ITP 315 3D Character Rigging and Animation
Units: 4
Fall 2019 – Tuesdays/Thursdays 3pm-4:50pm

Location: KAP 107
Course notes and resources on Blackboard.usc.edu.

Instructor: Lance Winkel
Office: OHE 530 H
Office Hours: Tuesdays / Thursdays 8am-10am, 2-3pm
Contact Info: winkel@usc.edu, 213.740.9959.
I check email daily and will reply within 24 hours.

Teaching Assistant:
Office: Physical or virtual address
Office Hours:
Contact Info: Email, phone number (office, cell), Skype, etc.

IT Help: Group to contact for technological services, if applicable.
Hours of Service:
Contact Info: Email, phone number (office, cell), Skype, etc.
Course Description
Explore the performance methodologies and advanced rigging processes used to bring life to 3D characters for games, cinematics, and performance animation.

Learning Objectives
Students will begin with a crash course in performance and animation fundamentals. Subsequent projects will take the student through the entire production of an original 3D character including organic modeling, character setup, and texturing. Students will learn how to plan out a rigging strategy based on script and storyboard. They will build skeletons, apply skin deformation and weights for proper flexion, incorporate constraints, customized controls for arc-based FK and goal-based IK movements, scripted and keyed connections, and build in controls for added performance efficiency. Characters will be animated into a complete performance reel. Pipelines for motion capture data and incorporation with game engines will also be explored.

Prerequisite(s): ITP 215
Co-Requisite(s): None.
Concurrent Enrollment: None.
Recommended Preparation: None.

Course Notes
Lecture slides, notes, and course resources, will be posted on Blackboard.usc.edu.

Technological Proficiency and Hardware/Software Required
Understanding of either Mac or Windows operating systems and general software use. Autodesk provides free academic licenses of the Maya and Motion Builder software that we will be using for this course.
Adobe Cloud provides discounted academic accounts but is not required if using lab computers.
Houdini, V-Ray, Nuke, and other software packages may be useful, but are not required.
ITP offers Open Labs which are posted at itp.usc.edu. ITP also offers remote desktop access for students enrolled in ITP courses. Instructions will be posted on Blackboard.usc.edu.

Required Readings and Supplementary Materials
- An Essential Introduction to Maya Character Rigging (Paperback)
- Character Modeling with Maya and ZBrush (Paperback)
- Maya Techniques: Hyper-Real Creature Creation (Paperback)
- MEL Scripting a Character Rig in Maya (Paperback)

Course slides are available on Blackboard.usc.edu
Autodesk Maya Online Documentation at knowledge.autodesk.com
Lynda.com via Blackboard.usc.edu
V-Ray https://www.lynda.com/V-Ray-training-tutorials/1173-0.html
Houdini https://www.sidefx.com/learn/collections/quickstart-houdinis-interface/

Description and Assessment of Assignments
Consult the Assignment posting on Blackboard.
Grading Breakdown

- Animation Project One (1 of 3) = 10 points
- Animation Project One (2 of 3) = 10 points
- Animation Project One (Finished) = 20 points
- Character Project (1 of 4) = 10 points
- Character Project (2 of 4) = 10 points
- Character Project (3 of 4) = 10 points
- Character Project (Finished) = 20 points
- Rigging Project (1 of 5) = 10 points
- Rigging Project (2 of 5) = 10 points
- Rigging Project (3 of 5) = 10 points
- Rigging Project (4 of 5) = 10 points
- Rigging Project (Finished) = 20 points
- Final Animation Project (1 of 3) = 10 points
- Final Animation Project (2 of 3) = 10 points
- Final Animation Project (Finished) = 50 points
- Final Exam = 50 points
- Participation = 30 points
- Total = 300 points

Grading Scale (Example)

Course final grades will be determined using the following scale

- A  95-100
- A- 90-94
- B+ 87-89
- B  83-86
- B- 80-82
- C+ 77-79
- C  73-76
- C- 70-72
- D+ 67-69
- D  63-66
- D- 60-62
- F  59 and below

Assignment Rubrics

Assignment details and grading rubric will be posted along with the assignment as it is posted.

Students with questions are encouraged to attend office hours for critique and to make sure they are understanding the scope of the assignments as detailed.

Assignment Submission Policy

All homework will be submitted on Blackboard. Detailed instructions and resources for each assignment will be posted on Blackboard along, http://blackboard.usc.edu

Grading Timeline

Grades will be posted within a calendar week after the submission due date.

