

# NEWM N448

## 3D Prototyping for Application in Medicine

*Section No.:*

*Credit Hours:* 3

*Time:*

*Location:* IT 255, Informatics & Communications Technology Complex  
535 West Michigan Street, Indianapolis, IN 46202 [\[map\]](#)

*First Class:*

*Website:*

*Instructor:* Zebulun M. Wood, MS in Technology, Lecturer

*Office Hours:* M, T 1-5, and/or by Appointment

*Office:* IT 463, Informatics & Communications Technology Complex  
535 West Michigan Street, Indianapolis, IN 46202 [\[map\]](#)

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<http://www.indianauploaded.org>

*Prerequisites:* (Undergrad) N243

*Equivalent/ Instructor Permission*

### **COURSE DESCRIPTION**

This course covers advanced modeling, sculpting, articulation, and printing of 3D objects from computer-generated images for applications in the medical industry. It also includes strategies for the collection, evaluation, and editing of medical data and the creation of prototypes for complete medical and surgical applications.

### **Extended DESCRIPTION**

Students will develop a set of objects, and display them appropriately for their intended medical application. Of possible objects, students will choose from a wide variety of medical data and challenges to evaluate and anticipate applicable solutions using 3D printing. Students will concept their proposals using collaborations and partnerships with campus partners and discover techniques and references gathered from industry research and experimentation.

### **Course Outcomes:**

Students will develop two printed objects, and display them appropriately for their intended industry. One will be experimental medical solution using already collected data; the other project must implement some partnership looking to solve a design or medical problem.

## Core Competencies:

- Students will have the ability to develop, discuss, and implement from preproduction, to production, to post production of prototypes of 3D print for use in various medical applications.
- Students will have the skills to model, prepare, articulate, and print 3D objects using common practices for 3D printing.
- Students will set-up 3D objects, for water tight printing using .stl and .obj file formats
- Students will create at minimum of applicable prototype for medical application.
- Students will understand how to collect, manipulate, and create 3D prints from various data sets.
- Students will learn entire production pipeline for creating geometry that can be printed at the most efficient costs and standards uses various data collection methods.

## Principles of Undergraduate Learning (PUL):

Learning outcomes are assessed in the following areas:

- 1A. Core communication: written, oral and visual skills
- 1B. Core communication: quantitative skills
- 1C. Core communication: information resources skills
2. Critical thinking [CT – Moderate emphasis]
3. Integration and application of knowledge [AoK – Major emphasis]
4. Intellectual depth, breadth, and adaptiveness [ID – Some emphasis]
5. Understanding society and culture
6. Values and ethics

## Learning Outcomes:

Upon completion of this course, the student will	PUL	Assessment
Develop, discuss, and implement from preproduction, to production, to post production;	CT, Aok, IRS, ID	ALL Assignments pg, 8-9
Exhibit the skills to model, prepare, articulate, and print 3D objects using common practices for 3D printing;	CT, AoK, ID	ALL Assignments pg, 8-9
Set-up 3D objects, for water tight printing;	IRS, CT, Aok, ID	ALL Assignments pg, 8-9
Create at minimum of applicable prototype for medical application;	CT, Aok, ID	ALL Assignments pg, 8-9
Understand how to collect, manipulate, and create 3D prints from various data sets.	CT, Aok, ID	ALL Assignments pg, 8-9

**Recommended Texts:****Virtual Prototyping & Bio Manufacturing in Medical Applications**

- Publisher: Springer Science + Business Media
- ISBN-13: 978-0-387-33429-5
- e-ISBN: 978-0-387-68831-2

**Resources for Reference**

[Converting MRI Data](#),

**Software used:**

[MIMICS](#) – data conversion

[3-Matic](#) – data conversion and manipulation

Autodesk Maya 2015 + Data Refinement

Zbrush 4r6 + Data Refinement

Adobe Production Suite (Photoshop, AfterEffects, Premiere,)

**Equipment needed:**

- Notebook
- Box Account [<http://www.box.iu.edu>]
- Portable Table

**EXPECTATIONS, GUIDELINES, AND POLICIES****Attendance:**

For success in this class I expect students to attend each class session. I will only allow missed classes if you give me notice a full week in advance. This class has a stringent attendance policy of 1 dropped letter grade for each 2 classes missed. I will take attendance at the beginning of each class.

