UNIVERSITY OF CALGARY
SCHOOL OF ARCHITECTURE,
PLANNING AND LANDSCAPE

Fall 2023

Course Number	ARCH 680.29 L01	**Classroom**	TBA
Course Name	Scripting and Generative Design		
Pre/Co-Requisites	Arch 504, Arch 512, or any equivalent courses with basics of parametric modeling		
Instructor	Jinmo Rhee	**Office Hours/Location**	Fri 12:00 – 01:00 pm or by appointment
	Email: jinmo.rhee@ucalgary.ca	**Phone:** 412-628-2948	
Class Dates	Blended In-Person: Sep 8 – Oct 6, Friday 9:00am to 11:50am Remote: Oct 20 – Nov 3 In-Person: Nov 24 – Dec 6, Friday 9:00am to 11:50am		
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:

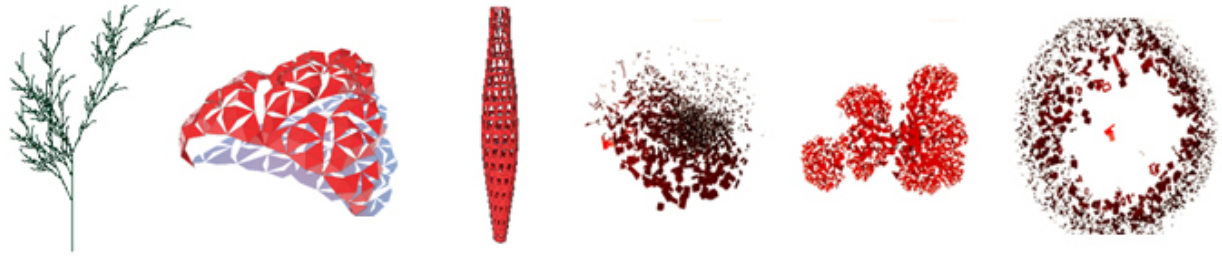
This course aims to prepare students to modeling geometry through scripted development of data scientific schemes for architecture/design applications — that is, to introduce students to basic scripting with a focus on algorithms relating to form making and to reinforce and extend basic concepts of generative modeling.

Contemporary approaches to modeling architectural geometry are computational — this is reflected in designers wanting much more control over the generative process by varying design constraints; in turn, this enhances the efficiency with which they can navigate design variations, analyze design artifacts and explore design manifestation. The complexity of constructing geometry sometimes can be translated as sequences of machining instructions, which composes algorithms and computational models. We refer to such algorithms and models as generative systems.

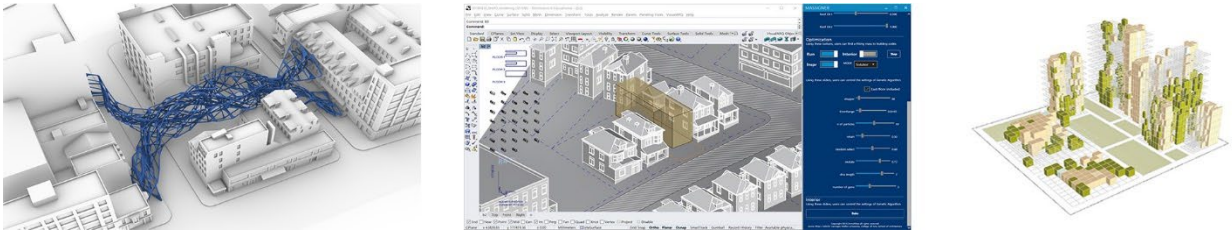
Generative systems have been an important topic in recent decades in computational design and in other disciplines. Earlier approaches were based on classical artificial intelligence and

optimization methods; recently, a variety of computational techniques from different fields, such as parametric modeling, agent-based modeling, or neural networks, have been incorporated in the development of new generative systems. With recent developments in machine learning, we can even develop models that learn automatically from data or experience.

The primary objective of the course is to foster students' ability to formulate design problems computationally, encompassing technical skills in computation and exploration of computational design thinking. The course will have two parts: the first will cover the basics of object-oriented programming using Python, scripting geometric constructions using GH Python in conjunction with Rhino/Grasshopper objects, and creating generative systems. The second part will focus on applying computational design techniques through a final project.



Example of Generative Modeling. L-System, Surface Subdivision, Aperture Openings varying according to Height, Various Growth Patterns



Example of Final Projects. Bridge Structure using Agent-based Modeling, Mass Optimization for a Residential Building, High-rise Building Form Finding

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

Online Delivery

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. write (simple) programs in Python to implement visually motivated solutions,
2. become familiar with the scripting syntax, program flow, and geometry manipulation through scripting in Rhino/Grasshopper,
3. model complex forms and relationships using geometric concepts and parametric tools,
4. model complex data flows toward desired design outcomes
5. apply algorithmic thinking to design problems,
6. develop a sensibility for generative modeling.

