684-002

EXPANDED DIGITAL PRACTICE:
DESIGN COMPUTING IN THE PROCESSING ENVIRONMENT

Class Meeting Time
Wednesdays: 10:00am – 1:00pm
E-Classroom

Office hours (by appointment)
Wednesdays: 2:30-3:30pm
Room 2018

1. INTRODUCTION

For many designers, the computer is just an advanced tool that enables, through the use of out-of-the-box software, the digitization of that which is predetermined and well-defined. In contrast to this view, characterized as computerization, an emerging expanded view of the role of the computer deals directly with computation – using the underlying principles of the computer's rule-based intelligence in order to determine formal and organizational strategies.

Expanded Digital Practice focuses on the investigation and exploration of the structures, processes and opportunities central to computational design. Such a practice requires that designers expand their notion of digital methodologies to include the fundamental paradigms of computer science. At the core of this practice is close attention to the organization of information and the use of algorithms.

We will work in the Java-based **Processing** programming environment:

Processing is a programming language, development environment, and online community that since 2001 has promoted software literacy within the visual arts. Initially created to serve as a software sketchbook and to teach fundamentals of computer programming within a visual context, Processing quickly developed into a tool for creating finished professional work as well.

Previous exposure to writing/reading code is not required.

The seminar is open to graduate students. If you have previously participated in ARCH393- System Stalker Lab, please speak to Prof. Przybylski prior to registering.

2. COURSE STRUCTURE

The primary format for learning takes place in the form of a **series of workshops**. At each session the instructor will walk through specific topics and issues after which students will engage in the lesson directly through working on various in-class exercises. Students will have the opportunity to develop the fundamental skills necessary to engage with the computational design discourse.

In addition to technically focused workshops, a series of **student-led presentations** will register these new skills to a broader discourse.

Workshop Topics

The goal for these working sessions is to allow for the students to become fully immersed in the conceptual frameworks and technical realities of working within a computational discourse. These sessions will move through basic coding components and culminate in the students' ability to develop custom algorithms.

BASICS
The topics in this section will be covered in the course

1. *Introduction to Processing* – pixels, processing, interaction
2. *Programming Basics* – variables, conditionals, loops
3. *Program Organization* – functions, objects
4. *Data Structures* – arrays
5. *Development Resources* – libraries, debugging
6. *Transformation* – mathematics, transformation 2D,3D
7. *Randomness & Noise*
8. *Using Images & Video*
9. *Using External Data* – text, data input, data streams
10. *Beyond Processing* – advanced object oriented programming / Java

ADVANCED TOPICS
The topics in this section will be explored as time permits.

11. *Advanced 1 – vectors and forces, oscillations, collisions*
12. Advanced 2 – particle systems, steering behaviours
13. Advanced 3 – fractals, recursion
14. Advanced 4 – cellular automata
15. Advanced 5 – genetic algorithms

Presentation/Research Topics (Examples)

Students will be carrying out short research projects that will position the new skills acquired during the workshops within a broader design discourse. Students will research the potentials and pitfalls of computing across all phases of design. The territory is vast; here is a sampling of potential topics:

1. Complexity – emergence / autonomy
2. Automation in design processes
3. Artificial Intelligence / Machine Learning
4. Adaptive Design
5. Simulation & Visualization
6. Data Processing + Design
7. Interactive Systems

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3. REQUIREMENTS

Workshop Participation (15%)
Students are expected to be active participants in the workshop sessions. Attendance will be taken each week and more than one unexcused absence will result in a failing grade for the participation component.

Workshop Exercises (25%)
Lab exercises will be assigned at the end of each session. Each exercise will be due (via electronic submission) prior to the following week's class.

Student Presentations (20%)
Each student will be scheduled to make a 25 minute presentation on their selected research topic. The presentations will take place at the start of class meetings. These presentations should be used to provoke questions with respect to the role of computing in design. A hand-out describing the evaluation criteria of these research-based presentations will be distributed early in the term. Depending on class size, students may be able to work in pairs on this requirement.

Course Project (40%)
Each student will be responsible for conceiving and developing their own Processing project. The expectation is that students isolate an aspect of their ongoing thesis work that could be explored within a computational/processing environment. A hand-out describing the requirements and evaluation criteria of this Project-based component will be distributed early in the term.

