribute, when the driver's values are changed so will the driven attribute. This does not mean the driven keys animate the object, as keyframes must be added to the driver object as this is what links the attributes to the time slider (Driven keys | Maya | Autodesk Knowledge Network, 2021).

A good example I found for driven keys was the example of a door opening when a character walks nearby (Autodesk, 2021). An animator used a ball and a cube to demonstrate the relationships within the driven keys. They set up a driven key relationship so that when the ball's translate Z was in a certain position, the cube's translate Y would be in a certain position too. After this was complete and the driven keys were set, the animator then set keyframes and animated the position of the ball, and as a result the cube moved automatically.

Gimbal Locks

Order of rotation and gimbal locks are another important feature of rigging. Rotation order is the process of orientation in how the object moves (Gimbal Locks, 2021). For example, if a three joint object such as an arm was set to an 'XYZ' order, the Z-axis will carry the Y and Z axes, and the Y-axis will carry the Z-axis (Gimbal Locks, 2021).

If the rotate mode is set to 'Gimbal' it allows the rigger to view the true representation of the different axes on the object/objects. If two axes cross each other or have a similar transformation it produces a 'Gimbal Lock' (Gimbal Locks, 2021). Gimbal locks can be worked around by choosing which axes are the most vital for the rig to work, and ordering them in the best way. Riggers usually communicate with the

animator to see how the chosen character wants to move, and the order is decided this way (Gimbal Locks, 2021).

Animation Controls

The last feature needed for rigging in Maya is the animation controls. This brings everything together to complete the full rig. A curve seems to be the most common object for animation controls. Curves are non-renderable, and by entering the component mode, I can modify the structure very easily. This is done by using the 'CV Curve Tool' (Autodesk, 2021). For every control, it's best to create a hierarchy using transform nodes. This means animation controls can be aligned with the joints I've previously made.

To position a control node correctly uses one of two methods. Selecting the control and the joint and pressing 'P' to parent the node under the joint. Making the values enough for the control node ensures that it is set in the same position as the joint, as well as the orientations being the same (Autodesk, 2021).

These controls can then take over the joint structure I have created which can be done with constraints. By selecting the control node and the corresponding joint, I can use the orient option under the constraint tab in the options menu; I apply this ensuring that 'Maintain Offset' is not enabled. If the controls are rotated, they power the joints. To further this control, as currently the joint chain and kinematic set up of the controls share no relationship (Autodesk, 2021). To rectify this, I parent the control node to the other node below it which creates a 'Forward Kinematics' relationship, much like I demonstrated with the joint chain.

IK Splines vs FK Splines

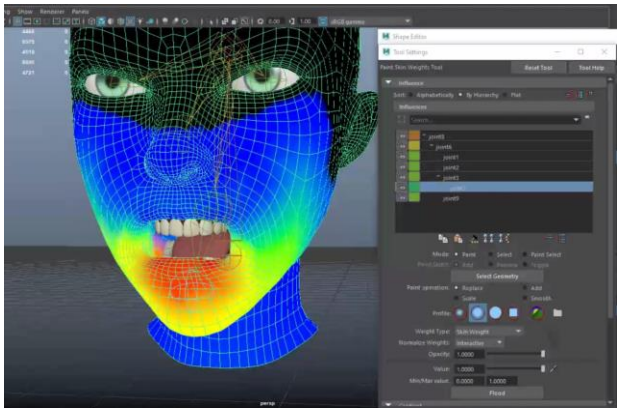
IK stands for 'Inverse Kinematics' and FK stands for 'Forward Kinematics'.

To use inverse kinematics, at least three bones are used in the process. These bones consist of the target, child and parent bone (FK and IK Spines, 2021). When the child and parent bone are highlighted we can then choose a bone to become the target of the inverse kinematic constraint. This will ensure the bones can be rotated correctly and the direction can always be altered (FK and IK Spines, 2021).

IK Splines are more useful when wanting subtle emphasis on different centers of weight, for example, an animation of aiming a bow or weapon. IK Splines usually control the shoulders or hip joints of my rig (FK and IK Spines, 2021). An FK Spline is for more emphasis, for example, a big powerful action like hitting a door with an axe (FK and IK Spines, 2021).

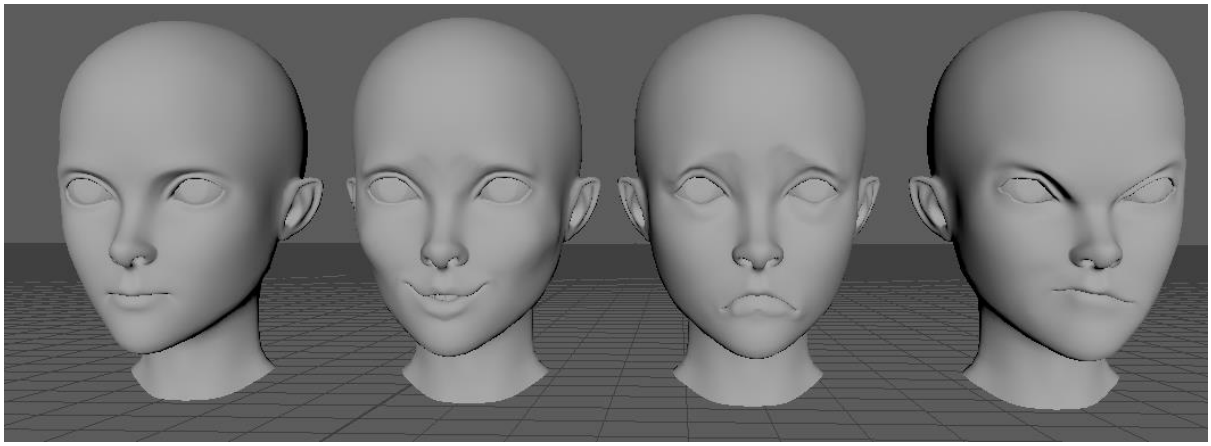
Blend Shapes

I duplicated the facial meshes we were given with Ctrl+D to make multiple copies of the heads, model heads could be used as long as the topology is neat. I played around warping the face to try and create some realistic facial expressions, ensuring I referenced real facial expressions to find the shape I wanted to make and ensure that it looked realistic. I used soft selection, and could change the fall off which helped. This was also really good practise of painting weights, using the different joints I had selected to control different sections of the face by painting on with my skin weights.



Another method is using a sculpting technique which I have seen more of in my research, where I can simply click and drag the mesh and move it around. This method seems much easier in my option, however, I tried both of two different faces to try them out. Was a lot of fun but some of the expressions broke the topology when I accidentally caused overlap.

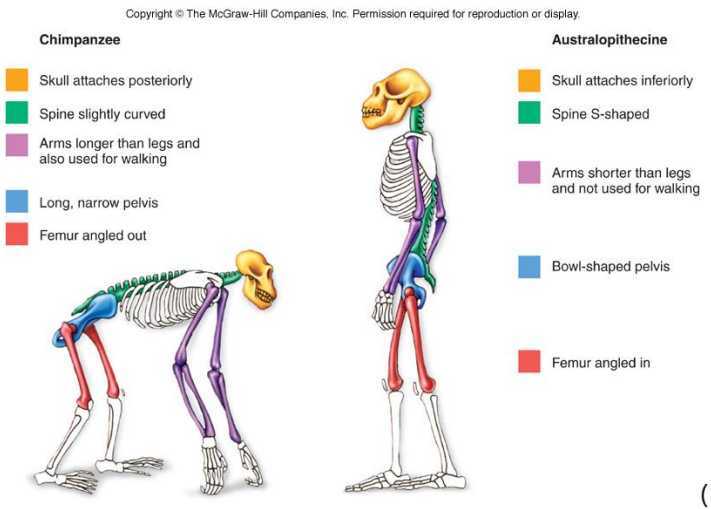
After I do some expressions I can also select the original face and go into the shape editor. From my research this seemed a lot cleaner and easier and also makes the maya file smaller which I noticed. I can change the values with a slider which is a lot easier than I thought it would be. I was dreading doing facial expressions the most but my tutor led a very helpful tutorial as well as a few articles I read on the knowledge autodesk website.



The grey heads is the method I used using the sculpt tool. I made sure not to touch the first face as this was what I called the control mesh. I could then select two objects and use the blend space to drag the slider and transition the face from one to the other.

Bipedal and Quadrupedal Rigs

Bipedal and quadrupedal travel differently. Us humans are bipedal, meaning we walk on two legs, whereas a quadrupedal creature travels using four limbs. If I were to rig a quadruped I would have to be aware of the differences in proportion, bone shape and joint locations. This is why skeletal anatomy is an extremely important area to research when rigging.



(BIPEDALISM - Huminitation-B, 2021)

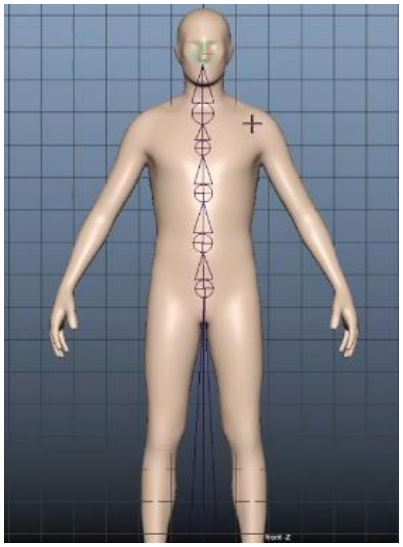
Character Rigging Process

To begin I imported a base human male from the content browser. I turned the mesh into a reference so that I can't grab it, which makes it easier for me to grab joints as well as switch to different views to grab joints at the same time. To move individual joints I

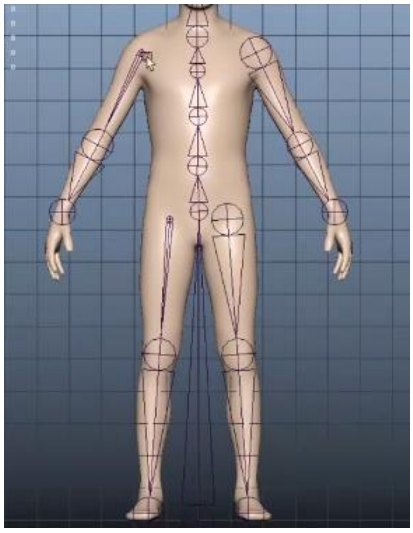
can use insert, or hold down D. This helps me align joints correctly if I have placed them wrong. I also ensured to turn X-Ray joints on, as this setting is crucial to place joints.

Upon entering rigging mode in maya, I used the create joint tool, using the front view to try and get the joints as even as possible. I clicked from the centre floor as this will be the root bone, then to the lower abdomen, bellybutton, diaphragm, sternum, meeting of the collar bones and then the nose. I also remembered to constantly change the name of my joints so that I would not get confused as more joints are added. When done I created the hierarchy so they're together in a chain, to which I can then go into the modify tab and rename the whole chain to 'JH_Spine'.

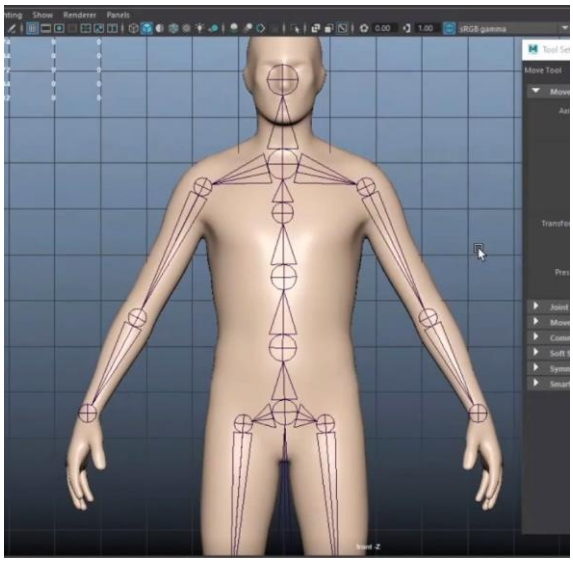
I cycled between multiple camera views to ensure my character's skeleton fit inside the mesh perfectly in all three different axes. I used the grid map to judge the size of the bones. I was happy with this joint chain, and could begin creating another chain for the arms and legs using the insert joint tool. I know I need to add all the joints before adding any Ik handles, otherwise I'd have to do it again which would be inefficient.



Then I activated symmetry and began to do the arms and legs, but for some reason unknown to me, the radius changed and made the bones uneven. I selected the joints individually and changed them in the modifier window, but I realised that after individually changing the radius of all the joints that I could've selected all of them at once and changed them. In the future I will ensure to do this instead.

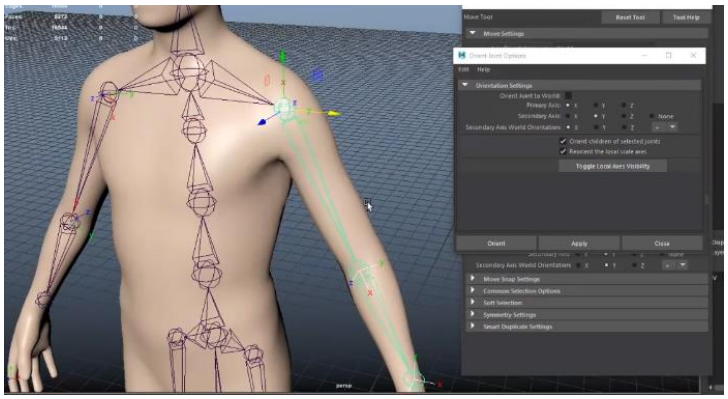


To parent the joints I had created together, ranging from the collar bone to the shoulders and from the lower abdomen to the middle of the hips I pressed P. This ensured that when the parent was moved, so would the child joints. I can also attach joints together, however I need to create the hip bones and the collar bones, so it is not necessary yet.

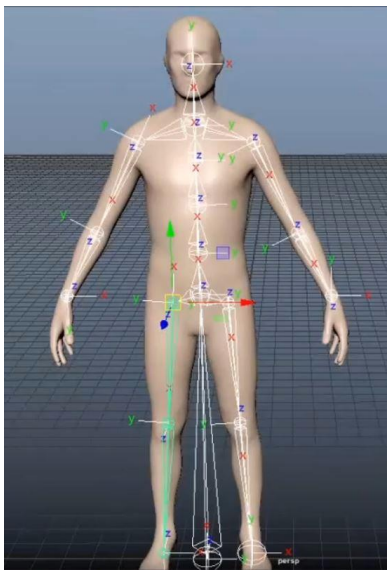


After this was complete it was time to orientate the joints. This is really important that the joints all do face the same way, otherwise the rotations will affect the whole rig, making the joints and bones bend in directions that I do not want. I spent time correcting the axis of each individual joint, ensuring they all pointed the same way. To do this, I went into skeleton<orientation<toggle axis visibility. I made sure that all the X axis follows down the line or up the line of what branch I was rotating. I'm aware that I can use scripts instead of doing it manually however I've no experience with scripts and wouldn't feel confident using them, however in the future I will do this to ensure efficiency. The joints need to face the same way in regards to the hierarchy of joints, if they face different directions when I start doing curved animations I have to put negative and positive values representative to the left and right arm. The orientation flipped when I used the symmetry so I need to manually reflip the orientation of the

joints which is the reason why. The Y axis should usually follow the movement of the body part.



After my manual orientation was what I believe to be correct, I deleted all the history and set transformations to 0. I needed to see if my body would move correctly, so I bound the joints to the 'skin'. I went into the IK Handle setting tab, and changed the setting to be 'rotate plane solver' then attached the IK handle to the leg and ankle, which let the leg move.



