UNIVERSITY OF CALGARY
SCHOOL OF ARCHITECTURE,
PLANNING AND LANDSCAPE

Winter 2024

Course Number	ARCH 680.30 L01	**Classroom**	TBD
Course Name	Data Processing for Computational Design		
Pre/Co-Requisites			
Instructor	Jinmo Rhee	**Office Hours/Location**	Thr 12:00 – 01:00 pm or by appointment
	Email: jinmo.rhee@ucalgary.ca	**Phone:** 412-628-2948	
Class Dates	All in-person		
Instructor Email Policy	Please note that all course communications must occur through your @ucalgary email. See Communication Guidelines section for more details.		
Name and Email of Teaching Assistant(s)			

Course Description:

This course is designed to equip students with a solid foundation in computational representation, spanning a wide range of data types, formats, and structures. This course delves into various algorithmic approaches, starting from foundational algorithms and progressing to classical and learning-based Artificial Intelligence (AI) techniques.
In today's design landscape, AI has emerged as a pivotal element. This course aims to facilitate a deep understanding of the fundamental data underpinning computation, which is integral to comprehending the evolving landscape of AI technology. It provides an insightful overview of the evolutionary trajectory of AI technology and its seamless integration within design disciplines, tracing its transformative journey over the past six decades.

This course begins with the development and data of early computer. We explore what a computer is, how it has evolved, and how modern computers are operated and structured. In the course of the development of the computer, we examine efforts to introduce computers into design, understanding the early stages of computational design. Moreover, this course expands the topic to the development history of AI and its relationship with design. We explore what AI is, how it came about, which moments emerged as key in the development history of AI, and envision how AI might be utilized in the design field in the future. Based on the developmental history of computers and AI, this course covers four computer systems that have led innovative changes in design: the rule-based system, agent-based system, parametric system, and learning-based system. Students will understand how each system works and, by

physically implementing simple examples without using a computer, comprehend the composition and characteristics of the data in each system. Based on this, they will implement and utilize each system for 3D modeling and apply it to a design project

Through a combination of engaging lectures, readings, discussions, interactive hands-on exercises, and projects, students will develop a comprehensive grasp of data comprehension. By the end of the course, students will possess the skills and knowledge required to harness the power of data processing, enabling them to drive innovative and effective design solutions in the context of modern computational design practices.

Course Hours: 3 units; Blended (Lectures and Lab Sessions)

Online Delivery (If applicable – can take this section out)

As a significant component of this course, we will be leveraging online platforms such as Desire2Learn (D2L) and Zoom to facilitate learning. Throughout the term, students are expected to actively engage in asynchronous learning tasks via the D2L learning environment and synchronous Zoom sessions if they will be. In the event that a student is unable to participate in real-time due to unforeseen circumstances, it is essential to notify the instructor in advance. This will enable us to collaboratively devise an alternative participation plan, which may involve watching recorded sessions, submitting a brief reflection, and actively participating in follow-up online discussions. To ensure a comprehensive understanding of the material, asynchronous online learning requires students to watch recorded lecture videos diligently and conduct their own lab sessions following the instructions provided in the videos.

Course Learning Outcomes:

Upon completion of this course, students will know and be able to:

1. understand AI technology and its seamless integration within design disciplines,
2. trace AI's transformative journey with design disciplines over the past six decades,
3. develop their own aspects of the role of AI in the design future,
4. construct and apply geometrical and spatial rules in a design project,
5. distinguish object and agent in computation and design an agent-based system to solve a design problem,
6. distinguish parameters and variables in computation and construct parametric algorithms for modeling,
7. understand the characteristics of learning-based system in a way of thinking and translate a design problem into a matter of learning-based system.

Learning Resources:

There is no textbook for this course but reading material will be provided.
The following are useful resources.

- Carpo, Mario. 2013. The Digital Turn in Architecture 1992–2012. John Wiley & Sons, Ltd.