4. REQUIRED TEXTBOOK

Students should own or have ready access to the following text:

Reas, Casey. Fry, Ben. *Processing : A Programming Handbook for Visual Designers and Artist*s.
        Cambridge Massachusetts; London England : MIT Press, 2007.

5. ADDITIONAL RECOMMENDED READINGS & SOURCES

PROCESSING RELATED:

Fry, Ben. *Visualizing Data: Exploring and Explaining Data with the Processing Environment*. O'Reilly Media, 2007.

Shiffman, Daniel. *Learning Processing : a beginner's guide to programming images, animation, and interaction*. Amsterdam ; Boston : Morgan Kaufmann/Elsevier, 2008.

Pearson, Matt. *Generative Art : a practical guide using processing*. Shelter Island NY : Manning Publications Co., 2011.

Terzidis, Kostas. *Algorithms for visual design using the Processing language*. Indianapolis, IN : Wiley Pub., 2009.

GENERAL DISCOURSE:

Jane Burry, Mark Burry. *The New Mathematics of Architecture*. Thames & Hudson. 2010

Casey Reas, Chandler McWilliams. *Form+Code in Design, Art, and Architecture (Design Briefs)*. Princeton Architectural Press. 2010.

Lisa Iwamoto. *Digital Fabrications: Architectural and Material Techniques (Architecture Briefs)*. Princeton Architectural Press. 2009.

Aranda, Benjamin. *Tooling*. Ed. Chris Lasch. 1st ed. ed. New York: Princeton Architectural Press, 2006.

Architectural Geometry. Ed. Helmut Pottmann and Daril Bentley. 1st ed. ed. Exton, Pa.: Bentley Institute Press, 2007.

From Control to Design : Parametric/Algorithmic Architecture. Ed. Tomoko Sakamoto and Albert Ferré. New York: Actar-D, 2007.

Manufacturing Material Effects: Rethinking Design and Making in Architecture. Ed. Branko Kolarevic and Kevin Klinger. New York: Routledge, 2008.

Steele, J., Iliinsky, N. *Beautiful Visualization : Looking at Data Through the Eyes of Experts*. Sebastopol, CA : O'Reilly, 2010.

Terzidis, Kostas. *Algorithmic Architecture*. 1st ed. ed. Burlington, MA: Architectural Press, 2006.

Architectural Design Journal -- several issues including:

> The New Structuralism: Design, Engineering and Architectural Technologies
> Volume 80, Issue 4, July/August 2010
>
> Patterns of Architecture
> Volume 79, Issue 6, November/December 2009
>
> Digital Cities
> Volume 79, Issue 4, July/August 2009
>
> Closing the Gap
> Volume 79, Issue 2, March/April 2009
>
> Versatility and Vicissitude
> Volume 78, Issue 2, March/April 2008
>
> Techniques and Technologies in Morphogenetic Design
> Volume 76, Issue 2, March/April 2006

Tufte, Edward R., 1942-. *Envisioning Information*. Cheshire, Conn.: Graphics Press, 1990.

Tufte, Edward R. *The Visual Display of Quantitative Information*. Cheshire, Conn.: Graphics Press, 1983.

Tufte, Edward R. Visual explanations : images and quantities, evidence and narrative. Cheshire, Conn.: Graphics Press, 1997.

6. TECHNOLOGICAL PLATFORMS + ACCESS

While there are numerous platforms suitable for the introduction of such techniques, we will be primarily working in a suite of tools built around Processing.

It is expected that students have a computer loaded with the Processing development tools available during each session in the E-Classroom.

Processing is available for free from the project's website (http://processing.org)

The processing community is extremely active and well-supported. It is recommended that you take advantage of numerous online resources.

Here are just a few:
http://processing.org/
http://www.shiffman.net/teaching/workshop/
http://www.openprocessing.org/

7. SCHEDULE

NOTE 1: The workshop progression is based on the sequence presented in *Processing : A Programming Handbook for Visual Designers and Artist*s.

NOTE 2: This list represents an exhaustive list of topics. The schedule will be adjusted to respond to the pace of the learning as required.

