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### Creating a Short Animated Film with Cloth Characters

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Creating a Short Animated Film with Cloth Characters

By

Elizaveta Alexeevna Kochan

An Undergraduate Thesis Submitted in Partial Fulfillment  
of the Requirements for the  
University Honors Scholars Program  
Honors College  
Digital Media Program  
College of Business and Technology  
East Tennessee State University

  
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Elizaveta Alexeevna Kochan, author May 6<sup>th</sup>, 2020  
Date

\_\_\_\_\_  
Marty Fitzgerald, Thesis Mentor Date

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Greg Marlow, Reader Date

## Abstract

This creative thesis involved making an animated short film from scratch, dubbed “Laundry Day” for the time being. The film follows two sentient clothing characters, a hoodie and a pair of pants, who need to get out of their owner’s room to get to the laundry room after accidentally being left behind. Please watch the short here and use the password “goodiehoodie”:

<https://vimeo.com/415387205>

This was a time consuming, challenging, and multifaceted project, but provided an accurate glimpse into how feature animation is made. The process of making any project like this is commonly called a pipeline, and can be simplified to seven categories: Story, Character, Environment, Animation, Effects, and Rendering. This paper will go into each of these and explain the technical and creative challenges I had to overcome to reach the final product.

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## Introduction

Animated short films are a fascinating art form, as they allow artists to experiment with interesting ideas and tech without the expectations of a full feature. They also function as a microcosm of a real-world production, and thus are great benchmarks for testing one's skills and pushing them to the limit. I have always wanted to take part in one of these experiments to challenge myself, create something worthwhile, and learn something valuable. This document follows the pipeline I had set up for my first short "Laundry Day", from the story drafts to the final rendering processes.

## Story

The first and most important step of making an animated short film is creating the story, otherwise, what would the short be about? The characters of this project were born out of an assignment to make a short about two animate inanimate objects. After a few hours of brainstorming possible object ideas ranging from clocks to snow globes, I ended up settling on socks thanks to their flexibility and relatability. At that point I knew for sure that the duo would team up to find their way to a washing machine. Later, I had the idea to create a humanoid out of clothes, which led me to pick a hoodie and a pair of pants as the main actors. I was also inspired by Pixar's "Lou," a short where the main character is composed of lost items, including a red hoodie. The design and execution of this concept intrigued me, and I wanted to face the same technical problems Pixar did.



Once I had the concept down, I began sketching out possible ideas for what the characters would look like. The duo had to have opposing personalities, as this would give the story some more conflict, and this heavily influenced their designs.

Hoodie ended up being a cheerful, extroverted type who has been at the house for a while, and Pants was new, and was thus unsure of his new surroundings. The designs went through a few iterations- originally Hoodie's eyes were his strings rolled up and the pocket would be the mouth. This looked odd, so I tried putting the eyes inside of the hood itself, but this severely limited emoting possibilities.



Finally, Hoodie got a pair of Groucho Marx glasses, which fit with his personality, stood in for his face, and freed up his hood. Pants was an interesting challenge as well; first, I wanted to use his pockets as his eyes because of their sad, downward curving shape. Not using the belt loop felt like a wasted opportunity though, so I opted for using his tag as eyes instead, which gave him a goofy and endearing appearance. Finally, I chose the complementary colors orange and blue for the pair as it helped to reinforce their personalities and relationship to each other.

After a few more passes of exploration and experimental storyboards, I chose the two above sketches as the final style guide for the main characters and environment. These drawings gave me a solid framework on the characters, their motivations, and the environment - a simple yet cozy student room.



Once the characters got sorted, the next step was working out the details of the story. I knew the beginning and the end- the duo would be left behind by their owner and would escape by assembling, but what would happen in the middle? The first few passes of the script had the clothes talk and banter, but that quickly got thrown out. Hoodie and Pants fit better as silent, yet very emotive protagonists, and focusing on dialogue did not make for very interesting camera choices. As a one-person team I could not spare much screen time on idle chatter when an expression could get the job done faster.

After making a basic 3D model of the room, I made a more sophisticated storyboard. Moving to 3D allowed me to experiment with camera angles, and not needing to redraw the room each time significantly expedited the iteration process.