**Incomplete:**

The instructor may assign an Incomplete (I) grade only if at least 75% of the required coursework has been completed at passing quality and holding you to previously established time limits would result in unjust hardship to you. All unfinished work must be completed by the date set by the instructor. Left unchanged, an Incomplete automatically becomes an F after one year. <http://registrar.iupui.edu/incomp.html>

**Deliverables:**

You are responsible for completing each deliverable (e.g., assignment, quiz) by its deadline and submitting it by the specified method. Deadlines are outlined in the syllabus or in supplementary documents accessible through OnCourse. Should you miss a class, you are still responsible for completing the deliverable and for finding out what was covered in class, including any new or modified deliverable. In fairness to the instructor and students who completed their work on time, a grade on a deliverable shall be reduced 10%, if it is submitted late and a further 10% for each 24-hour period it is submitted after the deadline.

**Exams/quizzes:**

There are no exams or quizzes

**Lab assignments:**

Class tutorials and demos must be completed with the instructor. Failure to do so can result in a detrimental effect on effort and class participation scores.

**Class assignments:**

I WILL require homework exercises following tutorials or in class demo each week. I expect these to be completed by the next class.

### **Grading Information:**

- Requirements (projects, papers, class participation)
- Percentage of each assignment
- If class participation is part of the final grade, you must explain to the student how the participation will be evaluated
- Method of assigning grades

### **WEEKLY SCHEDULE**

#### **Date for each class meeting:**

- Specific pre-class readings
- Specific subject matter/topics covered
- Goals and objectives of each class period

### **Tentative Weekly Outline**

(Based on student goals and previous knowledge) will change week to week.

#### Week 1:

Introduction – Syllabus, Student & Instructor Introductions,  
Student Knowledge Inventory  
Lecture: Equipment/Software Introduction  
Goals of Class, requirements for application and discovery  
Lab: Go over Current models in students' inventory  
**Assignment: Bring in models to inventory**  
**Collect resources and network for collaborations**

#### Week 2:

Lecture: Introduce equipment in action, \*things to watch out for  
Lab: review models, data types and options for editing  
**Assignment: Bring in models to inventory**  
**Continue Collect resources and network for collaborations**  
**Research trends and identify possible area of exploration**

#### Week 3

Lecture – History and trends in Medical Prototyping, identify process options  
Lab: review data, make watertight and to scale, print  
**Assignment: Bring in models to inventory**  
**Continue Collect resources and network for collaborations**  
**Research trends and identify possible area of exploration**  
**Create model from data, prepare for print**

#### Week 4 LAB DAY - Visit with Community Partners/ On Campus Partners

**Assignment: Final .stl ready for print/review**  
**Continue to Collect resources and network for collaborations**

Week 5

Guest Lecture: Invited Guest forecasting needs in Medical and Surgical Applications  
Review Model Application # 2 pitches

Lab:

**Assignment:** Check for watertight-ness/ material efficiency

Week 6

Guest Lecture: Invited Guest forecasting needs in Medical and Surgical Applications  
Review Model Application # 2 pitches

Lab:

**Model #1 Due:** Check for watertight-ness/ material efficiency

Week 7

Review first models for print check, selection on what to print to be determined

**Assignment:** Pitch 2<sup>nd</sup> Model and Collaboration/ Present Final Models from 1<sup>st</sup> round

Week 8

Lecture: Continue discussion Applications and Trends

Review Model Application # 2 pitches

Lab:

**Assignment:** Check for watertight-ness/ material efficiency

Week 9

Lecture: Cleaning/Prepping Data with various applications

Review models, begin printing ready models,

Lab:

**Assignment:** print approvals check (have watertight, and efficient)

Week 10

Lecture: Editing Accurately, Engineering in Design

Review models, begin printing ready models,

Lab:

**Assignment:** 2<sup>nd</sup> .stl ready for print/review / pitch final Prototype and Partnership  
Research of Trends forecasting for final project- Plan Development

Week 11

Lecture: Review final prints of model #2 and pitches for Final

Mold Prototyping for Mass Manufacturing

Lab:

**Model #2 :** Pitch for Final, Collaborative plan

Check for all articulated pieces watertight-ness/ material efficiency

Week 12

Lecture: Discuss chosen methods for models, and how to tackle implementation

Lab:

**Assignment:** Check for all prototyped pieces, Check for watertight-ness/ material efficiency

Week 13

Lecture: Visit with Community Partners

Lab: Begin check and print of final prototypes

**Assignment:** finish and prep for presentation with collaborators

Week 14:

Lecture:

Lab: Begin check and print of final prototypes

**Assignment:** finish and prep for presentation with collaborators

Week 15

**Present Final Prototype, Future Work, and Industry Forecast in your area**

Week 16

**Present Final Prototype, Future Work, and Industry Forecast in your area**

### **Grading Information:**

- **Weekly Assignments**

All assignments are to be delivered in a folder with your name, class #, and week # titled, if the assignment is Maya based; with zipped Maya project folders, and will be evaluated through Oncourse within the week.

