

Physical Computing for Design

MAT 111PC | Summer A 2026

Instructor: Sabina Hyoju Ahn

Class meetings: Tuesday, Wednesday, and Thursday, 11:00-12:25

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Course description

This introductory course explores the intersection of electronics, computation, and creative practice. Students design interactive systems, instruments, and interfaces using microcontrollers, sensors, and actuators. Hands-on exercises connect digital processes with physical materials to create expressive, multisensory experiences.

The course approaches physical computing as a material and sensory practice, exploring how signals from bodies, environments, and living systems can be translated into sound, light, motion, and touch. Students prototype interactive objects and devices while considering how technology shapes the experience of an encounter. Projects may engage with wearable systems, environmental sensing, interactive installations, or electronic musical instruments.

Learning outcomes

By the end of the course, students will be able to:

- LO1** Explain and apply basic electronics and microcontroller programming to construct and test circuits.
- LO2** Connect sensors and actuators and program mappings between input signals and perceptible outputs.
- LO3** Develop a physical computing project from a concept through prototyping, debugging, and demonstration.
- LO4** Analyze how material choices, sensing, and interaction shape meaning and experience in post-digital media art.
- LO5** Work constructively in a studio setting, documenting experiments, using feedback, and reflecting on design decisions.

Materials and equipment

Each student receives an Arduino kit with an Arduino UNO/Nano and USB cable, a breadboard and jumper wires, sensors such as a light sensor, potentiometer, and button, and actuators such as a servo motor and piezo buzzer. Wire cutters, wire strippers, and pliers are available for shared classroom use.

Bring a laptop with the Arduino IDE installed and a USB adapter if your laptop does not have a USB-A port. Students are responsible for purchasing replacement components they break or additional parts needed beyond the supplied kit.

Course schedule for weeks 1 through 3

Each week includes three class meetings. Assignments 1-4 are completed during the first four weeks and contribute to Weekly Labs and Participation. Readings and resources are identified on page 7.

Class	Topic	Activities and assignments	Preparation and materials
1.1	Physical computing and post-digital media art practices	Course overview; interaction and tangible interfaces; examples from media art and design; Arduino setup and Blink.	Install the Arduino IDE; use the Arduino getting-started guide.
1.2	Parts and circuit fundamentals	Breadboarding; input and output; transduction and transducers; basic Arduino coding and circuits.	Arduino kit, breadboard, LEDs, switch, and resistors.
1.3	Lab and Assignment 1	Design an LED circuit with a programmed pattern and no sensor input. Assignment 1 due.	Show how timing and repetition affect the visual behavior.
2.1	Basic electronics	Electricity, voltage, current, resistance, Ohm's law, series and parallel circuits; analog and digital input/output.	Arduino kit, RGB LEDs, photoresistors, and resistors.
2.2	Reading and controlling signals	Pulse-width modulation (PWM); analogRead() and analogWrite(); analog-to-digital conversion; if/else.	Arduino references and examples for input, PWM, and conditionals.
2.3	Lab and Assignment 2	Design an LED circuit with sensor input. Assignment 2 due.	Test the mapping between an input range and the LED response.
3.1	Inputs and outputs for sound	Potentiometers, piezo elements, and buzzers; soldering basics; analog amplifiers and oscillators; sensor-to-sound mapping; tone().	Arduino kit and sound components; relevant Arduino examples.
3.2	Tangible interfaces	For loops and conditionals; Serial Monitor, print and read; musical instruments; sensor-controlled sound or visual systems.	Serial communication and sound-output examples.
3.3	Lab and Assignment 3	Design a sound instrument or interface. Assignment 3 due.	Demonstrate how a physical action shapes the sound.

Studio process

Each lab moves from a working example to an intentional variation. Students test the circuit and code, observe the sensory result, and document changes. Presentations and critiques connect technical decisions to the experience of an interaction.

