DEA 4210: Interactive and Adaptive Environments

Tuesday and Thursday, 12:20-4:25pm in room [tbd]

- 4 credits; letter grade only.
- Prerequisite for DEA students: 2 studios at 2000-level or higher.
- DEA seniors get preference; DEA graduate students with permission.
- Enrollment by permission for those outside DEA. Encouraged: students, grad or higher-level undergrad, from IS, CS, MAE, ECE, FSAD and Architecture.
- Course website: (linked from https://arl.human.cornell.edu/academics.htm).

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I. Course Description (50 words max.)
The built environment made interactive and adaptive by embedded computation has great promise to support and augment us at work, school, and home, as we roam, interconnect, and age. Students will design and prototype artful, meticulous, cyber-physical artifacts and environments responsive to specific challenges of an increasingly digital society.

Please note:
- This syllabus, examples of prior student projects, and supporting materials are provided on-line at https://arl.human.cornell.edu/DEA4xxx%20Interactive%20Envs.htm. On this webpage, in the upper-left corner, “Documents” links to a webpage of downloadable readings supporting this course. To enter this “Documents” page, you will need to enter the case-sensitive password, ARDUINO, when prompted.
- This syllabus (v. 10.19.2016) is subject to revision; revisions will be dated and distributed online.

II. Course Objectives and Learning Outcomes
1. to identify under-constrained, “wicked” problems and opportunities of an increasingly digital society
2. to investigate design opportunities that may prove responsive to these problems and opportunities
3. to understand how digital technologies and human-centric design methods, combined, can be employed in the design of such physical environments (from furniture to the metropolis in scale)
4. to demonstrate an ability to realize, in working prototypes, interactive and adaptive physical environments

III. Background and Definitions
While Information Technology [IT] can control digital bits on display-screen surfaces on building or temperature and in building interiors, IT has the capacity to move physical mass to create interactive, and adaptive cyber-physical built environments. The prospect of this kind of intelligent environment was anticipated by architect and MIT Media Lab founder Nicholas Negroponte some forty years ago in his vision of “…a man-made environment that responds to and is ‘meaningful’ for him or her” [5].

Wired editor Kevin Kelly has since imagined a “world of mutating buildings” and “rooms stuffed with co-evolutionary furniture” [3]. And while Bill Gates envisions “a robot in every home,” [2] the late William J. Mitchell, former Dean of MIT’s School of Architecture and Planning, envisioned homes “as robots for living in” [4].
Interactive and adaptive environments meanwhile raise critical questions demanding response, such as:

- How will we program the built environment, from furniture to cities?
- How will interactive and adaptive environments recognize activities taking place inside them?
- How will designers (which may include end-users) associate particular human activities with desired built environment configurations? and
- How to design cross-operability and collective interactivity/intelligence of multiple Interactive and adaptive artifacts (furnishings, furniture, rooms) operating together as cyber-physical “ecosystems”?
- What are the safety, security and privacy issues related to interactive and adaptive environments, and how do designers design such environmental systems to protect property and living things from hackers and operating failures?

In the act of designing, designers typically anticipate in the form and function of their artifacts how people will use them and how these artifacts will respond to a range of possible, local conditions. In designing interactive and adaptive environments, however, there is a fundamental difference: investigators are engineering a responsive system that actively engages and interacts with inhabitants and local conditions in real time. So, unlike a conventional building that has a limited range of responses to dynamic, changing conditions, interactive and adaptive environments are intimately bound together with its users and local conditions in a designed performance.

Interactive and adaptive environments must go beyond simplistic formal achievements; they must instead explore ways for improving life, enhancing existing places, and supporting human interaction. This is no utopian dream in which technology or design transforms completely our everyday reality. Instead, design and technology together – a cyber-physical hybrid – supports human activity, responds naturally, and performs according to our needs and wants. Interactive and adaptive environments, when employed, must also complement and redefine our urban living patterns. Answers to life problems and opportunities will come not from computational or design solutions alone, but through the way computation, embedded in the physical, built environment, help support and enhance the interactions across people and their surroundings to create places of social and psychological significance.

