



USC

ITP 361 – Character Rigging for Games

Units: 4

Fall 2024

Lecture: Monday 10:00 am - 11:50 am

Lab: Wednesday 10:00 am - 11:50 am

Location: DMC 252

Instructor: Rashi Sinha, Scott Easley

Office: EGG 207

Office Hours: TBD

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TA: Dora Tsai

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Course Description

Learn the fundamentals of character rigging for video game production and development. Incorporate both technical and artistic input to create a malleable and solid character rig for use in any game. Explore IK/FK, vertex weighting, and blendshapes to construct several rigs with hands-on teaching and unique assignments every week. This course utilizes the study of real-world skeletal hierarchy and muscle systems to mimic a similar but digital rig in Maya, pushing it further alongside recent rigging innovations such as sliding muscle simulation, corrective blendshape and human pose estimation libraries.

Catalogue Description

Explore game character structure, mass, weight, and translate those into creating an entire working 3d character animation rig. Both artistic design and technical stability are optimized for any 3d character to be animated with stability and ease.

Course Interrelations

The basic differences between the classes of modeling, rigging and animation for a 3d character can be applied to the centuries-old tradition of marionette puppetry: Modeling is the carving and painting of the character from wood, rigging is the addition of hinges and strings to allow controls for a puppeteer, and animation would be the puppeteer using the various controls to simulate life in the marionette.

Learning Objectives and Outcomes

- Create a complex skeleton rig onto a lo-poly 3d character mesh for movement in a game engine.
- Compose unique rigs for any addendum meshes on the character (Props, Hair, Clothing).
- Arrange intuitive folder structure for team projects and automated updates.
- Construct blendshape libraries for character expression and spoken phonemes.

Prerequisite(s): ITP 215 or CTAN 452

Recommended Preparation: Any experience with 3d character rigs.

Course Notes

This course will assign a letter grade.

Students will submit work via Brightspace, and by showing builds to instructors and peers in class.

Technological Proficiency and Hardware/Software Required

The class uses the 3D software Maya 2024. Students are required to sign up for the educational free trial. Students not using lab computers or personal laptops can contact the instructor early in the semester to sign up for the ITP laptop loaner program.

USC Technology Support Links

[Brightspace help for students](#)

[USC Computing Center Laptop Loaner Program](#)

[Software available to USC Campus](#)

Lecture and Lab

Class will be divided between lecture and lab. Lecture is in the first half of class (MW 10:00 am – 10:50 am) and the lab is in the second half of the class (MW 11:00 am – 11:50 am).

Description and Assessment of Assignments

Items listed as ‘Homework’ are assignments that the student should be finished with to keep up in class, whereas items listed and underlined as ‘Deliverables’ are assignments to be handed in (using either Brightspace or a Google Drive as set up by the CTA) as a graded project.

Course Project: The purpose of the course is to be able to build a unique animation rig for any 3d modeled character. Students need to identify the issues specific to any characters’ unique topology; sample models will be provided to students in the first half of class, and a unique model per student in the latter half. Working as a group is acceptable with the understanding each student individually turns in a rig and if their separate 3d character models are similar enough in topology. A team can consist of no more than 4 persons.

Project Timeline:

- Week 2: In-class check of Maya installation and Google Drive access
- Week 5: Prototype Rig due (IK/FK, One-tenth number Weighting, Yoga animation)
- Week 8: Mid-term Goblin Rig due (Custom bone creation, IK hands, custom controllers)
- Week 14: Unique Character assignment and rigging report (issues with topology, proposed solutions)
- Final: Final Rigging due (review from assignee, problems, and pivot solutions)

Sample Project: Creating a skeletal structure from scratch to animate both the body and face of an existing 3d character model, as well as creating easily accessible controls that puppet that skeleton. The goal of this project is to develop an understanding about how character rigs are used by animators so that construction of any rig is intuitive and user-friendly.