I took screenshots of the room in Maya, loosely drew over them in Photoshop, and assembled everything into a video using Premiere and Photoshop's animation function. This basic video draft of the animation is called an animatic, and is used to figure out the timing and rhythm of the piece. Instead of having the characters talk to each other, I focused a lot more on showing how and why they had to come together instead of explaining it. Many small changes were made at this step, and I showed each iteration to family, friends, and mentors to make the story as clear as possible.

Up to this point I had much grander plans for the project - Hoodie and Pants would get into a bunch of trouble after leaving out the door, as they would run through the rest of the house. However, as I made the animatics, the sheer amount of work I would have to do just to get them out in the first place became abundantly clear, and I had to scale back to focus on the



first minute of the story. If I had a bigger team like an actual studio did, this vision could be possible, but at the end of the day I was only one person with a limited amount of time. This was a painful decision to make- I was very invested in the idea and already had a few assets built for the rest of the house- but looking back, this let me really polish the room, the characters, and the animation, so it was a worthy sacrifice to make.

By the time the final skeleton of the animatic took form, I had created basic rigs, or puppets, of the characters. This allowed me to finally move the entire production out of the drawing phase and into 3D by making a layout pass. This version acts as the bridge between the animatic and the final production, where artists figure out the timing of the character and camera movements in 3D before adding details. At this point, animation and textures were not important, so Hoodie and Pants slid around on a gray floor with unnatural and stiff movements, but it was exactly what I needed to visualize the product in 3D and start setting up my files for production.



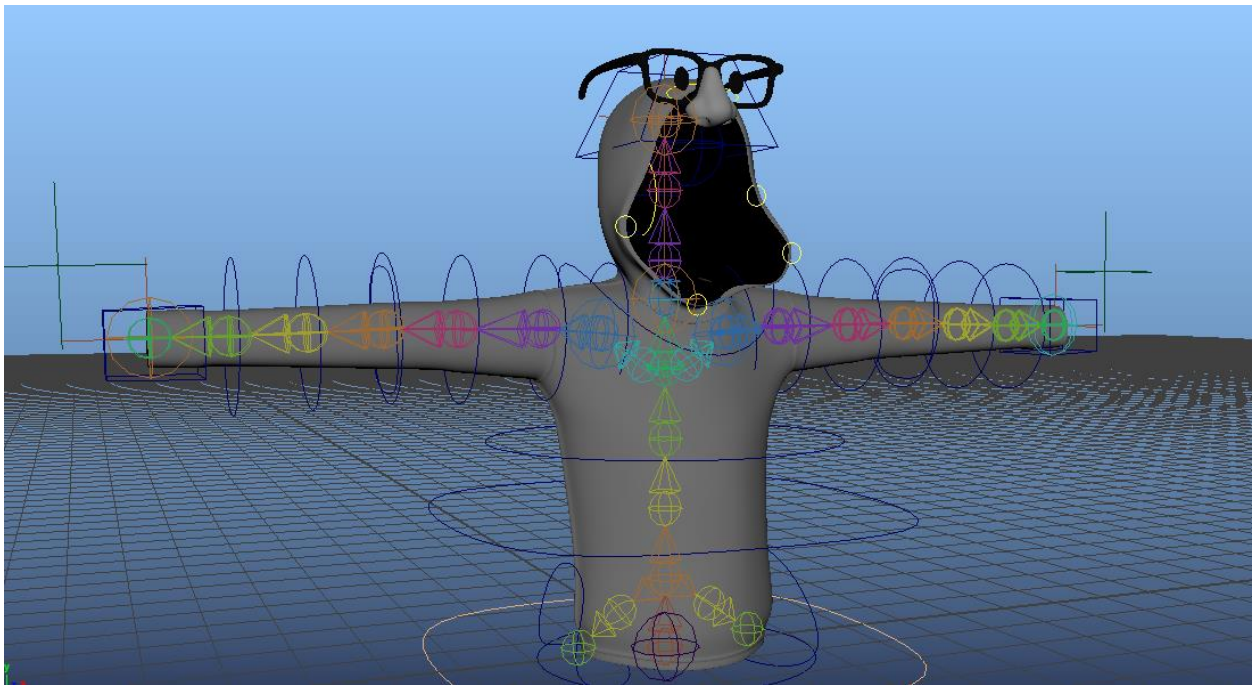
Looking back at this lengthy process, it is easy to ask- is it necessary to go through so many rough passes? Why not just jump into detail right off the bat instead of wasting time making animatics and layouts? Unfortunately, creating an animation is an extremely time-consuming process, and these first few steps are where the most important decisions are made. If the story and camera angles are not nailed down from the beginning, artists waste a lot of time making work that never gets shown in the final product. Overall, I spent roughly one or two months nailing down what I really wanted out of the short, and the rest of the two years were dedicated to making good work based on the foundation.