Each weekly assignment is worth 50 points each.

Weekly assignments will consist of certain parts and beginning to develop an appreciation of how production pipeline between data and print. Students will learn to see, evaluate, and develop a strong sense of foundations in prototyping.

- **Model # 1** is a preliminary check on pipeline and material efficiency for creating models for 3D print from medical data.
  - Worth 100 pts
- **Model # 2** is a primary check on student's ability to create a project problem and solution while understanding production and application of said object withing a given industry. Also the first time you will get to print your object
- **Final Prototype** this is your final, printed out, this must be a simulated or real partnership, medical solution to specific problem, or collaboration with real client.
  - 100 points towards model, level detail, quality, and efficiency

- 100 degree of difficulty, marketability of project
- 100 points for presentation

- **Professionalism (100 pts)**

Professionalism is the highest quality a student of industry can gain and respect. We are all adults, the following are areas in which we will earn or lower your grade over the 11 weeks of class.

- Attitude (be excited)
- Tardiness
- Contributing and requesting of Critiques in class
- Deliverables (turning in what is asked for, the way its asked for)
- Effort
- Looking and smelling the part
- Presentation Quality
- Teamwork (Are you contributing effectively? Socially?)
- Timeliness (time spent on projects versus peers)
- Time tracking (What are you worth? How long are you taking?)

Example:

	<b>Due Date</b>	<b>Assignment</b>	<b>Points</b>
Assignment #1		Bring in Models that you have already	50
Assignment #2		Check for watertight-ness/ material efficiency	50
Assignment #3		Check for watertight-ness/ material efficiency	50
<b>Model #1</b>		Final .stl ready for print/review	100
Assignment #5		Pitch/model 2 <sup>nd</sup> model of print	50
Assignment #6		Check for watertight-ness/ material efficiency	50
Assignment #7		Preliminary print approvals check	50
<b>Model #2</b>		2 <sup>nd</sup> .stl ready for print/review / pitch final articulated model	100
Assignment#8		Check for all articulated pieces watertight-ness/ material efficiency	50



Assignment #9		Check for all articulated pieces Check for watertight-ness/ material efficiency	50
<b>FINAL Model #3</b>		Delivery of final product/ files	300
<b>Professionalism</b>		Overall attendance, effort, communication	100

**Grading Scale:**

A+	100%	Professional level work, showing highest level of achievement
A	93–99%	Extraordinarily high achievement, quality of work; shows command of the subject matter
A–	90–92%	Excellent and thorough knowledge of the subject matter
B+	87–89%	Above average understanding of material and quality of work
B	83–86%	Mastery and fulfillment of all course requirements; good, acceptable work
B–	80–82%	Satisfactory quality of work
C+	77–79%	Modestly acceptable performance and quality of work
C	73–76%	Minimally acceptable performance and quality of work
C–	70–72%	Unacceptable work (Core course must be repeated for credit)
D+	67–69%	Unacceptable work (Course must be repeated for credit)
D	63–66%	Unacceptable work
D–	60–62%	Unacceptable work
F	Below 60	Unacceptable work

No credits toward major, minor, or certificate requirements are granted for a grade below C. No credits toward general education or elective requirements are granted for a grade below C–.

### **CODE OF CONDUCT**

All students should aspire to the highest standards of academic integrity. Using another student's work on an assignment, cheating on a test, not quoting or citing references correctly, or any other form of dishonesty or plagiarism shall result in a grade of zero on the item and possibly an F in the course. Incidences of academic misconduct shall be referred to the Department Chair and repeated violations shall result in dismissal from the program.