Project Purpose: Any rigging for a character has to account for that character’s unique needs within the game. The rigger must communicate with the person or team who needs the rig to and collect all relevant data for the end-goal of the character; how it moves, what their purpose is, and various other descriptions or information relevant to the character. The student needs to specifically identify one or more challenges in designing a character rig for export into the game engine, application, or similar visual media.

Grading Breakdown

Assignment	% of Grade	Due
Weekly Deliverables	50	Ongoing

Midterm Rig Deliverable	20	Week 10
Final Rig Deliverable	30	Week 15
TOTAL	100	

Assignment Rubrics

Assignments and Homework are due at the beginning of class of the assigned week and expected to be clear of extra and unconnected groups, history, constraints, expressions or other ‘rogue’ setups that do not affect the rigging in Maya to gain full points on the above breakdowns for deliverables.

Missing an Assignment Deadline, Incompletes:

The only acceptable excuses for missing an assignment deadline or taking an incomplete in the course are personal illness or a family emergency. Students must inform the instructor **before the assignment due date** and present verifiable evidence in order for a deadline extension to be granted. Students who wish to take incompletes must also present documentation of the problem to the instructor or student assistant before final grades are due.

For assignments turned in after the assignment deadline without prior permission from the instructor, a penalty will be imposed equal to 10% of the total available points for the assignment, for each day or part of a day that the assignment is late, up to a maximum of seven days.

Attendance Policy:

Punctual attendance at all classes is preferred to provide the best feedback loop for your character rigs, but accommodations can be made for asynchronous attendance if the student contacts the instructor early in the semester. Please contact the instructor before any absence from class or communicate as early as possible any special exception to attend class asynchronously. Make sure to also communicate equally with the CTA.

Social media, including text messaging and internet messaging, are excluded from class unless explicitly permitted by the instructor.

Diversity

In making games and interactive media in a professional and ethical way, it is important that you consider diversity. When looking at your projects, you should consider who is depicted and how this work will impact others. What kinds of individuals and communities are represented in your work? What point of view does your work express? This class may assist you in learning how to make work that includes diverse viewpoints, and may discuss racial, religious, gender and sexual orientation issues in the context of games and interactive media.

Creating an Inclusive Space

In this class, we make a commitment to foster a welcoming and supportive environment where students of all identities and backgrounds can flourish. This means that you will be expected to offer content warnings when appropriate, use students’ stated pronouns, and respect self-identifications. While debate and discussion are welcome, please remain aware of the implications of your words and the images that you include in your work. If the instructor or another student points out something problematic, avoid being defensive; this is a valuable opportunity for us to grow and learn together. If you have a concern about any aspect of the class, you are welcome to speak with the instructor or the advisor for the division.

Additional Policies

This course emphasizes teamwork, and one of the desired learning outcomes is for students to develop communication and leadership skills. Students are expected to treat each other with respect, listen to each other, and work together towards a shared, collaborative, healthy work culture. Any student found to be disruptive or engaging in behavior that doesn't meet the standards of respectful teamwork may be asked to leave by the instructor.

If you experience any problems with a fellow student regarding their work, please bring up your concerns with the instructor.