For philosopher Andrew Feenberg, “technology is not simply a means but has become an environment, a way of life” [1]. An interactive and adaptive environment is more than an aesthetic search, a stylistic possibility, or a technological quest; it is, instead, a way to develop new spatial patterns in support of human activities. This studio course, “Interactive and Adaptive Environments,” aims to cultivate new vocabularies of design and new, complex realms of understanding towards novel, computational and human-centered design propositions.

References
IV. Assessment of Student Performance and Grading Policies
Students will design and demonstrate two functioning, interactive and (we hope) adaptive environments, and provide associated documentation (as described in the next section). Students will receive a grade in response to the work presented and documented, weighted as follows:

- (20%) **assignment-1, working with Arduino**: working prototype, short video, and one-page paper.
- (total of 60%) **assignment-2, an in-depth project, TBD**
  - 20% for your design concept(s) and for articulating the aims/motivations for your design
  - 20% for your prototype—its functionality, aesthetic refinement, response to stated aim
  - 20% for your video

- (20%) **documentation** of both assignments on a CD, including a one-page paper for each assignment.
  Format for video: H.264 encoded MP4, at least 1280px x 720px, at most 5 minutes (2-3 minutes is a more common length), captioned for accessibility in .srt or .sbv format (example video from my lab).

  Format for one-page paper: [Extended Abstracts Format](example one-page paper from my lab).

The above materials will be completed to meet the submission requirements for an ACM conference like DIS (Designing Interactive Systems), TEI (Tangible, Embedded and Embodied Interaction), IDC (Interaction Design and Children), or CHI (Human-Computer Interaction). For each project, the student designer(s) will be designated first authors and the professor and TA will designated as last authors for any conference submission, as the professor and TA will be integral to the success of the submission.

Students are encouraged to join the ACM SIGCHI mailing lists (including the one for job postings) and also become a student member of SIGCHI which brings you a 1-year subscription to interactions magazine [print] and discounts on ACM conferences. See the course webpage for more information.

Throughout this course – an intimate and intensive “conversation” between students and faculty members – students will have ample opportunity to receive feedback on their work.

There are two necessary requirements for each of the assignments:
1. **Your interactive and adaptive environment must employ at least one sensor that actuates one or more motors to move physical mass.** (Your environment might also, potentially, control lighting, a computer display, and/or an audio device).
2. **Your interactive and adaptive environment must move physical mass to alter, spatially, the environment.**

The first requirement is simpler, the second, less tangible. Indeed, we know that since Descartes, great minds in philosophy, mathematics, and across the social and natural sciences strain to characterize the very concept of “space.” We ask that your demos be *spatial*: that enclosures, structural systems, physical boundaries, and/or key components (e.g. furniture) of a local environment “morph” (e.g. fold, bend, twist, undulate, elevate, incline, rotate, close, contract, soften, swell, breathe ...) in response to at least one phenomenon detected by one or more sensors. In this way, the designed, built environment is a *dynamic system* made of physical matter, digital information, inhabitants and other living things *in motion*. 
V. Academic Integrity and Other Policies
Switch off your mobile phone. 
Arrive on time, engage, and participate. 
Ask if there is something you don’t understand. 
Offer an insightful remark (when you find a natural break in our class activity). 
Cite the work of others (https://plagiarism.arts.cornell.edu/tutorial/index.cfm). See section below. 
Check your email address and the online course page for timely information about this course.

VI. Classroom Policies, including Attendance and Late Work
Attendance is mandatory, and counts for 10% of the grade. To facilitate attendance taking, please sit in the same seat every class beginning with the second session. For each absence, email the professor with an explanation for the absence, attaching supporting documentation (e.g. doctor’s note) if any. It is your education, so you should take responsibility for yourself in attending all class sessions.

Late-submission of all work for this course will NOT be accepted, except with a doctor’s certificate. You may be asked to share your assignment work with the class for display and general discussion; public discourse and critique of design activity is a normal practice of a design-oriented field.

