



Course Number	ARCH 680.20 L03	Classroom	The course will follow a hybrid format . Lectures will be real-time online . We will have scheduled physical meetings to discuss presentations and project reviews.
Course Name	Artificial Design: Machine Learning for Creative Purposes		
Pre/Co-Requisites			
Instructor	Dr. Alicia Nahmad Vazquez	Office Hours/Location	by appointment
	Email: Alicia.nahmadvazquez@ucalgary.ca		Phone: 5872159119
Class Dates	Mandatory real-time online Zoom classes, Tuesday & Thursday 9:00 – 10:30 Tuesday 6 th of September – Thursday 24 th November See the calendar below for specific dates.		
Instructor Email Policy	Please note that all course communications must occur through your @ucalgary email, and I will respond to emails sent via student's @ucalgary emails within 48 hours.		
Name and Email of Teaching Assistant(s)			

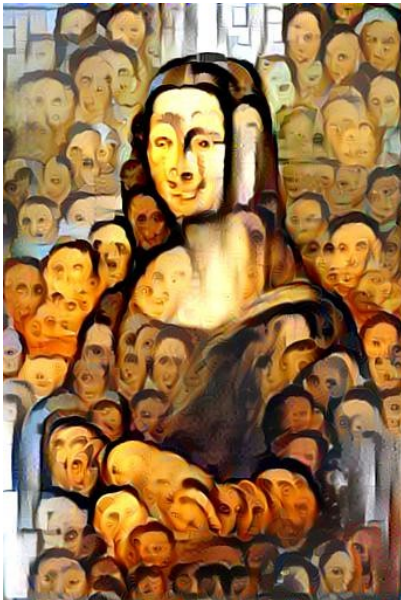
Course Description

In his 1991 book 'War in the age of intelligent machines' Manuel De Landa describes the radical shift in the relation between humans, machines and information brought by the emergence of new artificially intelligent weapons. He further explains their significance, going beyond warfare, to changing forever the forms through which human bodies, materials and machines are combined, organised, and deployed. The last two decades have seen a decreasing cost in computing power, the availability of larger datasets and the emergence of better algorithms. These three combined have led to a new era of Artificial Intelligence and learning machines that now permeates every aspect of our life.

The summer of 2022 has been a game changer for designers and creatives. Diffusion models such as MidJourney and DallE became omnipresent and easily accessible, making us question how we represent our concepts and how we manipulate words to express them better for

the AIs that are illustrating them. In these game-changing times it is critical to question: What does design mean in the age of intelligent machines? Machines that learn and that are radically changing the relationship between humans and technology and enabling novel dances of agency and co-creation. The elective Artificial Design interrogates the impact and explores the potentials of machines that learn to the design and architectural activity.

The elective will engage critically with the theoretical and discursive aspects of AI in the context of creative work. It will explore its significance to the design activity, its historical background, and its potential for spatial design. It will discuss the changes of agency that intelligent machines entail by modifying the relationship between the designer and its AI-mediated creation and examine new design ecologies and their AI-augmented or produced results in terms of novelty, bias, and identity. Additionally, the course will engage with the technical aspects of machine learning by using Neural Networks (Diffusion models, GANs, CNNs, LSTMs, etc) to explore the creative abilities of AI and their application to the different aspects of the architectural design process. The course will speculate on the novel sensibilities in architecture enabled by the new agencies provided by AI – dependent on the data applied to the different problems- .



The course will consist of a series of exploratory exercises and one final project delivered in the form of a movie, animated sequence or website based on the search space of a purpose trained and curated dataset. The scope will be decided based on the team or individual interests. Students are expected to work and engage individually in posts and critical discussions on D2L. Team work is possible if of interest for students.

We will be using runwayML, jupyter notebooks, lobeAI, google colab notebooks (python), rhino/grasshopper, visual studio code, Midjourney, Dall-E and github repositories.

Course Hours: 3 units

Online Delivery (If applicable)

This course will take place online via Desire2Learn (D2L) and Zoom.

The course will follow a hybrid format. Lectures will be real-time **online**. We will have scheduled **physical** meetings to discuss presentations and project reviews. Classes will be a mix of lecture, discussion, hands-on tutorials, homework reviews and presentations.

High Participation is expected.

If unable to participate live due to unforeseen circumstances, inform the instructor in advance to work out an alternative participation activity.

Course Learning Outcomes

The outcomes of the elective can be broadly described as theoretical and practical skills relating to design thinking, in relation to novel modes of agency such as those enabled by AI. Students will acquire knowledge on machine learning models, their architecture and databases that define them. Students will understand the characteristics between some of the models commonly used (Diffusion models, GANs, LSTM, CNN) and speculate their application to the design process.

