Course Syllabus

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Imaging and Modeling (ANAT 6205)

Course Director

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Office Hours: by appointment only

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  (mailto:JANE.BRUSILOVSKY@CUANSCHUTZ.EDU)**

Class Location and Hours

Day	Start	Stop	Location
Monday	1 pm	3:00 pm	in person
Tuesday	1 pm	3:30 pm	in person
Thursday	1 pm	3:30 pm	in person

Classroom: ED2N 1107

Please Note: Hours may change slightly some weeks, so please regularly check the Canvas Page

Course Description

Rapid advances in imaging techniques are providing an unprecedented window into internal anatomical structures previously poorly resolved or completely hidden from view. From the cellular to the organism level, these imaging techniques have led to untapped veins of anatomical research and novel medical

diagnoses. However, these techniques can also result in gigabytes and even terabytes of imaging data as they typically employ new high-throughput technologies. Structures of anatomical interest may be buried deep in this collection of digital data and may require advanced computational techniques coupled with manual annotation to excavate the structures of interest and illuminate a living world that is so often hidden from us.

Successful Anatomical Scientists and Medical professionals wishing to capitalize on these cutting-edge technologies must become proficient not only in the current state of imaging modalities and their future direction but in the language of the digital images themselves: the underlying ones and zeroes from which these image datasets are built.

In this course, we will cover the basic properties of digital images and learn basic image acquisition, processing, segmenting, modeling and rendering workflows using several industry standard software packages including MATLAB, Fiji, Blender, and 3D Slicer. We will also survey the current state, strengths and weaknesses of major imaging modalities from digital microscopy to magnetic resonance imaging by exploring sample image datasets from each of these modalities. Examples of these modalities will then be used for problem-based-learning tasks.

Hardware and Software Requirements

You are required to bring a laptop to class EVERY day. Most class exercises, labs, assignments and assessments will be performed on the laptop.

IMPORTANT: We will be using MATLAB **(https://www.mathworks.com) from DAY ONE. Be sure to have it installed on your laptop before you come to the first day of class.**

Minimum Laptop Requirements

You will need a decently equipped laptop that can handle the large image datasets and software packages that we will use in class. Please refer to the following guidelines when considering whether your current laptop is up to muster.

Critical

- 64-bit dual core CPU (Intel Core i5 or equivalent)
- 8 GB RAM minimum (16 GB strongly recommended, especially for Mac computers)

Highly Recommended

- 64-bit quad core CPU (Intel Core i7 or equivalent) or higher
- 32 GB RAM
- OpenGL-compatible graphics card (with at least 2 GB memory)
- 256 GB (or larger) SSD drive (solid state drives are much faster than ordinary drives, but hold less data)

PLEASE NOTE. If your laptop does not meet the minimum requirements, you will likely have difficulty completing class exercises and course assignments, especially the **Final Course Project**.

Upgrading suggestions: RAM is one of the *easiest and cheapest* upgrades that you can make to a laptop. Say, for example, you already have a 64-bit dual core processor, but you only have 4 GB of RAM: it is often very inexpensive to upgrade to 8 GB and is something that you can usually do yourself… unless you have a recent Mac, in which case you may be stuck, as recent models of mac laptops cannot be upgraded. Click on this **link** **(http://www.cnet.com/how-to/how-and-when-to-upgrade-your-macs-ram/)** to find out which Macs can be upgraded.

Buying Recommendations: Pay for additional CPUs before you pay for the RAM, but make sure that you have the minimum 8 GB RAM. An SSD drive is also very nice (because it's much faster), but they're expensive and typically don't hold as much data as a normal hard drive. If you are buying a new computer and have always used a Mac, or if you are OS-agnostic, then I **strongly recommend that you buy a Mac**. I use a Mac and know how to troubleshoot Macs if weird hardware or operating system issues come up. You can find great refurbished deals from Apple **here** **(https://www.apple.com/us-hed/shop/refurbished)**. If you love and are more comfortable with Windows, then stick with a Windows machine, but I have less experience with Windows Machines and you will have to troubleshoot any weird hardware issues that crop up on your own (or at the Windows store).