Course schedule for weeks 4 through 6

Class	Topic	Activities and assignments	Preparation and materials
4.1	Actuators and feedback	Motors, servos, feedback, libraries, and transistors.	Arduino kit; motors or servos and supporting components.
4.2	Biological data and motion	Servo position control and PWM concepts; external power for actuators; biological data transformations.	Read the relevant component documentation; review writing on moist media and living systems.
4.3	Lab and Assignment 4	Design a kinetic or tactile feedback system using motors. Assignment 4 due.	Test how an input or programmed behavior becomes motion or tactile feedback.
5.1	Project ideation and prototyping	Final project proposals and group critique; sensor-to-logic-to-actuator systems; multiple inputs. Proposal presentation: 5 minutes.	Prepare a concept, system diagram, parts list, and development plan.
5.2	Serial communication and debugging	Call-and-response, ASCII, prototyping methods, and Serial Monitor debugging.	Apply the techniques needed for the project.
5.3	Project lab	Project consultation; building and testing.	Document tests and identify a revision to pursue.
6.1	Project development	Continued prototyping, building, and testing.	Prepare the demonstration and documentation.
6.2	Final presentations	Project demonstrations and peer feedback for Group A.	Present the working prototype and explain the interaction.
6.3	Final presentations	Project demonstrations and peer feedback for Group B.	Present the working prototype and explain the interaction.

Project development

The final project brings together the sensing, programming, and feedback techniques explored in the first four assignments. Critique and consultation support decisions about scope and help students distinguish a working technical test from an intentional interaction.

Demonstration groups

Group A and Group B identify presentation sessions. They do not prescribe whether a project is individual or collaborative. Project documentation should identify contributors and their roles where relevant.

Course assessment and policies

Assessment considers the development of a physical computing practice across experiments, documentation, critique, and the final project. The weights below retain the original course assessment structure.

Component	Weight
Weekly labs and participation	30%
Documentation and reflection logs	15%
Final project proposal	10%
Final project execution	30%
Final presentation	15%
Total	100%

Weekly labs and participation

This component includes Assignments 1-4, engagement in discussions and critiques, consistent attendance, and timely lab completion. Labs are evaluated for a working circuit and program, understanding of the relationship between inputs and outputs, and purposeful experimentation. Students should be able to explain a design decision and respond constructively to feedback.

Documentation and reflection logs

Maintain a record of circuit diagrams or wiring photographs, relevant code, observations from tests, and revisions. Reflection should explain what changed, why it changed, and how the result affected the intended experience. Logs are assessed for clarity, continuity of the process record, and specific reflection on decisions and difficulties.

Final project assessment

The proposal assesses the clarity and feasibility of the idea. Execution assesses the working system and the quality of the interaction. The presentation assesses the demonstration and explanation of the work. The detailed assignment and criteria on pages 5-6 describe the evidence for each component; process documentation contributes to the separate documentation and reflection category.

Policies

Attendance: More than one unexcused absence may affect the final grade.

Late work: Late submissions without prior communication may receive reduced credit.

Academic integrity: All work must be your own unless otherwise specified. Clearly document any external code or sources used. For collaborative work, identify each contributor's role.

Final project assignment

Proposal: Week 5, Session 1 | Final demonstrations: Week 6, Sessions 2 and 3

Prompt

Design and build an interactive physical system that translates a signal from a body or environment into a perceptible response. Use an Arduino, at least one input, and at least one output to create an encounter through sound, light, motion, or touch. Your project may take the form of an instrument, a tangible interface, an interactive object, a wearable prototype, or an installation study.

Begin with a specific relationship you want a participant to notice or explore. Decide what the system senses, how the program interprets that signal, and how the output makes the relationship perceptible. Consider what the sensor can and cannot register, and how the material form of the object affects the interaction.

Project requirements

- Build a functioning sensor-to-logic-to-actuator system. Make the mapping between input and output intentional and explainable.
- Use programming concepts from class, such as conditions, loops, input ranges, timing, or serial communication, as appropriate to the design.
- Test the interaction, identify a specific difficulty or discovery, and make at least one documented revision based on observation or feedback.
- Connect the design to a course example or reading about physical computing, tangible interaction, post-digital media, or living systems.
- Document borrowed code, libraries, and other sources, and distinguish your own contribution.

Proposal presentation

In a ten-minute presentation, explain the concept and intended experience. Include a simple system diagram, the planned sensors and outputs, a parts list, and a feasible plan for the remaining sessions. Identify one question to test during prototyping.

