Kennesaw State University
College of Architecture and Construction Management
Department of Architecture

ARCH 4490: COMPUTATIONAL METHODS
Advanced Generative-Analytical Technologies in Architecture
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Prerequisites
ARCH 2004
The knowledge of computers and experience with 3D modeling, particularly Rhinoceros, is highly-recommended. No prior programming experience is expected or required.

Description
This course introduces students to computational thinking and the fundamental concepts of computation through explorations with generative scripting and parametric tools. The goal is to understand the potential of computation and the role it can play as part of one's design process; not as a collection of specific tools, but as a way of thinking about design. By the end of the semester, students will have the vocabulary and an understanding of computing that will inform their future explorations with more advanced tools and technologies.

NAAB Criteria
The Department of Architecture at KSU maintains accredited status through the National Architectural Accrediting Board (NAAB), which reviews the curriculum, facility, faculty, and program resources annually, and conducts an intensive site visit every six years. As part of this review, the NAAB will review student work produced in courses throughout the curriculum. This course will include content related to the following NAAB Student Performance Criteria:

- A.1 - Professional Communication Skills: Ability to write and speak effectively and use representational media appropriate for both within the profession and with the general public.
- A.2 - Design Thinking Skills: Ability to raise clear and precise questions, use abstract ideas to interpret information, consider diverse points of view, reach well-reasoned conclusions, and test alternative outcomes against relevant criteria and standards.
- A.4 - Architectural Design Skills: Ability to effectively use basic formal, organizational and environmental principles and the capacity of each to inform two- and three-dimensional design.
- A.5 - Ordering Systems: Ability to apply the fundamentals of both natural and formal ordering systems and the capacity of each to inform two- and three-dimensional design.

Objectives [What do I learn by the end of this class?]
The objective of this course is to learn relevant theories of computation, identify and investigate opportunities and challenges in the process of thinking and designing computationally. We will explore computational-design thinking with a focus on key concepts / strategies / benchmarks:

Essential computational design skills.
Strategies for applying computation to solve problems and generate novel ideas.
Knowledge of fundamental computational concepts, their history, and how they relate to design and architecture.
An understanding of the strengths and limitations of computational design.
Strategies for computing efficiently and effectively.
Strategies for integrating creative and new methods of design, computational thinking, parametric form-finding, and performance-based design.

Methods [what is the teaching method in this class?]
The course uses a series of lecture and lab sessions to provide students with the opportunity to learn and practice new concepts, tools and techniques of computation. During the lectures, students are introduced to various concepts and theories of computation. Following the lectures, the instructional content and software tutorials are delivered during the lab sessions.

Materials [What do I need to purchase for this course?]
Books
Menges, A. & Ahlquist S. (2011). Computational Design Thinking, UK: John Wiley & Sons.
Agkathidis, A. (2011). Computational Architecture: digital designing tools and manufacturing techniques, Netherlands: BIS Publishers.
Required Software
All required software is available on Do.Arch. lab computers, but most students will find that acquiring student versions of the required software will help them to execute their coursework. Rhinoceros (Rhino) 5/6 is required for the course. If you have already purchased it for studio, your version should be sufficient.
Grasshopper is a free plugin for Rhinoceros that you will need to download from grasshopper3d.com. Note that Rhino 6 already includes the Grasshopper plugin.

Evaluation [How am I graded for this course?]
Students are evaluated on the following criteria [quality of design and presentation / exercise success]:

Class Participation	10%
One-page Abstract	15%
Midterm Exam	20%
Proposal Presentation	20%
Final Project	35%

The grading is based upon the timely completion and final result of each assignment, and test. The grading scale is shown below:

A	90 – 100	Excellent/superior (4.0 on the Board of Regents scale)
B	80 – 89	Above average (3.0 on the Board of Regents scale)
C	70 – 79	Average (2.0 on the Board of Regents scale)
D	60 – 69	Below average (1.0 on the Board of Regents scale)
F	59 & below	Fail (0.0 on the Board of Regents scale)

These grades are determined according to the following criteria:
A (Excellent / Commendable): Meets or exceeds stated requirements of the course; exhibits significant improvement, development, and/or intellectual growth over the course of the term; exhibits research efforts from which both the instructor and students may learn; all work turned in on time and presented in a professional manner.
B (Good / Satisfactory): Meets the stated requirements of the course; exhibits good improvement, development, and/or intellectual growth over the semester; provides a measure for student emulation; and all work is turned in on time and well presented.
C (Fair): Meets most requirements of the course; exhibits limited improvement, development, and/or intellectual growth over the semester; and all work is turned in on time and neatly presented. For Bachelors of Architecture students, a grade of C is the minimum passing grade.
D (Passing): Fails to meet most requirements of the course (the work is incomplete to a significant degree); exhibits little or no improvement, development, and/or intellectual growth over the semester; and/or work is of a caliber only marginally acceptable at the university level. For Bachelors of Architecture students, a grade of D or worse in class requires repetition of the course before advancement.
F (Failing): Fails to meet the requirements of the course; and/or the work is incomplete or of a caliber unacceptable at the university level.