Upon completion of the course you will be able to:

1. Work remotely collaboratively and critically,
2. Have an intuition and high-level understanding of core machine learning concepts and algorithms, including supervised learning, unsupervised learning, reinforcement learning, transfer learning, classification, and regression. You will also have a critical approach to their repercussion in design, art, and architecture
3. Hands-on integration of machine learning tools in programs commonly used for design with a high level of abstraction (e.g. Grasshopper, Runway, etc.)
4. Contextualise your work within the contemporary discourse of machine learning in architecture and creative practices.
5. Learn to use pre-trained models to generate images and vides using python notebooks, google colabs and related tools.
6. Learn how to collect a custom dataset to train a machine learning model
7. Have a vocabulary for critical discussions around the social impact and ethics of data collection and application of machine learning algorithms.
8. Understand and be familiar with the current landscape of new media art generated from machine learning algorithms.
9. Distinguish between the different types of GANs/generative models and know when to use one over the other
10. See how to use machine learning in your creative workflow

The development, cleaning and curating of a dataset will allow the students to understand how the data used on the training process impacts the agency of the ML model. Students will also understand ethical considerations in the data collection process.

Students will be encouraged to critically address the question of how these new modes of intelligence can contribute to advance design to production processes and physically built environments rather than whereas machine learning can be integrated into the building processes and building outputs which seems inevitable by now.

Learning Resources

Required readings, textbooks and learning materials:

Textbooks:

- Deep Learning with Python by Francois Chollet, Manning 2017
- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurelien Geron, O'Reilly 2019.

Readings and Learning materials:

The following is a series of course notes from Stanford. They provide tutorials on numpy/Python, as well as using google Cloud (which is another online/cloud server that allows you to access GPUs, which are computing nodes you will need if you would like to train your own neural networks; we provide a tutorial on how to use Paperspace, which is a different cloud server).

It also provides tutorials/detailed explanations of how neural networks work for vision.
<http://cs231n.github.io/>

Below is a list of papers that cover various aspects of what research has been done in the intersection of Architecture, Art, and Artificial Intelligence, specifically deep learning. The majority of the works investigate how learned representations of neural networks can be used to edit and synthesize new images.

The papers that have the * symbol next to their number are technical papers that describe methods (like deep dreaming) in detail.

(1*) A Neural Algorithm of Artistic Style

<https://arxiv.org/abs/1508.06576>

This is the original style transfer paper that the Google 'Deep Style' Algorithm is based upon.

(2*) Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks

<https://arxiv.org/pdf/1703.10593.pdf>

This is the original CycleGAN paper used for 'Domain Transfer', which can be thought of as transferring the 'style' of one domain (captured by one dataset) to another domain (captured by a different dataset). In contrast to the Neural Style transfer method proposed in (1), this method can only transfer style between these two domains.

(3*) Inceptionism: Going Deeper into Neural Networks

<https://ai.googleblog.com/2015/06/inceptionism-going-deeper-into-neural.html>

This is the blog post from Google describing the Deep Dream method.

(4*) Deep Inside Convolutional Networks: Visualising Image Classification Models and Saliency Maps

<https://arxiv.org/pdf/1312.6034.pdf>

A nice example of this technique is given in <https://rajpurkar.github.io/mlx/visualizing-cnns/>

(5*) High-Resolution Network for Photorealistic Style Transfer

<https://arxiv.org/abs/1904.11617>

(6*) Neural Style Transfer: A Review

<https://ieeexplore.ieee.org/abstract/document/8732370>

(7*) Enhancing Image Quality via Style Transfer for Single Image Super-Resolution

<https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8290957&tag=1>

(9*) Enhancing Image Quality via Style Transfer for Single Image Super-Resolution

<https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8290957&tag=1>

(10*) Image Synthesis and Style Transfer

<https://arxiv.org/pdf/1901.04686.pdf>

(11) The Face of Art: Landmark Detection and Geometric Style in Portraits

http://delivery.acm.org/10.1145/3330000/3322984/a60-yaniv.pdf?ip=35.2.12.89&id=3322984&acc=ACTIVE%20SERVICE&key=93447E3B54F7D979%2E0A17827594E6F2C8%2E4D4702B0C3E38B35%2E4D4702B0C3E38B35&__acm__=1570034535_55366eda4519228e460b07ef17455780