Laptop preparation. All computers slow down over time. If you have had your laptop for a while, now is the time to clean it up. Remove old documents and applications. Run computer optimization tools like CleanMyMac or Cocktail (for the Mac.) or **Iolo System Mechanic (https://www.iolo.com/downloads/download-system-mechanic/?mid=25039&ranMID=25039&ranEAID=kXQk6*ivFEQ&ranSiteID=kXQk6.ivFEQ-jV0gc.4h8B1ya9Tp9r2HTQ)** for the PC. Install backup software and BACK UP YOUR COMPUTER. Remember, a file doesn't really exist unless it can be found in three different locations(e.g. on your computer, on a backup drive, and on another backup drive that is in a different location from the first drive).

RECOMMENDED EXTRAS

- A three button mouse - visualization software often employ that third mouse button for additional functions.

- An External Hard drive and backup software. Back up your laptop OFTEN. Laptops love to fail critically before major deadlines

- **A second Monitor**: to watch Zoom lectures from home while you follow along on your computer. There are reasonably priced 21" monitors on Amazon right now for less than a hundred dollars. A larger, 27" monitor is around $200. You could also potentially screencast your phone to your TV and watch zoom on the TV while you work on your laptop. Check out this **link** **(https://www.pocket-lint.com/apps/news/151726-how-to-get-zoom-on-your-tv)** or google "screencast phone to TV"

Required Software

- **MATLAB** **(https://www.mathworks.com)** - Free to you, site license available. See **here** **(https://olucdenver.sharepoint.com/matlab/Pages/default.aspx)** for installation instructions.

- **Zoom** - to watch online lectures. Get your zoom license here: https://ucdenver.zoom.us/ And be sure to use your CU Anschutz credentials to create your account

- **Fiji** **(http://fiji.sc/Fiji)** - Free. Download from **here** **(http://fiji.sc/Fiji)** .

- **3D Slicer** **(http://www.slicer.org)** - Free. Download from **here** **(http://www.slicer.org)**

- **Blender** **(https://www.blender.org)** - Free. Download from **here** **(https://www.blender.org)**

Course Outcomes and Learning Objectives

The course is divided into four major units, the first three of which will be assessed based on the following learning objectives.

1. **Unit 1:** Basic Programming, Digital images, and Image processing. The major learning objectives for this unit are as follows:

   - Define variable, function, and syntax as they relate to computer programming.
   - Assign values to variables in MATLAB and pass these variables into basic functions in MATLAB
   - Explain the base-2 (binary) numeral system and be able to count in binary.
   - Describe how computers store information using bits and bytes.
   - Be able to generate simple MATLAB scripts and use control elements to input and process data
   - Perform basic measures of central tendency (mean, median and mode) and display measurements as scatter, box, or bar plots (with error bars)
   - Perform basic statistic comparisons such as calculating the confidence interval, or perform parametric and non-parametric tests such as t-tests or correlations
   - Open and properly display any image using MATLAB or Fiji
   - Perform basic digital image processing using MATLAB or Fiji

2. **Unit 2:** Visible Light. The major learning objectives for this unit are as follows:

   - Describe electromagnetic radiation and define the frequency range of visible light
   - Describe the basic properties of a simple lens and explain how a lens forms an image
   - Describe the anatomy of the human eye and explain how the eye forms and detects images.
   - Explain the difference between photopic and scotopic vision and explain how the eye detects color.
   - Explain how an image sensor forms an image in a digital camera
   - Explain how a light microscope works and detail the differences between light, fluorescence, and confocal microscopy
   - Explain the difference between a grayscale and an RGB image

- Perform image processing on RGB images
- Open and properly display 3D image datasets using MATLAB or FIJI
- Perform basic image processing steps on 3D sets

