Subject:	DART
Course Number:	104
Descriptive Title:	Digital Modeling Principles and Tools
Division:	Fine Arts
Department:	Digital Art and Design Technology
Course Disciplines:	Multimedia
Catalog Description:	This is an introductory course in developing digital 3D models for animation, video games, pre-visualization, and VFX. Focus is placed on hand prototyping in simple materials to understand underlying topology and geometry concerns, and modeling with 3D digital tools. The concepts of form, light, and texture will be explored. Industry-standard low and high poly modeling methods are all explored.
Prerequisite:	
Co-requisite:	
Recommended Preparation:	
Enrollment Limitation:	
Hours Lecture (per week):	2
Hours Laboratory (per week):	3
Outside Study Hours:	4
Total Course Hours:	90
Course Units:	3
Grading Method:	Letter Grade and Pass/No Pass
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	FALL 2024
Transfer UC:	No
Effective Date:	
General Education ECC:	
Term:	
Other:	
CSU GE:	
Term:	
Other:	
IGETC:	
Term:	
Other:	

Student Learning Outcomes:	Upon completion of this course, students will be able to: 1. identify and use the workflows necessary to create 3D models, textures, materials, lighting and lighting. 2. create 3D models in both digital space from physical reference with an understanding of polygons, edge loops, topology and sub-division. 3. identify and explore career pathways within animation, technical arts, visual effects (VFX), and games.
Course Objectives:	1. Explore fundamentals of 3d objects and space such as scale, proportion, geometry, topology. 2. Explore the relationship between physical and digital objects, space, and production. 3. Examine various means of representing 3D objects and digital models in 2D (orthographic vs perspective, wireframe, shaded, fully rendered). 4. Make basic physical forms and models in simple materials like paper, cardstock, polymer clay etc. to use as reference for 3D digital models. 5. Explore digital polygonal modeling techniques. 6. Use procedural textures and materials as well as UV mapping to apply texture to models. 7. Examine various physical and digital lighting scenarios (point and spot light sources and environment lighting). 8. Understand digital rendering pipelines and processes. 9. Explore career pathways within animation, visual effects (VFX), and games. 10. Examine production pipelines and responsibility of each department, including the steps, skills, and processes within each pipeline stage. 11. Develop and bring concepts to life through iterative processes (i.e., mock-ups, prototypes, performance, etc.)
Major Topics:	I. **Essential 3D Design Concepts (2 hours, lecture)** A. Elements 1. Space / positive / negative 2. Mass / Volume / Form 3. Point / Edge / Plane 4. primitive shapes 5. curvature / convex / concave 6. Texture 7. Value / Gradient 8. Color 9. Opacity B. Principles 1. Scale 2. Proportion 3. Balance / symmetrical and asymmetrical 4. Repetition and Rhythm 5. Dominance and Recession 6. Continuity 7. Exaggeration II. **2D to 3D - Orthographic Projection and Drawing (2 hours, lecture)** A. Explore how two or more views represent objects in Euclidean space and Cartesian (XYZ) coordinates B. First and Third angle projection

C. Understanding “true” dimensions in an orthographic drawing
D. Foreshortening due to oblique edges and surfaces and lack of foreshortening due to perspective

III. **Observation and reference (2 hours, lecture)**
A. gathering and using photographic reference
B. sources of photographic reference
C. sources of 3D reference

IV. **Hand Prototyping in 3D (4 hours, lecture)**
A. 3D sketching
B. Generative design
C. folding paper and flat materials
D. shaping with clay
E. Iterative design process

V. **User interface: navigation and object manipulation in digital 3D software (2 hours, lecture)**
A. Covering Application Menu, Menu Bar, Tool Bar, Command Panel and Viewports.
B. Using keyboard shortcuts to switch directly between maximized viewports (Front, Side, Top and Perspective).
C. Using right click quad menu to switch between Move, Rotate and Scale modes

VI. **Creating, manipulating and modifying 3D primitives (4 hours, lecture)**
A. creating primitives
B. location / rotation / scale
C. coordinate systems (global / local / normal)
D. precise placement and relative placement of primitives
E. editing primitives
F. Booleans
G. parent / child relationships
H. Object Instancing