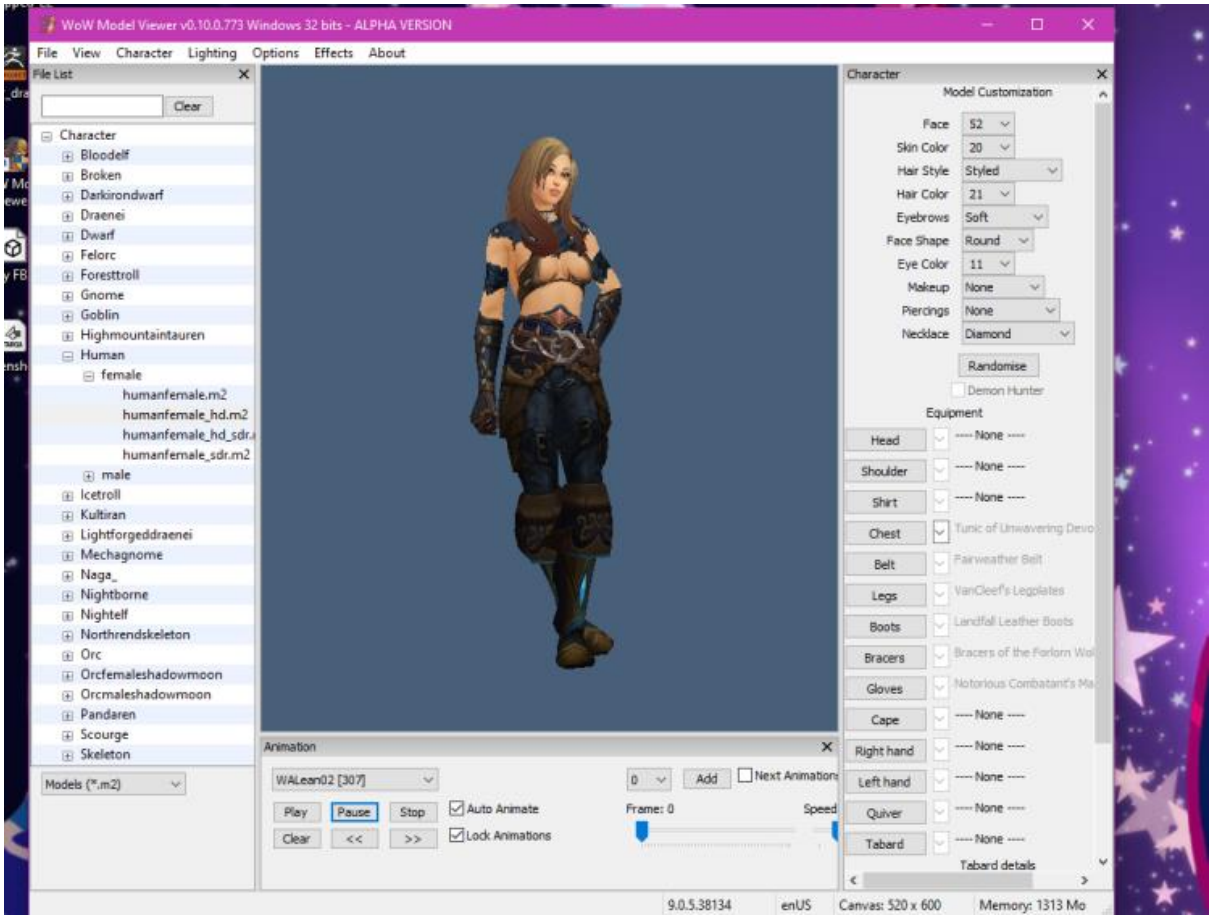
I could then go into the curbs tab, which is similar to the nurbs I am used to, and place one above the head, around the waist and the feet. These would work as handles to easily move my rig. I wanted the centre point of these handles to change, so I used the inset key to adjust the pivot point, much like I am used to in maya and snap the pivot to the centre bone. I also remembered to label each handle, however it wasn't necessary for this small rig. I parented my handles to the IK handles which I created earlier by entering the constraints tab and parenting them. I also forgot to make sure the offset was on so I went back and changed the settings. I could then move around my

character by using the handles and not having to grip each individual joint, which saves plenty of time in animating.

I then added my pole vectors to the knees to stop them looking as though my mesh's legs had broken, using the curbs again and placing them not directly onto the kneecap but further away to create a longer pivot, remembering to change the pivot by using the insert key and finally parenting it to the IK handle. There were some issues with the painting of the weights however I had a small practise on some of the joints however I decided to instead create the FK based spine system. Did this by using the curbs and aligning them along the spine. I used three curbs, one around the neck, one around the waist and one around the hips. I parented them to each bone which gave me control of the spine. Instead of spending my time painting the joints on my practise model I decided to now use my knowledge to learn how to rig on a model I actually intend to use in real life, for art purposes and my portfolio.

Rigging my Character

Progressing forward into my project, I have decided to utilize my skills in rigging and creating some 3D artwork of my World of Warcraft character; for the purpose of personal use and adding to my portfolio, as well as to further my skills within a more complex rig, specifically targeting the face as the base mesh model I used to practise didn't really have a face, and the blend shapes I did practise on were attached to nobody. I intend to import my character model from the game as an OBJ (using the WoW Model Viewer software). I'd then bring the model into Maya, texture the mesh with the exported textures from WMV and then begin to rig the body.

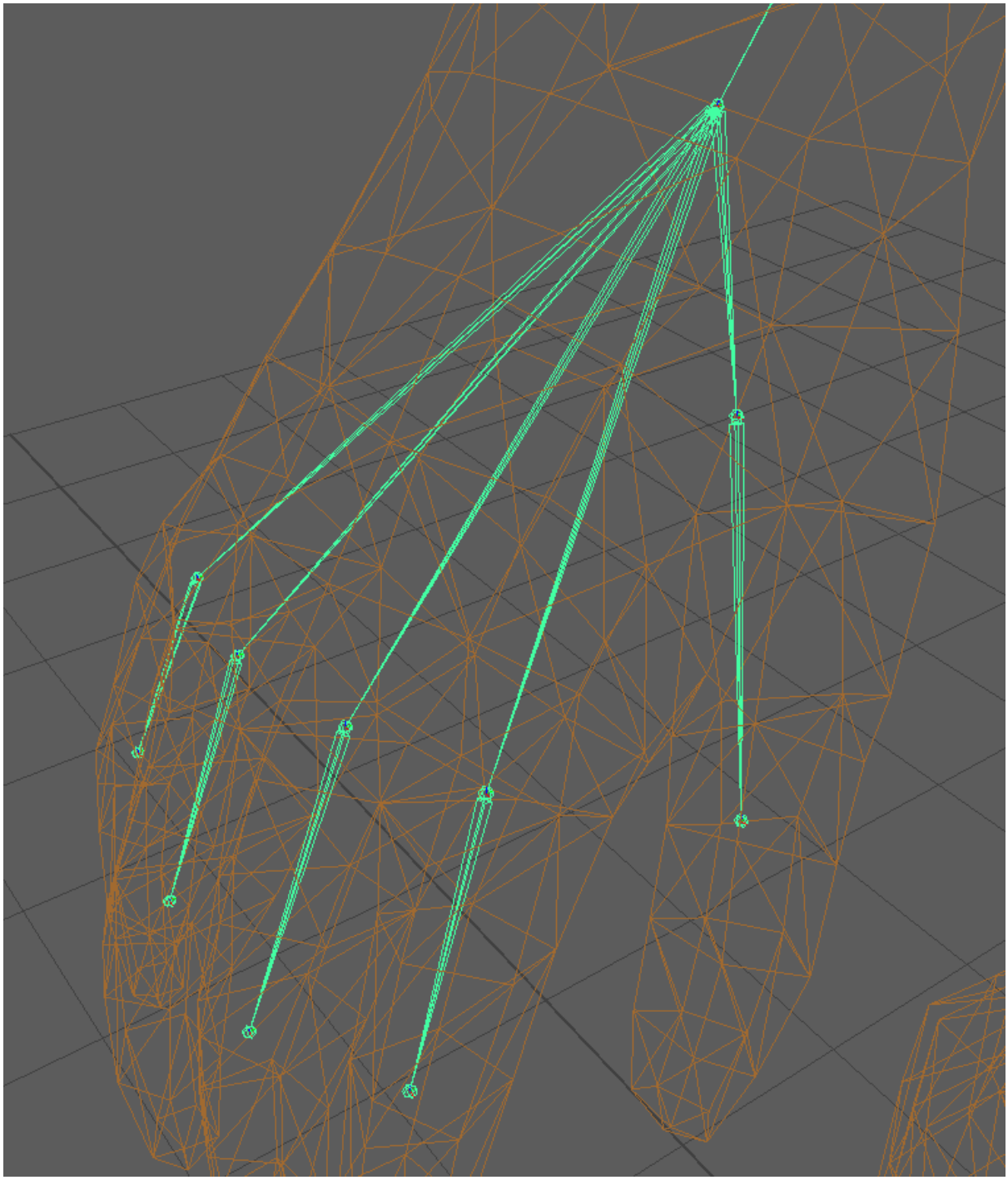


This is how my model looks in Wow Model Viewer. I added the correct hair, skin tone, face shape and other customizable attributes including the correct clothing attire my character has in the game. I exported the mesh ensuring that I removed all animations and other non-mesh only features and exported it as an OBJ so that I could see the textures separately alongside the mesh.

In maya I first changed my grid's dimensions so it was to the scale of Unreal Engine 4, so my model was not too big or too small. This is because I intend to pose my model in the engine later.

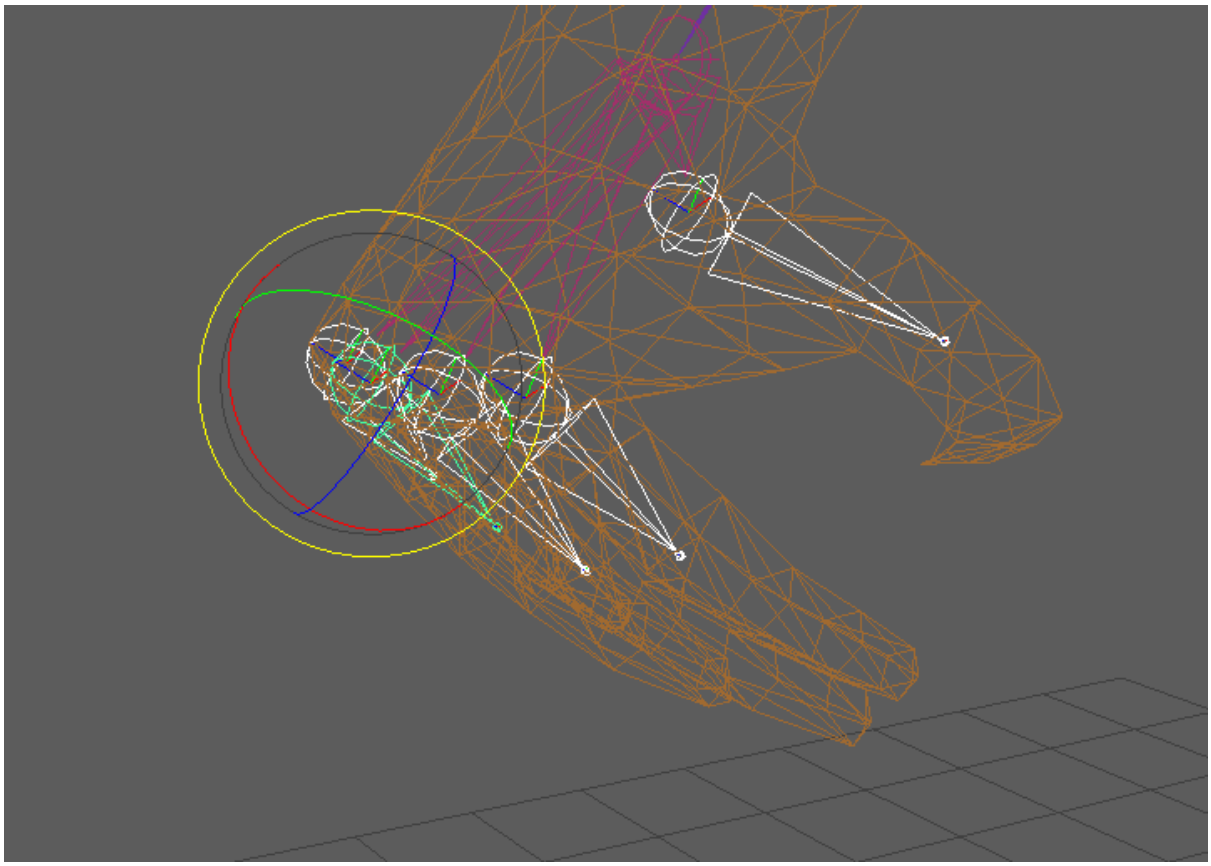
I began creating my joint chain, using all camera angles to make sure it was centered. I then did the left arm and leg, mirroring them across the YZ axis so that the left limbs joints were symmetrical to the right limbs joints. I also kept my hand and finger rig very simple as it is not a necessity for my character to be able to grip well. I decided to keep the joint diameter small as I preferred the straight lines as opposed to triangular bones. I worked quite zoomed in which helped me to view the centered area of the joint. I made the centre point for my character's upper body where the bottom of her sternum would be, all the joints parented to this centre joint. I also decided to do the collar bone differently than I had originally been shown, as the collar bones don't meet in the middle, I instead made a V-shape down to the centre of the sternum and connected them at that centre point. I also connected a small joint on the lower back of the mesh.

Instead of having the hip bones sideways, I instead angled them down and added some handles pointing straight outward so she moved more naturally. I also added some handles around the same height as the belly button, to be able to control the waist line, as well as some handles straight down at the front and back of the legs.



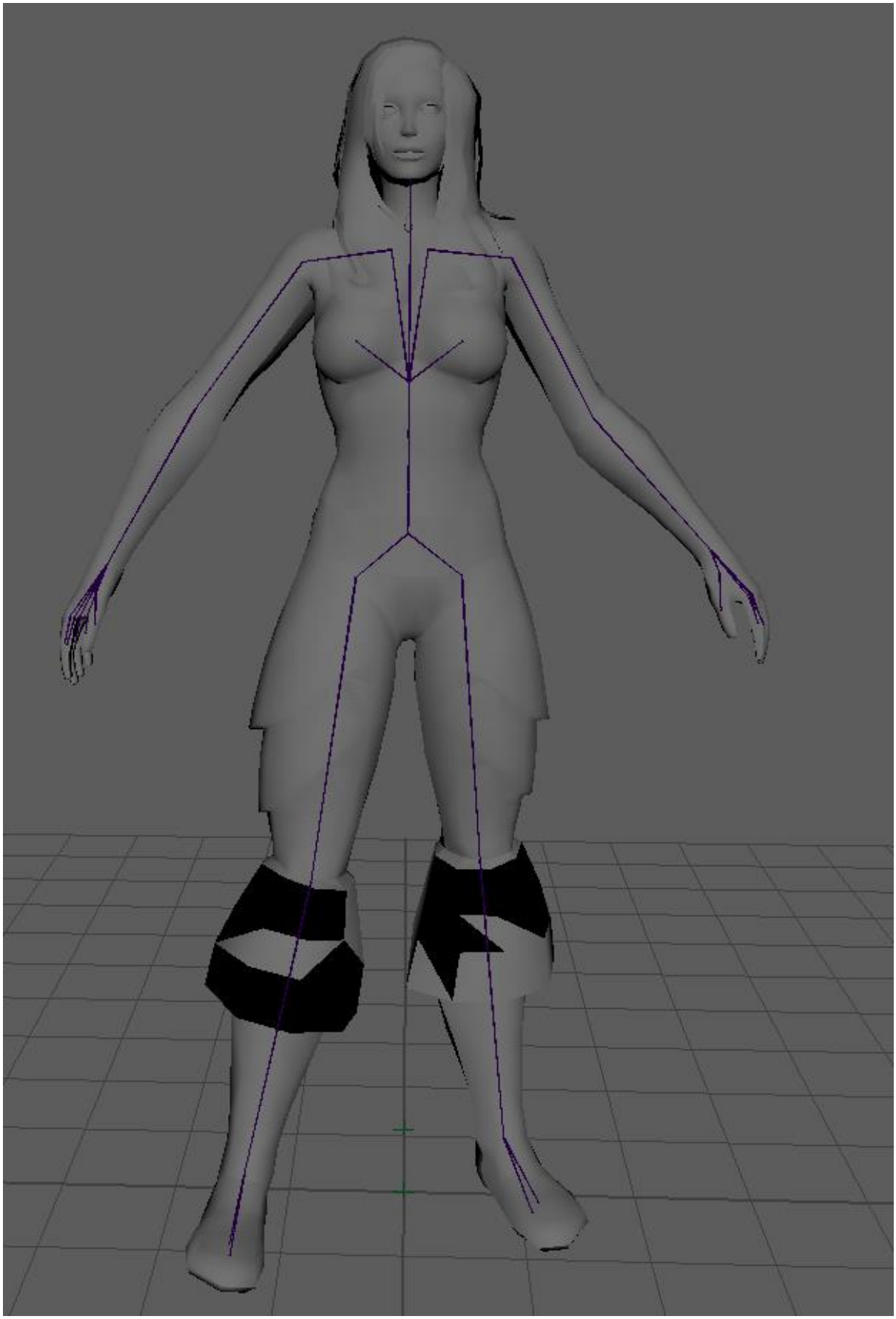
I tried to create a driver system, the driver being the wrist, the driven being the fingers. I added an attribute called grip and changed the mini/maxi to -10/10. This caused the grip to flex or contract depending on my values. I had a lot of problems connecting

them however it wasn't necessary, so in the future I will practise using the drivers as this would be an extremely helpful tool, especially when needed to create grip.