3. **Unit 3:** Medical Imaging Modalities

- Describe how X-ray radiation is used to create images of the internal body.
- Give a general overview on how magnetic resonance is used to create an internal image of the body
- Describe how ultrasound is used to create internal images of the body
- Compare and contrast the strength and weaknesses of CT scans vs MRI vs Ultrasound
- Open and properly display DICOM images using software such as MATLAB, Fiji, and 3D Slicer
- Model 3D structures from DICOM datasets using software such as MATLAB, Fiji, 3D Slicer, and BLENDER

4. **Unit 4:** Final Course Project

- see below

Final Course Project

The final project is your opportunity to show off your new imaging and modeling savvy. For this project, you will need to process and model a three-dimensional image dataset using the imaging and modeling workflow steps learned in this course. You can use any suitable anatomical dataset you can find that is available to use for educational purposes. A critical component of this project will be to develop, describe, and execute a metrological method to measure something anatomical from a three-dimensional medical image dataset — for example, measuring the volume of a segmented object.

The metrology that you develop can be based on a publication. For example, in this **Anatomical Record article   (http://onlinelibrary.wiley.com/enhanced/doi/10.1002/ar.22655/)** , discussed here on **CNN (http://thechart.blogs.cnn.com/2013/03/20/why-our-noses-are-different-shapes/?hpt=hp_t5)** , the authors generate volumetric measurements to evaluate whether nasal architecture accommodates the need for effective conditioning of respired air. A feasible class project could be to generate similar measurements in the cadaveric datasets that you will receive during the course, and compare and discuss your results to the results in the publication.

This project includes two main parts: a written component and a presentation component. The written component should contain the following sections: Introduction, Methods, Results, Discussion, Citations. You can also include Supplementary Documentation that includes any pertinent MATLAB scripts , source files, or image datasets used to generate your models.

The presentation component should be 10 minutes long and there will be three minutes for questions. The presentation should give an overview of your methodology and discuss the insights you gained about your tissue system by modeling it.

This project will be evaluated on its extent, scope, clarity, and thoroughness. A grading rubric will be made available so you can plan your project.

Group Projects: Imaging and Modeling projects are rarely a one-person effort. To reflect this, group projects will be allowed. However, it is expected that each individual in the group will contribute equally to the design and implementation of the project. Moreover, the scope of a group project should be commensurately larger than an individual project. That is to say, a 3-group project should be roughly 3X the size of an individual project.

A more detailed guideline for the Final Project will be posted in the Modules section of the Canvas site.

Assessment

Assignments	5%
Quizzes	20%
Exams	50%
Final Project	25%

Comments:

- There will be homework and quizzes most weeks. This course is designed to emphasize experiential learning and problem solving. Homework is typically graded based on completion and good-faith effort.

- Exams. There will be three main exams

- Final Course Project - due at the end of the semester

PLEASE NOTE. The stated learning objectives above represent the minimum required level of information you will need to master to pass this course. To receive an A in this course, you will need to demonstrate an advanced level of comprehension by integrating these fundamental facts with information presented in the lectures, the Canvas Content pages, MATLAB scripts, or in class discussions or with new information that you have compiled on your own.

Grading Policy

At the end of the course, a final letter grade will be assigned according to the following scale (note, this maybe different from other courses in the program). As per program policy, a minimum grade of B- is required for successful completion of the course.

Grade	Percentage	Grade	Percentage
A	94–100	C+	77–79
A-	90–93	C	73–76
B+	87–89	C-	70–72

Grade Percentage Grade Percentage

B	83–86	D+	67–69
B-	80–82	D-	60–63
	F		<60

PLEASE NOTE, there is a **different Grading scale** in I&M that for the other MHA courses. This is due to the differing evaluation tools and group-effort assessments used in Imaging and Modeling.