Final deliverables

- A working physical prototype and a live demonstration in the assigned presentation session.
- The Arduino sketch and any required libraries or supporting files, a wiring diagram or clearly labeled photograph, a parts list, and brief setup instructions.
- A short video of the interaction that shows both the participant's action or environmental input and the resulting output.
- A 400-600-word project reflection explaining the concept, input-output mapping, one significant revision, a connection to course material, and a remaining limitation. Include process evidence in the documentation log.

Learning outcomes assessed: LO1, LO2, LO3, LO4, and LO5. Relevant resources include the Arduino guides, class circuit and code examples, and a reading selected from page 7.

Final project assessment criteria

The execution rubric below applies to the 30% Final Project Execution component. Proposal, documentation, and presentation retain their separate weights in the course assessment.

Execution criterion	Weight within execution	Evidence of successful work
Circuit and program	30%	The prototype operates as intended. Wiring, power, and code support the chosen components, and the student can explain the path from sensing to output.
Interaction and sensory design	30%	The input-output mapping and material form support a clear experience. The relationship between participant or environment and system response is deliberate.
Testing and refinement	20%	The final prototype incorporates a meaningful revision arising from a test or critique. The student can demonstrate the difference the revision made.
Concept and context	20%	The project develops an identifiable question or intention and connects its design decisions to a relevant course example or reading.

How the rubric is applied

Strong work provides clear evidence and a precise explanation for a criterion. Satisfactory work meets the main requirement with minor gaps. Developing work demonstrates partial understanding or an incomplete result. Work requiring substantial revision does not yet demonstrate the outcome. Complexity or the number of components alone does not determine quality.

Proposal criteria

The proposal is assessed for a clear intention and participant experience, an understandable system plan, feasible scope and materials, and a focused question for testing. Feedback should guide the next prototype rather than prescribe a single final form.

Presentation criteria

The presentation is assessed for an effective demonstration, a clear explanation of the input-output mapping, and reflection on one design decision and one revision. Students should be able to discuss the work's limitations and respond to questions about the process.

Documentation criteria

The separate documentation and reflection component assesses whether the development record is understandable and useful: circuit and code information, evidence from tests, attribution, and specific reflection. The execution rubric evaluates how testing improved the final system; the documentation grade evaluates the quality of the record and analysis.

Readings and resources

The following materials support electronics, programming, and critical discussion. Use technical references alongside the relevant labs, and draw on a conceptual reading when developing the final project.

Core materials

Banzi, Massimo, and Michael Shiloh. Getting Started with Arduino.

Arduino. Arduino Projects Book.

Ascott, Roy. Selected writing on moist media, from the course reading collection.

Manovich, Lev. The Language of New Media (2001).

Cramer, Florian. What Is “Post-Digital”? (2014). A Peer-Reviewed Journal About, 3(1), pp. 10-24.

[Arduino Projects Book supplied in the original course resources](#)

[Ascott course reading collection](#)

[Cramer and the APRJA issue on post-digital research](#)

Recommended reading

Collins, Nicolas. Handmade Electronic Music: The Art of Hardware Hacking.

Hertz, Garnet. Art + DIY Electronics.

Fleischer, Rasmus. How Music Takes Place: Excerpts From “The Post-digital Manifesto.” e-flux journal 42 (2013).

Armstrong, Rachel. Living Architecture: How Synthetic Biology Can Remake Our Cities and Reshape Our Lives.

[Fleischer article in e-flux](#)

[Monoskop collection on post-digital aesthetics](#)

Technical resources

[Arduino IDE download](#)

[Arduino getting-started guide](#)

[Adafruit Learning System](#)

[Arduino Project Hub](#)

Additional references may include Arduino video tutorials and examples from other platforms such as Bela, ESP32, Raspberry Pi, and Teensy.

Connecting readings to practice

Weeks 1-2: Arduino setup, electronics, and programming references; introductions to post-digital media. Week 3: sensor-to-sound mappings and tangible interfaces. Week 4: actuator references and discussion of moist media or living systems. Weeks 5-6: project-specific technical references and a conceptual reading that helps explain the final design.