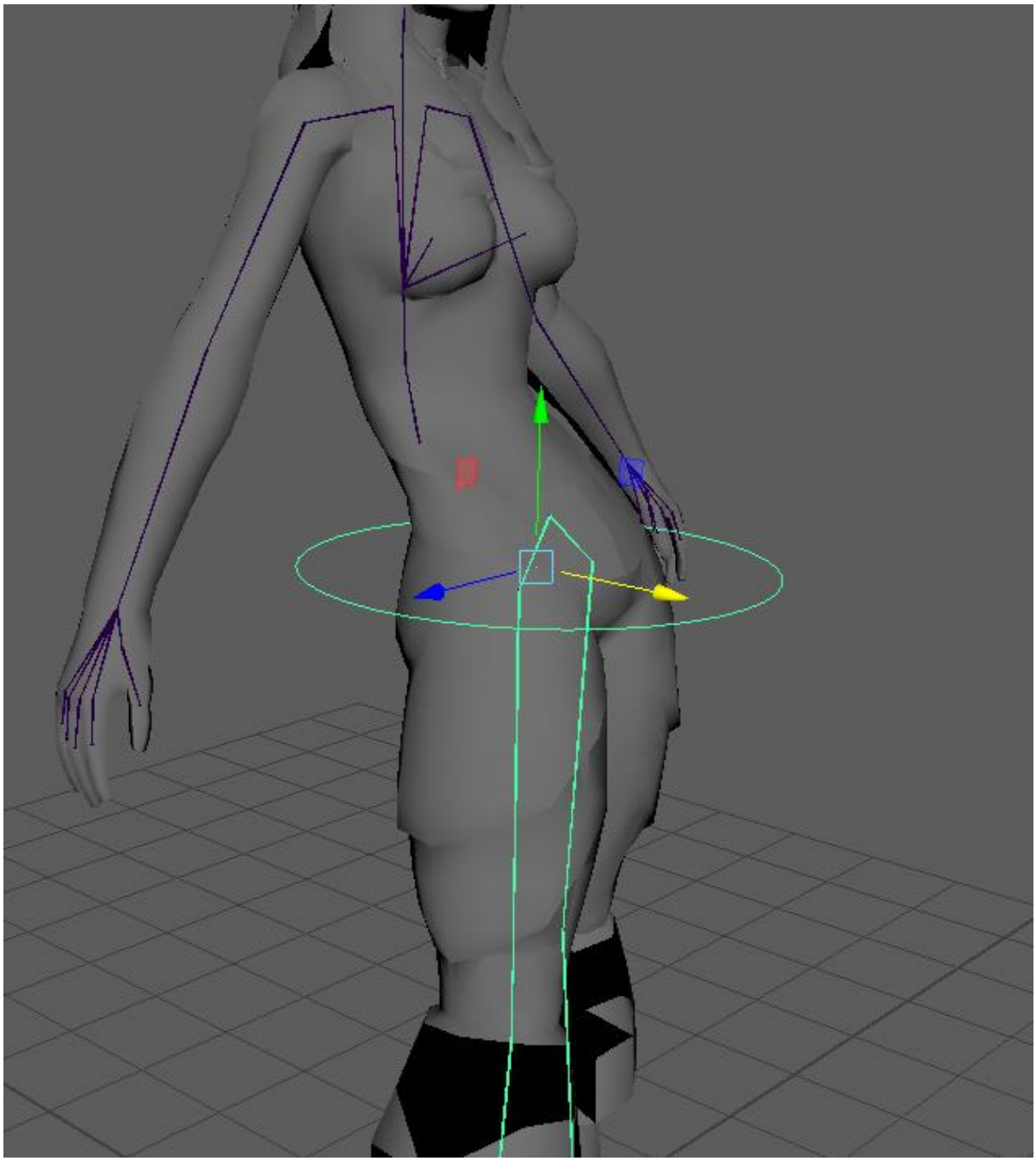
There were also a lot of weight issues occurring, and a lot of warping of the mesh. I would be more concerned if it was a necessity for my character to grip however I have identified the issue and know how to fix it if I need to; in the industry they do not rig characters to grip if they don't need to.

After completing the spine rig and meticulously placing all of my joints in place, pairing them accordingly in the hierarchy it was now time to paint my weights. This rig was a lot more complex than my initial one, as I had to be careful how many joints I had and where I placed them so my textures didn't warp. I referenced existing, professional rigs to help me determine where I needed the joints. I also plan to add a lot of pole vectors so that it is easy to move the arms and legs.



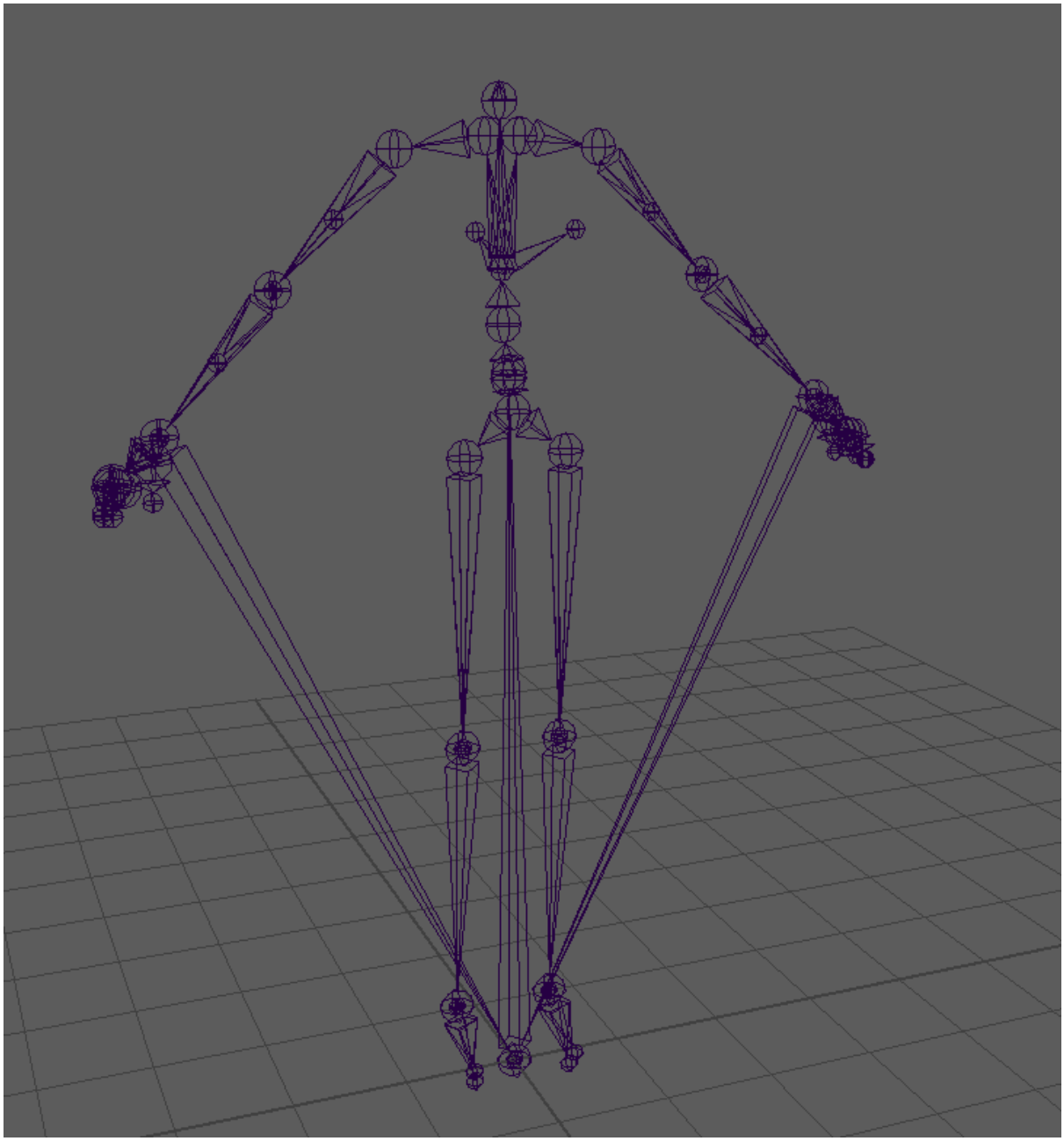
Here is how my rig looks after building the initial spine and joints. I ensured to constantly freeze transformations and delete the history so as to evade errors I had the

first time. I prefer making the radius of the joints and bones small so that I can clearly see the bones more clearly, as well as using a wireframe of my mesh so that it looks more like an X-Ray. I found this a lot easier to do and it saved me a lot of guessing where was the best place to insert joints. I also constantly jumped through different camera angles to centre the rig, I also constantly moved the mesh around to check the skin was bound correctly.

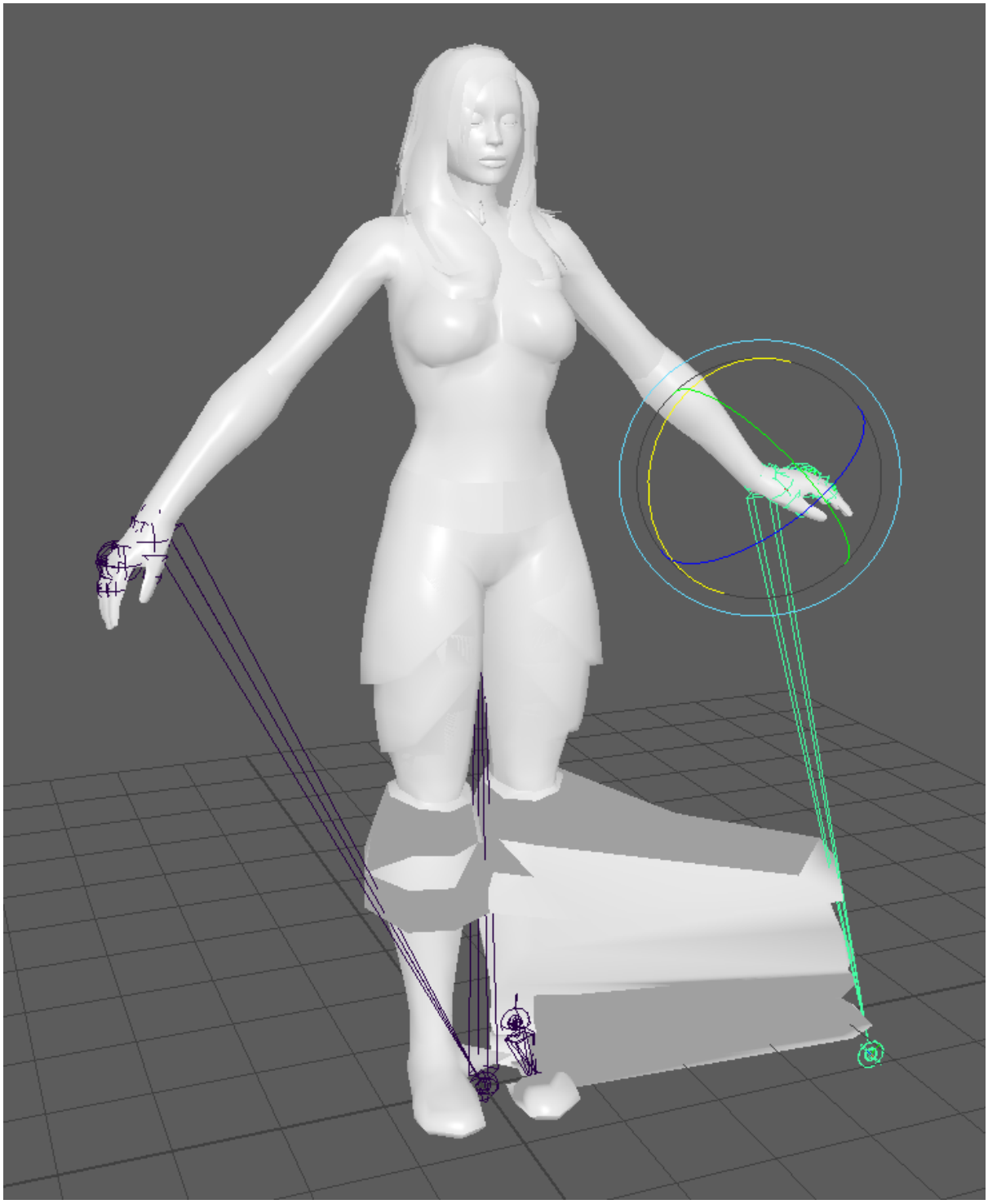


I then began to add some nurbs to the rig however I was finding them too large and distracting to work around. I'm quite particular with presentation so I instead decided to simply add some extended joints and bones around the rig which I could grab

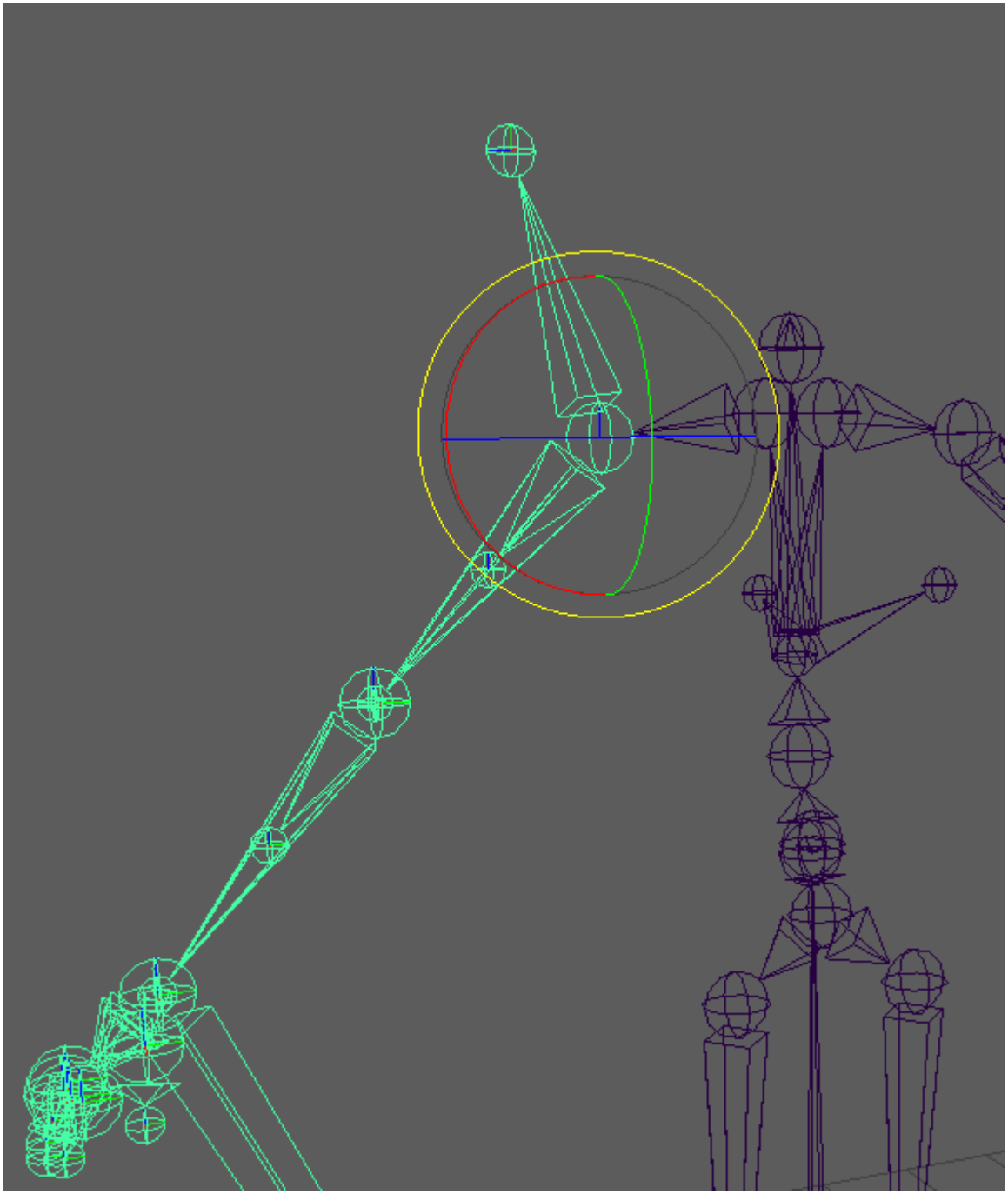
instead, and then just delete them once the rig was done. This was a lot quicker instead of adding nurbs and let me grab the bones a lot easier. For some reason my hips were disconnected from the spine too, but I discovered that I can fuse joints together with a simple tool.



Here is the rig with the added bones to the wrist, connected to the centre point on the floor.



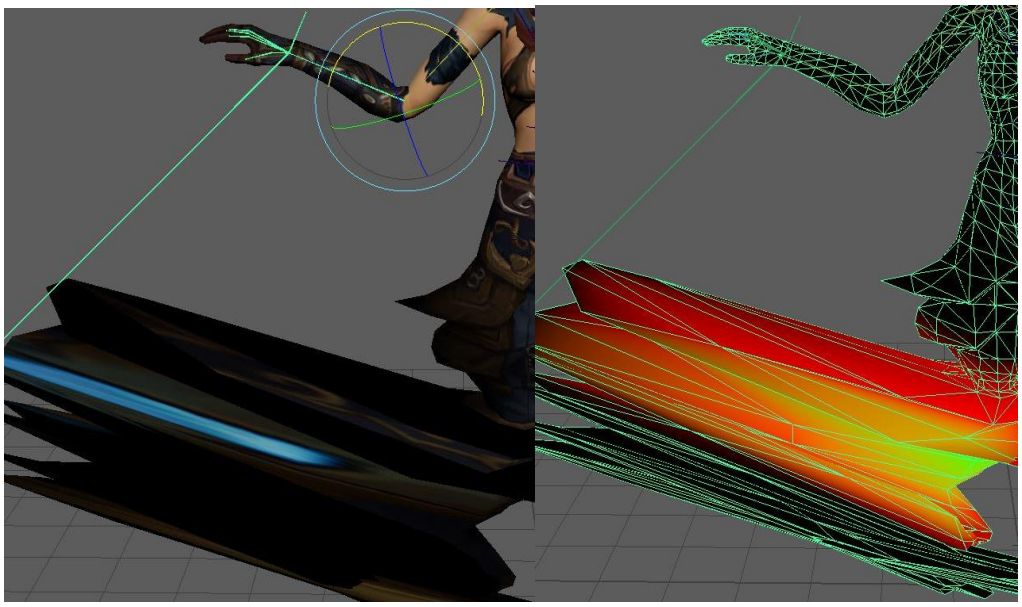
Here as an example of how the bone is parented however I will remove any influence from any of the bones I am using as pole vectors at a later stage.



