SCHOOL OF ARCHITECTURE UNIVERSITY OF FLORIDA

AI IN THE BUILT ENVIRONMENT

COURSE NUMBER: ARC 6XXX

TERM: SUMMER 2024

NUMBER OF CREDIT HOURS: 3

The planning, design, and construction of the built environment are on the verge of a fundamental transformation. A key element of this transformation is a radical shift in paradigm from planning and design representations of unconnected data to practices with an overwhelming amount of information-rich data. Artificial Intelligence (AI), in particular Machine Learning (ML), provides planners, designers, and constructors with new models and methods to engage in these data-heavy processes to synthesize meaningful information for all areas of their practice, from planning to design to fabrication to erection. This course provides the College of Design, Construction, and Planning (DCP) students an opportunity to learn about the application of AI in their disciplines.

CLASS LOCATION: *ZOOM*

CLASS MEETING TIMES: *tbd*

INSTRUCTORS SPRING: Dr. Karla Saldana Ochoa

OFFICE HOURS: *tbd*

COURSE WEBSITE: http://elearning.ufl.edu

COURSE DESCRIPTION:
An introduction to Artificial Intelligence (AI) and its applications to real-world problems in planning, design, and construction of the built environment. Includes application in professional practice in architecture, construction management, interior design, landscape architecture, sustainability and the built environment, and urban and regional planning.

COURSE OBJECTIVES:

- Understand how AI technologies can be used to guide the planning, design, and construction of the built environment.
- Apply existing AI models in architecture, construction management, interior design, landscape architecture, sustainability and the built environment, and urban and regional planning disciplines.
- Build a simple Machine Learning model.
- Understand the current limitations of machine learning technologies.

INSTRUCTIONAL METHODS:
The class meets three lecture hours per week.

COURSE POLICIES:

ATTENDANCE POLICY:

Attendance and participation in class activities are required. Attendance and participation grades will be computed in proportion to the number of presences on the days the rolls were taken and participation on a given topic in the class forum. Requirements for class attendance and make-up quizzes, assignments, and other work in this course are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

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. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/

UF POLICIES:

UNIVERSITY POLICY ON ACCOMMODATING STUDENTS WITH DISABILITIES:

Students requesting accommodation for disabilities must first register with the Dean of Students Office (https://disability.ufl.edu/). The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation. You must submit this documentation prior to submitting assignments or taking the quizzes or exams. Accommodations are not retroactive, therefore, students should contact the office as soon as possible in the term for which they are seeking accommodations

UNIVERSITY POLICY ON ACADEMIC MISCONDUCT:

Academic honesty and integrity are fundamental values of the University community. Students should be sure that they understand the UF Student Honor Code at https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/ . Although joint work on assignments may be acceptable in some cases, duplication of an assignment, both manually or by computer will be considered an act of academic dishonesty and dealt with accordingly. On all work submitted for credit by students at the university, the following pledge is either required or implied**: "On my honor, I have neither given nor received unauthorized aid in doing this assignment.**"

GETTING HELP:

For issues with technical difficulties for E-learning in Canvas, please contact the UF Help Desk:

- Learning-support@ufl.edu
- (352) 392-HELP - select option 2
- https://lss.at.ufl.edu/help.shtml

GRADING POLICIES:

Assignments	Percentage
Module Assignments (6 total@10% each)	60%
Final Group Project	30%
Attendance and Participation	10%
Total	100%

GRADING SCALE:

Grades will be computed according to the following scale:

A=93-100; A- =90-92.9; B+ =87-89.9; B=83-86.9; B- =80-82.9; C+ = 77-79.9; C=73-76.9; C-=70-72.9; D+ =67-69.9; D=63-66.9; D- =60-62.9; E<60.

- The attendance grade will be computed in proportion to the number of presences on the days the rolls were taken, and the participation grade is based on responding to a given discussion topic in the class forum.

- At the end of each module, an assignment that covers topics discussed in that module will be given. Specific evaluation criteria will be provided with each assignment.

- A final group project will be assigned that requires implementing existing AI algorithms in a project in the built environment to facilitate planning, design, and construction strategies.