All students are responsible for reading, understanding, and applying the *Code of Student Rights, Responsibilities and Conduct* and in particular the section on academic misconduct. Refer to *The Code > Responsibilities > Academic Misconduct* at <http://www.indiana.edu/~code/>. All students must also successfully complete the Indiana University Department of Education "How to Recognize Plagiarism" Tutorial and Test. <https://www.indiana.edu/~istd> You must document the difference between your writing and that of others. Use quotation marks in addition to a citation, page number, and reference whenever writing someone else's words (e.g., following the *Publication Manual of the American Psychological Association*). To detect plagiarism instructors apply a range of methods, including Turnitin.com. <http://www.ulib.iupui.edu/libinfo/turnitin>

#### **Academic Misconduct:**

1. **Cheating:** Cheating is considered to be an attempt to use or provide unauthorized assistance, materials, information, or study aids in any form and in any academic exercise or environment.
  - a. A student must not use external assistance on any "in-class" or "take-home" examination, unless the instructor specifically has authorized external assistance. This prohibition includes, but is not limited to, the use of tutors, books, notes, calculators, computers, and wireless communication devices.
  - b. A student must not use another person as a substitute in the taking of an examination or quiz, nor allow other persons to conduct research or to prepare

- work, without advanced authorization from the instructor to whom the work is being submitted.
- c. A student must not use materials from a commercial term paper company, files of papers prepared by other persons, or submit documents found on the Internet.
  - d. A student must not collaborate with other persons on a particular project and submit a copy of a written report that is represented explicitly or implicitly as the student's individual work.
  - e. A student must not use any unauthorized assistance in a laboratory, at a computer terminal, or on fieldwork.
  - f. A student must not steal examinations or other course materials, including but not limited to, physical copies and photographic or electronic images.
  - g. A student must not submit substantial portions of the same academic work for credit or honors more than once without permission of the instructor or program to whom the work is being submitted.
  - h. A student must not, without authorization, alter a grade or score in any way, nor alter answers on a returned exam or assignment for credit.
2. **Fabrication:** A student must not falsify or invent any information or data in an academic exercise including, but not limited to, records or reports, laboratory results, and citation to the sources of information.
  3. **Plagiarism:** Plagiarism is defined as presenting someone else's work, including the work of other students, as one's own. Any ideas or materials taken from another source for either written or oral use must be fully acknowledged, unless the information is common knowledge. What is considered "common knowledge" may differ from course to course.
    - a. A student must not adopt or reproduce ideas, opinions, theories, formulas, graphics, or pictures of another person without acknowledgment.
    - b. A student must give credit to the originality of others and acknowledge indebtedness whenever:
      1. directly quoting another person's actual words, whether oral or written;
      2. using another person's ideas, opinions, or theories;
      3. paraphrasing the words, ideas, opinions, or theories of others, whether oral or written;
      4. borrowing facts, statistics, or illustrative material; or
      5. offering materials assembled or collected by others in the form of projects or collections without acknowledgment
  4. **Interference:** A student must not steal, change, destroy, or impede another student's work, nor should the student unjustly attempt, through a bribe, a promise of favors or threats, to affect any student's grade or the evaluation of academic performance. Impeding another student's work includes, but is not limited to, the theft, defacement, or mutilation of resources so as to deprive others of the information they contain.
  5. **Violation of Course Rules:** A student must not violate course rules established by a

department, the course syllabus, verbal or written instructions, or the course materials that are rationally related to the content of the course or to the enhancement of the learning process in the course.

6. **Facilitating Academic Dishonesty:** A student must not intentionally or knowingly help or attempt to help another student to commit an act of academic misconduct, nor allow another student to use his or her work or resources to commit an act of misconduct.

## **OTHER POLICIES**

1. **Right to revise:** The instructor reserves the right to make changes to this syllabus as necessary and, in such an event, will notify students of the changes immediately.
2. **IUPUI course policies:** A number of campus policies governing IUPUI courses may be found at the following link: [http://registrar.iupui.edu/course\\_policies.html](http://registrar.iupui.edu/course_policies.html)
3. **Classroom civility:** To maintain an effective and inclusive learning environment, it is important to be an attentive and respectful participant in lectures, discussions, group work, and other classroom exercises. Thus, unnecessary disruptions should be avoided, such as ringing cell phones engagement in private conversations and other unrelated activities. Cell phones, media players, or any noisy devices should be turned off during a class. Texting, surfing the Internet, and posting to Facebook or Twitter during class are generally not permitted. Laptop use may be permitted if it is used for taking notes or conducting class activities. Students should check with the instructor about permissible devices in class. IUPUI nurtures and promotes “a campus climate that seeks, values, and cultivates diversity in all of its forms and that provides conditions necessary for all campus community members to feel welcomed, supported, included, and valued” (IUPUI Strategic Initiative 9). IUPUI prohibits “discrimination against anyone for reasons of race, color, religion, national origin, sex, sexual orientation, marital status, age, disability, or [veteran] status” (Office of Equal Opportunity). Profanity or derogatory comments about the instructor, fellow students, invited speakers or other classroom visitors, or any members of the campus community shall not be tolerated. A violation of this rule shall result in a warning and, if the offense continues, possible disciplinary action.
4. **Bringing children to class:** To ensure an effective learning environment, children are not permitted to attend class with their parents, guardians, or childcare providers.
5. **Course Evaluation Policy:** Course evaluations provide vital information for improving the quality of courses and programs. Students are required to complete one course and instructor evaluation for each section in which they are enrolled at the School of Informatics and Computing. This requirement has three exceptions: (a) The student has withdrawn from the course; (b) only one student is enrolled in the section (in which case anonymity is impossible); and (c) the section is a laboratory that must be taken with a course having a different section number. Course evaluations are completed at <https://soic.iupui.edu/app/course-eval/>. Course evaluations are open from the eleventh week. Course evaluations are anonymous, which means that no one can