VII. Statement on Academic Integrity and Honesty
Each student in this course is expected to abide by the Cornell University Code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the student's own work, except in the cases of projects that are specifically structured as group endeavors. In compliance with the Cornell University policy and equal access laws, the faculty, teaching assistants, and teaching associates for this course are available to discuss appropriate academic accommodations that may be required for students with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances, so that arrangements can be made. Students are encouraged to register with Student Disability Services to verify their eligibility for appropriate accommodations.

VIII. Topical Outline and Schedule By Week
1. Interactive & Adaptive Environments: Definitions, Research, Practices; Introduction to Arduino
2. Arc of the semester in two weeks: short assignment
3. Review the short assignment
4. Identifying the problem: literature review on state of the art; form design teams, long assignment
5. Investigating design opportunities: literature review on the state of the art
6. Proposal of alternative design responses and their discussion
7. Prototyping progress reports and discussion
8. Prototyping progress reports and discussion
9. Prototyping progress reports and discussion
10. Prototyping progress reports and discussion
11. Prototyping progress reports and discussion
12. In-class demonstration of working prototypes; Prototype refinement and first video
13. Prototype and video refinement
14. Prototype and video refinement
15. Final Project Presentations; Conclusions and Lessons Learned
IX. Materials
Material costs for this studio are expected to be approximately $100 per student. This includes the purchase, by each student, of:

- **1 Seeedstudio Grove for Arduino - Starter Kit V3** available widely (see ONLINE HARDWARE RETAILERS on course webpage) and, e.g., from Amazon.com for $49.99 at the time this document was prepared \(\rightarrow\) https://www.amazon.com/Seeedstudio-Grove-Arduino-Starter-Kit/dp/B00NCF251C/ref=sr_1_1?ie=UTF8&qid=1476373133&sr=8-1&keywords=Grove+arduino+starter+kit

- **1 Arduino UNO R3** available widely (see ONLINE HARDWARE RETAILERS on course webpage) and, e.g., from Amazon.com for $23.97 at the time this document was prepared \(\rightarrow\) https://www.amazon.com/Arduino-Uno-R3-Microcontroller-A000066/dp/B008GRTSV6/ref=sr_1_1?ie=UTF8&qid=1476372931&sr=8-1&keywords=arduino+board

- **Typical studio project consumables** (cardboard, plastic, ...) and possibly other electronic and mechanical hardware, as needed.

X. Reading List
One book is required for this course:

- Green, K. E. *Architectural Robotics: Ecosystems of Bits, Bytes and Biology*. Cambridge, MA: 2016. chapters 1-2 and 12, chapters 6-8, figures and tables.

Additional reading materials for this course are listed and downloadable from the on-line course page, https://arl.human.cornell.edu/academics.htm. Key titles include:


XI. Consent
To prepare the required paper and video for this course, enrolled students may conduct peer-to-peer participant studies using their peers, enrolled in the same course, as participants. These studies will use methods considered in my course DEA 2370, Human-Centered Design Methods, the new core course for all DEA students. These methods may include interviews, observations, surveys, co-design activity, heuristic evaluations, and cognitive walkthroughs. As part of this design research activity, students conducting these studies may take written notes, photographs, and/or video as a means of documentation. This documentation may be reproduced in the papers and videos for submission to CHI or a like conference, and may be presented at the conference. Student will not be identified by name in such submissions/presentations, and no aspect of these studies should cause discomfort or risk to participants; nevertheless, should any student in the class chose not to participate in any aspect of the study, or have questions about her/his participation, please make this known to the instructor prior to the start of such study. Non-participation will not impact your grade for this course in any way.

XII. You are encouraged to join ACM SIGCHI and DRN
Students enrolled in this course are encouraged to join email postings (aka listservs) for ACM SIGCHI ANNOUNCEMENTS and DESIGN RESEARCH NEWS (both of these for design opportunities) and also ACM SIGCHI JOBS (in design). Students are also encouraged to become a student member of SIGCHI which brings you a 1-year subscription to interactions magazine [print] and discounts on ACM conferences. Directions for joining all of these.