(12) The Shape of Art History in the Eyes of the Machine

<https://www.aaai.org/ocs/index.php/AAAI/AAAI18/paper/view/16993/15929>

(13) The Art of Human Intelligence and the Technology of Artificial Intelligence: Artificial Intelligence Visual Art Research*

https://link.springer.com/chapter/10.1007/978-3-030-01313-4_15

(14) Unsupervised Learning of Artistic Styles with Archetypal Style Analysis

<http://papers.nips.cc/paper/7893-unsupervised-learning-of-artistic-styles-with-archetypal-style-analysis.pdf>

(15) Can we teach computers to understand art? Domain adaptation for enhancing deep networks capacity to de-abstract art

<https://reader.elsevier.com/reader/sd/pii/S0262885618301057?token=D47FAAF1F42313384C97BC48FB44F1C159EB5C0A016E4B538038D0F70B384E2AD6C8EE66AC7310D350E1C110FD8737EF>

(16) Deep Learning Architect: Classification for Architectural Design Through the Eye of Artificial Intelligence

https://link.springer.com/chapter/10.1007/978-3-030-19424-6_14

(17) Finding Principal Semantics of Style in Art

<https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8334453&tag=1>

(18) Autonomy, Authenticity, Authorship and Intention in Computer Generated Art

https://link.springer.com/chapter/10.1007/978-3-030-16667-0_3

(19) Understanding Art through Multi-Modal Retrieval in Paintings

<https://arxiv.org/pdf/1904.10615.pdf>

(20) Towards the Algorithmic Detection of Artistic Style

https://www.researchgate.net/profile/Jeremiah_Johnson18/publication/330828467_Towards_the_Algorithmic_Detection_of_Artistic_Style/links/5c59a4f092851c48a9bbf322/Towards-the-Algorithmic-Detection-of-Artistic-Style.pdf

(21) Deep Learning Concepts for Evolutionary Art

https://link.springer.com/chapter/10.1007/978-3-030-16667-0_1

(22) Feature Fusion from Multiple Paintings for Generalized Artistic Style Transfer

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3387817

(23) Discovering Visual Patterns in Art Collections with Spatially-consistent Feature Learning

<https://arxiv.org/abs/1903.02678>

(24) Difussion Models <https://www.archpaper.com/2022/08/artificial-intelligence-convincing-images-buildings-good-thing/>

Technology requirements (D2L etc.): In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Broadband internet connection
- [Student IT Resources](#)
- Software: RunwayML, LobeAI, Rhino, grasshopper, Google colabs (not need to install), Anaconda, and Visual Studio Code for the classes. Additionally, Adobe InDesign and After Effects for documentation.

Most current laptops will have a built-in webcam, speaker and microphone.

Workshop Safety Training Requirement

If a course requires the use of the SAPL workshop, students must complete all online University of Calgary safety courses, the online Trajectory safety training course, as well as in-person workshop training and a grade of pass on the final evaluation project, to be granted access to the SAPL workshop. This training is offered once a year, around the start of the Fall term and has a completion deadline.

Additional Classroom Conduct and Related Information

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
Model Exploration	Explore the runway environment and their pretrained hosted models. Test model chaining	16%	1 to 10
StyleGAN	Collect or create your own dataset and use it to train a StyleGAN Perform Vector operations Create a video of the latent space	20%	1 to 10
Classifiers (Teachable machine/ Lobe) or Grasshopper exercise	Exercise using classifiers and/or grasshopper interoperability	14%	1 to 10
Pix2Pix	Students will develop an interactive painting app using pix2pix.	20%	1 to 10
Difussion Models	Students will focus on developing a project based on their interests. We	20%	1 to 10

	<p>will use diffusion models and 3D translation techniques.</p> <p>Projects can be based on the set of exercises developed during the class or on a specific interest of the student. We will discuss the projects during the course.</p> <p>Students are invited to use software and tools of their preference for their final project.</p>		
Presentations, participation & Coherency		10%	1 to 10
<p>Attendance and Participation Expectations: Students are expected to be present on all the synchronous sessions and participate during class. They are also expected to participate by continuously posting progress on the class digital communication platform.</p> <p>Guidelines for Submitting Assignments: Assignments will be submitted through d2l and discussed during class , students are expected to present their work so others can learn and discuss findings</p> <p>Final Examinations: The course will have a final presentation of a ML project selected and developed by the students, using the tools shown during class and their own research. Projects can be submitted either individually or as a team</p> <p>Expectations for Writing (https://www.ucalgary.ca/pubs/calendar/current/e-2.html):</p> <p>Late Assignments:</p> <p>Criteria that must be met to pass: The course is designed as a collection of individual submissions for each of the different exercises.</p>			

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/salp-3-3.html>)

CACB Student Performance Criteria

A2 Design Skills

Topic Areas & Detailed Class Schedule

Include information relevant to the class schedule, such as weekly topics, readings, and assignment due dates. For online, remote or blended courses include whether course activities are synchronous (i.e., real-time/Zoom) and asynchronous (i.e., students complete on their own time such as discussion boards, watching videos, etc.). It is recommended that important dates including the first day of classes, holidays, term breaks and last day of classes also be included.