Additional Policies

- Make-up policy for exams: To make up for a missed exam, the student must provide a satisfactory reason (as determined by the instructor) along with proper documentation. Make-up exams are generally only offered in emergency situations.
- Before logging off a computer, students must ensure that they have saved any work to either a USB drive or a service such as Dropbox. Any work saved to the computer will be erased after restarting the computer. ITP is not responsible for any work lost.
• ITP offers Open Lab use for all students enrolled in ITP classes. These open labs are held beginning the second week of classes through the last week of classes. Hours are listed at: http://itp.usc.edu/labs/.
Course Schedule: A Weekly Breakdown

Week 1 – Introduction and review of animation principles

Day 1
- Introduction to the class
- Overview of course plan and objectives
- Review of basic animation principles

Day 2
- Planning a performance based on story
- Thinking through and breaking down motions
- Weight, mass, and physicality
- Arced verses linear motion
- Staging and animation layout in a 3D scene
- Posing to the camera

Reading
- Review slides and course notes on Blackboard
- Character Modeling with Maya and ZBrush, Chapter 1 and 2

Project
- Animation Project One (Week 1 of 3): Using a video camera, record several takes of a five to ten second performance that reveals a character dramatically changing emotions. While using another person as an actor is okay, for the purposes of understanding the physicality of the performance, it is much more preferable for you to act out the performance yourself. Also, shoot several subsequent shots of the action with the actor emoting to the camera for facial study. Isolate the best performance. Using the supplied character rig, block out the actions for the performance as key poses. Strong gesture and silhouette are encouraged. Due Week 2.

Week 2 – Intermediate Animation and Timing Techniques

Day 1
- Initial layout critique
- Building stronger poses and factoring in timing
- Speed, performance, and the illusion of motion
- Persistence of vision

Day 2
- Review of animation curve editing tools and techniques
- Understanding “what is real?”
- Predicting the audience’s innate sense of expectations
- Anchoring limbs
- When to move, when not to move
- The illusion of friction

Reading
- Review slides and course notes on Blackboard
- Character Modeling with Maya and ZBrush, Chapter 3 and 4
- An Essential Introduction to Maya Character Rigging, Chapter 1 and 2

Project
- Animation Project One (Week 2 of 3): Based on initial critique, refine and improve the key poses to enhance and push the performance. Continue adding keys and fleshing out the main physical performance. Due Week 3.

Week 3 – Facial Animation Techniques

Day 1
- Preparing and importing audio for facial animation timing
- Animating faces for emotion and dialogue
Facial GUI vs. facial joint array vs. blend shape driven expressions

**Day 2**
Performance critiques – in class  
Fine tuning performance

**Reading**
Review slides and course notes on Blackboard  
Character Modeling with Maya and ZBrush, Chapter 5 and 6  
An Essential Introduction to Maya Character Rigging, Chapters 3 and 4

**Project**
Animation Project One (Week 3 of 3): With the physical performance captured, and a camera setup to center on the face, import the audio and animate the facial phonemes. Due Week 4.

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**Week 4 – Fundamental Character Modeling Techniques**

**Day 1**
Character design fundamentals  
Defining “what is the story?” and “who is the character?”  
Designing a character to directly support the story

**Day 2**
3D Modeling fundamentals  
Building a smart and efficient character base mesh  
Overview of pipelines and software tools for character modeling (Maya, Mudbox, ZBrush, Poly, Subdiv, NURBS, etc.)  
Planning the modeling process

**Reading**
Review slides and course notes on Blackboard  
Character Modeling with Maya and ZBrush, Chapter 7 and 8  
Maya Techniques: Hyper-Real Creature Creation, Lesson 1 and 2

**Project**
Character Project (Week 1 of 4): Based on a rough concept and the story details handed out in class, design the character to support the modeling, rigging, and animation that will be required throughout the remainder of the course. Block out the character using the techniques demonstrated in class. Due Week 5.

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**Week 5 – Musculature and Detail Modeling Techniques**

**Day 1**
Intermediate 3D character modeling concepts and techniques  
Edge loops  
Details, contours, and profile

**Day 2**
In-class character in-progress model critiques  
Silhouette and staying on character  
Musculature and anatomy  
Flexion, range of motion, and structure to support movement

**Reading**
Review slides and course notes on Blackboard  
Techniques: Hyper-Real Creature Creation, Lesson 3

**Project**
Character Project (Week 2 of 4): Fix any early design issues, overly complex geometry, proportion problems, and/or bad edge loops. Add in details and musculature evenly across the entire character, taking care not to overwork any specific area too heavily too quickly. Remember that every vertex should contribute to the shape of the object.
Vertices that are not contributing to shape are a waste and should be removed, or adjusted. Fingers, muscles, and details should be complete. Due Week 6.