Reading Materials:

- Mario Carpo, The Second Digital Turn – Design Beyond Intelligence, Cambridge, MIT Press, 2017 AI & Architecture: An Experimental Perspective
- Stanislas Chaillou, Harvard Graduate School of Design | Feb. 24th, 2019 https://towardsdatascience.com/ai-architecture-f9d78c6958e0
- Rajagopal, A., & Tetrick, C. (2017). The rise of AI and machine learning in construction. Autodesk Universityhttps://www.autodesk.com/autodesk-university/article/Rise-AI-and-Machine-Learning-Constru ction-2018
- Blanco, J. L., Fuchs, S., Parsons, M., & Ribeirinho, M. J. (2018). Artificial intelligence: Construction technology's next frontier| McKinsey.https://www.mckinsey.com/business-functions/operations/our-insights/artificial-intelligence-c onstruction-technologys-next-frontier#
- Tan, P. N., Steinbach, M., & Kumar, V. (2016). ***Introduction to Data Mining.*** Pearson Education India, Chapter 2: "Data" and Chapter 3 "Exploring Data."
- Book: Bradley E Cantrell, Justine Holzman; Responsive Landscapes: Strategies for Responsive Technologies in Landscape Architecture; Routledge, 2016 https://www.routledge.com/Responsive-Landscapes-Strategies-for-Responsive-Technologies-in
- -Landscape/Cantrell-Holzman/p/book/9781138796652
- Article: Mimi Zeiger; "Live and Learn"; Landscape Architecture Magazine, vol. 109, Iss.2, Feb 2019, pp. 78-89
- Nishant, R., Kennedy, M., & Corbett, J. (2020). Artificial intelligence for sustainability: Challenges, opportunities, and a research agenda. International Journal of Information Management, 53, 102104. https://doi.org/10.1016/j.ijinfomgt.2020.102104
- Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S. D., Tegmark, M., & Fuso Nerini, F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. Nature Communications, 11(1), 233. https://doi.org/10.1038/s41467-019-14108-y

Software / Language: Python, Jupyter Notebooks

AI Category: Use-AI
Use & Apply AI: Applying AI knowledge, concepts and applications in different scenarios. AI course content is over 50%

AI Student Learning Outcomes

Know and Understand
SLO2. Recognize, identify, describe, define and/or explain applications of AI in multiple domains.
Lecture Weeks 01, 02, 03, 04, 06, 08, 10

Use and Apply
SLO3. Select and/or utilize AI tools and techniques appropriate to a specific context and application.
Assignments: A1, A2, A3, A4, Final Project

COURSE SCHEDULE:

WEEK	DISCIPLINES	CONTACT HOURS	APPLICATIONS IN DCP	CLASSES	ASSIGNMENTS
WEEK 01	AI/ML	3	-	**Introduction to AI (SLO2)**. Lecture on Machine Learning, Neural Networks, Deep Learning, Back propagation, and examples of application in the Built Environment Practice	-
WEEK 02	Data Collection, Visualization, & Coding	6	-	**Collecting Data (SLO2)**. Lecture on crawlers, scrapers, API keys. Run python code to **use** crawlers and API keys to systematically collect images and text from web databases based on **specific context and application**.	**A1 (SLO3)**: Collect Data from existing websites using the materials taught in class and preprocess the collected data. **15 points**
WEEK 03				**Data Visualization (SLO2)**. Lecture on feature vectors and data visualization methods. Run python code to **apply** data procession **techniques**: Word: Word Frequency and Word Embeddings. Images: RGB encoding and Edge Detection	
WEEK 04	Computer Vision	6	Image analysis	**Computer vision (SLO2)**. Lecture on CNNs overview and theory. Explanation of Image analysis, Remote sensing, SLAM, and Point clouds	**A2 (SLO3)**: **Apply** Computer vision algorithms. Run notebook and Q1: recognize objects on collected images. Q2. Segment objects on collected images. **15 points**
WEEK 05				**Computer vision.** Run python Code to **apply** CNNs for Object Detection and Image Segmentation on images	
WEEK 06	Generative Models	6	Generative design	**Generative Algorithms (SLO2)**. Lecture on Generative algorithms, overview, and theory. Explanation of GANs, Diffusion models and examples in computational design.	**A3 (SLO3)**: Conduct a study on how different attributes modify the final output from sketch to rendering **application on architecture context** with generative algorithms. **15 points**
WEEK 07				**Generative Algorithms.** Lecture on training data for Image Generative algorithms (GA), **Use** existing GA, to understand the attributes that influence the output.	
WEEK 08	NLP	6	Text mining Sentiment analysis	**Natural Language Models (SLO2)**. Lectures on Transformers and Large Language Models: overview and theory	**A4 (SLO3)**: Run python code exercise **using** BERT (a transformer) as a base model to perform text classification. **15 points**
WEEK 09				**Natural Language Models. Apply** ChatGPT API to create an assistant to process text data.	
WEEK 10-12	-	9	-	Final Project and Presentations	**Final project (SLO3)**: specific application based on students' interest. **40 points**

<u>Disclaimer:</u> This syllabus represents the current plans and objectives. As we go through the semester, those plans may need to change to enhance the class learning opportunity. Such changes, communicated clearly, are not unusual and should be expected.