Credits

This course is **Four** Credit Hours. In addition to attending all lectures and labs, you should plan to spend at least 10 hours a week outside of lecture working on the assignments for the course.

CANVAS

Check your email and the CANVAS website DAILY for important notices about this course.

MSMHA General Course Policies

Please refer to the student handbook for more information on these policies:

Religious Accommodation Policy: Students who anticipate the necessity of being absent from class due to the observation of major religious observance must provide advance notice to the Course Director in writing.

Disability Accommodation Policy: Students with documented learning and/or physical disabilities should inform the Course Director as soon as possible to discuss and arrange for reasonable accommodations. All reasonable efforts will be made to accommodate students with regard to note taking, reading assignments, and test taking.

Equal Opportunity Policy: In line with the goals of the University, we will maintain a work and study environment free of discrimination on the basis of race, color, sex, gender, marital status, religion, national origin, veteran status, handicap or age and to maintain an environment of respect for all.

Recording Policy: You are permitted to use tablets or laptop computers to take notes. In addition, you are permitted to video or audio record any or all lectures for the purpose of self-study. However, you are not permitted to use notes, tapes or other recorded data for the purposes of sale or posting on the internet.

Withdrawal Policy: Students may withdraw from a course with an ANAT prefix no later than the completion of 70% of the course (by the end of Week 12). Please contact the Course Director to discuss possibility of a course withdrawal.

Incomplete Policy: Incomplete (I) grades are not granted for low academic performance. To be eligible for an "I" grade, you must:

1. Successfully complete a minimum of 75% of the course

2. Have a special circumstance(s) beyond your control that prevents you from attending class and/or completing coursework. Documentation is required.

3. Make arrangements to complete missing coursework with the original instructor

4. If the missing coursework is not completed within 1 year from the end of the semester in which the original course was scheduled, the "I" grade will convert to an "F" grade on your official transcript.

Resolution of Conflicts Policy: Good faith efforts will be made by students, faculty, and program and university administration to settle all appeals, complaints and grievances on an informal basis. Such efforts include conferences between the persons directly involved and others who may help solve the problems. Formal conflict resolution policies are detailed in the policies and procedures of the Graduate School, University of Colorado Denver.

Course Summary:

Date	Details	Due
Wed Sep 2, 2020	📝 **UNIT 1 - MATLAB Onramp** (https://ucdenver.instructure.com/courses/472984/assignments/1168550)	due by 11:59pm
Mon Aug 30, 2021	📅 **I&M Class** (https://ucdenver.instructure.com/calendar?event_id=235504&include_contexts=course_472984)	1pm to 3pm
	📝 **UNIT 1 - Reading 1** (https://ucdenver.instructure.com/courses/472984/assignments/1168552)	due by 1pm
Tue Aug 31, 2021	📅 **I&M Class** (https://ucdenver.instructure.com/calendar?event_id=235561&include_contexts=course_472984)	1pm to 3:30pm
	📝 **UNIT 1 - Reading 2** (https://ucdenver.instructure.com/courses/472984/assignments/1168553)	due by 1pm
Thu Sep 2, 2021	📅 **I&M Class** (https://ucdenver.instructure.com/calendar?event_id=235544&include_contexts=course_472984)	1pm to 3:30pm