**Week 6 – Facial Modeling Techniques**

**Day 1**
- Defining facial features and anatomical primitives
- Modeling eyes
- Modeling teeth and mouth
- Modeling eyelids and anatomical face structure (NURBS vs. polygon)

**Day 2**
- Facial modeling and edge looping techniques
- Assembling all the pieces
- Seamlessly integrating and unifying all the pieces

**Reading**
- Review slides and course notes on Blackboard
- Maya Techniques: Hyper-Real Creature Creation, Lesson 4

**Project**
- Character Project (Week 3 of 4): Fix any problems. Work out any shape or proportion problems before moving on to the facial features. Starting with anatomical primitives, model in the eyes and mouth with attention to strong evenly distributed edge loops. With eyes and mouth complete, model in the remainder of the facial details, and then combine all of the facial features into the head. Due Week 7.

**Week 7 – Character Model Cleanup and Rigging Preparation**

**Day 1**
- Final cleanup considerations
- Clothing, armor, and prop building
- Incorporating Props
- Preparing to make the character move

**Day 2**
- In-class character full model critiques
- World centering the character
- Freezing transforms
- Deleting history
- Node orientation

**Reading**
- Review slides and course notes on Blackboard
- Maya Techniques: Hyper-Real Creature Creation, Lesson 5
- MEL Scripting a Character Rig in Maya, Chapter 1

**Project**
- Character Project (Week 4 of 4): Refine and add any final anatomical details to the character. Build in any remaining clothing, armor, and props. Cleanup the model and complete final preparations to rig the character beginning next week. Due Week 8.

**Week 8 – Character Skeleton Construction**

**Day 1**
- Cursory overview of the range of available character rigging tools and techniques
- Understanding character movements and kinematics
- Predicting the needs of a character rig based on story necessity
- Building skeletons to drive 3D character movement
- Planning Joint Arrangement for pure FK, IK, Spline IK, Dynamic Musculature, and other specialized character needs.
- Dual-root and Multi-root Joint Hierarchies

Syllabus for COURSE ID, Page 7 of 5
Day 2
Review of hierarchies, history, and deformation order
Goal vs. arc based motion
How to plan and organize an efficient, durable, and sound character node network

Reading
Review slides and course notes on Blackboard
Maya Techniques: Hyper-Real Creature Creation, Lesson 6 and 7
An Essential Introduction to Maya Character Rigging, Chapters 5 and 6

Project
Rigging Project (Week 1 of 5): Assess the needs of story and begin rigging the character model by building a skeleton joint hierarchy. Completely name all joints. Freeze transforms, orient joints, incorporate IK/FK to address the performance needs, and any additional controls as necessary. Due Week 9.

Week 9 – Character Skinning Techniques
Day 1
Proper posing for healthy character deformation
Relaxed Pose vs. T-Pose
3D Character skinning techniques

Day 2
Painting and refining character skin weights
Deformation systems
Cables, hoses, clothing armor, and other accessories

Reading
Review slides and course notes on Blackboard
Maya Techniques: Hyper-Real Creature Creation, Lesson 8, 9, and 10
An Essential Introduction to Maya Character Rigging, Chapters 7 and 8

Project
Rigging Project (Week 2 of 5): Properly align the character rig and joint skeleton. Bind the character to the rig and begin resolving any problems with the initial bind. Due Week 10.

Week 10 – Facial Rigging Techniques
Day 1
Techniques for facial deformation
Blend shape based facial movement
Modeling facial deformation targets
Joint based facial movement

Day 2
Hybrid facial rigs
Advanced topics on deformation order
When to GUI or not to GUI

Reading
Review slides and course notes on Blackboard
Maya Techniques: Hyper-Real Creature Creation, Lesson 11, 12, and 13
MEL Scripting a Character Rig in Maya, Chapter 2

Project
Rigging Project (Week 3 of 5): Assess the needs of the performance to determine which expressions need which type of deformer based on the character model. Temporarily zero out the influence of the bind deformation. Duplicate the geometry of the character, and begin modeling facial expressions and phoneme targets. Once complete, apply the expressions to the character using a blend shape deformer. Build and add joint influence for any additional joint driven expressions. Due Week 11.
Week 11 – Advanced Character Rigging and controls

**Day 1**
Modeling custom wire controllers
Wire controller generators, scripts, and plug-ins

**Day 2**
Character control and integration
Custom attributes and advanced control techniques
Connecting attributes, expressions, and set driven keys

**Reading**
Review slides and course notes on Blackboard
Maya Techniques: Hyper-Real Creature Creation, Lesson 14, 15, 16
MEL Scripting a Character Rig in Maya, Chapter 3

**Project**
Rigging Project (Week 4 of 5): Add attributes and control nodes as necessary to streamline performance. Use expressions and driven keys to better automate animation of the character. Due Week 12.