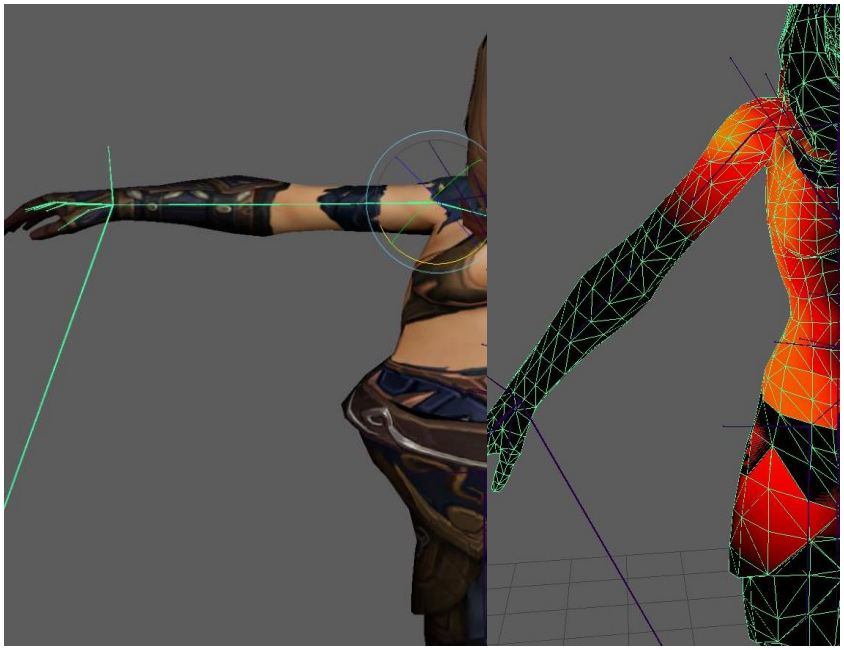
I added more joints around the shoulders and parented them to the arm chains, which allowed me to rotate the whole arm with easier access too.

I added more bones alongside the hips, poking out of the mesh and also down the back of the model so I could grab the spine. After creating what looked quite messy, I realised that I could have simply just turned the static mesh into a reference so I didn't grab the mesh like I did in my first rig. This was a very silly mistake and I created what looked like a very messy rig adding a lot of different bones everywhere instead of simply turning on this setting however in the future I am well aware of this and will not do it again on the body, however having the long bones come off the wrist and shoulders I

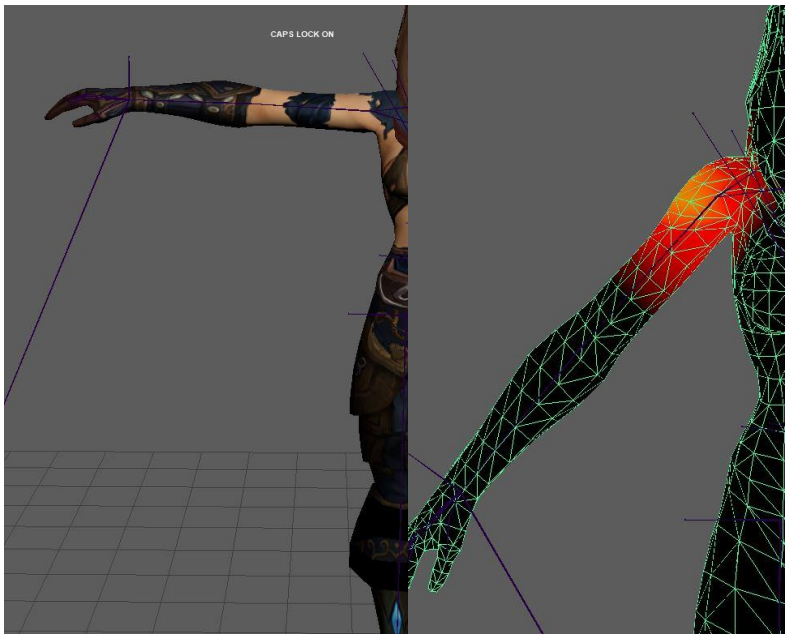
found extremely helpful, I may have just gone a bit overboard with the hips and spine, not realising that they weren't that needed.



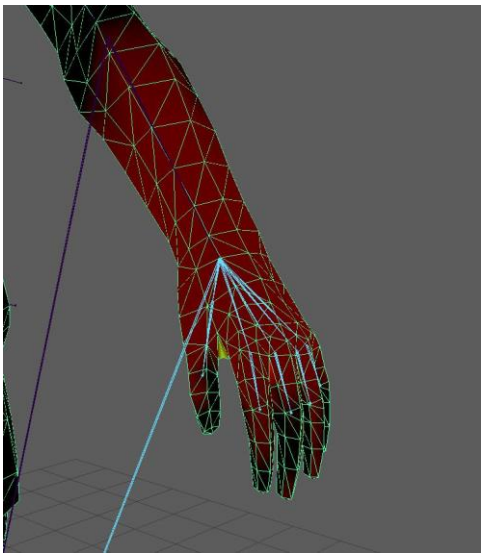
Even though my rig was coming together, unconventionally messy or not, the weights were completely unbalanced, and had been defaultly painted poorly, I think this was due to the topology of the clothing I added to the base mesh. I had to spend a lot of time painting and experimenting with different values and brush types. I used the smooth brush the most, however for erasing it was a lot easier to switch to the hard brush mode, which was a lot quicker. I didn't realise this at first which would have saved me a lot of time, however for future rigs when removing influence that is unwanted I will be a lot more efficient.



When I pulled this arm up, it pulled along with it a lot of the topology from the torso, so I used my paint tool and set the value to zero, erasing any influence anywhere but the arm. I then used the smooth tool to blend out the edges of the shoulder and the arm.



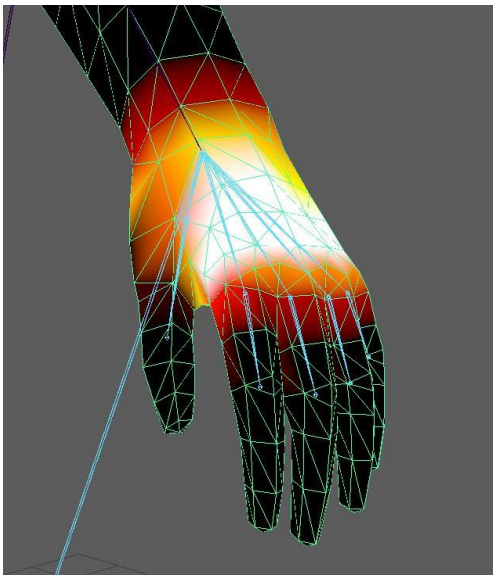
After spending time removing the influence with the hard brush tool, and I was happy with the result, I went through all my different joints and bones in hierarchical order in the paint weight mode to see where my model was being influenced incorrectly.

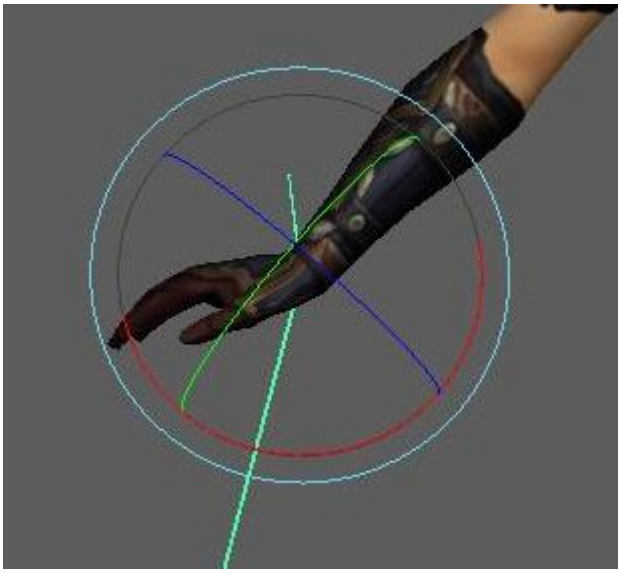


The weights for the wrists and fingers were really difficult to paint and figure out how I should paint them, as was a section I had yet to touch, so I went in very particular and ensured to constantly be moving the wrist around by the bones to find the best method and values for the influenced joints.

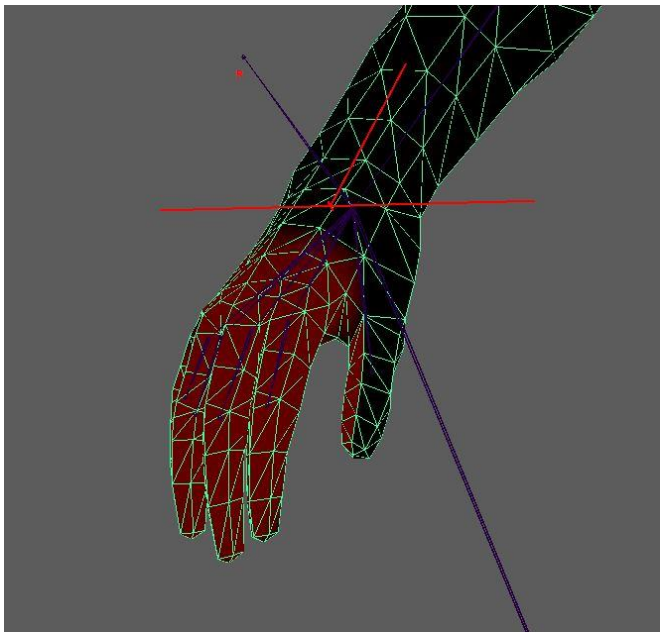
I wanted to make sure that the knuckles were not affected, nor any of the arms, so I spent time carefully painting around the area to get the perfect finished weight. I added the most influence in the area just under the knuckles and

above the wrist, smoothing the influences so it only slightly brushed over the knuckles.

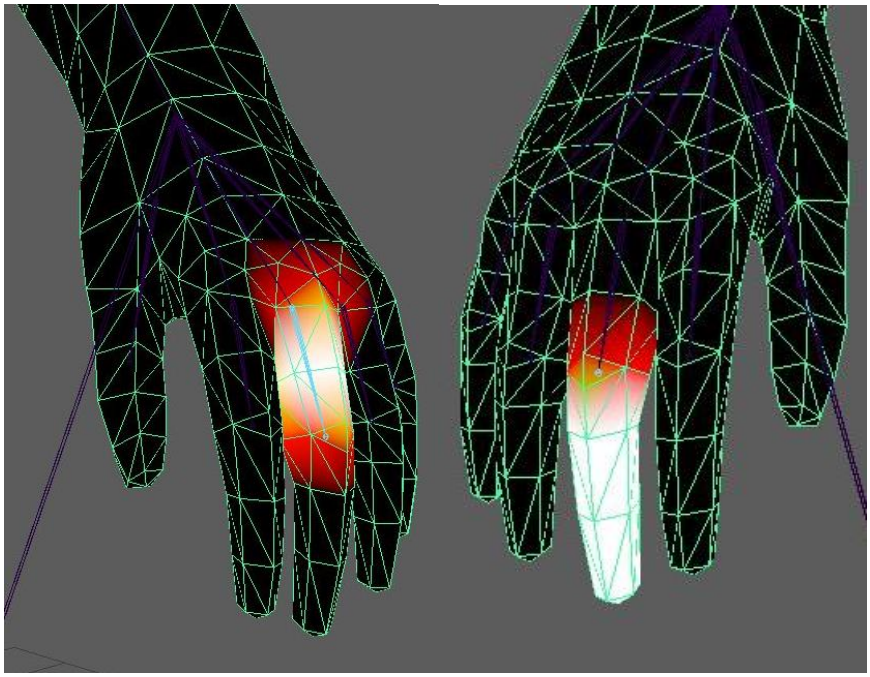




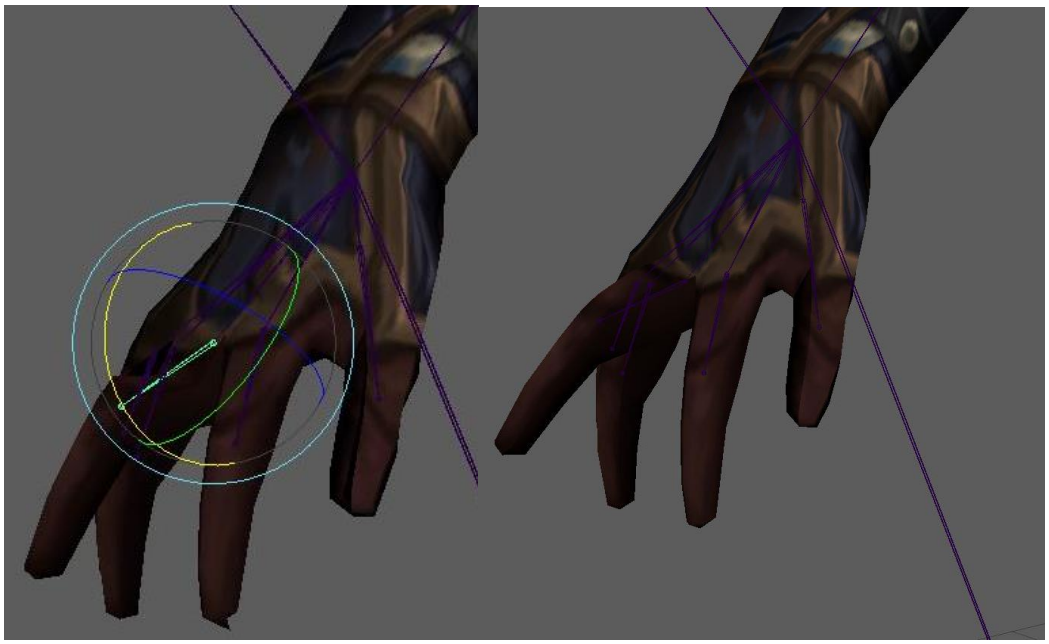
As shown in my image above, the weights were finally perfect for the wrist, with no awkward pulling of any topology around the arm. It was time to move on to the fingers as well as the upper arm, which took the longest time.



The fingers' default influences were completely off, so I spent quite a lot of time removing influence from all the fingers, and then individually painting each finger joint at a time. I created the fingers with two joints, one leaving from the wrist to the knuckle, and the other from the knuckle to the middle knuckle of the finger. I corrected these individually 20 times. I decided to make the hands more simplified than our university tutor showed us, as for my goal, my character's hands did not need to be able to grip. The main focus will be the face and body. I made it so that the middle knuckle on the finger had the most influence on the whole tip of the finger.

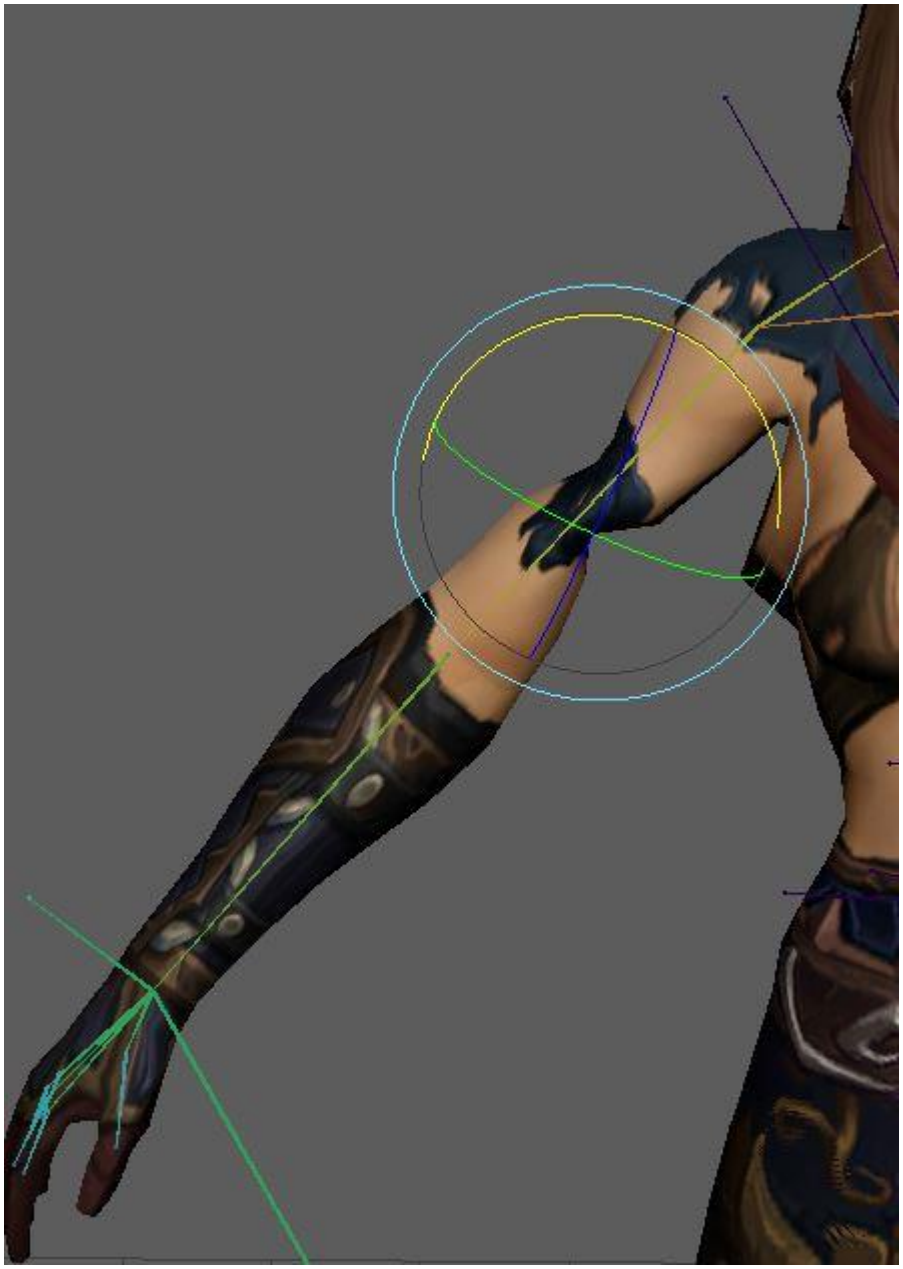


Here are the final weights for the fingers.