Date	Details	Due
	📝 **UNIT 1 - Reading 3** [(https://ucdenver.instructure.com/courses/472984/assignments/1168554)](https://ucdenver.instructure.com/courses/472984/assignments/1168554)	due by 1pm
Mon Sep 6, 2021	📅 **NO CLASS - Labor Day** [(https://ucdenver.instructure.com/calendar? event_id=235530&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235530&include_contexts=course_472984)	1pm to 3pm
Tue Sep 7, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar? event_id=235512&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235512&include_contexts=course_472984)	1pm to 3:30pm
	📝 **UNIT 1 - MATLAB Grader Assignments** [(https://ucdenver.instructure.com/courses/472984/assignments/1168549)](https://ucdenver.instructure.com/courses/472984/assignments/1168549)	due by 1pm
	📝 **UNIT 1 - Reading 4** [(https://ucdenver.instructure.com/courses/472984/assignments/1168555)](https://ucdenver.instructure.com/courses/472984/assignments/1168555)	due by 1pm
	📝 **UNIT 1 - Reading 5** [(https://ucdenver.instructure.com/courses/472984/assignments/1168556)](https://ucdenver.instructure.com/courses/472984/assignments/1168556)	due by 1pm
Thu Sep 9, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar? event_id=235546&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235546&include_contexts=course_472984)	1pm to 3:30pm
	📝 **UNIT 1 - Fizz Buzz Problem** [(https://ucdenver.instructure.com/courses/472984/assignments/1168547)](https://ucdenver.instructure.com/courses/472984/assignments/1168547)	due by 1pm
Mon Sep 13, 2021	📅 **EXAM - UNIT ONE** [(https://ucdenver.instructure.com/calendar? event_id=235527&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235527&include_contexts=course_472984)	1pm to 2pm
	📝 **UNIT 1 - Reading 6** [(https://ucdenver.instructure.com/courses/472984/assignments/1168557)](https://ucdenver.instructure.com/courses/472984/assignments/1168557)	due by 1pm
	📝 **UNIT 1 - Tables and Plots** [(https://ucdenver.instructure.com/courses/472984/assignments/1168558)](https://ucdenver.instructure.com/courses/472984/assignments/1168558)	due by 1pm
	📝 **UNIT 1: Variable Indexing** [(https://ucdenver.instructure.com/courses/472984/assignments/1168542)](https://ucdenver.instructure.com/courses/472984/assignments/1168542)	due by 1pm

Date	Details	Due
	📝 **UNIT 1 - EXAM** [(https://ucdenver.instructure.com/courses/472984/assignments/1168546)](https://ucdenver.instructure.com/courses/472984/assignments/1168546)	due by 5pm
Tue Sep 14, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar?event_id=235514&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235514&include_contexts=course_472984)	1pm to 3:30pm
	📝 **UNIT 1: Control Flow, Functions, and Visualizations** [(https://ucdenver.instructure.com/courses/472984/assignments/1168535)](https://ucdenver.instructure.com/courses/472984/assignments/1168535)	due by 1pm
	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar?event_id=235547&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235547&include_contexts=course_472984)	1pm to 3:30pm
	📝 **UNIT 1 - Digital Images** [(https://ucdenver.instructure.com/courses/472984/assignments/1168545)](https://ucdenver.instructure.com/courses/472984/assignments/1168545)	due by 1pm
Thu Sep 16, 2021	📝 **UNIT 1 - MATLAB Onramp Certificate** [(https://ucdenver.instructure.com/courses/472984/assignments/1168551)](https://ucdenver.instructure.com/courses/472984/assignments/1168551)	due by 1pm
	📝 **UNIT 1: Digital Images** [(https://ucdenver.instructure.com/courses/472984/assignments/1168543)](https://ucdenver.instructure.com/courses/472984/assignments/1168543)	due by 3pm
	📝 **UNIT 1 - Image Enhancement and Segmentation** [(https://ucdenver.instructure.com/courses/472984/assignments/1168548)](https://ucdenver.instructure.com/courses/472984/assignments/1168548)	due by 5pm
Mon Sep 20, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar?event_id=235506&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235506&include_contexts=course_472984)	1pm to 3pm
Tue Sep 21, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar?event_id=235515&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235515&include_contexts=course_472984)	1pm to 3:30pm
Thu Sep 23, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar?event_id=235548&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235548&include_contexts=course_472984)	1pm to 3:30pm