Week 12 – Character Rig Final Phase Testing Methods

**Day 1**
Peer-Review and Peer-Evaluation
Hands on testing of the completed character rig

**Day 2**
Customizing interface and camera controls to optimize the animation process.
Developing the story for the final animation project

**Reading**
Review slides and course notes on Blackboard
Maya Techniques: Hyper-Real Creature Creation, Lesson 17 and 18
MEL Scripting a Character Rig in Maya, Chapter 4

**Project**
Rigging Project (Week 5 of 5): Based on the in-class testing and feedback for the character rigs, make final changes and improvements as necessary. Lock and hide unnecessary or vulnerable aspects of the rig. Story concepts and storyboards are also due. Due Week 13.

Week 13 – Preparing to animate

**Day 1**
Camera and scene setup
Props
Blocking in for elaborate movement and interaction

**Day 2**
Actor accessories (swords, guns, devices, ropes, ladders, vehicles, platforms, etc)
Transitioning between hand, holster, and free movement
Working with dynamics and other scene complexities

**Reading**
Review slides and course notes on Blackboard
MEL Scripting a Character Rig in Maya, Chapter 5

**Project**
Final Animation Project (Week 1 of 3): Make story changes and improvements to storyboards and layout based on in-class critique. Begin animating the final project. See the Final Project details below.

Week 14 – Enhancing character performance with dynamic effects

**Day 1**
Critique of blocked-in animation

**Day 2**
- Adding Dynamic effects to enhance character performance
- Object emission characteristics
- Surface matting techniques
- Dust, rain, sweat, splashing, fire, and wind techniques

**Reading**
- Review slides and course notes on Blackboard
- MEL Scripting a Character Rig in Maya, Chapter 6

**Project**
- Final Animation Project (Week 2 of 3): Continue work on the final project. Incorporate dynamic effects to the final as necessary.

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**Week 15 – Special Topics in Character Animation and 3D Special Effects**

**Day 1**
- Combining a 3D character convincingly into a live action scene
- Matching lighting, texturing, and surface details
- Special topics in character animation and visual effects
- Integrating effects with live actors

**Day 2**
- Critique of full performance
- Remaining time will be Final Exam Study Session

**Reading**
- Review slides and course notes on Blackboard
- See Blackboard for additional slides and assigned reading.

**Project**
- Final Animation Project (Week 3 of 3): Finish the Final Project for review in-class Day 2 of Week 15.

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**Final Exam – Thursday, December 7, 2-4pm, OHE 542**
- All students must attend Final Exam session!
- Multiple choice, Bring pencil and eraser, No make-ups!

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**ITP 315 – Final Project:**
Create an animated sequence using your rigged 3D character puppet. The animation must be at least twenty seconds long, but can be made up of many separate consecutive shots.

**Performance:**
A significant event is about to occur. This can be something positive or negative, heartwarming or bone chilling, sublime or action packed. You may choose the event, but the character must express a significant emotional response and dramatically respond to this event. Throughout the performance, your animated character performance should demonstrate the following:
- Walk cycles, Run cycles, Relaxed Poses, and other general performance cycles should be assembled into Poses and Clips using non-linear Characterized performance workflow.
- The animated character cannot stand in place and it must move and rotate outside of a single axis.
- Feet and other limbs must not slide relative to the stage, ground plane, or background plate, when they are in contact with the ground.
- Limbs must remain registered to any props when they are in contact with them.
- Character facial gestures should be synchronized with some dialogue or audio track or go through a significant range of expression that is APPROVED BY THE INSTRUCTOR if not synced to audio.
- Camera setup and placement to enhance performance
• Furthermore, the performance must demonstrate the fundamental animation principles that we have discussed:
  o Squash and stretch
  o Anticipation
  o Follow through
  o Overlapping
  o Staging
  o Slow in and slow out
  o Arcs
  o Secondary motion or action
  o Timing
  o Exaggeration
  o Aesthetic quality
  o Appeal

**Staging:**
To finish the project, the Character will need to be performing and interacting relative to a simple environment. Even a simple set will do, but you can use other models you have made, or sets, or footage. Try to make sets look clean. If using footage, make it look quality. This space will serve as a stage or set for the performance, and can be created with any or a combination of the following methods:
  • 3D geometry
  • Composite Sets made up of 2D images projected against 3D Geometry
  • 2D background plates

**Grading Criteria:**
The Final project is worth 50 points.
  • Demonstrated effort (10 points)
  • Complexity, range, and effective use of tools (10 points)
  • Quality of the finished product
    o Animation performance (20 points)
    o Visual quality (10 points)

Have fun! Make awesome work!
Statement on Academic Conduct and Support Systems

Academic Conduct
Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” https://policy.usc.edu/scampus-part-b/. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems
Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

National Suicide Prevention Lifeline - 1-800-273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. http://www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. https://engemannshc.usc.edu/rsvp/

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. http://dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. https://studentaffairs.usc.edu/ssa/

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. https://diversity.usc.edu/

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, http://emergency.usc.edu

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.
Provides overall safety to USC community. http://dps.usc.edu