view the name of the student completing the evaluation. In addition, no one can view the evaluation itself until after the instructor has submitted the final grades for the course. In small sections, demographic information should be left blank, if it could be used to identify the student. A course evaluation must close before the grade for that course can be released. To ensure students have had ample opportunity to complete the evaluation, an uncompleted course evaluation could delay the release of the grade for up to a week.

6. **Communication:** The instructor should respond to emails within 48 hours, excluding weekends and holidays, and announce periods of extended absence in advance. The instructor should provide weekly office hours or accept appointments for face-to-face, telephone, or teleconferenced meetings.
7. **Email:** Indiana University uses your IU email account as an official means of communication, and students should check it daily for pertinent information. Although you may have your IU email forwarded to an outside email account, please email faculty and staff from your IU email account.
8. **Disabilities Policy:** In compliance with the Americans with Disabilities Act (ADA), all qualified students enrolled in this course are entitled to reasonable accommodations. Please notify the instructor during the first week of class of accommodations needed for the course. Students requiring accommodations because of a disability must register with Adaptive Educational Services (AES) and complete the appropriate AES-issued before receiving accommodations. The AES office is located at UC 100, Taylor Hall (Email: [aes@iupui.edu](mailto:aes@iupui.edu), Tel. 317 274-3241). Visit <http://aes.iupui.edu> for more information.
9. **Administrative Withdrawal:** A basic requirement of this course is that students participate in all class discussions and conscientiously complete all required course activities and/or assignments. If a student is unable to attend, participate in, or complete an assignment on time, it is the student's responsibility to inform the instructor. If a student misses more than half of the required activities within the first 25% of the course without contacting the instructor, the student may be administratively withdrawn from this course. Administrative withdrawal may have academic, financial, and financial aid implications. Administrative withdrawal will take place after the full refund period, and a student who has been administratively withdrawn from a course is ineligible for a tuition refund. Contact the instructor with questions concerning administrative withdrawal.
10. **Emergency Preparedness:** Safety on campus is everyone's responsibility. Know what to do in an emergency so that you can protect yourself and others. For specific information, visit the emergency management website. <http://protect.iu.edu/emergency>

## MISSION STATEMENT

The Mission of IUPUI is to provide for its constituents excellence in

- Teaching and Learning;
- Research, Scholarship, and Creative Activity; and
- Civic Engagement.

With each of these core activities characterized by

- Collaboration within and across disciplines and with the community;
- A commitment to ensuring diversity; and
- Pursuit of best practices

IUPUI's mission is derived from and aligned with the principal components—Communities of Learning, Responsibilities of Excellence, Accountability and Best Practices—of Indiana University's Strategic Directions Charter.

### **STATEMENT OF VALUES**

IUPUI values the commitment of students to learning; of faculty to the highest standards of teaching, scholarship, and service; and of staff to the highest standards of service. IUPUI recognizes students as partners in learning. IUPUI values the opportunities afforded by its location in Indiana's capital city and is committed to serving the needs of its community. Thus, IUPUI students, faculty, and staff are involved in the community, both to provide educational programs and patient care and to apply learning to community needs through service. As a leader in fostering collaborative relationships, IUPUI values collegiality, cooperation, creativity, innovation, and entrepreneurship as well as honesty, integrity, and support for open inquiry and dissemination of findings. IUPUI is committed to the personal and professional development of its students, faculty, and staff and to continuous improvement of its programs and services.