Course Schedule: A Weekly Breakdown

****Subject to change****

	Topics	Lectures and Lab	Deliverables
Week 1 Aug. 26th Aug. 28th	Class expectations and methodologies. Components, concepts, and deliverables for the course will be discussed. Proficiency Survey: Forms and interviews will take place to acquire student artistic skill sets for interests and outcomes of class	Using Maya to control and animate a rig. <i>Lecture:</i> What is a 'rig', keyframes, and IK/FK switching in Maya. Simple and easy control sets <i>Lab:</i> <i>Experiment with needs for rig to use inverse and forward kinematics and when to use either. Set static keyframes to check deformations.</i>	Homework: Animate rigged 'Skyrig' character doing a pushup move using IK/FK system and basic pose keyframing.
Week 2 Sep. 2nd 9/2 Labor Day NO CLASS Sep. 4th	Creating joints Skinning Paint Weights on proxy Dragon head	Bone Placements, Deformations: Weighting Skins to hierarchical joints <i>Lecture:</i> No class. <i>Lab:</i> <i>Basic joint placement. Skinning and Percentile weighting through 3d painting in Maya</i>	Homework: Paint weights on existing skyrigged Naruto SDK.
Week 3 Sep. 9th Sep. 11th	Using a rigging script to automatically create basic biped rig. How and when to use rigging scripts versus custom builds Yoga animation to check deformation and areas of limitation (Ex: heavily-armored fighters) Spreadsheet weighting – finer detail, better accuracy, much slower pace but superior results	Rigging Scripts and skeletal hierarchy <i>Lecture:</i> Creation of separate hierarchies of joints, controls, and meshes. rigging processes created through a script or saved template files. Use various camera views to determine character joint location to use a rigging script. <i>Lab:</i> <i>Utilizing Attribute Editor to polish and refine one-tenth decimal weighting for character mesh. Go over baseman rig and clean up the weights ring-by-ring.</i>	Homework: Use automatic rigging script 'Skyrigger' to place a rig on the baseman mesh. Paint weights, then clean up weights using the component editor and add Yoga animation to check deformations.

<p>Week 4 Sep. 16th</p> <p>Sep. 18th</p>	<p>Constraints and Nurbs shape controllers for IK & FK controllers.</p> <p>IK/FK switch setup, set driven keys, custom channels</p>	<p>Controllers for animations</p> <p><i>Lecture:</i> Three joints set up for arm with IK and FK controllers using nurbs shapes</p> <p><i>Lab:</i> Set up an IK/FK switch for the arm joints using set driven keys and custom channels.</p>	<p>Homework: Set up a base rig for the dragon head with IK neck and controllers. Add an animation to show the working rig and post a movie on Discord.</p>
<p>Week 5 Sep. 23rd</p> <p>Sep. 25th</p>	<p>Nurbs curves controllers, layers and drawing overrides.</p> <p>Dragon Head: custom rig set up with ik/fk controllers, skinning, weighing, jaw inputs.</p>	<p><i>Lecture:</i> Create custom shapes for controllers using nurbs curves. Controller placement and display settings.</p> <p><i>Lab:</i> Create a custom joint set up for the dragon head with Ik chain for neck, controllers, jaw input slider, skinning and weighting.</p>	<p>Homework: Set up a base rig for the dragon head with IK neck, controllers and custom jaw inputs. Skin and polish weights. Add an animation to show the working rig.</p>
<p>Week 6 Sep. 30th</p> <p>Oct. 2nd</p>	<p>Goblin mesh : arm rigging, Joint orientations</p>	<p>Joint orientations, animator friendly rigs</p> <p><i>Lecture:</i> Load mesh, separate out the arm. Set up a custom rig for the goblin arm, correct joint orientations and animate arm bend and fingers.</p> <p><i>Lab:</i> Create IK/FK system for goblin arm using set driven keys, animator friendly controllers. Custom rig for ball. Interactive arm and ball animation.</p>	<p>Homework: Golin arms rigged with IK/FK system and controllers. Custom Ball rig with switch to stick to hand. Animate goblin arms with the ball.</p>
<p>Week 7 Oct. 7th</p> <p>Oct. 9th</p> <p>10/10 - 10/11 FALL BREAK</p>	<p>Phonemes & Expressions</p> <ul style="list-style-type: none"> ● Blendshapes ● Sculpt tools ● Soft select ● Extra rigged models (Ex: Tongue) 	<p>Rigging Needs for Faces</p> <p><i>Lecture:</i> Blendshapes library through soft select, 3d sculpting and warp deformers.</p> <p><i>Lab:</i> Work on creating expressions for goblin head and animation.</p>	<p><u>Deliverable:</u> <u>Assignment</u> Goblin Arm animation and Goblin head rigged with 2 blendshapes and animated expressions. Follow submission instructions provided by TA.</p>

