Course title: Science, Engineering and Technology Workshops
Course code: ARCH 3003 CGAD
Programs offering course: Global Architecture and Design
Language of instruction: English
U.S. semester credits: 3.00
Contact hours: 45.00
Term: Spring 2021

Course Description

Computation has always played a big role as a tool and inspiration in architecture and urban design. Computer technology in the 1980s gave architects and engineers (Peter Eisenman, Frank Gehry, Frei Otto) parametric tools to analyze and simulate the complexity observed in nature and apply it to structural building shapes and urban organizational patterns. These automated processes were giving predictions of settlements, patterns, simulations and animated forms. There is a clear distinction in the contemporary paradigm between computerized design and computational design (Kostas Terzidis, Achim Menges and Sean Ahlquist). While the former (computerized design) suggests the use of the digital tools and the dramatic computational power of the machine, it still works with a conventional design processes, albeit accelerated by the use of modern technology. It is the latter (computational design), which digitalizes not only the data but the whole process of the design thinking. Using the parametric design method, we formalize parameters based on our initial design ideas and then turn them into a responsive outputs (definitions, codes). These outputs help us form information based skeletons, which allows us to incorporate complex information in design objects and processes, as well as to respond in real time within the design workflow. Software tools not only shape a dialogue in the process of translating our ideas into architectural responses, but also question our understanding of new materials and fabrication methods.

Global AD SET Workshop functions between digital and physical environment, using primarily Grasshopper - a visual node-based editor programming language developed by David Rutten at Robert McNeel& Associates. It runs as a plug-in within the Rhinoceros 3D CAD2 application. The course explores various morphologies, simulates aggregations and growth in natural tissues, studies ecological and social behaviors that are tied to the general Global AD Studio task. It explores physics-simulation engines such as Kangaroo, and introduces the possibilities of scripting languages such as Python or C#. The course prepares students for simulating complex material behaviors and, on that basis, generating material informed geometries. Within this connection, students also learn how to prepare design projects for fabrication and develop a new set of skills for advanced fabrication and computational design.

Learning Objectives

By completing this course, students will:

- compare and contrast computational design and computerized design;
- learn about and categorize new materials and morphologies;
- develop skills to use high performance, cost feasible, and equitable technologies;
- develop computational design thinking and use different parametrical digital tools;
- apply new technologies in urban context through a collaborative project.

Course Prerequisites

Basic 3D modeling skills

Methods of Instruction

In class slide lectures, tutorials and desk crits of project development, material and fabrication lab experience.

Assessment and Final Grade

1. Modelling 20%
2. Algorithmic Design 20%
3. Fabrication 20%
4. Theoretical Knowledge of the Tools 20%
5. Class Participation 20%
   TOTAL 100%

Course Requirements

Modelling

Students will model complex geometries within an appropriate detail level, will work in different scales and dimensions (multiscalar modelling) as well as learn of different representation strategies.

The modelling part is evaluated throughout the course, final evaluation (5%) is based on the SET submission in week 16.

Algorithmic Design

At the beginning students will have the opportunity to approach Grasshopper and the basics of parametric design while achieving immediate results. In the next step students will learn how to deal with the complexity of emergent patterns and how to evaluate their potential performance. At the end students will be able to simulate aggregations and growth in natural tissues, simulate ecological and social behaviors, generate specific self-organization morphologies and incorporate more specific evaluation criteria as well as generate emergent structure playgrounds with potential fields of social interactions.

The algorithmic design part is evaluated throughout the course, final evaluation (5%) is based on the SET submission in week 16.

Fabrication

The emerged studio project structures will be digitally modelled via component system and physically fabricated (hand build, 3D printed, CNC or Laser cut). At the end 2D drawings for laser cutting prototyping of the project structures will be extracted.

The fabrication part is evaluated throughout the course, final evaluation (5%) is based on the submitted physical model in week 16.

Theoretical Knowledge of the Tools

Students would be informed of the development and conceptual process behind contemporary digital design tools.

The theoretical part is evaluated throughout the course, final evaluation is based on the final studio project presentation, where the student would be required to explain his design including his theoretical knowledge of the tools.

Class Participation

Students should be present during lecture hours and follow the tutorial tasks. When there are no tutorials students are expected to work on their projects in studio and participate in desk crits.

