Course Syllabus

Course Information
Department - Cell and Developmental Biology
Number - Anatomy 6202
Title - Imaging and Modeling II
Semester - Spring 2013
Catalog description – This course will cover 3-D concepts of model creation and display as they relate to anatomy. A general theme of Virtual-Reality-Based simulation will be used to tie the concepts together. Laboratory exercises will be utilized to cement concepts through experience.
Meetings:   Labs:   Mondays, 9:00AM – 1:00 PM
            Lectures:  Wednesdays, 9:00 AM – 11:40 AM

Instructor Information
Name - Karl Reinig, PhD
Office Hours – Rm 5205, Bld 500
Mondays 1:10 to 1:45pm, Wednesdays noon to 12:30 pm. Other opportunities can be arranged.
Phone – (720) 505-2827
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Course Goals
This course directly supports the MSMHA goal that students will be able to analyze and discuss the current state of the field of anatomic simulation and body imaging, which is foundational to each of the other MSMHA goals. In addition, the course will increase the tool set of the students, to be applied to their scholarly project.

Learning Objectives and course schedule
The topics, as well as their associated learning objectives are introduced for each week as follows:
Week 1 - Fundamentals of 3-D objects

Prepare
None

Describe how:
- Light is controlled to produce images on a computer monitor.
- Vectors are used to describe 3-D locations.
- Various primitives are combined to display relevant shapes, including anatomy.
- Transforms are used to alter the scene.
- The 3-D pipeline gives a “Director's” control of a scene.
- Different polygonal file formats have a common basis.
- To write simple C++ programs.

Laboratory
Create a medium complexity polygonal model utilizing techniques introduced in the first lecture.

Prepare
Install a C++ compiler on student’s laptop. Instructions for doing this will be included in the first lecture.

Week 2 - Methods of gathering 3-D data

Prepare
Research a surface scanning system and be prepared to give a 5 minute in-class synopsis of its abilities and limitations.¹

Describe foundational elements of:
- Cryosectioning.
- MRI and CT, including DICOM.
- Surface scanning.

Laboratory
Create a voxel data set from scratch (DICOM).
Create a program to and then create a polygonal model using a digitizing device.

Prepare
None

Week 3 - Segmentation and classification

Prepare
Research a segmentation and classification program and be prepared to give a 5 minute in-class synopsis of its abilities and limitations.

¹ Presentations will be in Power Point and will introduce the audience to major assertions and conclusions of the source, as well as how to locate the source. Assessment will be based on the presenter’s demonstrated understanding of the source, including their ability to answer related questions. Suggested sources will be given during the previous laboratory.
Describe and employ:
Drawing based methods for classifying volumetric data.
Automated methods.
Surface spline methods.

Laboratory
Segment and classify a voxel dataset.

Preparation
Install a segmentation program (link given in previous lecture) on student’s laptop

Week 4 - Volumetric Rendering

Preparation
Research a ray-tracing program and be prepared to give a 5 minute in-class synopsis of its abilities and limitations

Demonstrate basics of:
Ray-tracing.
Making polygons from segmented voxel data.

Mid-term exam\(^2\)
10:45 – 11:30 Wednesday the 13\(^{th}\) of February 2013

Laboratory
No laboratory this week (university holiday).

Week 5 - Adding realism to polygonal models

Preparation
Research a 3-D painting program and be prepared to give a 5 minute in-class synopsis of its abilities and limitations.

Demonstrate how:
Texture-maps are used to add the appearance of detail to a scene.
Bump mapping is used to give the appearance of higher detailed lighting.
3-D painting can be used to apply texture-mapping and bump mapping to models.

Laboratory
Take pictures from a live model and map them to a polygonal model of a human.

Preparation
Install a 3-D painting program on student’s laptop (link to 3-D painting program will be given during previous lecture).

\(^2\) The Mid-Term Exam will consist of a combination of short essay responses and multiple choice questions. The questions will be designed to determine the student’s working knowledge (ability to use the concepts) of the topics presented to this point. Students will be given 45 minutes to complete the exam.
Week 6 – Haptics display

Preparation
Research an example haptic display device and be prepared to give a 5 minute in-class synopsis of its abilities and limitations.

Demonstrate how:
Mechanical devices can produce complex feels.
To write a simple program for getting a haptic device to produce a feel.

Laboratory
Write a program to produce the feel of a rubber ball.

Preparation
Install a haptic device driver on student’s laptop (link will be given during previous lecture).

Week 7 - Virtual environments

Preparation
Research an example of a virtual environment for training a medical skill and be prepared to give a 5 minute in-class synopsis of its abilities and limitations.

Describe how:
To combine stereo graphic and haptic display.
Needles, scalpels, palpation, etc. can be represented in a virtual environment.
To utilize a particular VR-based API to develop an anatomic training simulation.
3-D printing can be used to produce physical models from electronic data.

Laboratory
Create a primitive simulator utilizing a supplied API.

Final Exam³
9:00 am Friday the 8th of March 2013

Prerequisites
Anatomy 6201

Materials
Student supply their own laptop computer that either runs a MAC or Windows operating system. The laptop must have access to the internet.

³ The Final Exam will be cumulative and follow the same basic format as the Mid-Term Exam. Students will be given 1 hour to complete the exam.
**Grading Policies**
Grades will be calculated as a weighted sum of exams (midterm 20% and final 30%), attendance (lectures 10%, laboratories 20%), and presentations 20%.

**Grading scale**
- A: 90-100%
- B: 80-89%
- C: 70-79%
- D: 60-69%
- E: < 60%

**Assessment**
Exams will be comprised of short essay and multiple choice questions. Missed exams are to be made up within one week and arranged prior to the exam.

**Expectations**
Students will spend 2 and 2/3 hours per week in lectures and 4 hours per week in laboratories. In addition, it is expected that students will spend approximately 2 hours per week outside of lectures and laboratories.

**Honor Code**
Students are expected to adhere to the guidelines established in the Student Honor Code.