- Carpo, Mario. 2017. The Second Digital Turn: Design Beyond Intelligence. Cambridge: MIT Press.
- Cross, Nigel. 1977. The Automated Architect. Viking Penguin.
- Krishnamurti, Ramesh. 1982. “SGI:An Interpreter for Shape Grammars.” Centre for Configurational Studies, 75.
- Mitchell, William J. (William John). 1989. The Logic of Architecture : Design, Computation, and Cognition. Cambridge, Mass: MIT Press.
- Negroponte, Nicholas. 1970. The Architecture Machine. Cambridge, Mass: MITPress.
- Rhee, Jinmo, Pedro Veloso, and Ramesh Krishnamurti. 2023. “Three Decades of Machine Learning with Neural Networks in Computer-Aided Architectural Design (1990–2021).” Design Science 9 (January): e25. https://doi.org/10.1017/dsj.2023.21.
- Schumacher, Patrik. 2016. Parametricism 2. 0: Rethinking Architecture’s Agenda for the 21st Century. New York, UNITED KINGDOM: John Wiley & Sons, Incorporated. http://ebookcentral.proquest.com/lib/cm/detail.action?docID=4658587.
- Veloso, Pedro, and Ramesh Krishnamurti. 2021. “Self-Learning Agents for Spatial Synthesis.” In , 265–76. https://doi.org/10.1007/978-3-030-57509-0_24.
- William, J Mitchell. 1977. Computer-Aided Architectural Design.

Other readings will be added to this list.

Technology Requirements (D2L etc.):

To ensure a productive and enriching learning experience at the University of Calgary, students enrolled in online, remote, and blended courses must have reliable access to the following technology:

- A computer with a supported operating system, equipped with the latest security and malware updates.
- A current and updated web browser to access course materials and online resources.
- A webcam, either built-in or external, to actively participate in virtual sessions and collaborative activities.
- A microphone and speaker (built-in or external) or a headset with a microphone for effective communication during online interactions.
- Current antivirus and/or firewall software enabled to safeguard against potential security threats.
- A broadband internet connection to ensure seamless access to online content and virtual classrooms.

Additionally, this course will utilize specific software tools, namely Grasshopper in Rhinoceros. Students are required to have Rhinoceros version 6.0 or higher (preferably 7.0) and Grasshopper installed on their laptops to fully engage in the course activities.

As the primary platforms for online learning, D2L and Zoom will play essential roles in delivering course materials, conducting virtual lectures, and facilitating interactive discussions. Prioritize ensuring that you have access to D2L and Zoom to make the most of the online learning opportunities provided.

Additional Classroom Conduct and Related Information

Q&A Sessions and Office Hours

D2L has a section for Discussion which will be used for Q&A sessions. Students can post questions about concepts and assignments. Other students can reply to the post to share their experience or ideas and logic about a problem. However, the D2L Discussion is not a place to catch up on missed classes. In necessary circumstances where you are unable to attend class, please make sure to inform us via email and the instructor will address the situation accordingly.

Office hours and supplementary sessions can be conducted remotely through Zoom. The links for these meetings will be announced in D2L or via email.

Digital Works and Back-up Requirements

In this computation course, the majority of the materials and assignments will be in digital format. Therefore, it is imperative for all students to take responsibility for maintaining back-up files of their digital works and productions. Regardless of the nature of the issue, such as data loss due to electrical problems or the misplacement of storage devices, these circumstances cannot serve as excuses for missed assignments or late submissions.

To ensure the safety and accessibility of your work, it is highly recommended to utilize OneDrive, the cloud storage service provided by the University of Calgary. OneDrive offers a reliable platform with no size limitations, making it an ideal solution for safeguarding your files. By diligently backing up your work, you can confidently approach the course knowing that your progress and efforts are secure and protected from unexpected data loss incidents.

Plagiarism Policy

Copying any materials without citation is considered plagiarism and is strictly prohibited in this course. Code plagiarism refers to using code from external sources without proper attribution to the original authors. Any instance of code plagiarism will be treated as a breach of academic integrity, leading to severe consequences as per University policies. Please ensure all code submissions are your own, properly cited, and demonstrate your understanding of the material. If you have questions about using external code or proper citation, seek clarification from the instructor.

Communication Guidelines

Please reserve email communication for crucial queries and important concerns. For software-related questions or inquiries about the course content, it is recommended to ask the instructor during office/lab sessions or use the D2L Discussion section. By following these communication guidelines, we can ensure a more efficient and effective means of addressing your inquiries and fostering a collaborative learning environment.

Guidelines for Zoom Sessions in Online Classes

Students are expected to participate actively in all Zoom sessions and to turn on their webcam. Please join our class in a quiet space that will allow you to be fully present and engaged in the Zoom sessions. Students must behave in a professional manner during the session. Students,

employees, and academic staff are also expected to demonstrate behaviour in class that promotes and maintains a positive and productive learning environment.