## Characters

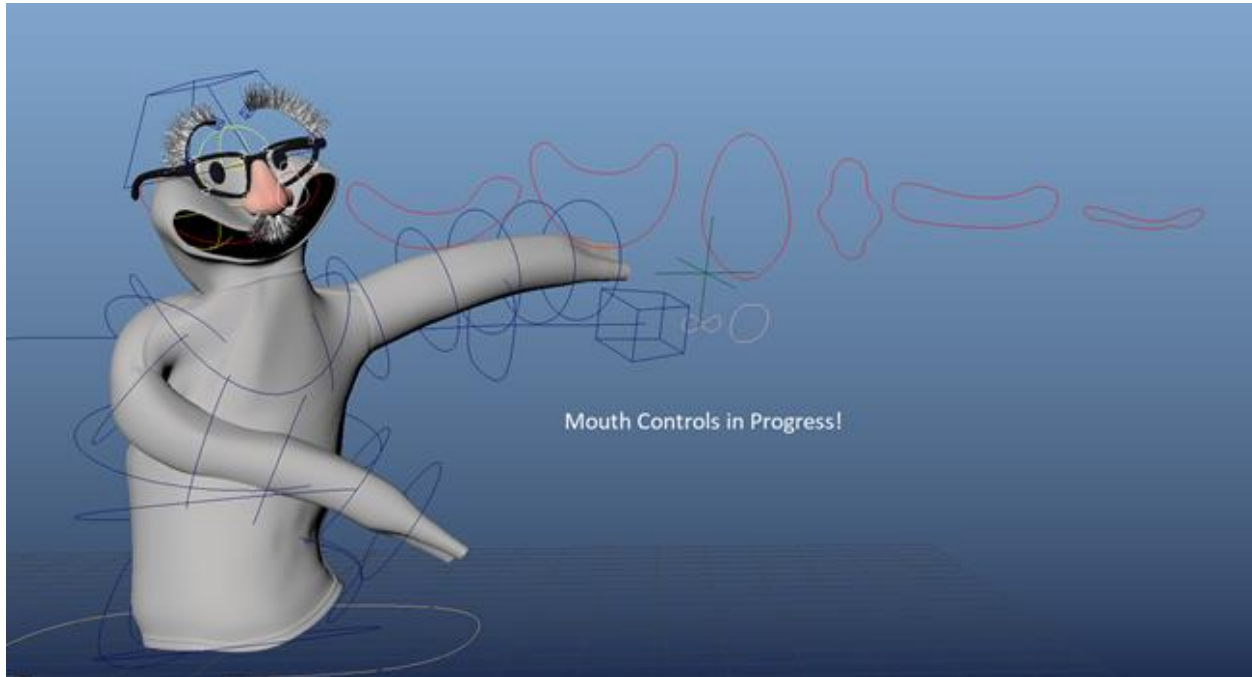
Because of my limited time, I began roughing out 3D work immediately after deciding on the most important details. While the story beats could change, I had a strong idea for what the characters and environments would look like, so I went ahead with making the actors and the environment. Unfortunately, I did not have the time to create a human character, so I used CGTarian's Ray, a free rig created for educational purposes. The rest of the 3D assets were all scaled to this character to make the environment feel believable.

The first and most important hurdle I had to overcome was creating Hoodie, especially solving the problem of turning his hood into a mouth. My goal with the rig was creating a setup where I could change mouth shapes on the fly in appealing ways. Traditionally, animation puppets are made of a 3D mesh which is skinned to a digital armature made of joints. This method works perfectly fine for the body of the character, which is what I ended up doing for Hoodie's body and sleeves. The mouth, however, required a different approach. Skinning his mouth with just joints or similar influence objects did not give a very pleasant result, as neighboring mouth controls did not affect each other. This gave Hoodie's face a rubbery and uncanny effect, seen below.