As you can see in this before and after, the finger initially warped and twisted, whereas now the finger lifts perfectly.

After painting all of the weights, which was a struggle due to the amount of time and concentration it took, I bent and twisted all of the joints to ensure they worked properly. I did have to spend a lot of time fussing with the upper arm as it just would not bend correctly, instead the mesh would tug and bend in places which were wrong.



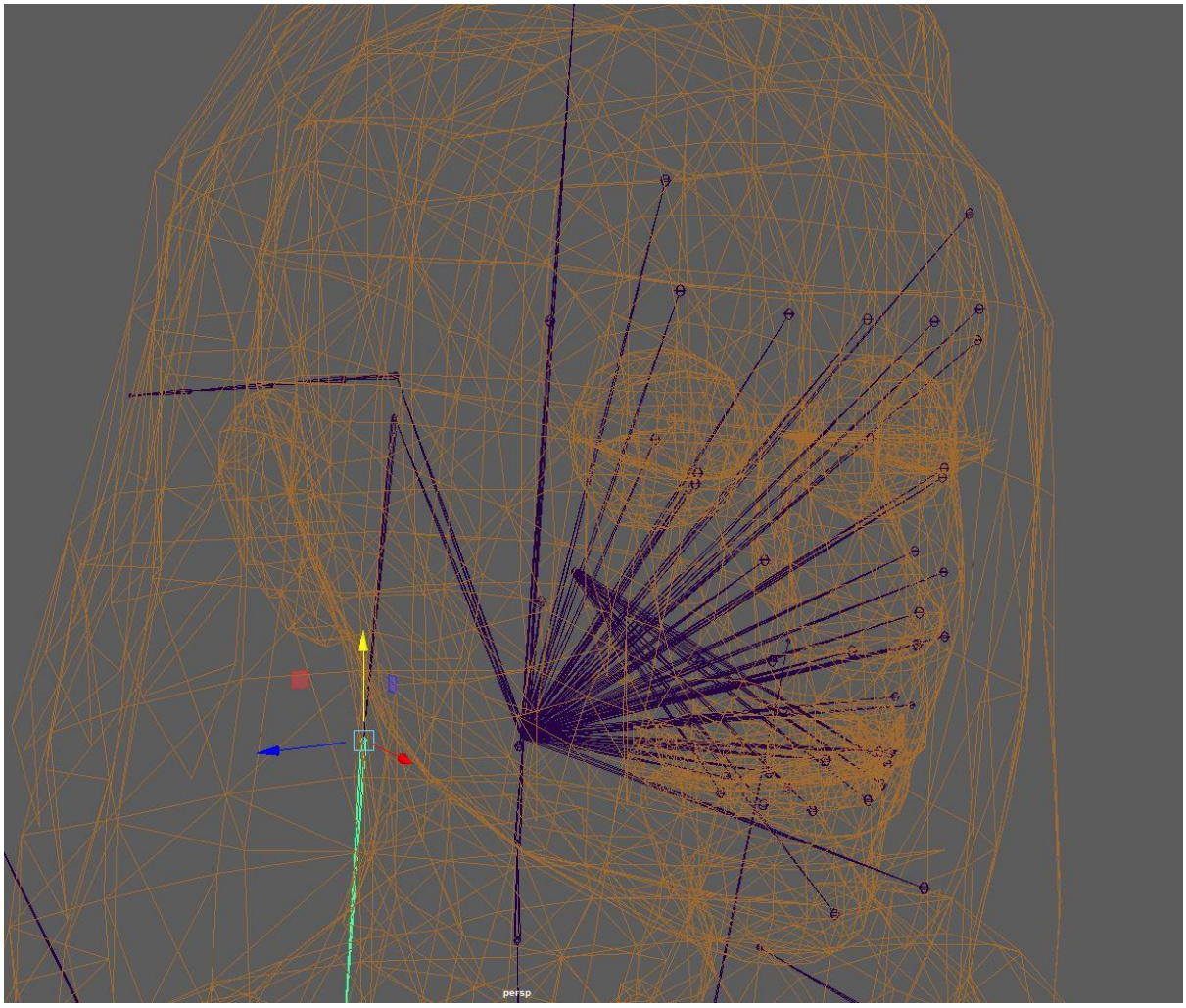
I had no idea why this was, as I wanted the shoulder to rotate forward, instead the arm would just twist. I ended up erasing the blend weights influence entirely and starting from scratch to fix the right arm. This still did not work, however I played around with the joint orientation which seemed to fix the issue. In the future, I may install the orientation scripts to save time, as it would've fixed this problem instantaneously.

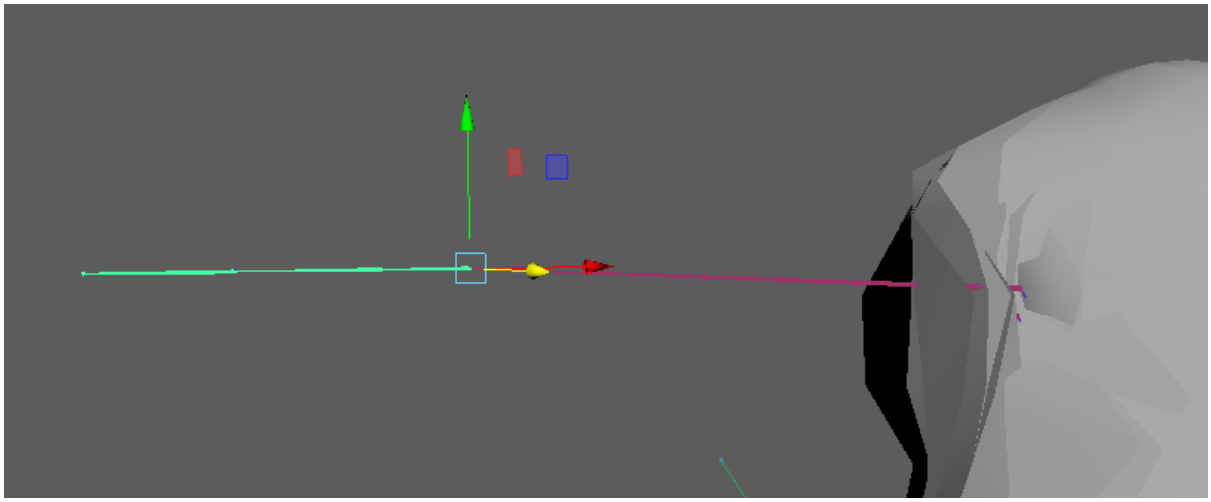
I also had another extremely strange error with the arm, as when I tried to lift her shoulder, I believe it was dragging topology from the inside of my mesh. This really confused me again, and it was quite frustrating to fix. In the end, I fixed the issue as I redid the weights again and tried unbinding the skin whilst I fixed the joint position before binding it again. This was the last issue I had with the body.

Finally it was time to rig the face. I also kept in mind that I had another layer for the character's eyes, and would want to rig them too so that I could change where the character was looking. I want to be able to move the top and bottom eyelids, nose, eyebrows in three points, the lips and cheekbones.

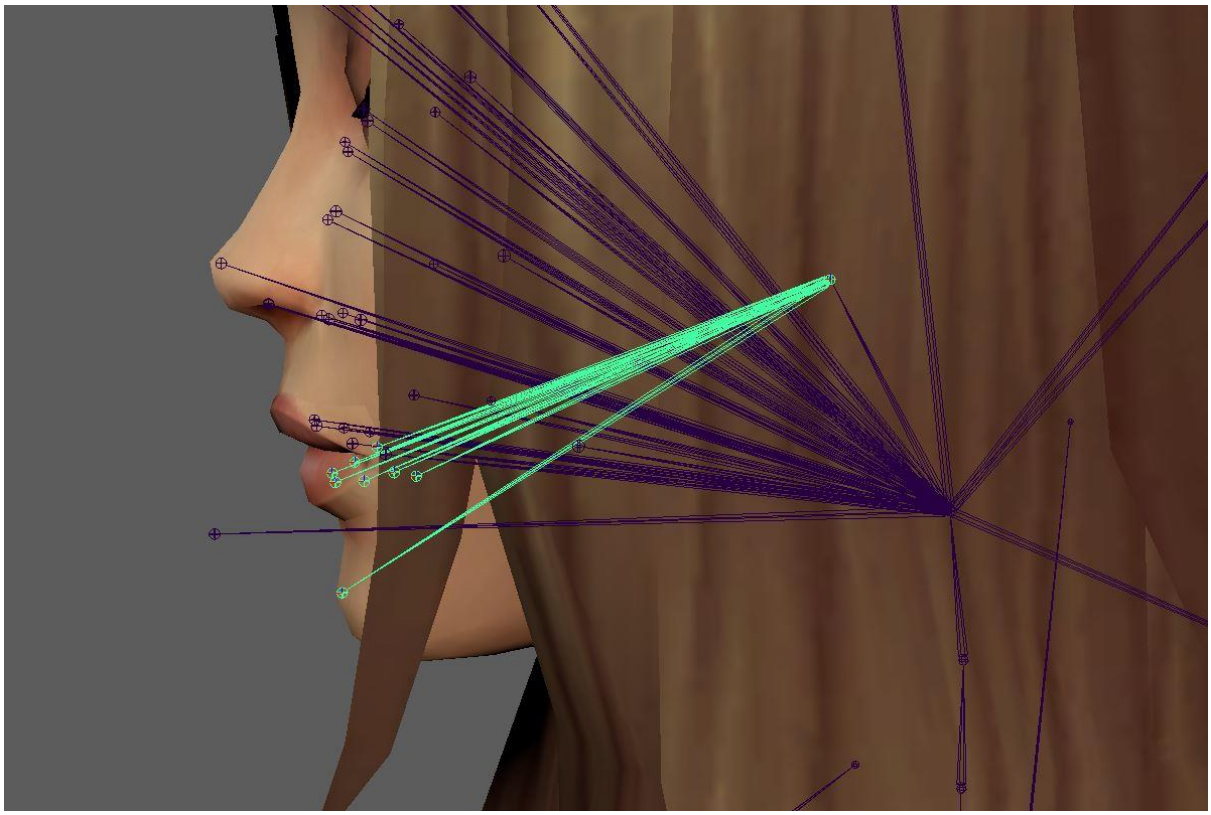
I made two separate parts for the head, one centre point controlling the majority of the face whilst the other just controlled the chin, jaw and mouth. I also added a lot of points for the lips as I wanted her to be able to possibly look as though she was talking, so the connections to the skin needed to have little influence on specific parts of the lip.

I again put the face into X-Ray mode so I could see exactly where I was placing all of my joints, as well as my pole vector. It did get a little confusing to look at, and crowded, however it ended up working well. I think in future rigs, I will try putting certain parts of the rig into layers so I can hide what I am not looking at. This will also aid me in not grabbing accidental joints and bones, which also got frustrating, due to having to trial and error which joint I want to grab. My naming conventions were also poor as I forgot they were important, and it would take too long to name them all, I'd rather spend time just doing the rigging.

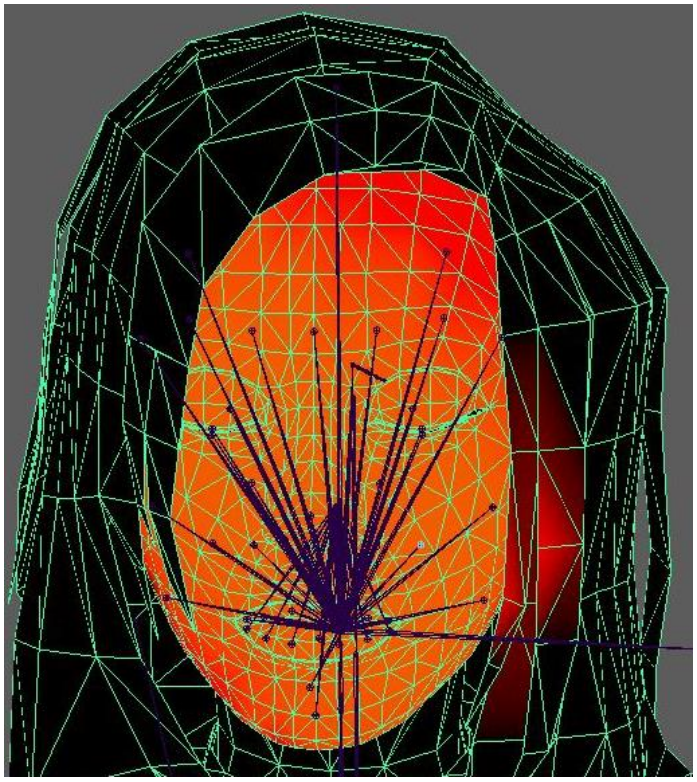




I also added some bone chains around the model and attached them directly to the hair, so when my character turns her head, her hair can also be moved. It got complicated when I was painting the weights and I didn't want to have to decide which parts of the face would control the hair, so I did it separately. Next time I can add influence to the hair on the joints around the neck.



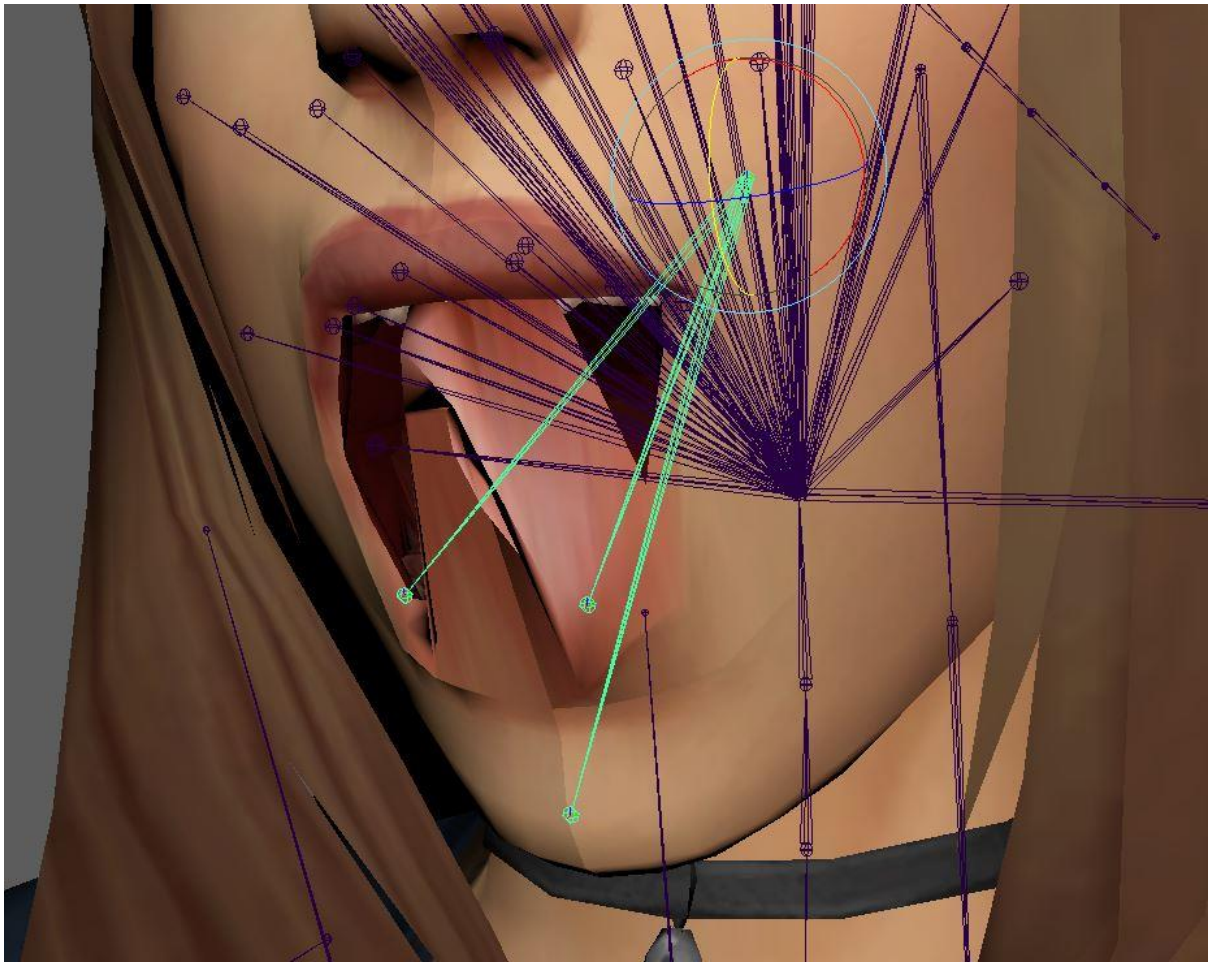
Painting the weights for the face took an incredibly long time, as well as ordering my joint hierarchy. I had a lot of problems with trying not to pull on the character's hair, and moving parts of the face I wanted to not be influenced. I resulted in plugging in my tablet to help me paint very small influences upon the joints.