Assessment Components:

Assessment Method	Description	Weight	Aligned Course Learning Outcome
Assignment 1	Design Implementation using Rule-based System.	15	1,2,3, and 4
Assignment 2	Design Implementation using Agent-based System.	15	1,2,3, and 5
Assignment 3	Design Implementation using Parametric System.	15	1,2,3, and 6
Assignment 4	Design Implementation using learning-based Systems.	15	1,2,3, and 7
Final Project	Design project developing and applying a data processing system	30	4,5,6, and 7
Participation	Class attendance and active engagement.	10	1,2, and 3

Assessment and Evaluation Information

Attendance and Participation Expectations:

For in-person classes, punctuality is essential, and it is expected that students attend all sessions on time. The course will feature lectures and small group discussions, and your active engagement in these activities, including asking and answering questions, will be considered as part of your participation. Additionally, your performance in in-class activity sessions, which will occur 1-3 times during each class and last for 20-50 minutes, will also contribute to your overall participation assessment.

Guidelines for Submitting Assignments:

Every assignment will include specific submission instructions provided in the assignment handouts and template files. Please ensure that you read and follow these instructions carefully

when submitting your work. Following the specified guidelines for submission is crucial for the successful evaluation of your assignments.

Final Examinations: There will be no final exam for this course. Instead, we will have a comprehensive 3-hour review session dedicated to the final projects. During this session, students will have the opportunity to present and discuss their final projects in detail. The review will serve as a culmination of your efforts and provide a platform for showcasing your achievements throughout the course.

Expectations for Writing:

Expect collegial-level writing. Follow university guidelines.

Late Assignments:

A 5%-point deduction will be applied *for each day* an assignment is submitted late. For instance, if a student submits an assignment (15 points max.) *two days late*, the highest achievable score for that assignment will be *90%* (13.5 points). Please ensure timely submission to avoid any deduction in your scores.
Final Project will have different breakdown and late submission policy, referring to the final project handout.

Criteria that must be met to pass:

Successful completion of assignments is a vital requirement for passing this course. Each assignment should not take more than 2 hours at most to complete. It is strongly recommended to aim for a score of over 70% on each assignment to ensure satisfactory progress.
In the event that you do not meet the desired scores in the assignments, the Final Project presents an additional opportunity to compensate for any low grades. Make the most of this chance to improve your overall grade in the course.

Grading Scale:

Grade	Grade Point Value	4-Point Range	Percent	Description
A+	4.00	4.00	95-100	Outstanding - evaluated by instructor
A	4.00	3.85-4.00	90-94.99	Excellent - superior performance showing comprehensive understanding of the subject matter
A-	3.70	3.50-3.84	85-89.99	Very good performance
B+	3.30	3.15-3.49	80-84.99	Good performance
B	3.00	2.85-3.14	75-79.99	Satisfactory performance
B-	2.70	2.50-2.84	70-74.99	Minimum pass for students in the Faculty of Graduate Studies
C+	2.30	2.15-2.49	65-69.99	All final grades below B- are indicative of failure at the graduate level and cannot be

				counted toward Faculty of Graduate Studies course requirements.
C	2.00	1.85-2.14	60-64.99	
C-	1.70	1.50-1.84	55-59.99	
D+	1.30	1.15-1.49	50-54.99	
D	1.00	0.50-1.14	45-49.99	
F	0.00	0-0.49	0-44.99	

A student who receives a "C+" or lower in any one course will be required to withdraw regardless of their grade point average (GPA) unless the program recommends otherwise. If the program permits the student to retake a failed course, the second grade will replace the initial grade in the calculation of the GPA, and both grades will appear on the transcript

The School of Architecture, Planning and Landscape will not permit the Flexible Grade Option (CG Grade) for any course offered by the School.
https://www.ucalgary.ca/pubs/calendar/current/f-1-3.html

CACB Student Performance Criteria (for Architecture courses only)

The following CACB Student Performance Criteria will be covered in this course at a primary level (other criteria will be covered at a secondary level): A2: Design Skills; A3: Design Tools; B1: Critical Thinking and Communication; B3: Architectural Theory.