Date	Details	Due
	📝 **UNIT 2: Light and Color models** [(https://ucdenver.instructure.com/courses/472984/assignments/1168538)](https://ucdenver.instructure.com/courses/472984/assignments/1168538)	due by 1pm
Mon Sep 27, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar? event_id=235507&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235507&include_contexts=course_472984)	1pm to 3pm
	📝 **UNIT 2 - Homework 1, RGB HSV Image Exercises** [(https://ucdenver.instructure.com/courses/472984/assignments/1168560)](https://ucdenver.instructure.com/courses/472984/assignments/1168560)	due by 1pm
Tue Sep 28, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar? event_id=235516&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235516&include_contexts=course_472984)	1pm to 3:30pm
Thu Sep 30, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar? event_id=235549&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235549&include_contexts=course_472984)	1pm to 3:30pm
	📝 **UNIT 2 - Digital Photography** [(https://ucdenver.instructure.com/courses/472984/assignments/1168537)](https://ucdenver.instructure.com/courses/472984/assignments/1168537)	due by 3pm
Mon Oct 4, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar? event_id=235508&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235508&include_contexts=course_472984)	1pm to 3pm
	📝 **UNIT 2 - Homework 2 - Microscopy Images** [(https://ucdenver.instructure.com/courses/472984/assignments/1168561)](https://ucdenver.instructure.com/courses/472984/assignments/1168561)	due by 1:15pm
Tue Oct 5, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar? event_id=235517&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235517&include_contexts=course_472984)	1pm to 3:30pm
Thu Oct 7, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar? event_id=235550&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235550&include_contexts=course_472984)	1pm to 3pm
	📝 **UNIT 2 - Microscopy** [(https://ucdenver.instructure.com/courses/472984/assignments/1168536)](https://ucdenver.instructure.com/courses/472984/assignments/1168536)	due by 1pm

Date	Details	Due
Mon Oct 11, 2021	📅 **EXAM TWO** **(https://ucdenver.instructure.com/calendar? event_id=235528&include_contexts=course_472984)**	1pm to 2pm
	📝 **UNIT 2 - EXAM** **(https://ucdenver.instructure.com/courses/472984/assignments/1168559)**	due by 5pm
Tue Oct 12, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar? event_id=235518&include_contexts=course_472984)**	1pm to 3:30pm
Thu Oct 14, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar? event_id=235551&include_contexts=course_472984)**	1pm to 3:30pm
	📝 **UNIT 2 - Photography Assignment** **(https://ucdenver.instructure.com/courses/472984/assignments/1168562)**	due by 1pm
Mon Oct 18, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar? event_id=235503&include_contexts=course_472984)**	1pm to 3pm
Tue Oct 19, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar? event_id=235519&include_contexts=course_472984)**	1pm to 3:30pm
Thu Oct 21, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar? event_id=235552&include_contexts=course_472984)**	1pm to 3:30pm
Mon Oct 25, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar? event_id=235509&include_contexts=course_472984)**	1pm to 3pm
Tue Oct 26, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar? event_id=235520&include_contexts=course_472984)**	1pm to 3:30pm
Thu Oct 28, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar? event_id=235553&include_contexts=course_472984)**	1pm to 3:30pm