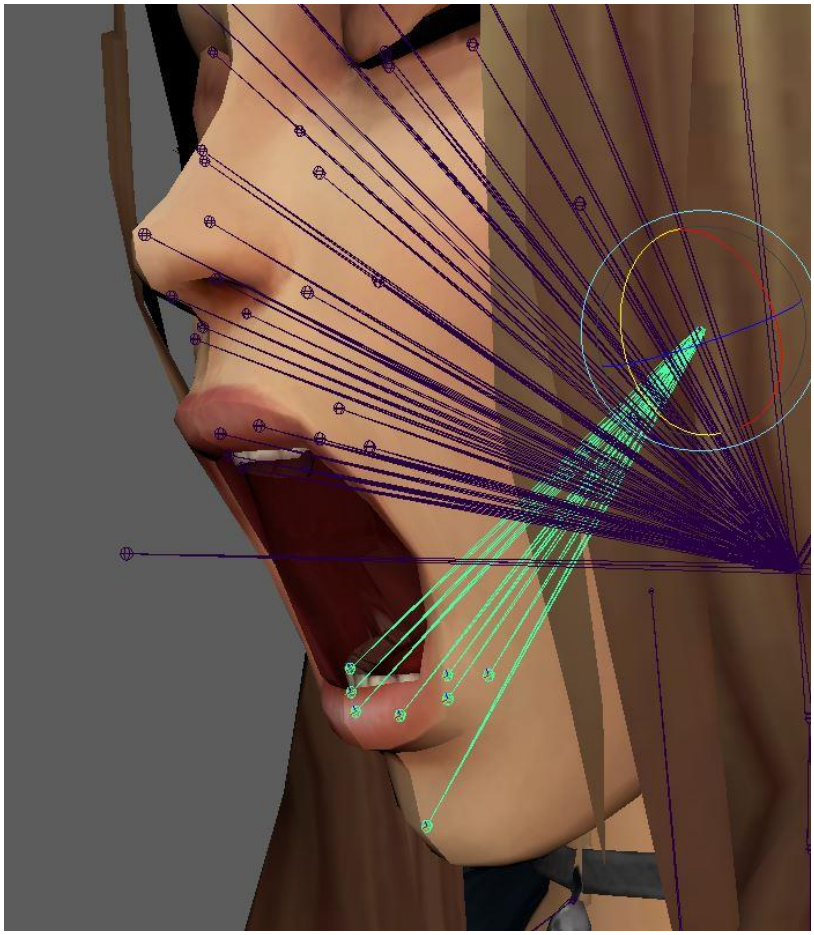
Initially all of my face joints had influence over the whole face, so I used the hard brush with a set value of zero to remove all of the influence before painting on my own.

I spent some time looking in a mirror and seeing which areas of skin moved with each corresponding part of the face to see what areas needed to be influenced as I painted. I also looked at sources online to see what parts of the face should influence where.

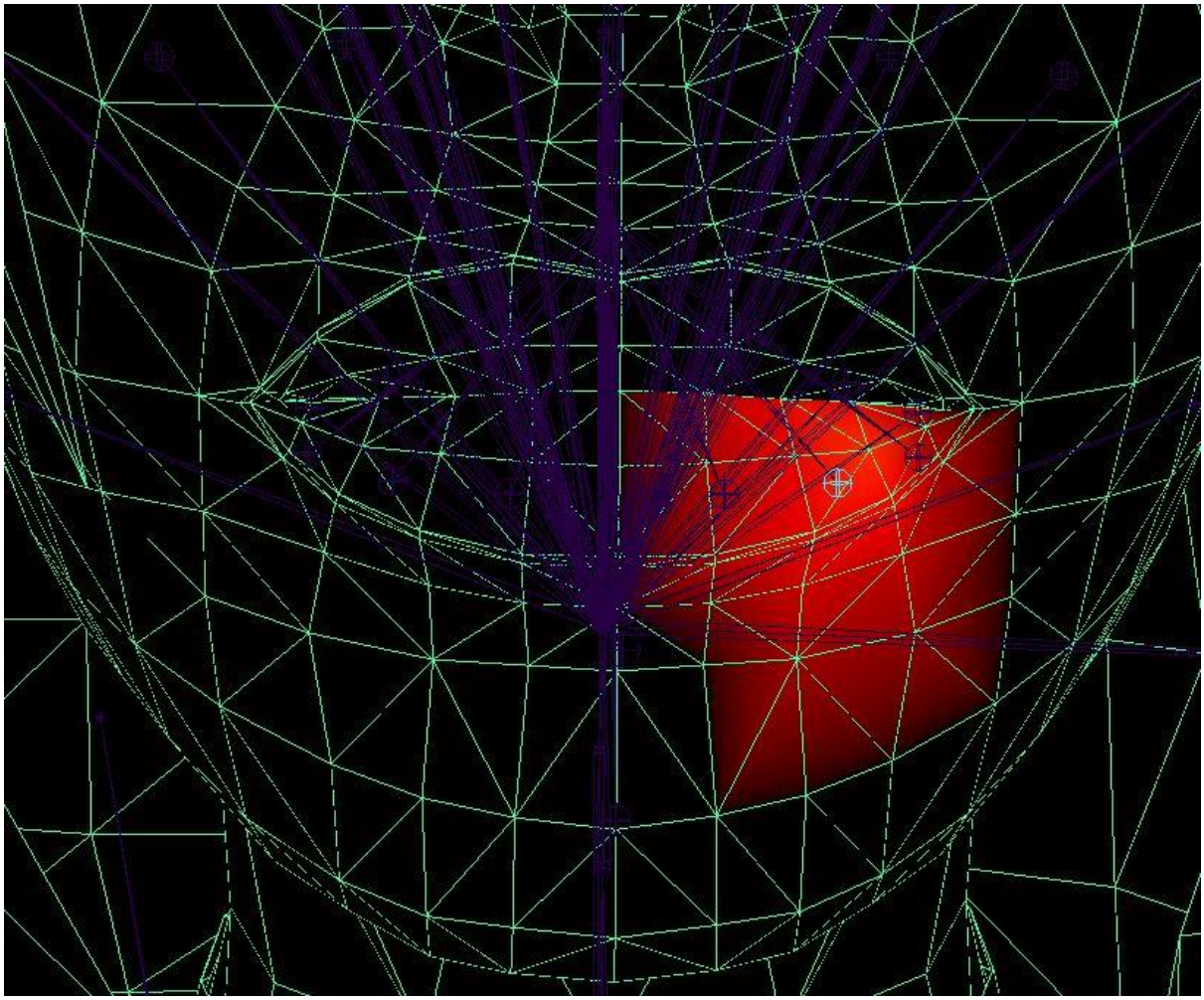
I worked very carefully when creating the lips to ensure they could be fully controlled, making the areas of influence extremely small. On each part of the lip. I added more points on the lower lip, as I realised during research that the top lip doesn't move as much as the lower lip when talking, smiling or emoting in general.



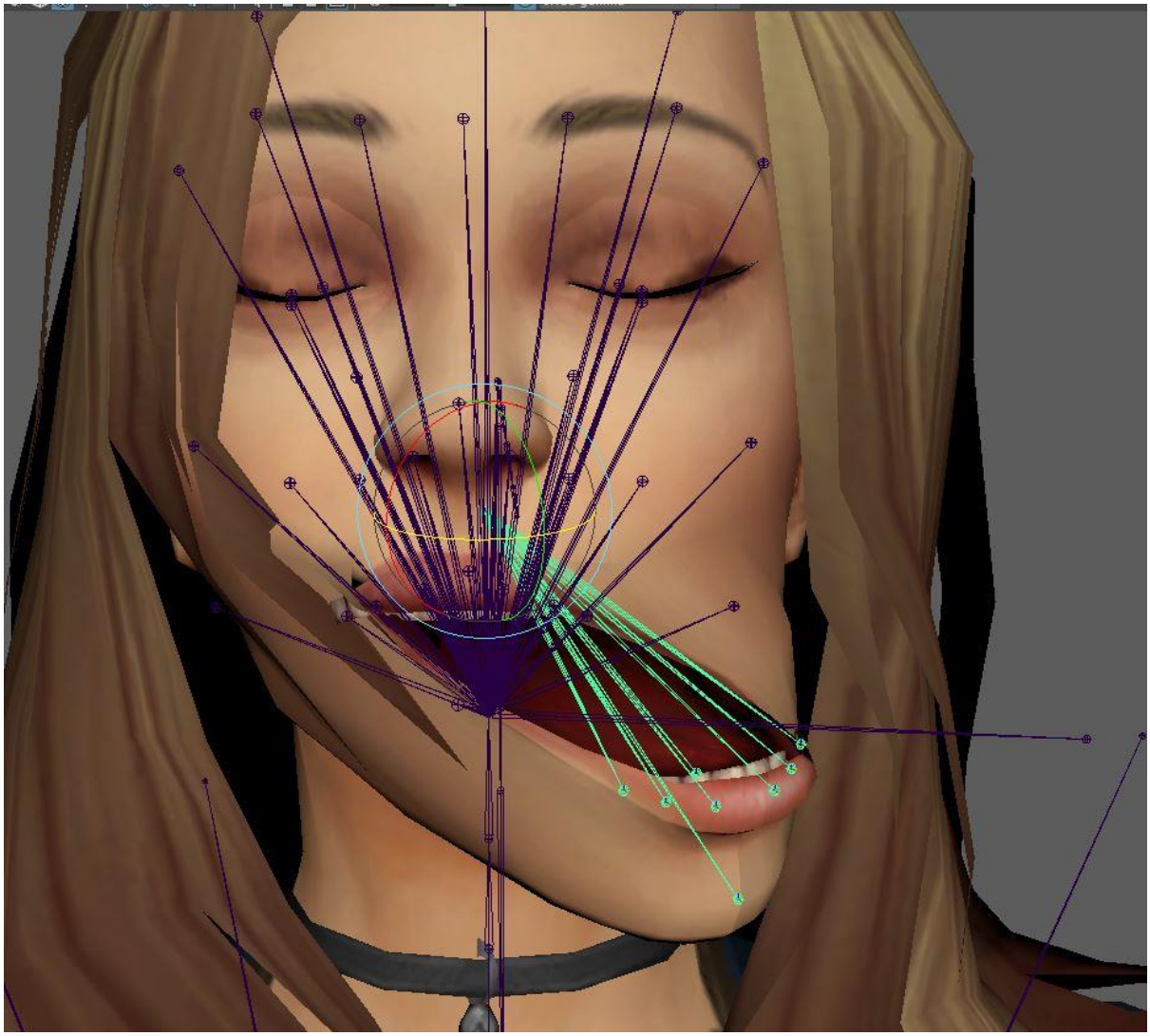
Here there were too little joints to be able to correctly move the jaw. I had to add more to be able to move the lips correctly, as if I added more influence on these joints on the lip, the emotes wouldn't be as detailed as I would want, so I added more here with little influence.



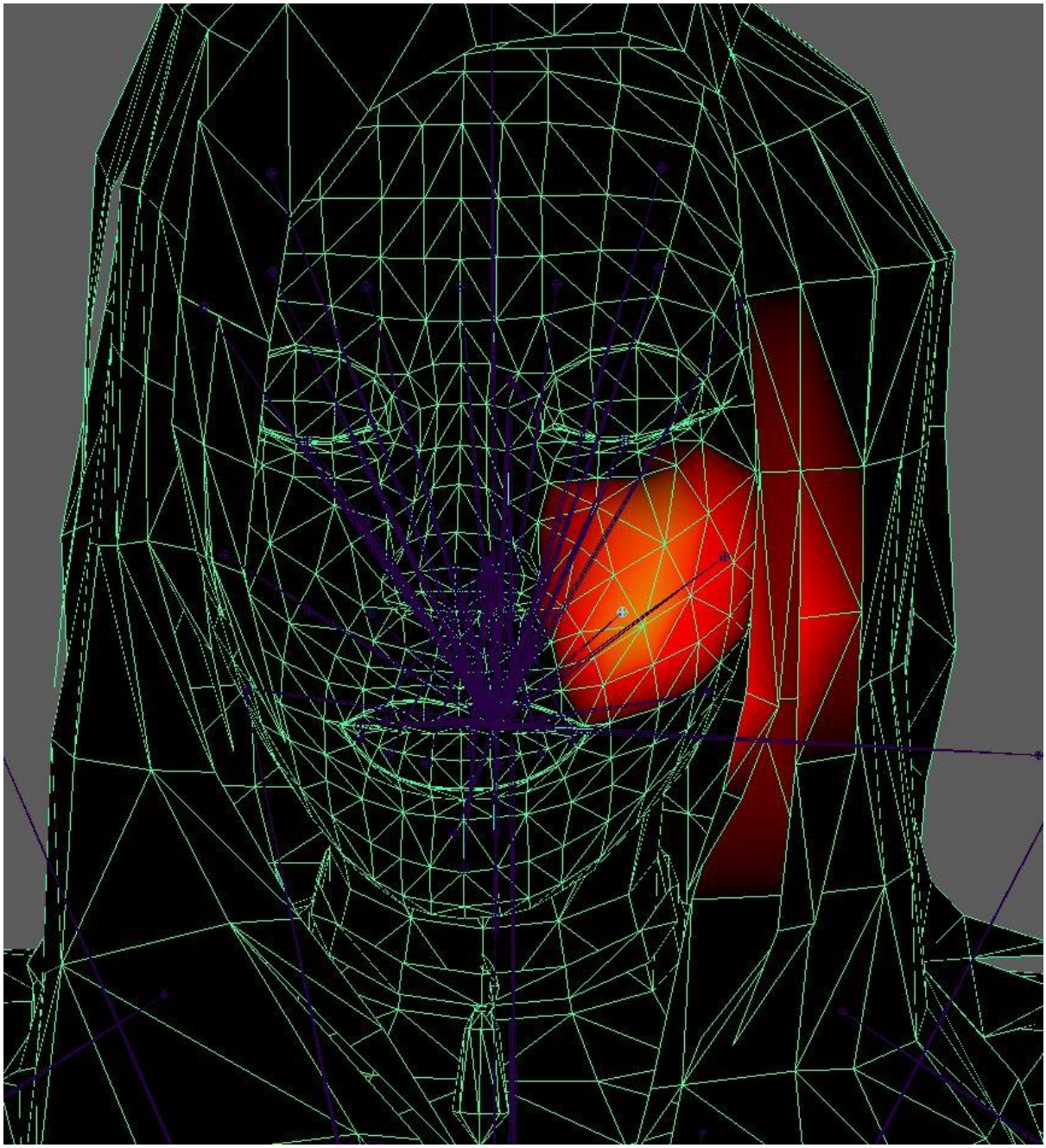
As you can see, I kept the influences small and added more joints so that the jaw could be fully controlled, and blended well. The mouth opened perfectly and the topology did not bend. I spent time placing each joint well and I was very happy with the result. In the future, I will use my tablet sooner when rigging the face as it helped me work a lot quicker towards the end.



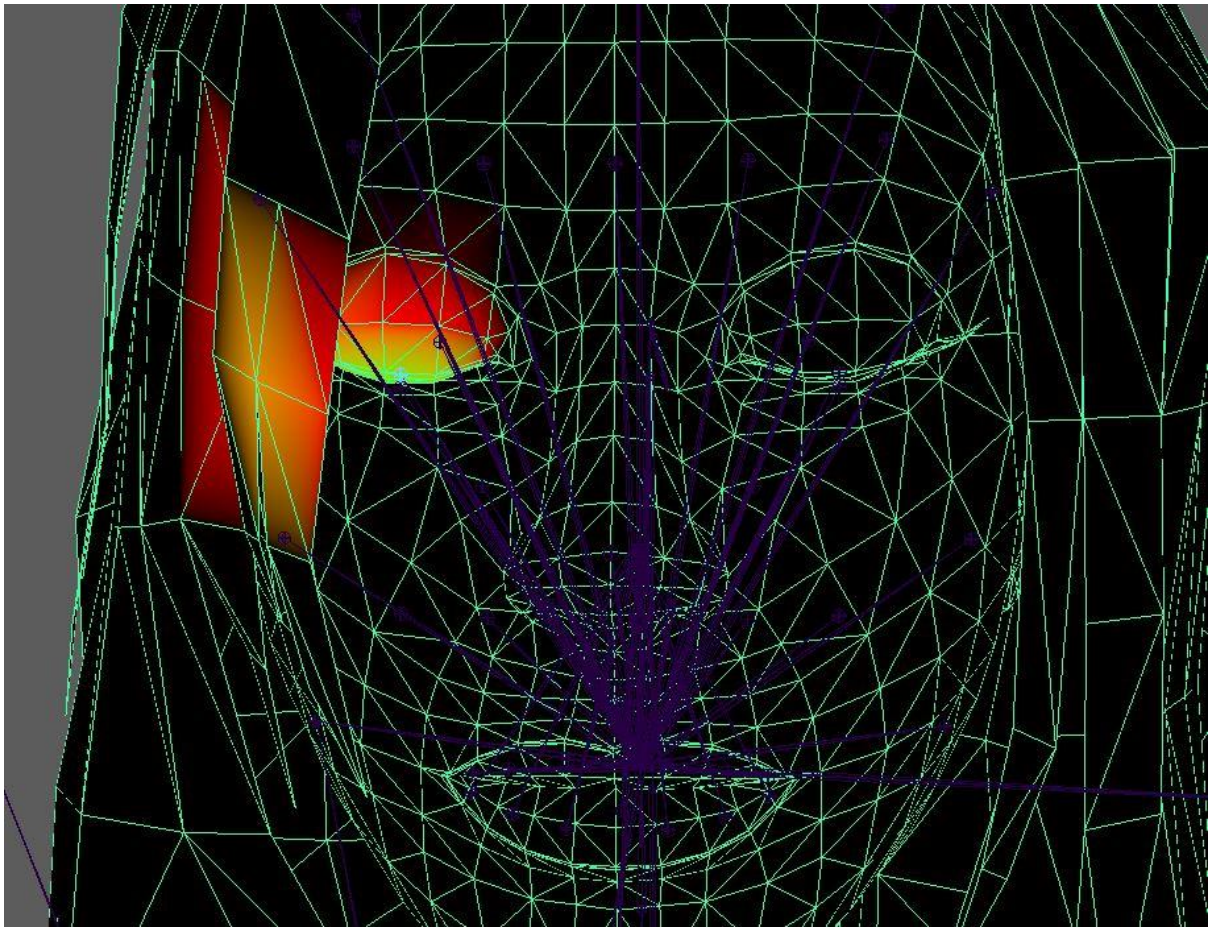
Here is an example of what little influence I added per joint on the lip. I did this so that her smile could be detailed. I also made sure to add some influence below the lip, blending it very softly as when the lower lip moves, so does the skin above the chin, as well as the corners as of the mouth.