After several failed attempts, I realized that instead of using joints as individual influences I could try using a curve instead. This would be the equivalent of gluing a string around Hoodie's mouth and pulling it around. Thankfully, this worked well- after I created a curve that matched the shape of Hoodie's mouth and attached it using a wire deformer, the rest of the hood would drag along in a more natural way. On top of this I wanted to have the option to create custom curve shapes which might be difficult to make with my controlled setup, so I

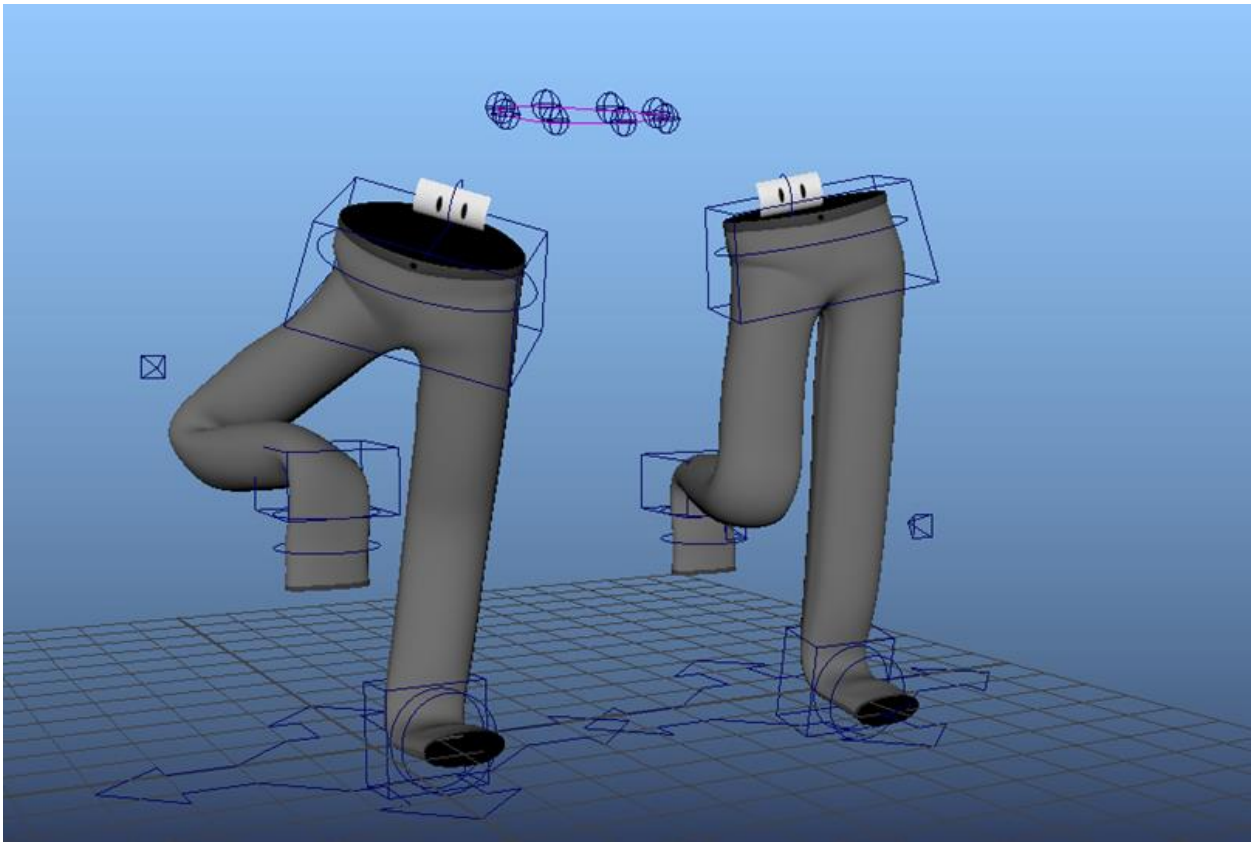
added a blend shape collection which let me quickly swap between the skinned curve and my custom presets.



Another glitch with Hoodie's production came much later down the line when I started making animations with him. This was a shortcoming on my part, but the first major version of Hoodie had way too many joints in his arms. In brief animation tests this looked fine, as his arms did not need to do anything complex. In fact, the wiggly look served the tests well, as the extra joints let the arms move in entertaining ways. Later however, his arms needed to behave realistically, especially in cases where he needed to keep his hands in place and let the rest of the body move. The existing rig did not let him do this at all, and his arms twisted and popped instead. Eventually, I had to go back and completely restructure his arms, and while it was quite annoying in the moment, it made a big difference in the final animations.