VII. **Polygonal modeling concepts and techniques (10 hours, lecture)**
A. box modeling
B. scratch modeling
C. quads, tris, and n-gons
D. quad topology
E. edge loops
F. face loops
G. n-poles
H. Subdivision surface modeling concepts and techniques
1. Subdivision of quad topology
2. edge loops and insets

VIII. **Materials, textures, and lighting (4 hours, lecture)**
A. procedural materials
B. shader basics
C. texture coordinates and transforms
D. UV Mapping
1. Creating seams
2. Unwrapping primitives
3. UV islands
4. UV textures
E. Lighting Basics
1. discrete light sources
2. Image based (HDRI) lighting

	F. Rendering basics 1. explore CPU vs GPU rendering 2. understand shader / renderer dependency IX. **Career exploration and visiting talks (4 hours, lecture)** A. 3D Modeling and Animation in films / animation / games / media B. Visiting professional talks X. **Critique and evaluation of peer work (2 hours, lecture)** XI. **Paper folding 3D shapes and flat patterns (4 hours, lab)** A. Faceted paper primitives and flat patterns B. Orthographic drawing of faceted paper primitives XII. **Composition of paper primitives (4 hours, lab)** A. Sketch, Draw, and make a simple 3D composition consisting of 3 or more intersecting paper primitives planes and surfaces B. Use both planar and faceted curved surfaces C. Chose a faceting frequency for curved surfaces XIII. **3D model of paper primitive composition (4 hours, lab)** A. replicate hand model with a polygonal primitive model XIV. **Simple clay to 3D character (12 hours, lab)** A. Sketch draw and make a simple character in polymer clay for topology study in 3D B. Photograph or 3D scan clay for reference C. Sketch topology studies to find major edge loops D. Model simple character in 3D with photo reference XV. **Environment model from observation and photo reference (8 hours, lab)** A. gather photo and dimension reference of an interior/exterior environment (on campus for example) B. use perspective matching tools to establish a 3d model of the environment from a particular point of view C. use primitives to model the environment XVI. **Handheld prop or vehicle model (10 hours, lab)** A. create a reference sheet for a prop or vehicle design (or use a design from DART101) B. sketch and draw a concept for the prop or vehicle (or use sketches from DART101) C. Primitive model, box model, or scratch model, the prop or vehicle D. Place prop or vehicle in environmental scene for later materials / lighting / rendering XVII. **Materials and lighting (6 hours, lab)** A. Make material samples that apply to specific models from the class B. UV map at least one previous model to apply texture and material C. Use procedural shaders for at least one previous model D. Use HDRI and discrete light sources to light models with materials E. Render test renders of material samples and models with materials F. Bonus: add procedural simulated effects like particles, smoke, etc to a final rendering XVIII. **Critique and evaluation of peer work (6 hours, lab)**
Total Lecture Hours:	36
Total Laboratory Hours:	54
Total Hours:	90

Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	Create a 3D model from a paper reference model. Use only quads to make the model and make sure the final model can be subdivided without losing sharp edge quality. The final model will be assessed for accuracy of scale and proportions to the original paper reference and the technical accuracy of the quad topology.
Critical Thinking Assignment 1:	Create reference for an exterior scene lit in both day and night. Photo document the environment. Then research lighting techniques used in exterior scenes, create a model of the reference scene and use found materials to quickly texture the scene, then apply the researched lighting techniques to the exterior scene model.
Critical Thinking Assignment 2:	Use a triangulated reference model as an underlay to sketch main face and edge loops to establish proper edge flow and topology for the form. Then model over the form with a mid poly count to test the proposed topology and edge flow. Avoid any poles that share more than 5 edges.
Other Evaluation Methods:	Completion, Presentation
If Other:	
Instructional Methods:	Demonstration, Discussion, Guest Speakers, Lab, Lecture, Multimedia presentations
If other:	
Work Outside of Class:	Skill practice
If Other:	
Up-To-Date Representative Texts:	William Vaughn, Digital Modeling, 1st Edition, New Riders Pub, 2012. (Discipline Standard)
Alternative Texts:	
Required Supplementary Readings:	
Other Required Materials:	
Requisite	
Category	
Requisite course:	
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	
Requisite Skill and Matching skill(s): Bold the requisite skill(s). if applicable	
Requisite course:	
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Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). if applicable	
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Arnold Martin
Date:	09/01/2023
Original Board Approval Date:	06/17/2024
Effective Term:	FALL 2024