



# USC

**ITP 361 – Character Rigging for Games**

**Units: 4**

**Spring 2022**

**Lecture: Tuesday 12:00 am - 1:50 pm**

**Lab: Thursday 12:00 pm – 1:50 pm**

**Location: KAP 267**

**Remote:** Zoom Room info on class Blackboard

**Instructor: Scott Easley**

**Office:** EGG 207

**Office Hours:** TBD

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**CTA:** Rashi Sinha

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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 Blackboard, and by showing builds to instructors and peers in class.

### Technological Proficiency and Hardware/Software Required

The class uses the 3D software Maya 2019. Students are required to sign up for the three-year 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.

### Lecture and Lab

Class will be divided between lecture and lab. Lecture is in the first half of class (Thursday 9:30 am – 12:30 pm) and the lab is the second half of the class (Friday 2:00 pm – 4:00 pm).

### 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 Blackboard 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	
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### 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\*\***

	<b>Topics</b>	<b>Lectures and Lab</b>	<b>Deliverables</b>
<b>Week 1</b> Jan 11, Jan 13	<p><b>Class expectations and methodologies. Components, concepts, and deliverables for the course will be discussed.</b></p> <p><b>Proficiency Survey: Forms and interviews will take place to acquire student artistic skill sets for interests and outcomes of class</b></p>	<p><b>Using Maya to control and animate a rig.</b></p> <p><i>Lecture:</i>            What is a 'rig', keyframes, and IK/FK switching in Maya.            Simple and easy controlsets</p> <p><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></p>	<p><b>Homework:</b>            Animate rigged 'Skyrig' character doing a pushup move using IK/FK system and basic pose keyframing.</p>
<b>Week 2</b> Jan 18, Jan 20	<p><b>Using a rigging script to automatically create basic biped rig. How and when to use rigging scripts versus custom builds</b></p>	<p><b>Rigging Scripts and skeletal hierarchy</b></p> <p><i>Lecture:</i>            Creation of separate hierarchies of joints, controls, and meshes. rigging processes created through a script or saved template files</p> <p><i>Lab:</i>  <i>Use various camera views to determine character joint location to use rigging script. Take 'baseman' mesh and rig it using Skyrigger</i></p>	<p><b>Homework:</b>            Use automatic rigging script 'Skyrigger' to place a rig on the baseman mesh.</p>
<b>Week 3</b> Jan 25, Jan 27	<p><b>Paint weights on rigged baseman</b></p> <p><b>Yoga animation to check deformation and areas of limitation (Ex: heavily-armored fighters)</b></p>	<p><b>Deformations: Weighting Skins to hierarchical joints</b></p> <p><i>Lecture:</i>            Percentile weighting through 3d painting in Maya</p> <p><i>Lab:</i>  <i>Paint the weighting for existing baseman mesh onto existing skyrig. In-class tutorial and video tutorial. Cut/paste animation file to prove weighting accuracy.</i></p>	<p><b>Homework:</b>            Polish weighing assigning of mesh control vertices using painting weights for baseman rig, then place 'yoga' animation on it.</p>

<p><b>Week 4</b> Feb 1, Feb 3</p>	<p><b>Spreadsheet weighting – finer detail, better accuracy, much slower pace but superior results</b></p> <p><b>Weight baseman</b></p>	<p><b>Spreadsheet Weighting</b></p> <p><i>Lecture:</i> Utilizing Attribute Editor to polish and refine one-tenth decimal weighting for character mesh.</p> <p><i>Lab:</i> Translate character to 1000 units to check weighting, using copy, prune or hammer weights for optimization</p>	<p><b>Deliverable:</b> Precisely weighted baseman rig vertices using attribute editor spreadsheet to one decimal place – turn in to class Google Drive before start of class.</p>
<p><b>Week 5</b> Feb 8, Feb 10</p>	<p><b>Setting up custom bones. Study biology for real-life examples of skeletons and bone proximity to skin</b></p> <p><b>Skinning</b></p> <p><b>Setting up default workspace</b></p> <p><b>Poly loops</b></p>	<p><b>Default workspace and Bone placement</b></p> <p><i>Lecture:</i> Creating Maya project per project. Studying biology to determine optimal joint placement.</p> <p><i>Lab:</i> Download Goblin mesh, determine which sections deform and how. Head is separate mesh. Set up custom skeleton.</p>	<p><b>Homework:</b> Place custom bones throughout entire body of provided Goblin mesh – no facial.</p>
<p><b>Week 6</b> Feb 15, Feb 17</p>	<p><b>Creating IK/FK joints. When to use them and why. Creating control sets for easy and accessible animator use</b></p>	<p><b>Set Driven Keys for IK/FK switching</b></p> <p><i>Lecture:</i> Set driven keys greybox setup, then apply it to Goblin mesh. Determine triage of systems for next weeks.</p> <p><i>Lab:</i> Create IK/FK switch in goblin for arms.</p>	<p><b>Homework:</b> Create IK/FK controller with set driven keys as template. Once complete, re-create the IK/FK switch for arms on the Goblin.</p>
<p><b>Week 7</b> Feb 22, Feb 24</p>	<p><b>Nurbs curves controllers, connecting to layers for visibility toggle</b></p>	<p><i>Lecture:</i> Custom NURBS controllers, deviating shape and color for clarity as a 3d UI.</p> <p><i>Lab:</i> Create full body rig for Goblin. IK/FK arms, IK legs, FK body, driven by NURBS controllers.</p>	<p><b>Homework:</b> Attribute editor spreadsheet-weighted Goblin with FK/IK controls on arms.</p>