Pants was significantly simpler to rig than Hoodie and took less time. For one, legs are in general easier to rig than the torso and arms, and he was using the same mouth system Hoodie did, which I had figured out by this point. He took a few iterations, but in the span of a couple of weeks I had a complete puppet, while Hoodie took an entire semester to finish. He had two versions- one where his legs bent forward and one which bent backward. This prevented his mesh from deforming and twisting, which was vital for cloth simulation to work smoothly. I could move his eyes by keying his UVs, and his blinks I created separately in Premiere and imported back into Maya as an animated texture.

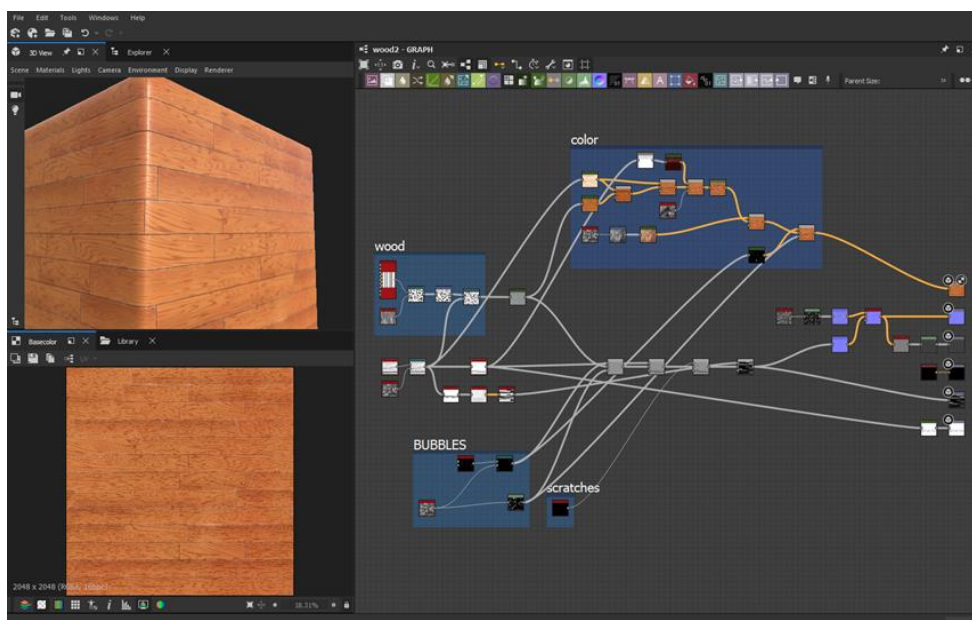




## Environment



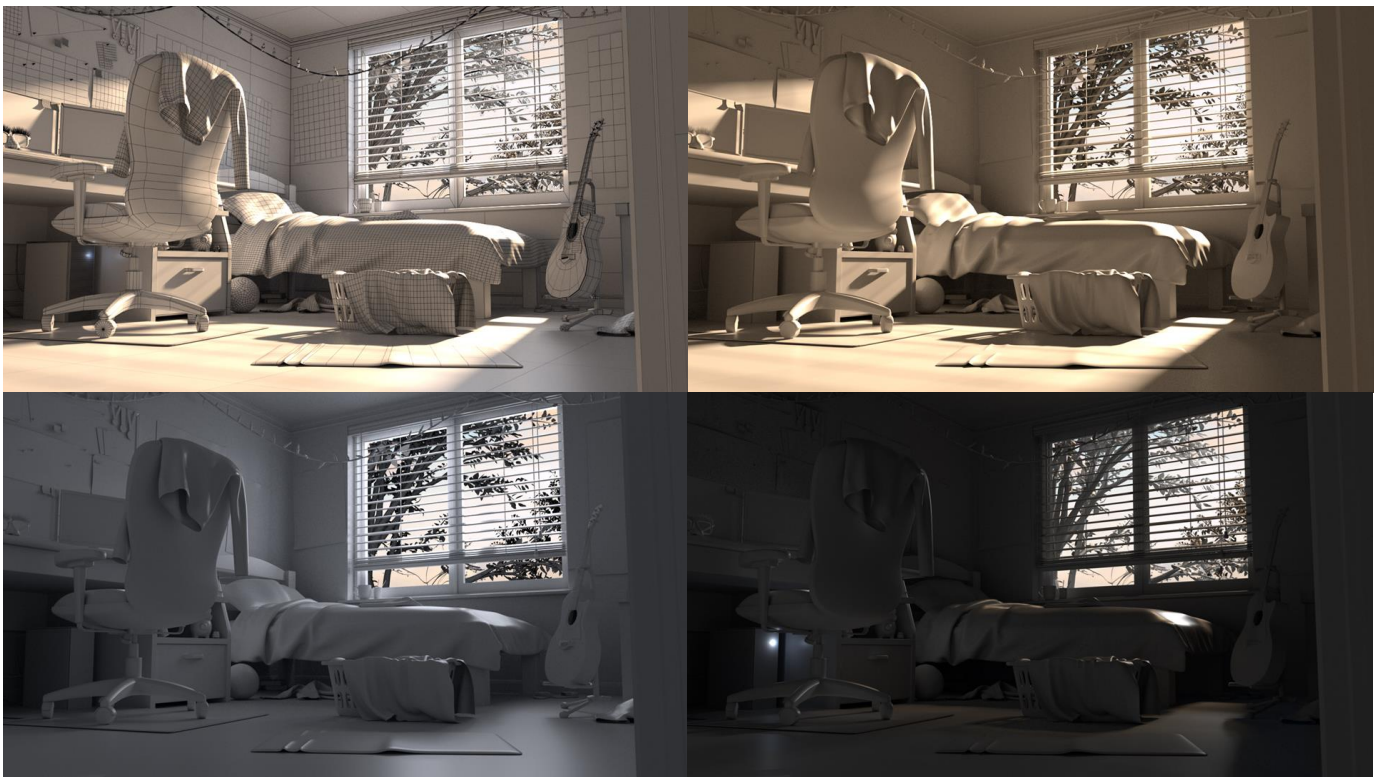
From the start I had a good idea of the look I wanted to accomplish for the room: warm, comfortable, and pleasant to look at. Andy's room from Toy Story 3 was a massive help for referencing the clutter and lighting. Creating it all from scratch was no easy task; to make any environment feel truly lived in, one needs to add lots of insignificant details, which can be a huge time and patience sink. This room alone took me an entire semester to make. To make the most of my time I planned my short in a way such that only the western side of the room had the most screen time, and this let me focus on one really appealing view.



Most of the textures were made in Substance Designer, a relatively new program which allows artists to procedurally create textures from elements like tiles and stripes. Above is an example of what the program looks like and how I set up the floor texture. Designer boasts an impressive node-based workflow

