

Advanced Construction Information Technologies

CGN 6905 Section 20837

Class Periods: Wednesday Period 6-8 (12:50PM – 3:50PM EST)

Location: BLK0315

Academic Term: Fall 2024

Instructor:

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(352) 294-6619

Office Hours: W: 11:50PM-12:50PM, Zoom: <https://ufl.zoom.us/j/4369404526>

Course Description

3 credit hours

Course Pre-Requisites / Co-Requisites

Instructor permission

Course Objectives

Exploration of emerging technologies for automation applications in various engineering disciplines (e.g., civil engineering and manufacturing), including hardware and software systems such as sensors, scanning techniques, big data analytical tools, machine learning, artificial intelligence, and visualization methods; using applicable tools such as Arduino and Jupyter Notebook to develop automation application solutions to effectively enhance the design, inspection and management of manmade assets, such as civil infrastructure systems. Students will:

1. Understand working principals of modern information systems and information technologies
2. Understand main methods and tools for main phases of information processing – sensing, scanning, analysis, decision-making, and visualization
3. Understand the basics of robotics and automation
4. Be able to develop simple sensing systems using open-source tools such as Arduino
5. Be able to apply machine learning and artificial intelligence tools to solve applicable engineering problems

Materials and Supply Fees

No materials and supply fees.

Required Textbooks and Software

No required textbooks.

Course Schedule (team project demo/presentations/exams highlighted in red)

Dates		Topics	Homework Due	Paper reading
1	8/28	Course Overview Information Science Basics: 1) information science; 2) information systems; 3) Cyber-Physical Systems; 4) Human-in-the-loop; 5) applications in civil engineering and manufacturing.	--	--
2	9/4	Big Data I: Principles; Curse of Dimensionality; MapReduce method.	--	--
3	9/11	Big Data II: Apache Hadoop basics; Applications of big data in civil engineering and manufacturing.	--	Paper #1: CPS
4	9/18	Class presentation: History of IT for engineering	HW#1: Facebook	Paper #2: Big Data I
5	9/25	Sensors: Working principles of sensors; Arduino basics; Barcodes; RFID; indoor localization techniques; smart phone app development for civil engineering and manufacturing.	--	Paper #3: Big Data II
6	10/2	Sensor development: In-class Arduino projects (materials will be provided by instructor) for construction sites.	--	Paper #4: Sensing I
7	10/9	Scanning: LiDAR; depth camera; photogrammetry; Smart Phone App Demo	HW#2: App demos	Paper #5: Sensing II
8	10/16	Machine Learning/Artificial Intelligence/Deep Learning I: Review of statistics; uncertainties; linear algebra review; feature extraction methods (PCA and sparse coding). Smart building design proposal presentation	HW#3: Smart building design	Paper #6: Sensing III
9	10/23	Machine Learning/Artificial Intelligence/Deep Learning II: regression analysis and artificial neural networks (ANN); TensorFlow and Jupyter Notebook environment; ANN programming (prediction and classification of civil engineering problems).		Paper #7: Visualization I
10	10/30	Machine Learning/Artificial Intelligence/Deep Learning III: Convolutional Neural Networks (CNN) and programming (image classification of construction objects).	--	Paper #8: Visualization II
11	11/6	Machine Learning/Artificial Intelligence/Deep Learning IV: Recurrent Neural Network (RNN) and Long short term memory (LSTM) methods; LSTM programming (time series prediction of construction process); CNN programming (voice recognition); Autoencoder and generative adversarial networks (GANs) (principles).	--	Paper #9: Machine Learning
12	11/13	Machine Learning/Artificial Intelligence/Deep Learning V: Natural Language Processing (NLP) and programming (sentiment analysis); Large Language Models (LLMs) – transformer architecture; reinforcement learning (RL : Q-learning and genetic algorithm) and programming for construction resource and space planning.	--	Paper #10: VR/AR/MR/XR
13	11/20	Visualization and Robotics: Virtual reality, augmented reality and mixed reality; robotics basics; applications in civil engineering and manufacturing; technology demos.	HW#4: AI project demo(Individual)	--
14	12/4	TERM PROJECT PRESENTATIONS/DEMO	--	--
15	12/6	FINAL EXAM (ONLINE)	Final Presentation file and Report Due	--

Attendance Policy, Class Expectations, and Make-Up Policy

Class attendance is required and will be monitored through random attendance checks. Students are responsible for any information communicated during class. Project presentation attendance is mandatory. Missed presentations can only be made up when it is an excused absence. Excused absences must be consistent with university policies in

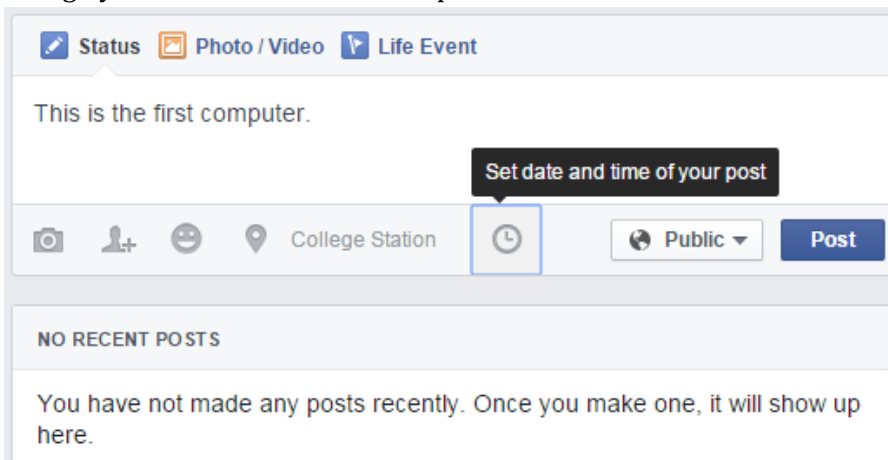
the graduate catalog (<https://catalog.ufl.edu/graduate/regulations>) and require appropriate documentation. Student must contact the instructor as soon as the student knows that he/she will have an excused absence to arrange for makeup. Additional information can be found here: <https://gradcatalog.ufl.edu/graduate/regulations/>