Course Schedule Date	Topic	Assignments/Due Dates

Sept 6 - 9	Introduction, theoretical positioning, state of the art and previous examples 2. Machine learning 101	
Sept 12 - 16	1. Google Colab Notebooks intro 2. Play with models in Colab	
Sept 19 - 23	1. Colab MNIST 2. Runway	
Sept 26 - 29	1. Data Set Creation 2. Generative Adversarial Networks with a focus on StyleGAN (Training GANs)	First assignment due 27.09
Friday September 30	National Day for Truth and Reconciliation	
Oct 3 - 7	Fall Block Week	
Monday October 10	Thanksgiving Holiday	
Oct 11 - 14	1. Training GANs 2. Inference & Vector Operations	
Oct 17 - 21	1. Assignment Presentation 2. Image classifiers	Second assignment due 18.10
Oct 24 - 28	1. Runway to GH 2. Manipulating Images in GH	
Oct 31 – Nov 4	1. 3 rd Assignment Presentation 2. Pix2Pix	Third assignment due 01.11
Nov 7 – 10	Term Break	
Friday November 11	Remembrance Day	
Nov 14 - 18	1. Pix 2 Pix drawing app 2. Connecting models through ports & drawing app	
Nov 21 - 25	1. Pix2Pix assignment presentation 2. How Diffusion models work + Disco Diffusion	Fourth assignment due 22.11
Nov 28 – Dec 2	1. Superresolution & Frame interpolation 2. Final presentations	Final presentation 01.12
Dec 5 - 7		
Indicate the following dates:		
<ul style="list-style-type: none"> If applicable, dates, times and locations of all approved class activities scheduled outside of regular course hours 		

Guidelines for Zoom Sessions

Zoom is a video conferencing program that will allow us to meet at specific times for a “live” video conference, so that we can have the opportunity to meet each other virtually and discuss relevant course topics as a learning community.

To help ensure Zoom sessions are private, do not share the Zoom link or password with others, or on any social media platforms. Zoom links and passwords are only intended for students registered in the course. Zoom recordings and materials presented in Zoom, including any teaching materials, must not be shared, distributed or published without the instructor’s permission.

The use of video conferencing programs relies on participants to act ethically, honestly and with integrity; and in accordance with the principles of fairness, good faith, and respect (as per the [Code of Conduct](#)). When entering Zoom or other video conferencing sessions (such as MS Teams), you play a role in helping create an effective, safe and respectful learning environment. Please be mindful of how your behaviour in these sessions may affect others. Participants are required to use names officially associated with their UCID (legal or preferred names listed in the Student Centre) when engaging in these activities.

Instructors/moderators can remove those whose names do not appear on class rosters. Non-compliance may be investigated under relevant University of Calgary conduct policies (e.g. [Student Non-Academic Misconduct Policy](#)). If participants have difficulties complying with this requirement, they should email the instructor of the class explaining why, so the instructor may consider whether to grant an exception, and on what terms. For more information on how to get the most out of your zoom sessions visit:

<https://elearn.ucalgary.ca/guidelines-for-zoom/>

If you are unable to attend a Zoom session, please contact your instructor in advance to arrange an alternative activity for the missed session (e.g., to review the recorded session). Please be prepared, as best as you are able, to join class in a quiet space that will allow you to be fully present and engaged in Zoom sessions. Students will be advised by their instructor when they are expected to turn on their webcam (for group work, presentations, etc.).

The instructor may record online Zoom class sessions for the purposes of supporting student learning in this class – such as making the recording available for review of the session or for students who miss a session. Students will be advised before the instructor initiates a recording of a Zoom session. These recordings will be used to support student learning only and will not be shared or used for any other purpose.

University of Calgary Policies and Supports

COVID-19 PROCEDURE FOR SICK STUDENTS: <https://www.ucalgary.ca/risk/covid-19-procedure-for-sick-students>

UNIVERSITY OF CALGARY COVID-19 UPDATES: <https://www.ucalgary.ca/risk/emergency-management/covid-19-response>

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/university-policies-procedures/accommodation-students-disabilities-procedure>

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://ucalgary.ca/policies/files/policies/student-academic-misconduct-policy.pdf>

<https://ucalgary.ca/policies/files/policies/student-academic-misconduct-procedure.pdf>

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 (www.ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright.pdf) 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 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/policies/files/policies/sexual-violence-policy.pdf>

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