Learning Resources:

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

- Arturo Tedeschi. AAD – Algorithms-Aided Design. Len Penseur Publisher, 2014.
- Robert Woodbury. Elements of Parametric Design. Routeledge, 2010.
- Helmut Pottmann, Andreas Asperl, Michael Hofer, and Axel Kilian. Architectural Geometry. Bentley Institute Press, 2007.
- Wassim Jabi. Parametric Design for Architecture. Lawrence King Publishing, 2013.
- Rajaa Issa, Essential Mathematics for Computational Design – Third Edition.
- Andrew Payne & Rajaa Issa, The Grasshopper Primer – Third Edition.
- Zubin Khabazi, Generative Algorithms.
- Jinmo Rhee and Eddy Man Kim. Digital Media Series, Grasshopper. 2020
- Jinmo Rhee and Eddy Man Kim. Digital Media Series, Rhinoceros. 2019

Other readings will be added to this list.

Online Resources:

- GH Gateway >> for access to tutorials, videos, and other resources
- GH Forum >> for answers to specific GH questions from the GH community
- Grasshopper Primer >> great reference material to have on hand
- Rhino Scripting Gateway >> for access to tutorials, example code, etc.
- Rhino Python Forum >> for answers to specific scripting questions in Rhino
- RhinoCommon SDK >> have this open for reference while scripting in Rhino
- Python >> general support for programming in Python
- Lynda >> great video tutorials on all things digital. Sign in through CMU for free access
- Stack Overflow >> an all-purpose online forum to ask programming questions
- ChatGPT >> an online chatting platform using AI system. Students can ask questions regarding to scripting and algorithms to ChatGPT.

Technology requirements:

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 Jupyter Notebooks and 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. Rest assured, clear instructions for installing Jupyter Notebooks will be provided during class sessions.

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, uploading any file which includes code is prohibited. Further, 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.

Code Plagiarism Policy

Copying code 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
Assignments (A)	In the initial seven classes, students will complete 9 scripting exercises (A1 – A9), each worth 7 points.	63	1, 2, and 3
Final Project (P)	The Final Project consists of four parts,	30	4, 5, and 6

	each scored as follows: 5, 5, 10, and 10 points respectively.		
Participation	Class attendance and active engagement.	7	1, 2, 5, and 6

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. In the case of asynchronous remote classes, you are required to watch the recorded videos and complete lab exercises independently.
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 short lab sessions, which will occur 2-3 times during each class and last for 10-25 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. 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 (6 points max.) two days late, the highest achievable score for that assignment will be 90% (5.4 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 (A) 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 (P) 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:

Students are not graded on a curve.

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

		Preview	In-Class		Review	Delivery Mode
Class 01	**8-Sep**	01.Syllabus 02.Basic Data Types	Syllabus Review	Data Type	**A1, A2** **Due: 14-Sep**	IN-PERSON
Class 02	**15-Sep**	03.Operation	Operations	GHPython Workshop 1	**A3** **Due: 21-Sep**	IN-PERSON
Class 03	**22-Sep**	04.Conditionals 05.Functions	Conditionals	Functions	**A4, A5** **Due: 28-Sep**	IN-PERSON
Class 04	**29-Sep**	06.Loop	Loop	GHPython Workshop 2	**A6** **Due: 05-Oct**	IN-PERSON
Class 05	**6-Oct**	07.Set and Dictionary 08.Recursion	Set and Dictionary	Recursion	**A7, A8** **Due: 12-Oct**	IN-PERSON
Class 06	**13-Oct**	09.OOP	Object-Oriented-Programming	GHPython Workshop 3	**A9** **Due: 19-Sep**	IN-PERSON
Class 07	**20-Oct**	10.Data Structure	Data Structure	Project 1. Openings	**P1** **Due: 2-Nov**	REMOTE
Class 08	**27-Oct**		GHPython Workshop 4	GHPython Workshop 5		REMOTE
Class 09	**3-Nov**		GHPython Workshop 6	Project 2. Initial Demo	**P2** **Due: 23-Nov**	REMOTE
Block Week	10-Nov	No Class				
Fall Break	17-Nov					
Class 10	**24-Nov**		Project 3. Working Demo	Project 4. Development	**P3** **Due: 30-Nov**	IN-PERSON
Class 11	**1-Dec**		Project 5. Final Demo	Project 6. Documentation	**P4** **Due: 6-Dec**	IN-PERSON
Class 12	**TBD**		Final Project Review			IN-PERSON

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