Evaluation of Grades

ID	Assignment	Total Points	Percentage of Final Grade
Individual project			
A	HW#4: AI project	100	15%
B	Final Exam	100	30%
C	Weekly paper review	100	5%
Team projects			
D	HW#1: Facebook timeline	100	10%
E	HW#2: Smart app demo	100	10%
F	HW#3: Smart building design	100	10%
G	Term project	100	20%
H	Peer Evaluation (team members)	1.0	Multiplier
Final Grade=A *15%+ B*30%+C*5%+H*(D+E+F)*10%+H*G*20%			

HW#1: Facebook Timeline – History of Construction Technologies

- Form a team of 2.
- Pick a technology focus area, such as BIM, AI, Robotics etc.
- Add “ITee” as your friend on Facebook.
- Log into “ITee” and add new statuses on your selected tech. Please research the HISTORICAL milestones of the selected tech, and add articles, pictures, and/or videos about it. Please note, you also need to set time and date of your posts to when it actually happened. For example, if you added an article about the first computer, you should date your post “February 14, 1946”, when the first computer was announced, even though you added the article on September 18, 2024.



Facebook “ITee” account info

Username: dujing82@gmail.com

Password: To be provided in class.

- 5. Present your findings and initiate discussions (30 minutes) in the class on September 18.**
- It will be peer evaluated based on: (1) Contents (full length articles; videos, images) – 30%; (2) Relevance and Connection to the trend of the selected technology – 20%; (3) Ability to engage class in discussion – 20%.

HW#2: Smart app development and demo

- Form a team of 2.
- Design a smart phone app using idiot-proof development platform, such as AppSheet: <https://www.appsheet.com>.

3. Consider including the following functions:
 - a. GPS tracking
 - b. Camera
 - c. Barcode scanner
 - d. Map
 - e. Interactive charts
4. Write a user's manual.
- 5. Demonstrate the app (15 minutes) to the class on October 9.**
6. It will be peer evaluated based on: (1) Purpose (how relevant is it to a realistic construction management problem?) – 25%; (2) Development (Did the development follow software development process? (identify needs → User requirement → Architecture → Development → Testing) -25%; (3) Functionality (how effectively and efficiently the app can solve the identified problem? How well does the app meet user needs?) – 25%; (4) Usability (how easy it is to use the app?) – 25%.

HW#3: Smart building design proposal

1. Form a team of 2.
2. Propose a cost-effective renovation plan for Weil Hall to make it smarter.
3. Consider including the following functions:
 - a. Indoor air quality monitoring
 - b. Indoor localization
 - c. Occupancy status
 - d. Energy monitoring and optimization
 - e. Emergency system
4. Prepare a presentation file.
- 5. Demonstrate the proposal (15 minutes) to the class on October 16.**
6. It will be peer evaluated based on: (1) Purpose (how relevant is it to the needs?) – 30%; (2) Functionality (how effectively and efficiently the proposal can solve the identified problem?) – 30%; (3) Economy (how cost effective is the proposed solution? Please include an estimate of cost) – 40%.

HW#4: AI Project

1. Select a problem related to civil engineering or construction. Examples include but not limited to:
 - a. Predicting commodity/material price
 - b. Construction object detection on jobsite
 - c. Voice recognition for human resource management
 - d. Jobsite optimization solution
 - e. Other applications
2. Use the AI methods learned in class to develop a solution.
3. Develop working model with Jupyter notebook
- 4. Demonstrate your AI model in class on November 20.**
5. It will be evaluated based on: (1) Relevancy (how relevant is it to the domain?) – 30%; (2) Technical development (how well was the AI model developed?) – 30%; (3) Creativity (By the end, did the student present a reasonable solution to the problem?) – 40%.

Term Project (team project)

1. Form a team of 2
2. Pick a technology focus area from the followings:
 - a. Scanning (LiDAR or Photogrammetry)
 - b. Sensing
 - c. Indoor localization
 - d. VR/AR
 - e. Machine learning
 - f. Human-Robot Collaboration
 - g. Human factors in construction projects

3. Design a research project in the selected technology focus area, including: (1) A technical report (~3,000 words) to describe the background, the problem, the objectives, the design of the study or experiment, the results, the findings and conclusions; (2) A demonstration of the technology; (3) A final presentation to the class.
4. **Final demo and presentation (40 minutes) to the class on December 4.**
5. Equipment and devices will be loaned by the instructor if available. **STUDENTS MUST MAKE SURE ALL LOAN EQUIPMENT AND DEVICES ARE RETURNED TO THE INSTRUCTOR IN ORIGINAL CONDITIONS.**
6. The term project will be evaluated based on: (1) Relevancy (how relevant is it to the domain?) – 20%; (2) Technical development (how well the project was developed to meet the research needs?) – 20%; (3) Technology demonstration (how well did the team demonstrate the developed technology) – 20%; (4) Final report – 40%.

Grading Policy

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

[UF Graduate Catalog](#)
[Grades and Grading Policies](#)

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class

lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another

and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/state-authorization-status/#student-complaint>.