CIEE Prague Class Participation Policy

Assessment of students’ participation in class is an inherent component of the course grade. Participation is valued as meaningful contribution in the digital and tangible classroom, utilizing the resources and materials presented to students as part of the course. Students are required to actively, meaningfully and thoughtfully contribute to class discussions and all types of in-class activities throughout the duration of the class. Meaningful contribution requires students to be prepared, as directed, in advance of each class session. This includes valued or informed engagement in, for example, small group discussions, online discussion boards, peer-to-peer feedback (after presentations), interaction with guest speakers, and attentiveness on co-curricular and outside-of-classroom activities.

Students are responsible for following the course content and are expected to ask clarification questions if they cannot follow the instructor’s or other students’ line of thought or argumentation.

The use of electronic devices is only allowed for computer-based in-class tests, assignments and other tasks specifically assigned by the course instructor. Students are expected to take notes by hand unless the student is entitled to the use of computer due to his/her academic accommodations. In such cases the student is required to submit an official letter issued by his/her home institution specifying the extent of academic accommodations.
accommodations.

Class participation also includes students’ active participation in Canvas discussions and other additional tasks related to the course content as specified by the instructor.

Students will receive a partial participation grade every three weeks.

**CIEE Academic Honesty Policy**

CIEE subscribes to standard U.S. norms requiring that students exhibit the highest standards regarding academic honesty. Cheating and plagiarism in any course assignment or exam will not be tolerated and may result in a student failing the course or being expelled from the program. Standards of honesty and norms governing originality of work differ significantly from country to country. We expect students to adhere to both the American norms and the local norms, and in the case of conflict between the two, the more stringent of the two will preside. Three important principles are considered when defining and demanding academic honesty. These are related to the fundamental tenet that one should not present the work of another person as one’s own.

**The first principle** is that final examinations, quizzes and other tests must be done without assistance from another person, without looking at or otherwise consulting the work of another person, and without access to notes, books, or other pertinent information (unless the professor has explicitly announced that a particular test is to be taken on an “open book” basis).

**The second principle** applies specifically to course work: the same written paper may not be submitted in two classes. Nor may a paper for which you have already received credit at your home institution be submitted to satisfy a paper requirement while studying overseas.

**The third principle** is that any use of the work of another person must be documented in any written papers, oral presentations, or other assignments carried out in connection with a course. This usually is done when quoting directly from another's work or including information told to you by another person. The general rule is that if you have to look something up, or if you learned it recently either by reading or hearing something, you have to document it.

The penalty ranges from an F grade on the assignment, failure in the course to dismissal from the program. The Academic Director is consulted and involved in decision making in every case of a possible violation of academic honesty.

**N.B. Course schedule is subject to change due to study tours, excursions, or local holidays. Final schedules will be included in the final syllabus provided to students on site.**

**Attendance**

Regular class attendance is required throughout the program.

If you will miss a class for any reason, notify the Program Coordinator and your instructor beforehand via Canvas. You are responsible for any materials covered in class during your absence, and except in the specific cases listed below, credit will not be granted for missed assessments.

Excessive absences will result in a notification letter, and finally a warning letter, sent to you and your home school, based on the following:

<table>
<thead>
<tr>
<th>% of course hours missed</th>
<th>Number of CIEE classes</th>
<th>Minimum penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 10%</td>
<td>One to Three 90-min. classes; or One 180-min. class</td>
<td>No penalty</td>
</tr>
<tr>
<td>10% - 20%</td>
<td>Four 90-min. classes</td>
<td>Written notification* to the student, followed by a warning letter to the student and home school; 3% reduction in the final grade</td>
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<tr>
<td></td>
<td>Five 90-min. classes</td>
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<tr>
<td></td>
<td>Two 180-min classes</td>
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<tr>
<td>More than 20%</td>
<td>Six 90-min. classes; or Three 180-min. classes</td>
<td>Automatic course failure, and possible expulsion with notification to the home school</td>
</tr>
</tbody>
</table>

* The notification letters are intended to ensure that you are well advised in advance of any potential for failure or dismissal, so that you can take steps to avoid this.

As the table shows, **missing more than 20% of any class (e.g., due to undocumented illness, travel delays, flight cancellations, over-sleeping, etc.) results in automatic failure of the course.**
If you miss an assessment in class due to an absence, you will be able to make it up in the following instances:

- You provide a relevant doctor's note from a local medical professional to your Program Coordinator within 24 hours of your absence (a scan or photograph sent via e-mail are acceptable)
- A CIEE staff member verifies that you were too ill to attend class.
- You provide evidence of a family emergency to your Program Coordinator.
- You have an approved absence related to the observance of a religious holiday from the Academic Director based on a request submitted before you arrived onsite.