Topic Areas & Detailed Class Schedule

		Topic	Assignments / Due Dates
Class 01	**11-Jan**	**Development of Early Computer and Data**	
Class 02	**15-Jan**	**Emergence of AI (History of AI)**	
Class 03	**18-Jan**	**Rule-based System in Design 1**	
Class 04	**25-Jan**	**Rule-based System in Design 2**	**A1 Due: 24-Jan**
Class 05	**1-Feb**	**Agent-based System in Design 1**	
Class 06	**8-Feb**	**Agent-based System in Design 2**	**A2 Due: 7-Feb**
Block Week	**15-Feb**	No Class	
Spring Break	**22-Feb**		
Class 07	**29-Feb**	**Parametric System in Design 1**	
Class 08	**7-Mar**	**Parametric System in Design 2**	**A3 Due: 6-Mar**

Class 09	**14-Mar**	**Learning-based System in Design 1**	
Class 10	**21-Mar**	**Learning-based System in Design 2**	**A4** **Due: 20-Mar**
Class 11	**28-Mar**	**Final Project1**	
Class 12	**4-Apr**	**Final Project2**	
Class 13	**11-Apr**	**Final Project Review**	**FP** **Due: 10-Apr**

University of Calgary Policies and Supports

ACADEMIC ACCOMMODATION

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The student accommodation policy can be found at: https://www.ucalgary.ca/legal-services/university-policies-procedures/student-accommodation-policy

Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities:https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf. Students needing an accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to their instructor (contact information on first page above).

SAS will process the request and issue letters of accommodation to instructors. For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/ .

ACADEMIC MISCONDUCT

Academic Misconduct refers to student behavior which compromises proper assessment of a student's academic activities and includes: cheating; fabrication; falsification; plagiarism; unauthorized assistance; failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses; and failure to comply with exam regulations applied by the Registrar.

For information on the Student Academic Misconduct Policy and Procedure please visit: https://www.ucalgary.ca/legal-services/university-policies-procedures/student-academic-misconduct-policy

Additional information is available on the Academic Integrity Website at https://ucalgary.ca/student-services/student-success/learning/academic-integrity.

COPYRIGHT LEGISLATION:

All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright (https://www.ucalgary.ca/legal-services/university-policies-procedures/acceptable-use-material-protected-copyright-policy) and requirements of the copyright act (https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html) to ensure they are aware of the consequences of unauthorised sharing of course materials (including instructor notes, electronic versions of textbooks etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy (https://www.ucalgary.ca/pubs/calendar/current/k.html).

INSTRUCTOR INTELLECTUAL PROPERTY

Course materials created by instructors (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may NOT be reproduced, redistributed or copied without the explicit consent of the instructor. The posting of course materials to third party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course at the same time may be allowed under fair dealing.

FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY

Student information will be collected in accordance with typical (or usual) classroom practice. Students' assignments will be accessible only by the authorized course faculty. Private information related to the individual student is treated with the utmost regard by the faculty at the University of Calgary.

SEXUAL AND GENDER-BASED VIOLENCE POLICY

The University recognizes that all members of the University Community should be able to learn, work, teach and live in an environment where they are free from harassment, discrimination, and violence. The University of Calgary's sexual violence policy guides us in how we respond to incidents of sexual violence, including supports available to those who have experienced or witnessed sexual violence, or those who are alleged to have committed sexual violence. It provides clear response procedures and timelines, defines complex concepts, and addresses incidents that occur off-campus in certain circumstances. Please see the policy available at https://www.ucalgary.ca/legal-services/university-policies-procedures/sexual-and-gender-based-violence-policy .

UNIVERSITY STUDENT APPEALS OFFICE

If a student has a concern about a grade that they have received, they should refer to Section I of the Undergraduate Calendar (https://www.ucalgary.ca/pubs/calendar/current/i-3.html) which describes how to have a grade reappraised. In addition, the student should refer to the SAPL's Procedure for reappraisal of grades

OTHER IMPORTANT INFORMATION

Please visit the Registrar's website at: https://www.ucalgary.ca/registrar/registration/course-outlines for additional important information on the following:

- Wellness and Mental Health Resources
- Student Success
- Student Ombuds Office
- Student Union (SU) Information
- Graduate Students' Association (GSA) Information
- Emergency Evacuation/Assembly Points
- Safewalk