which allowed me to link up various effects and elements to quickly create professional textures. To make the floor, I added wood swirls, scratches, and wore out the edges of the tiles to give it a realistic appearance. This approach was used throughout the whole project, from the bed to the rug to the chair.

To light the room, I decided to move the window from behind the table like I had in the concept sketches to the west wall. If I kept the first setup, Hoodie would have way too intense of a light behind him, which did not match the mood I wanted. Moving the window over the bed lit Hoodie from screen right and nicely illuminated the center of the room. However, sunlight alone was not enough to fill the space, so I added small individual lights to give the illusion of bouncing rays. These lights fell into three categories: direct sun rays, ambient sky lights, and small extra lights emitted by objects and the sky dome. This setup had to be tweaked a few times to remove redundant lights, but the result was very appealing and natural. As I started rendering out the final shots, I would occasionally need to add extra lights to make the characters pop from the background.



## Animation and FX

Once the layout, puppets, and environment were done, I was ready to move into final production. This leg lasted around a semester and a half and included animating each of the sixteen scenes, applying effects and additional lighting to the characters, rendering each shot, and finally putting everything together in video form.

Making things move in general is a very time consuming and meticulous process no matter what form it takes. In the case of 3D, once the animator sets the poses they want their characters to strike, the program evenly interpolates from one to the other. This sounds great at first, but unfortunately the motions computers make are floaty, mathematical, and bland. For a more believable performance, artists need to go through multiple passes to give the program information and refine details.