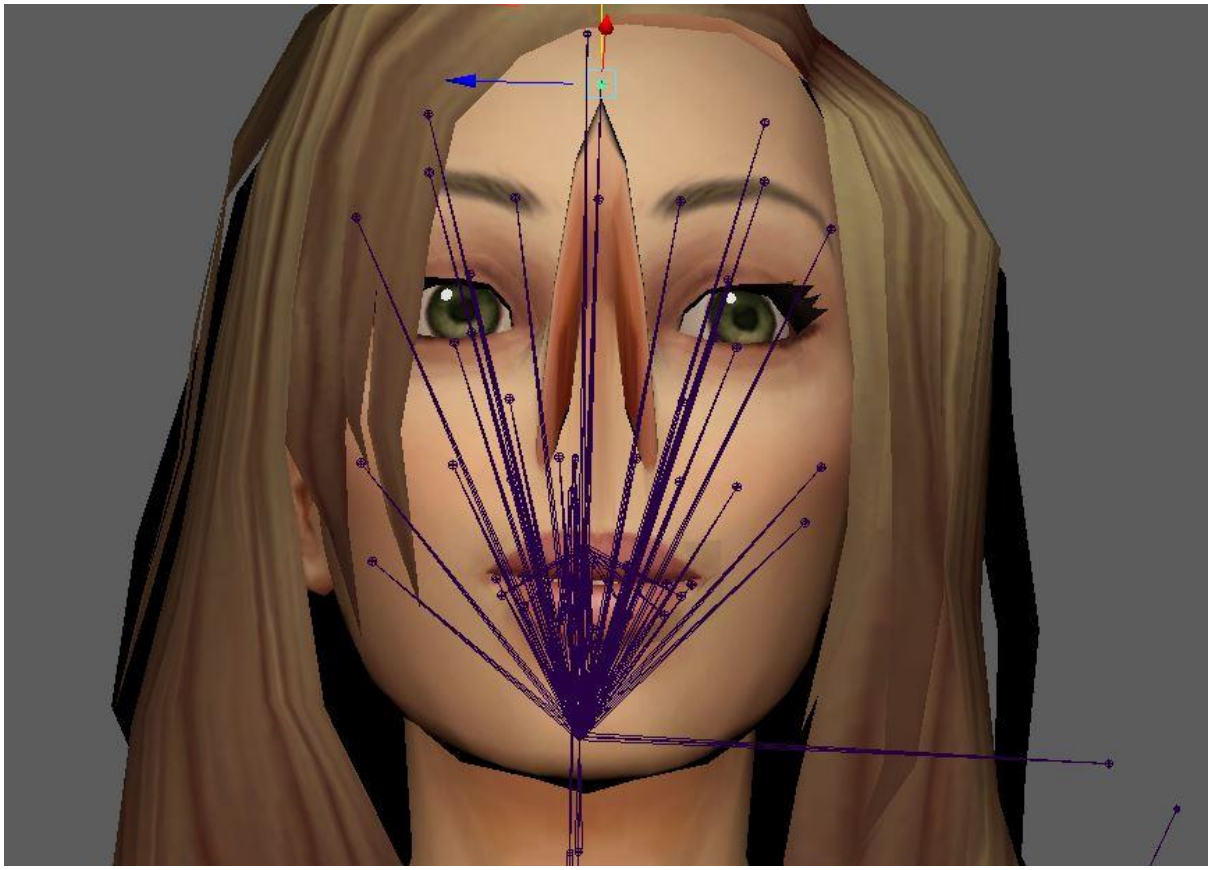
As shown in this image however, some of the hair was being pulled, but I would not need her jaw to move this far so it didn't matter much to me. I tested smaller movements where the hair moved very slightly and it didn't affect much of the rig at all.



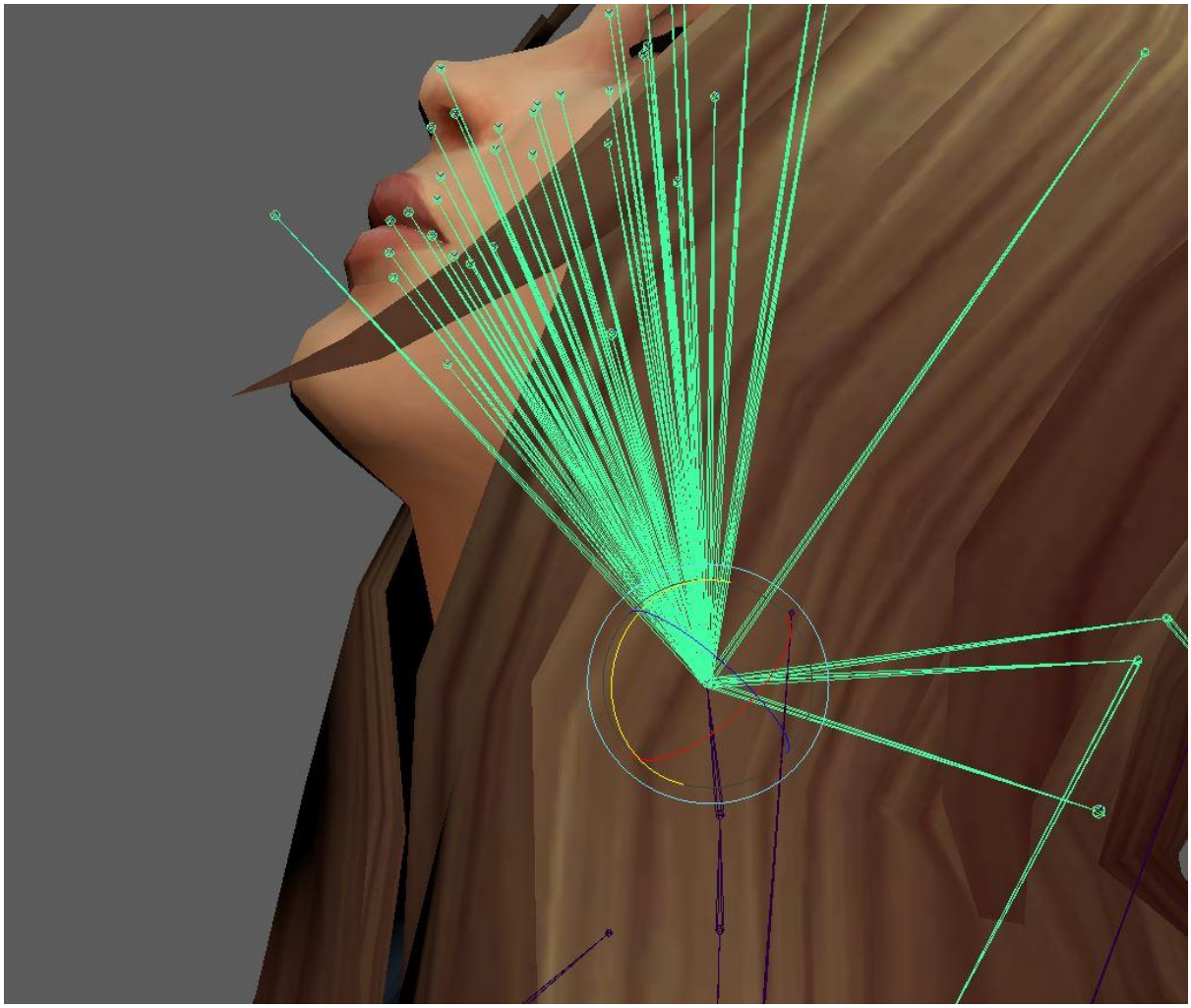
I was having a peculiar error when painting, as when I tried to erase the influence off of the hair it would also remove some off of the cheek. This was very annoying, however I couldn't do much about it as the hair is not a separate mesh. I tried multiple different angles to try and remove the hair influence however this just directly removed influence from the face.



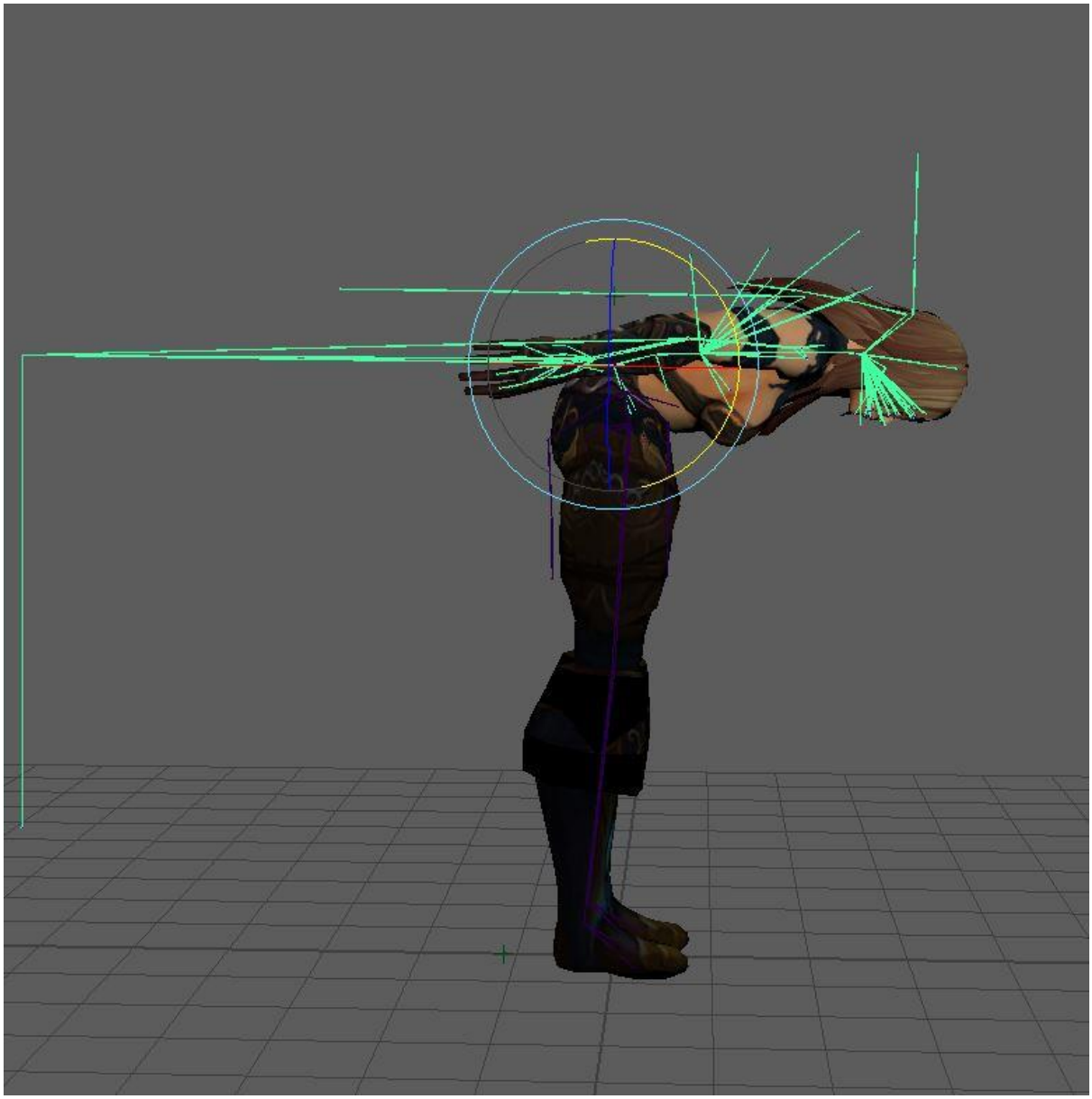
This was happening for the eyelid weights, too. However the hair only bent ever so slightly so I was not too phased, and the texture of the hair did not warp. The eyelids would only need to move ever so slightly so it doesn't really effect the hair, so I decided to leave these weights as they were.



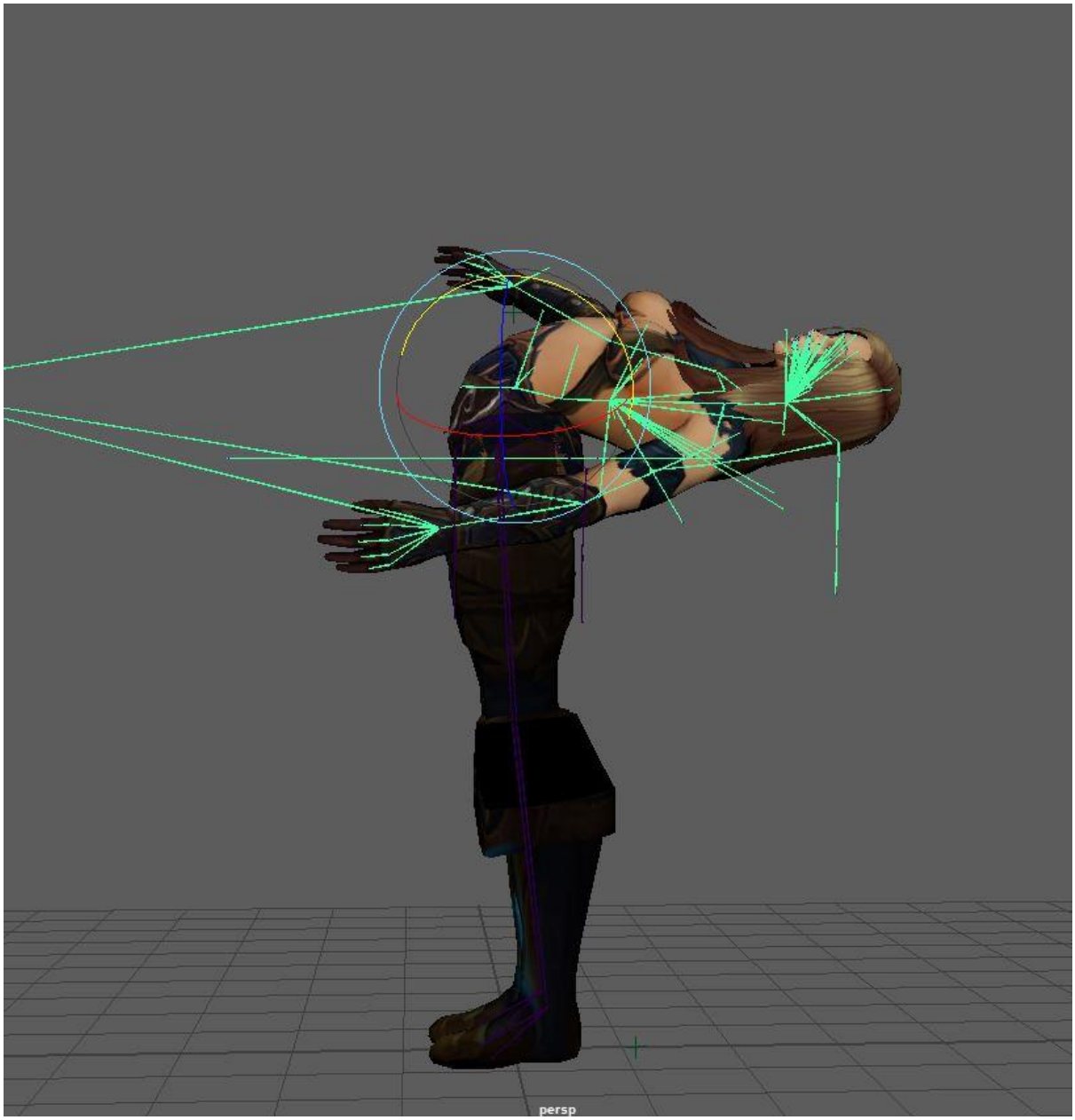
I began to play around with all different parts of the face to make sure each joint only pulled on what I wanted it to. The eyes moved well without errors and the hair only slightly pulled on a few of the cheek joints. The eyelids opened well, and the eyeballs moved how I wanted them to. The whole rig was starting to work well; when I was done with the facial rig I pressed 'p' to parent the rigs to the spine with a handle.



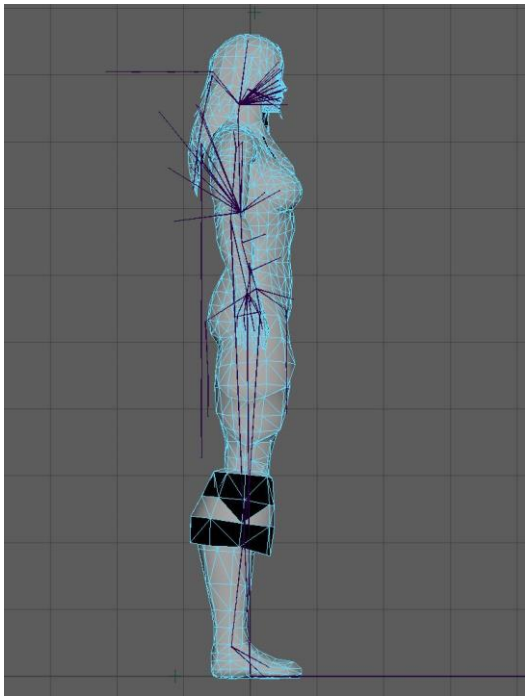
Controlling the whole of the head from the pole vector also worked smoothly, with no pull from the neck and no wrong influences pulling any unwanted topology.