W1	January 4	**Course Introduction** *Workshop 1:* Using Processing Structure 1: Code Elements Shape 1: Coordinates and Primitives
W2	January 11	*Workshop 2:* Data 1: Variables Math 1: Arithmetic, Functions Control 1: Conditional Execution Control 2: Repetition Workshop 1 Exercises Due at 10AM (electronic submission)
W3	January 18	*Workshop 3:* Shape 2: Vertices Math 2: Curves Colour 1: Colour by Numbers Image 1: Display and Tint Data 2: Text Workshop 2 Exercises Due at 10AM (electronic submission)
W4	January 25	*Workshop 4:* Data 3: Conversion and Objects Typography 1: Display Math 3: Trigonometry Math 4: Random Transform 1: Translate, Matrices Transform 2: Rotate and Scale Workshop 3 Exercises Due at 10AM (electronic submission) **PROJECT PROPOSAL DUE**

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schedule continued...

W5	February 1	**Student Presentation 1** *Workshop 5:* Structure 2: Continuous Structure 3: Functions Shape 3: Parameters, Recursion Workshop 4 Exercises Due at 10AM (electronic submission)
W6	February 8	**Student Presentation 2** *Workshop 6:* Input 1: Mouse I Drawing 1: Static Forms Input 2: Keyboard Input 3: Events Input 4: Mouse II Input 5: Time, Date Workshop 5 Exercises Due at 10AM (electronic submission)
W7	February 15	**Student Presentation 3** *Workshop 7:* Motion 1: Lines, Curves Motion 2: Machine, Organism Data 4: Arrays Image 2: Animation Workshop 6 Exercises Due at 10AM (electronic submission)
W8	**February 22**	**READING WEEK - NO CLASS THIS WEEK**
W9	February 29	**Student Presentation 4** *Workshop 8:* Image 3: Pixels Typography 2: Motion TYpography 3: Response Colour 2: Components Image 4: Filter, Blend, Copy, Mask Image 5: Image Processing Output 1: Images Workshop 7 Exercises Due at 10AM (electronic submission)
W10	March 7	**Student Presentation 5** *Workshop 9:* Structure 4: Objects I Drawing 2: Kinetic Forms Output 2: File Export Input 6: File Import Workshop 8 Exercises Due at 10AM (electronic submission)
W11	March 14	**Student Presentation 6** *PROJECT WORKING SESSION* Workshop 9 Exercises Due at 10AM (electronic submission)
W12	March 21	**Student Presentation 7** *PROJECT WORKING SESSION*
W13	March 28	**Final Class - Final Project Presentations** **PROJECT DUE** *BONUS WORKSHOPS - TIME PERMITTING* *Workshop 10 :* Input 7: Interface Structure 5: Objects II Simulate 1: Biology Simulate 2: Physics

8. OFFICIAL BUSINESS

EVALUATION

Students must complete all projects and assignments and obtain a passing average in order to receive credit for this course.

Workshop Participation	15%
Workshop Exercises	25%
Presentation	20%
Course Project	40%

DEADLINES & EXTENSIONS

ARCH 684 deadlines can only be extended in the case of illness and incapacity. Requests for such extensions must be made before the project deadline, as soon as is possible, using the request for extension form available from Donna Woolcott. Your request must be accompanied by a medical certificate when necessary, and must be submitted to the instructor.

Late submissions without approved extensions will lose 10% of project value per day.

SUBMISSIONS

Digital files are required to accompany all project submissions. Details of electronic submissions will be provided with project and assignment hand-outs.

AVOIDANCE OF ACADEMIC OFFENSES

Academic Integrity: To create and promote a culture of academic integrity, the behaviour of all members of the University of Waterloo is based on honesty, trust, fairness, respect and responsibility.

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4,
http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline,
http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm

Appeals: A student may appeal the finding and/or penalty in a decision made under Policy 70 - Student Petitions and Grievances (other than regarding a petition) or Policy 71 - Student Discipline if a ground for an appeal can be established. Read Policy 72 - Student Appeals,
http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm

OFFICIAL BUSINESS (continued)

Note for students with disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term. Once registered with OPD, please meet with the professor, in confidence, during my office hours to discuss your needs.

COMMUNICATION

During the course of the term, the instructor may need to send communications to ARCH 684: Expanded Digital Practice students. Please ensure your email address on file is current.

From time to time you will receive general communications from the instructor regarding course business. It is expected that you check your email address regularly, and that once material has been sent, it has been officially received. Copies of all official correspondence will be archived for future reference.