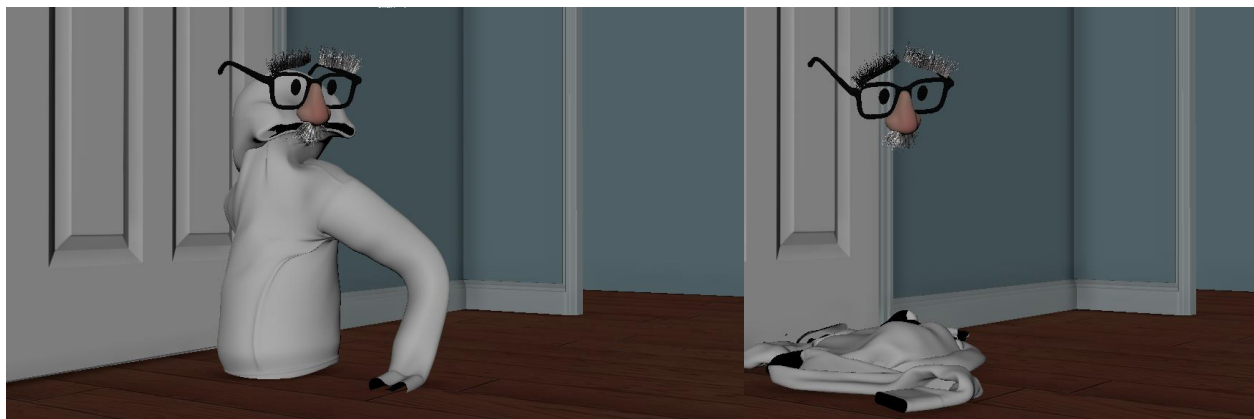
When animating Hoodie and Pants, I focused on poses with strong silhouettes and personality, as well as smooth motion arcs (pictured above). I did not want there to be any sudden distracting jags in the movement, which didn't fit floppy and soft cloth characters. I took lots of video references of myself and various volunteers for this project, but always made sure to not limit myself to it; in some cases, I improvised a scene based on rhythms and motions I visualized beforehand. Some of the harder scenes, like Hoodie and Pants getting up off the floor, took a week or two to fine tune, while simpler 1-2 second shots took a day each.

Once all the animation work in a shot was complete, the next step was making the meshes of Hoodie and Pants behave like cloth. Trying to replicate physical behavior like this by hand is very difficult, so I used a setting in Maya that processes each object as if it were really

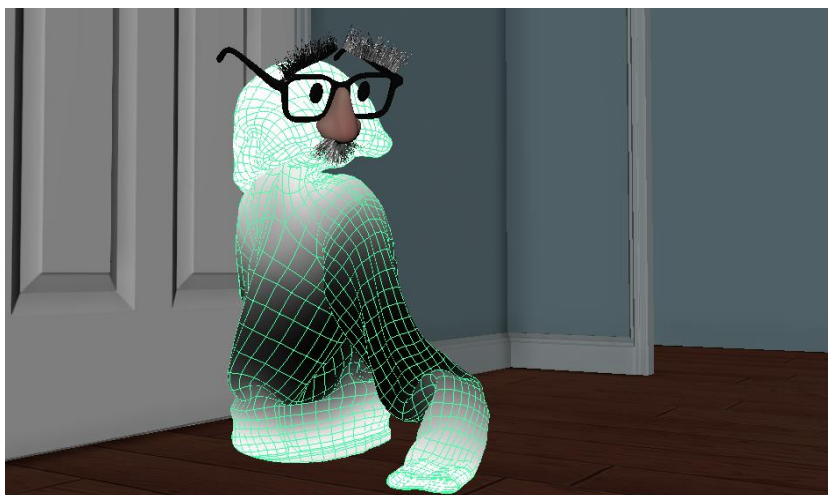


made of clothing. This technique is called simulation and is commonly used in the industry for hair, cloth, water, and so on.

In my case, I would take the finished animation of each character and export it out into a geometry cache. This separates the mesh from the influence of the rig and stores the vertex animation in a different file. After importing this cache back into Maya, I converted it into an nCloth object, telling the program to calculate each vertex as if it were connected to its neighbors and influenced by gravity. However, this alone is not enough to complete the effect- once an object is converted to nCloth, it ignores the animation data and anticlimactically crumples to the floor. Not very helpful.