<p><b>Week 8</b> Mar 1, Mar 3</p>		<p><b>Review weighting of Goblin and quality check using Yoga animation. Review deep bends for hinge joints (Ex: knees) and lesser range of movement (Ex: ankles)</b></p>	<p><b>Deliverable:</b> Midterm of rigged IK/FK arms Goblin with Attribute Editor assignment of weights to one decimal place and Yoga animation, uploaded to class Google Drive. Due at beginning of class.</p>
<p><b>Week 9</b> Mar 8, Mar 10</p>	<p><b>Phonemes &amp; Expressions</b></p> <ul style="list-style-type: none"> <li>● Blendshapes</li> <li>● Sculpt tools</li> <li>● Soft select</li> <li>● Extra rigged models (Ex: Tongue)</li> </ul>	<p><b>Rigging Needs for Faces</b></p> <p><i>Lecture:</i> Blendshapes library through soft select, 3d sculpting and warp deformer</p> <p><i>Lab:</i> Create blendshape library of 3 phonemes and 3 expressions.</p>	<p><b>Homework:</b> Make blendshape heads from Goblin head mesh</p> <ul style="list-style-type: none"> <li>- Phonemes</li> <li>- Expression</li> <li>- Mouth Bags</li> <li>- Tongue/Teeth</li> </ul>
<p><b>Week 10</b> Mar 22, Mar 24</p>	<p><b>Order of operations affecting rig. Hierarchy of adding to rig using inputs of blendshapes, weighting deformer and other influences.</b></p>	<p><b>Stacking deformer and operators – inputs and influences</b></p> <p><i>Lecture:</i> Connecting addendum controllers to existing rig.</p> <p><i>Lab:</i> Create eye controls, expression controls on existing body rig</p>	<p><b>Homework:</b> Make blendshape heads with new jaw and eye controllers.</p>
<p><b>Week 11</b> Mar 29, Mar 31</p>	<p><b>Reference goblin rig Cut/paste yoga Add hat to rig using references, prove automated 'update' to any animations.</b></p>	<p><b>References</b></p> <p><i>Lecture:</i> Setting up a pipeline for team of animators. Examples of mid-production problems and several possible solutions</p> <p><i>Lab:</i> Plan working pipeline for your final assigned character.</p>	<p><b>Homework:</b> Test out a 'horse leg' IK/FK system</p>
<p><b>Week 12</b> Apr 5, Apr 7</p>	<p><b>Receive final mesh Students list issues with rigging by reviewing the mesh and researching the moves expected in game from that character. Study biology of similar real-world skeletons</b></p>	<p><b>Final Mesh</b></p> <p><i>Lecture:</i> Planning rig and pipeline structure pipeline for your specific mesh and the team of animators.</p> <p><i>Lab:</i> <b>Begin rigging and pipeline creation.</b></p>	<p><b>Homework:</b> Receive final mesh of quadruped, plan and schedule how to rig character for animation.</p>

<b>Week 13</b> Apr 12, Apr 14	<b>Intro quadruped mesh Rig up quadruped bone locations depending on research and mesh edge flow</b>	<b>Lab: Rig final character basic body, basic head</b>	<b>Homework:</b> Body and head has one hierarchical skeleton with one-decimal weighting.
<b>Week 14</b> Apr 19, Apr 21	<b>Verifying individual IK FK systems for chosen character (Ex: arms, legs, props). Determine priority of legs and body deformations</b>	<b>Final Character IK/FK arms (and/or legs)</b>	<b>Homework:</b> Tertiary control systems for legs, body and facial.
<b>Week 15</b> Apr 26, Apr 28	Export and upload finished rigged character complete with custom 'Yoga' animation to show deformations	Rigged character exported in following formats: Separate FBX file and ASCII Maya file – and corresponding yoga- animation playblast. Uploaded to Google Drive Folder for class.	<b>Final Deliverables:</b> <b>Uploaded into class Google Drive</b>
<b>Final</b> May 4-11 (Finals Week - Exam Days)	<b>Present final rigged character to class</b>	<b>Character shown complete with 'yoga' animation to show working major joint deformations (Hips, knees, elbows, spine)</b>	<b>Final Presentation:</b> 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](http://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](http://policy.usc.edu/scientific-misconduct).

### Support Systems:

*Counseling and Mental Health - (213) 740-9355 – 24/7 on call*  
[studenthealth.usc.edu/counseling](http://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](http://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](http://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](http://equity.usc.edu), [titleix.usc.edu](http://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](http://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](http://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](http://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](http://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](http://dps.usc.edu), [emergency.usc.edu](http://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](http://dps.usc.edu)

Non-emergency assistance or information.

*Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)*

[ombuds.usc.edu](http://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.