**Please note:** Absences incurred due to documented illness, documented family emergency or the observance of a religious holiday approved before arrival onsite do not count towards the total of absences. Students may self-certify one absence due to illness without providing a doctor’s note as long as they notify the Program Coordinator within 24 hours of their absence by e-mail or a text message.

**Other attendance-related policies**

If you transfer from one CIEE class to another during the Add/Drop period, you will not be considered absent from the first session(s) of the new class provided you were marked present for the first session(s) of the original class.

If you are over 15 minutes late for a class, the instructor is required to mark you absent.

In case of class conflicts (irregularities in the class schedule, including field trips and make-up classes), always contact the Academic Department to decide the appropriate course of action.

Please remember to track your attendance on the Canvas Course Sites and report any errors in the record to the Academic Department within one week of the discrepancy date, as later claims may not be considered.

These attendance rules also apply to any required co-curricular excursion, activity, or event, and to for-credit internships.

CIEE staff does not manage absences at partner institutions providing direct enrollment classes (FAMU, ECES and FSV), but they have similar attendance policies and attendance is monitored there. Grade penalties may result from excessive absences.

**N.B. Course schedule is subject to change due to study tours, excursions, or local holidays. Final schedules will be included in the final syllabus provided to students on site.**

**Weekly Schedule**

**Week 1**

<table>
<thead>
<tr>
<th>Class: 1.1</th>
<th>Introductory lecture: Computational Design Thinking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Introduction to Rhinoceros 5.0</td>
</tr>
<tr>
<td></td>
<td>Reading: AAD – p.15-p.33</td>
</tr>
</tbody>
</table>

**Week 2**

| Class: 2.1 | Introduction to Grasshopper |

<table>
<thead>
<tr>
<th>Class: 2.2</th>
<th>Basic geometry: vector, points, curves, surfaces, meshes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Panelling, fields &amp; attractors</td>
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<tr>
<td></td>
<td>Interactive environment in Grasshopper</td>
</tr>
<tr>
<td></td>
<td>Reading: AAD – p.33-p.61</td>
</tr>
</tbody>
</table>

**Week 3**

| Class: 3.1 | Lists & data management, data flow, operators, functions & booleans |
|  | Reading: AAD – p.69-p.120 |

**Week 4**

| Class: 4.1 | Simulation and form-finding: Kangaroo |

| Class: 4.2 | Simulation and form-finding: Kangaroo |
Week 5
Class: 5.1 Simulation and form-finding: Kangaroo
Reading: AAD – p.361-p.395

Week 6
Class: 6.1 Fabrication tools: lasercutting and 3d-printing
Reading: AAD – p.309-p.360

Week 7
Class: 7.1 Fabrication tools: lasercutting and 3d-printing
Reading: AAD – p.309-p.360

Week 8
Class: 8.1 Looping tools: Anemone
Reading: AAD – p.297-p.309

Week 9
Class: 9.1 Agent systems
Reading: AAD – p.217-p.255

Week 10
Class: 10.1 Agent systems
Reading: AAD – p.217-p.255

Week 11
Class: 11.1 Optimization tools: Ladybug&HoneyBee
Reading: AAD – p.441-p.461

Week 12
Class: 12.1 Optimization tools: Karamba
Reading: AAD – p.405-p.440

Week 13
Class: 13.1 Introduction to rendering
Reading: AAD – p.255-p.296

Week 14
Class: 14.1 Introduction to animation
Reading: AAD – p.255-p.296

Week 15
Class: 15.1 SET submission
Final Evaluation of Modelling, Algorithmic design, Fabrication, and Theoretical knowledge of the tools

Course Materials
Readings
AAD_Algorithms-Aided Design, Parametric Strategies Using Grasshopper® by Arturo Tedeschi
Online Resources

Grasshopper specific:

http://www.grasshopper3d.com/ - Grasshopper website

http://www.grasshopper3d.com/page/tutorials-1 - Grasshopper tutorials page

Essential mathematics for computational design:


food 4 Rhino (home of all Rhino + GH Plugins):

http://www.food4rhino.com/

Introductory level:


http://ledatomica.wordpress.com/2012/02/05/bend-workshop-manual/

http://www.plethora-project.com/2012/02/05/rhino-grasshopper/

https://vimeo.com/user4779230/videos

http://www.exlab.org/category/resources/

https://vimeo.com/exlab

http://wiki.bk.tudelft.nl/toi-pedia/Grasshopper

http://www.liftarchitects.com/

http://designreform.net/

http://modelab.nu/?cat=3

http://www.i-m-a-d-e.org/fabrication