To fix this, I used an nCloth function called “Input Mesh Attract,” which let me “paint” areas on the model to follow along with the input information. If I painted some vertices to be set to 1, they would move to match the input mesh shape. However, if I set a vertex to a value of .5, it would still simulate the cloth but blend 50% of the original animation into the sim. This allowed me to retain specific features, like Hoodie’s mouth, his “feet” and his hands, but let his torso and arms flop around and feel loose.



Here you can see the process in action: everything that is painted white follows along with the original mesh, but the dark sections behave however they please as they are set to 0. Each shot required a slightly different paint job, but overall, the approach was always the same. Pants and Hoodie had their mouths



completely follow with the mesh to keep the original expressions intact, and the tips of their “arms” drove the motion.

As for the behavior of the cloth itself, Maya has dozens of sliders and switches that affect density, thickness, stickiness, flexibility, and so on. If one isn’t careful, the cloth can have very ridiculous results...



To avoid these catastrophes, I used professionally made cloth presets that came prepackaged with Maya. In most cases, these give excellent results, but still need to be tweaked from time to time for specific scenarios. For Hoodie, I used LooseThickKnit, and for Pants I used HeavyDenim, which acted like their namesakes. Most of the time, I would need to adjust the presets’ thickness or self-collision strengths for the most painless and good-looking results. After reaching the look I wanted, I exported the cloth to another geometry cache as I didn’t need to run any more simulations.



Even then, these results were not always perfect. In very dense areas, like Hoodie's chin and his armpits, the vertices would get crowded and push themselves out in unpredictable ways, as you can see above with the black blotches. In the end I resorted to smoothing out the mesh with sculpting tools and then keyframing groups of vertices, or deleting the offending vertices altogether. While this was the most efficient solution, Maya did not really like it at first and crashed often. I learned to avoid editing large swaths of the mesh at once to keep the program from getting overwhelmed.

Finally, after all the problems in the cloth pass were solved, I could flesh out the effect by giving the characters volume. Up to this point, the meshes were all a single plane thick, and while it helped with efficiency, it also made the characters look more like paper than actual cloth. I couldn't simulate mesh with volume either, as the neighboring planes would start colliding with each other and cause more trouble than it was worth. After digging around for a while, I stumbled on a YouTube tutorial describing a cloth workflow where one could stick a mesh with higher resolution to a lower resolution cache. This was a defining moment for me in the project, as this technique took the look of the cloth to the next level and made it feel less like a computer-generated object.



Above you can see the difference between the animation pass and the final cloth look. All that was left to do at this point was render out the shots and composite them together into a final video. This animation to cloth workflow alone took approximately 120 hours overall to complete.

## Rendering and Compositing

The last step in making a 3D animation is rendering the scenes and stitching the frames together in video editing software. In computer graphics, rendering or image synthesis is the process of generating images based on meshes, textures and lights that are placed in the scene. To make the illusion of motion, long sequences of images are rendered out one by one and then processed into a video.



Near the beginning of the rendering process, I experimented with splitting up each scene into just the background, the characters, and their shadows, assembling everything later to form a complete frame. Due to the complexity of the background, each frame would take 2 hours to render, but Hoodie and Pants alone would take 5-10 minutes per frame, so separating the renders this way let me save a lot of time.

In the end, the short ended up being roughly 20 seconds longer than I had anticipated. While the original animatic and layout passes worked fine in their limited mediums, in the end I wanted to have the animation feel a little slower paced.

## Conclusion

This was a long and exhaustive process, but it gave me a great look into the animation pipeline and a solid portfolio piece. Despite the technical and creative challenges I went through, one of the greatest lessons I gained from this project was learning how to time myself and efficiently weave each leg of the pipeline to get as much done as a one person team. While this thesis outlines the process in a very linear way, the production itself was a bit more turbulent- the story and 3D assets were being created at the same time, and near the end of the project I often had to take turns between tweaking renders and animating the next shot. I have also learned (the hard way) that I need to design my rigs more carefully to include a broad and practical range of motion, and that not thinking everything through the first time could have lasting consequences on production. Essentially, measure thrice, cut once.

While most of the work on the short is complete, there are still a few things I plan to do before officially releasing to the public. First off, I plan to add sound effects and music to the short to enhance the experience. Most likely I will find these on stock websites. I also plan to go back and tweak some minor render glitches to really polish the film up before sending it out. Overall, however, I am very pleased with this project. I was able to learn a lot about Maya, effect simulation, and the artistic process, and hope to apply these valuable lessons to future projects.



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