Course Policies [Expectations of students/How should I behave in this course?]

Academic Integrity- All written and graphic submittals, in-class presentations, and other academic tasks should be your individual and original work unless specifically noted. It is assumed that you are aware of and will comply with the spirit and specifics of the KSU Department of Student Conduct and Academic Integrity. I may ask you to produce identification at examinations and may require you to demonstrate that graded assignments completed outside of class are your own work. Plagiarism of programs/scripts is a complicated subject. Good code is reusable and good programmers reuse code when they can. I expect you to seek out and learn from others' code. However, there is a difference between implementing an algorithm and copying someone else's program without making a contribution of your own. Sometimes this difference can be hard to define, so I will work with you to make that determination. If you reuse a piece of someone else's code, I ask that you cite your source within the comments of your own code and provide a link to the original, if possible. If you are ever in doubt about what to do with regards to reusing code, ask me.

Disability - If you have a diagnosed disability which influences your ability to learn or have your work assessed in the classroom, all efforts will be made to accommodate your needs. Please provide a copy of your Letter of Accommodation from the KSU Office of Disability Services by the end of the second week of classes (their office is located in Joe Mack Wilson Student Center, Suite 160, phone: 470-578-7361, e-mail: sds@kennesaw.edu). All information about your disability and accommodations will remain confidential.

Attendance

In order to fully benefit from and participate in this course, full attendance is expected. Three (3) unexcused absences automatically lower your final grade one letter grade. More than three (3) unexcused absences will constitute grounds for automatic failure of this course. Documentation of excused absences must be submitted in writing and show evidence of the medical or family emergency. When possible, notify me as early as possible in advance of a potential absence.

Late Work

Late work will not be accepted, and will not receive credit. A printed hard copy of each submittal is due at the beginning of the class period on the due date indicated in the class schedule. If you are unable to complete an assignment due to an excused absence, notify me on the due date and turn in the assignment at the next class meeting. Failure to turn in two assignments on their due dates is grounds for automatic failure of the course.

Respectful Interaction - All perspectives and opinions are welcomed and will be respected in class, as long as they are presented in a manner that is respectful. Be mindful of your conduct when engaged in experiences and discourses with those who differ from you in appearance, race, ethnicity, beliefs, gender, sexuality, style, politics or intellectual position. If you feel personally uncomfortable or alienated, or that diversity in general is any way stifled in this class, please let your advisor know so that the situation can be remedied. Also, be aware that our classroom is a public place, so be sensitive to images and other materials you might display on your computer or in your projects, which might be offensive to others. In addition, you are required to abide by the spirit and the specifics of the KSU Sexual Misconduct Policy available at: https://policy.kennesaw.edu/content/sexual-misconduct-policy.

Electronics & Equipment - Cellphones must be put on silent mode and computer usage is limited to class work – and only during designated times – while attending lectures and labs. You are required to abide by the KSU policy on Responsible Use of University Computing and Electronic Communication Resources. Remember that harassment, as defined in the KSU Sexual Misconduct Policy, is prohibited, even when carried out through computers or other electronic communication systems, including course-based chat rooms or message boards.

Contact - The best way to contact me outside of class is via KSU e-mail, whether it is a question, an announcement, or a request for a meeting. I will do my best to respond to your emails as quickly as possible but cannot guarantee an immediate response. Similarly, whenever it is necessary for me to communicate with you outside of class-time, whether collectively or individually, it will be via email. These notices might be regarding schedule changes, additional readings, information pertinent to your assignments, etc. As per university policy, I will use your KSU email address, and you are responsible for regularly checking your KSU email.

Tentative Class Schedule

Week 01

Introduction

LEC1: Computational Thinking and Thinking about Computing

Week 02

LAB: GH Intro + Math Operations & Data Sets

LEC2: Intro, Formation, Transformation, Variational Evolution, (10-49)

Week 03

LAB: Math Operations & Data Sets

LEC3: General System, Systems Generating Systems, Cybernetics, Human thru Machines, (50-85)

Week 04

LAB: Parametric Patterns

LEC4: Research Topics Introduction, (no readings)

Week 05

LAB: Parametric Patterns | One-page Abstracts Due

LEC5: A New Agenda for Computer-Aided Design & Algorithmic Form, Practical Computing, (86-119)

Week 06

LAB: Parametric Spaces | Midterm Exam

LEC6: Morphogenesis & Mathematics of Emergence, Philosophy of Mathematics for Design, (158-178)

Week 07

LAB: Parametric Spaces

Proposal Presentations

Week 08

LAB: Morphology & Deformation

LAB: NURBS Surfaces

Week 09

LAB: Meshes

LAB: GHPython Scripting

Week 10

LAB: GHPython Scripting

Final Project Due