Date	Details	Due
	📝 **UNIT 3 - Create A Sketchfab account** **(https://ucdenver.instructure.com/courses/472984/assignments/1168564)**	due by 1pm
Mon Nov 1, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar?** **event_id=235510&include_contexts=course_472984)**	1pm to 3pm
Tue Nov 2, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar?** **event_id=235521&include_contexts=course_472984)**	1pm to 3:30pm
Thu Nov 4, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar?** **event_id=235554&include_contexts=course_472984)**	1pm to 3:30pm
	📝 **UNIT 3 - QUIZ - MRI and Ultrasound** **(https://ucdenver.instructure.com/courses/472984/assignments/1168539)**	due by 1pm
	📝 **UNIT 3 - Radiography, CT, and Nuclear Medicine** **(https://ucdenver.instructure.com/courses/472984/assignments/1168540)**	due by 1pm
	📝 **UNIT 3 - Slicer Models** **(https://ucdenver.instructure.com/courses/472984/assignments/1168566)**	due by 3:30pm
Mon Nov 8, 2021	📝 **UNIT 3 - EXAM - GROUP Effort** **(https://ucdenver.instructure.com/courses/472984/assignments/1168565)**	due by 9am
	📅 **EXAM THREE** **(https://ucdenver.instructure.com/calendar?** **event_id=235529&include_contexts=course_472984)**	1pm to 2pm
	📝 **UNIT 3 - EXAM - Individual Effort** **(https://ucdenver.instructure.com/courses/472984/assignments/1168541)**	due by 6pm
Tue Nov 9, 2021	📅 **I&M Class** **(https://ucdenver.instructure.com/calendar?** **event_id=235522&include_contexts=course_472984)**	1pm to 3:30pm

Date	Details	Due
Thu Nov 11, 2021	🗓 **I&M Class (https://ucdenver.instructure.com/calendar? event_id=235555&include_contexts=course_472984)**	1pm to 3:30pm
Mon Nov 15, 2021	🗓 **I&M Class (https://ucdenver.instructure.com/calendar? event_id=235679&include_contexts=course_472984)**	1pm to 3pm
Tue Nov 16, 2021	🗓 **I&M Class (https://ucdenver.instructure.com/calendar? event_id=235523&include_contexts=course_472984)**	1pm to 3:30pm
Thu Nov 18, 2021	🗓 **I&M Class (https://ucdenver.instructure.com/calendar? event_id=235556&include_contexts=course_472984)**	1pm to 3:30pm
	📝 **UNIT 3 - BLENDER - Make that Donut (https://ucdenver.instructure.com/courses/472984/assignments/1168563)**	due by 1pm
Mon Nov 22, 2021	🗓 **NO Class (https://ucdenver.instructure.com/calendar? event_id=235526&include_contexts=course_472984)**	1pm to 3pm
Tue Nov 23, 2021	🗓 **NO Class (https://ucdenver.instructure.com/calendar? event_id=235525&include_contexts=course_472984)**	1pm to 3pm
Mon Nov 29, 2021	🗓 **I&M Class (https://ucdenver.instructure.com/calendar? event_id=235511&include_contexts=course_472984)**	1pm to 3pm
Tue Nov 30, 2021	🗓 **I&M Class (https://ucdenver.instructure.com/calendar? event_id=235524&include_contexts=course_472984)**	1pm to 3:30pm
Thu Dec 2, 2021	🗓 **I&M CLASS (https://ucdenver.instructure.com/calendar? event_id=235558&include_contexts=course_472984)**	1pm to 3:30pm
Mon Dec 6, 2021	🗓 **I&M Class (https://ucdenver.instructure.com/calendar? event_id=236712&include_contexts=course_472984)**	1pm to 3pm

Date	Details	Due
Tue Dec 7, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar? event_id=236713&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=236713&include_contexts=course_472984)	1pm to 3:30pm
Thu Dec 9, 2021	📅 **I&M Class** [(https://ucdenver.instructure.com/calendar? event_id=236714&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=236714&include_contexts=course_472984)	1pm to 3:30pm
Thu Dec 16, 2021	📅 **Final Presentations** [(https://ucdenver.instructure.com/calendar? event_id=235560&include_contexts=course_472984)](https://ucdenver.instructure.com/calendar?event_id=235560&include_contexts=course_472984)	10am to 3:30pm
	📝 **Final Presentation** [(https://ucdenver.instructure.com/courses/472984/assignments/1168544)](https://ucdenver.instructure.com/courses/472984/assignments/1168544)	due by 6pm
	📝 **Written Report** [(https://ucdenver.instructure.com/courses/472984/assignments/1168567)](https://ucdenver.instructure.com/courses/472984/assignments/1168567)	due by 11:59pm