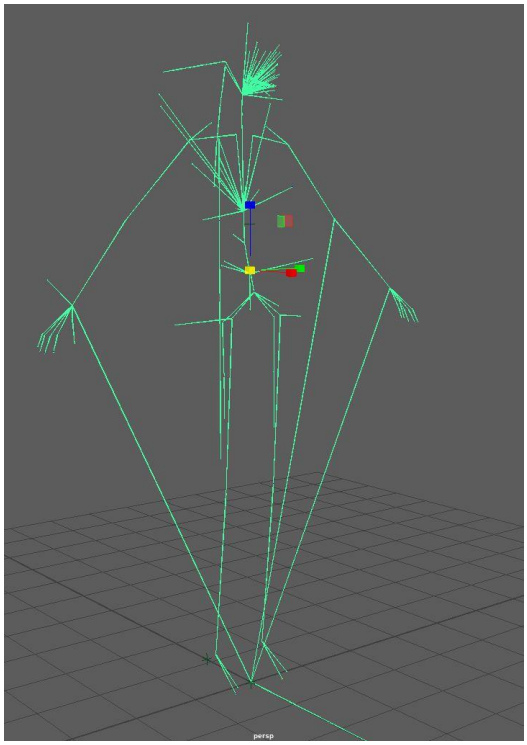


I tested the top half of the model, and the topology moved perfectly. As you can see there is no influence anywhere on the bottom half of the model when the top half is moved, which is exactly what I wanted.

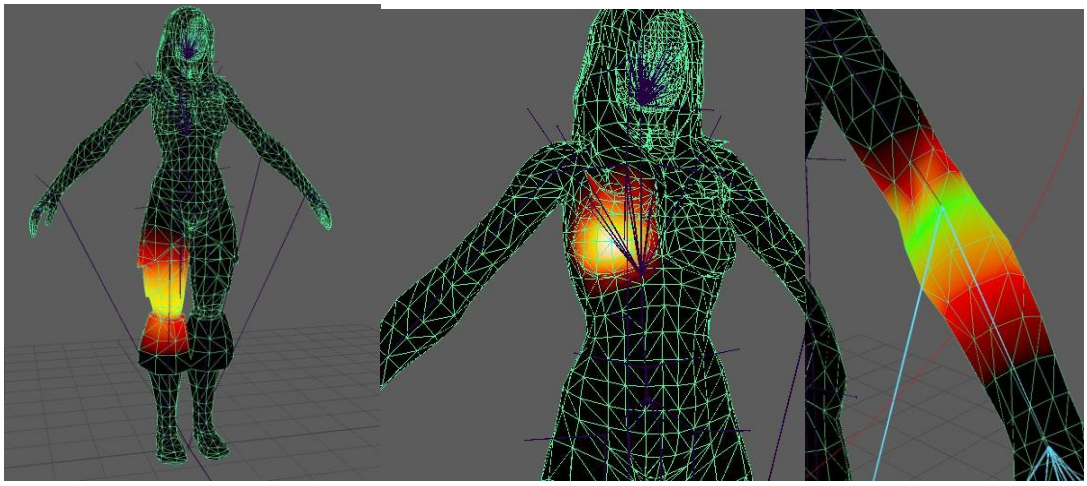


There was no warping and the pole vectors helped tremendously show the direction of the rig. Here are a series of images showcasing my final rig.



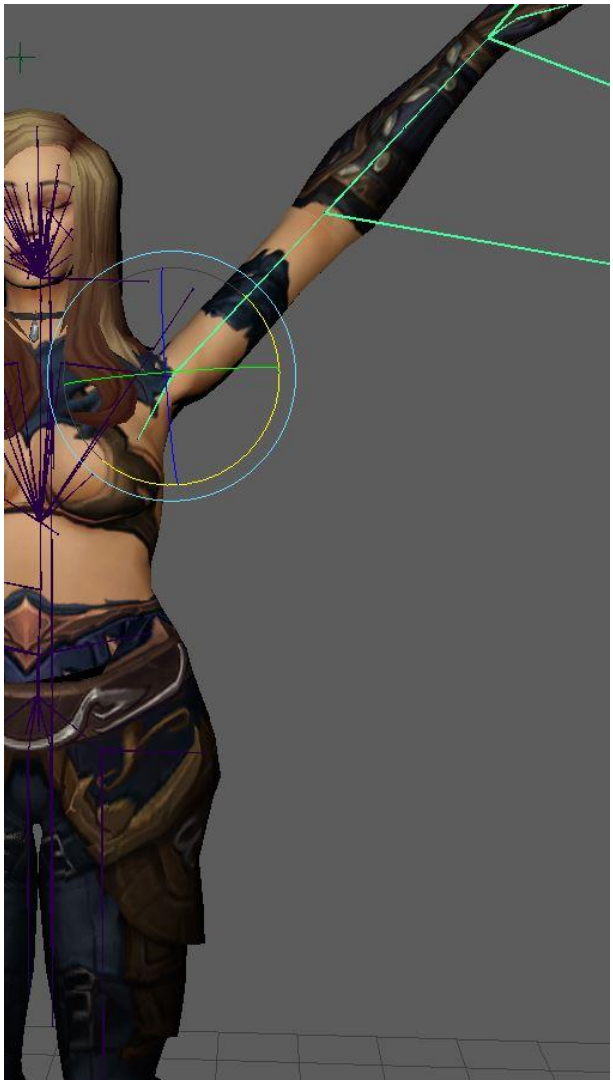


In the future, I will try and see if there are any other features available to help make my rig colourful so I can easily see what is what, as towards the end around the chest and head it started to become very confusing, especially with the fact that I decided to keep the bones stuck outside the model just so I could grab sections of the rig without grabbing the model.



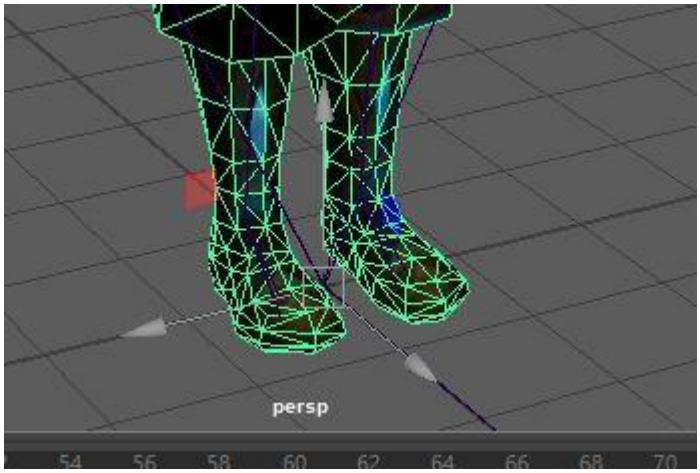
I painted the weights very well, as I was really happy with the new skills I obtained during this process. When the joints are scaled and transformed, they scale perfectly as I am able to resize limbs without having to edit the mesh, I can instead just scale the rig.

For a dramatic example I pulled on the legs, showing how the top half of the model remains still however the rig stays even and does not warp or spike anywhere I do not want.



The arms which I was having issues with earlier also bent perfectly, and I could move them forward, back left and right without any twisting or unwanted topology breaking.

Finally it was time to animate my model. I simply googled ‘casual walking girl’ and used a reference to recreate, grabbing and orienting joints to match the image perfectly. After I finished this, I tried unbinding the rig from the skin and moving the mesh away so I could export it on it’s own, as when I tried exporting it on it’s own and placing it unreal it was not posed. I didn’t know why this was, however I knew it was definitely the rig affecting it however I needed to single out the posed mesh and export it, however I had some problems.



For some reason, the axis of the mesh alone was locked. I eventually found a fix which was going into the general editor window, the control panel, going into the locked tab where I could see that all transformers were locked. I grabbed these and moved them across to the unlocked tab so I could move the mesh. I resaved the maya file as a new name so I had a copy, and tried to delete the rig from the mesh, however when I did this, the mesh would just transform back to the original t-pose. Instead, I went into the group tap in the content browser and found where my mesh was, I held down the middle mouse button and pulled it out on its own away from the group. I could then easily export my mesh and delete all other data.

I began building my environment. I originally opened a showcase map of the Watermill assets from the unreal engine library. My model worked well however I had some texture issues; the model looked glossy like wax, so I played around with the material to fix it. I ended up going into every material and adding 2 constants, both with the value of 1 and plugging them into the metallic and roughness map, which mattified and contrasted my model really well, so it looked realistic. I'm not sure if there is a quicker way to add this to every material however in the future I will research further into my Unreal Engine journey to figure out a quick fix for the glossed models, as it ended up being the same for all of the assets (furniture, weapons, building structures etc) which were exported from WoW Tools.

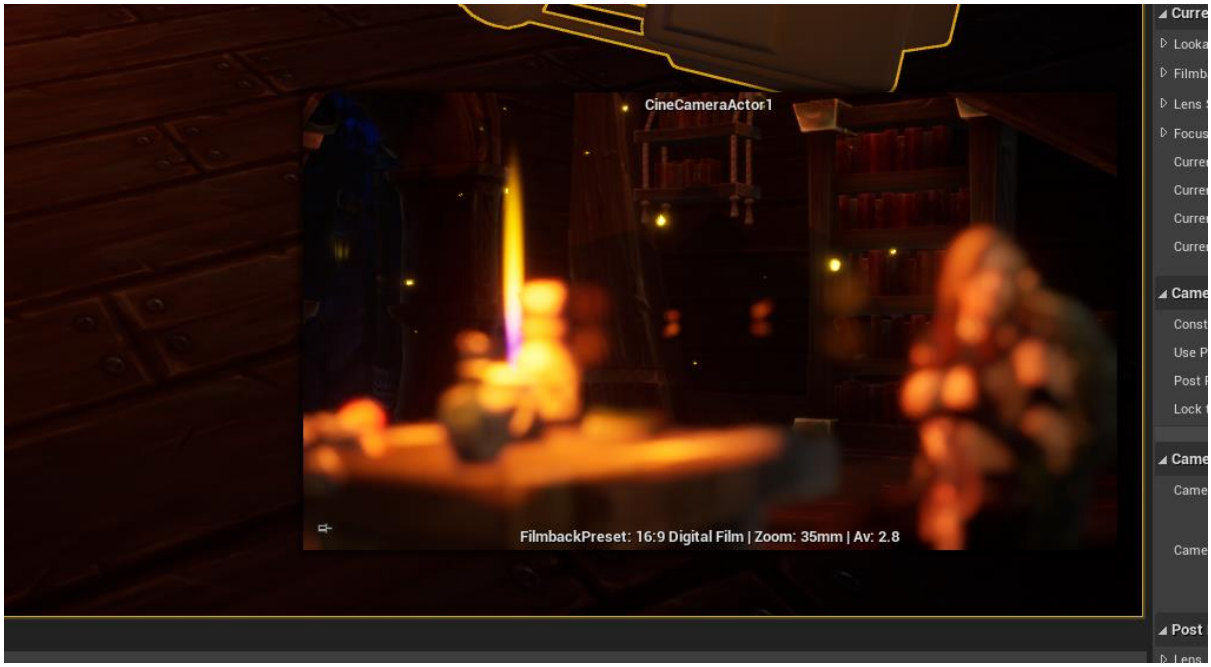
 As you can see on the legs and body, the model was very reflective and waxy.

 This is now what the model looked like after adding the constant values to two of the maps.

I was really enjoying creating these art pieces, so I now wanted to create my own environment using assets from the actual game.

I first imported a large Kul Tiran house from the game, alongside a lot of assets such as chairs, tables, bottles, tarps, chandeliers and more to begin creating an environment inside the building around my character. I imported these all individually, searching for the specific items I remembered from the game.

Here is the finished environment, which started from a completely empty building. I had to go into every single texture and add the constant values to remove the reflective waxy coating on all of the assets which took a while.



I began to play around with the lighting, particle effects and a lot of assets which I had used in previous briefs to set a scene. I added a camera and set event begin play - set view target with blend and referenced my camera actor.

I built the lighting and began to take screenshots of my scene.

I really enjoy how this looks so far and I am incredibly happy with the rig. I'm able to easily modify her and place the character wherever I want in the scene. I will add more lights, and possibly import some assets into maya with the character to rig her around a chair, or with a weapon before importing her back into Unreal Engine.

I added some cold light to contrast with the warmth and was done with my first ever rig!

Evaluation

What happened on the project?

This module helped me build knowledge and practical skills, enabling me to efficiently rig my own 3D character in Maya and import it into Unreal Engine 4 where I can pose it for visual art purposes.. I documented my studies, existing techniques and history of animation. I achieved these aims over the last few months and know a lot of in depth features and techniques to rig again in the future.

What was produced?

I produced a simplistic rig using the base mesh from the content browser in maya, creating joints, bones, IK handles and nurb handles to edit the model. I bound all the skeleton to the mesh and could move the model well. I also produced a series of blend

shapes using a stock head and painted all the weights onto the face, allowing me to create facial expressions. Using these two skills combined, I imported a world of warcraft character mesh and decided to rig her face and body together, including some of the hair. She moved extremely well after a month of building the rig and painting the weights, and was finally able to move almost perfectly. Her body moved great, however the eyelids and hair were still a little bit troublesome, but it was not to worry as it was a great learning experience for me, and would be fixed by using a different mesh.

What did I enjoy the most?

I think that my favourite part of this module was the whole rigging experience. I think this was due to how rewarding the end result was once the character was fully rigged. I loved seeing my character literally come to life and be able to implement her into another software, as well as texture her myself. I really enjoyed learning about the IK handles, the constraints and the parenting within the hierarchy. I found it extremely interesting and am very happy with my new found knowledge on how to rig a character, and in the future can possibly go on to rig non-human forms.

What was the most challenging?

The most challenging part of this brief would definitely be when I first started and tried to create the practise rig on the content browser male mesh. I had so many issues and strange movements when first building the rig, much as the skin not moving with the bones even though it was combined, joints moving the complete wrong way and forgetting which way around I needed to parent bones and joints together. It was a very challenging experience however once I tried and failed multiple times I slowly started to get the hang of the rig and eventually produced a brilliant one. In the future I now know how to overcome these errors even by simply freezing transformations and changing small settings such as offsets and the maya tab itself.

I also found the painting of the weights challenging. Not so much the actual process, but the trial and error factor which came into it, and repeating the same process on every single influence. I found it put me off doing the rig for some time and it felt too repetitive to fire out in one night alone. For this same reason this is why my naming conventions failed to uphold a high standard, as it was easy to forget and repetitive. Next time I will check the weights as I build the skeleton so as to not have to paint them all at once next time. I will also be quicker and more efficient as I am used to the settings of the values and brushes to work quicker.

Feedback from peers?

‘The rig itself looks well made, the legs and arms look well placed, but one thing I noticed is the pole vectors for an IK rig are placed at the base of the mesh. I thought they were supposed to be placed centrally at the back of the elbows at a distance to restrict the movement to match a human. But I cannot see any. If they are there, I would recommend showing them in a screenshot. I also cannot find the Nurbs circles, these are essential to an animator and helps the selection of the limbs for quick animation.
After talking to Eve I found that she has replaced the nurbs circles with bones, these bones are used to control the limbs and after re-examining her development log can see that they work. Overall the rig is complete and is in working order. Well done.’

‘I think your final result looks fantastic. I really enjoy how you posed this model yourself and you clearly have learnt a lot about where the bones belong in the skin and how body parts on humans should move. Looking at your rig itself, I would definitely add some nurbs to help you with this process and try and ever so slightly increase the radius of some of your bones so you can see the hot spots.’

‘Great job, the final render of your mesh looks cool and I really think you did a good job of the scene too. I would add some handles on the model as it looks complicated and make sure they’re labelled better but apart from that great work.’

What did I learn from this feedback?

I really appreciate this feedback and could not agree more. As I do prefer the thin bones in the rig I do think it would be a lot easier if I would have increased the size of just the joints alone so they were easily visible and I could see the centre of them, instead of everything looking like just lines. I also agree with adding some nurbs, possibly small ones based all around the body so I can grab these pole vectors with ease, instead of all the different pole vectors I created being randomly placed and sticking out of the body, all labelled correctly as I forgot to label my assets towards the end of the rig. I really like how my peers liked the look of the pose and enjoyed the end result.

What have I learnt about planning?

Time wise with this module, I took longer intervals on it than the other projects. I felt as though the rigging process was quite repetitive and I wanted to be more creative this term so I focused on other projects more for a while. When I decided that I wanted to create some 3D art in my spare time, I realised that I needed to genuinely rig the character myself if I wanted to do this, so it inspired me greatly to intertwine this into my

What would I do differently next time?

Next time I would work a lot harder on the presentation of my rig to remove the confusion factor. This includes the naming conventions of each IK handle, joints, and the pole vectors created. I'd love to try rigging more characters for 3D art purposes and plan over summer to try and get as much practise as I can before the new year starts in September. I may also try rigging a non human form next time, a quadruped of sorts so that I am able to not only understand and rig the anatomy of a human but instead practise on creatures, as more often than not in games there will be a lot of organisms which need to be rigged which are not basic bipeds. I think it may be fun to try and rig the chinese dragon I made for my other module and see how that goes, however I think that may be a lot more complicated due to the extremely long spine and crazy skull the chinese dragons have. It would be fun to try however, and I think it would aid me in my portfolio as well as give me the opportunity to develop my skills more and think ahead.

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