<p>Week 8 Oct. 14th Oct. 16th</p>	<p>Biped Full Body rig with blendshapes</p>	<p><i>Lecture:</i> Goblin mesh, determine which sections deform and how. Set up a custom skeleton for a full body.</p> <p><i>Lab:</i> Create a full body rig (custom skeleton, skinned and weighted) for Goblin mesh including head joints and blend shapes.</p>	<p>Homework: Rigged Goblin mesh with component Editor assignment of weights to one decimal place, 2 blendshape expressions and Yoga animation to showcase working skeleton.</p>
<p>Week 9 Oct. 21st Oct. 23rd</p>	<p>IK/FK set up. Creating control sets for easy and accessible animator use.</p>	<p><i>Lecture:</i> IK setup for Goblin, FK controllers and IK/FK switch</p> <p><i>Lab:</i> Finish Goblin rig with complete IK/FK setup and yoga animation.</p>	<p>Deliverable: Assignment (MIDTERM) Rigged IK/FK Goblin mesh with component Editor assignment of weights, 2 blendshape expressions and Yoga animation to showcase the working rig. Follow submission instructions provided by TA.</p>
<p>Week 10 Oct. 28th Oct. 30th</p>	<p>Advanced Skeletons Full-body rig Facial rigs</p>	<p><i>Lecture:</i> Use the advanced skeleton auto-rigger to create a rig for the body of the given mesh. Test with posing.</p> <p><i>Lab:</i> Download as_guy mesh. Using the auto-rigger to create advanced facial rigs including, eyes, eyebrows, teeth, mouth shape. Animate face.</p>	<p>Deliverable Assignment: Full Advanced rig (body and face) setup on "as_guy" mesh using the auto-rigger plugin. Pose the body and animate the face.</p>
<p>Week 11 Nov. 4th Nov. 6th</p>	<p>Rigging with expressions</p>	<p><i>Lecture:</i> Expressions, rigging on car wheels.</p> <p><i>Lab:</i> Rig horse tail to blow in the wind.</p>	<p>Deliverables Assignment Rigged and animated tail</p>

Week 12 Nov. 11th 11/11 Veterans Day NO CLASS Nov. 13th	Understanding animator needs and planning rigging pipeline.	Final Mesh <i>Lecture:</i> No class <i>Lab:</i> <i>Understanding rigging needs outlined by an animator and how to plan custom rigs around it.</i>	Homework: Work on rigging the nightcap head mesh.
Week 13 Nov. 18th Nov. 20th	Constraints for eyes and accessories.	<i>Lecture:</i> Constraints requirements for eyes, glasses. <i>Lab:</i> <i>Create a facial and head rig for nightcap head including the hat, eyes/glasses, brows, mustache etc.</i>	Deliverables: Assignment Rigged and animated nightcap head. Follow submission instructions provided by TA.
Week 14 Nov. 25th Nov. 27th No Class 11/27 - 12/01 Thanksgiving Break	Intro quadruped mesh Rig up quadruped bone locations depending on research and mesh edge flow	Lab: Rig final character (centaur) basic body, basic head	Work on final rig
Week 15 Dec. 2nd Dec. 4th	Verifying individual IK FK systems for chosen character (Ex: arms, legs, props). Determine priority of legs and body deformations	Lab: Final Character IK/FK arms (and/or legs) Add yoga animation.	FINAL Deliverables: Follow assignment and submission instructions provided by TA.
Finals Week Dec. 11th - Dec 18th	Submit final rigged character	Character shown complete with 'yoga' animation to show working major joint deformations (Hips, knees, elbows, spine)	Final Presentation: Showcase of final rigged character exported into a game engine doing 'yoga' moves as a deformation test/turnaround. Also presented is the research as well as critiques with improvements for the character.

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”

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, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call

suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298

equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776

dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)
ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.