Vision in Art and Neuroscience

Fall 2019
U: 9.72 G: 9.720 | 2-2-8
TR 3-5 | 10-150

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Course Description

We will treat perception as an act of creation, the creation of an individual’s world of experience. From limited and noisy data incoming through the senses, our brains construct the rich world we perceive. Creating visual art throws that world of experience back to the outside, and in it we find reflected some mechanisms of the constructive process of vision. As such, we can find examples in art which allow us to “perceive perception.” Through readings, lecture, discussion, and project-based work, the course will explore the neural and computational mechanisms of vision and their parallel manifestations in visual art. We will learn to use and develop new tools in the arts (working mostly with light) and neurosciences (of vision and computation) to build installations which allow us to physically experience different levels of the hierarchy of visual processing discussed in the course. The course is divided into one seminar-style lecture and one session of studio instruction per week. Students will use the studio time to develop a project for exhibition in the Compton Gallery at the end of the semester.

Course Structure

The course consists of one two-hour seminar (Tuesday) and one two-hour studio workshop (Thursday) per week. Seminars will include slide talks, demonstrations, video documents, etc. by the team as well as invited guests. Carefully chosen readings and student presentations will fuel discussions. The seminar will be divided into six modules that build upon each other to introduce core principles of vision neuroscience, the experiential parallels of which will be pursued in the studio workshops. In the first weeks of class, studio workshops will be spent in a darkroom where students will be guided through experiments and demonstrations visualizing the fundamental interactions of light and vision. As the semester progresses, studio sessions will be devoted to individual student project development: design, prototyping/testing and construction for exhibition. At the end of the semester, there will be a public exhibition opening in Compton Gallery where students will be expected to give brief talks revealing their works from theoretical and experiential angles. This short talk, together with the semester project and the project write-up, will replace a final examination for the course.
Thursday 9/5  Introduction

Module 1  The origins of structure in perception & art
Tues  9/10  Seminar
Reading due:
- *Perception Viewed As An Inverse Problem* (Pizlo 2000)
- *Bayesian Models of Object Perception* (Kersten and Yuille 2003)
- *Multiple Worlds* (Koenderink 2012)
- *Notes On a Total Light* (Lippard 1967) from Focus on Light, NJ State Museum
Optional: *Stabilized Images On The Retina* (Pritchard 1961)
- *Experimental Phenomenology: Art and Science* (Koenderink 2012)

Thurs  9/12  Studio demos + experimentation  |  *point and line refrain*
Reading due:
- Selections from *Point and Line to Plane* (Kandinsky 1947)
- *The Thinking Eye*, Paul Klee Notebooks (1956)

Module 2  Early (low and intermediate-level) visual processing
Tues  9/17  Lecture and discussion: Pawan Sinha
Reading due:
- *Primer: Receptive Fields* (Lennie 2003)
- Selections from *Suprematism Manifesto* (Malevich 1924)
  *White Manifesto* (Fontana 1946)

Thurs  9/19  Studio demos + experimentation [perceptual geometry LED Matrix assignment]
  *perceptual geometry charette*
Reading due:
- Selections from *Lumia: Thomas Wilfred and the Art of Light* (2017)

Tues  9/24  Seminar
Reading due:
- *Points* (Koenderink 2017)
- *Perceptual Geometry* (Schwettmann 2018) talk
- Selections from  *Language of Vision* (Kepes 1951)
  *Vision in Motion* (Moholy-Nagy 1947)

Thurs  9/26  Studio demos, discussion and experimentation
  *perceptual geometry reveal*
Reading due:
- *On the Purity of Light* (Piene 1958) from Zero, MIT Press

Module 3  Binocular vision: depth and motion perception
Tues  10/1  Lecture and discussion: Pawan Sinha
Thurs 10/3 Studio demos + experimentation [diffractive imaging assignment]

diffractive depth charette

Reading due:
Selection from *James Turrell: A Retrospective* (Holzherr 2013)

Tues 10/8 **Seminar: student presentation** (no pres. software + must include demos)

Reading due:
*Perceived Lightness Depends On Perceived Spatial Arrangement* (Gilchrist 1977)


*Pictorial Space* (Koenderink 2012)

*Gauge Fields in Pictorial Space* (Koenderink, Van Doorn 2012)

Thurs 10/10 Studio demos + experimentation

diffractive depth reveal

Reading due:
Selection from *More Light* (Lipp, Zec 1985)

**Module 4  ** *Color and light*

Tuesday 10/15 No class (*Holiday*)

Thurs 10/17 Color guest lecture: Rosa Lafer-Sousa

Tues 10/22 Project proposal due (1 page write-up incl. preliminary material list)

**Seminar: student presentation** (no pres. Software + must include demos)

Reading due:
Selections *Interaction of Color* (Albers 1963)

*Sensory, Computational, and Cognitive Components of Human Color Constancy* (Smithson 2005)

*Perception of Three-Dimensional Shape Influences Colour Perception through Mutual Illumination* (Bloj et al. 1999)

Thurs 10/24 Individual project meetings + studio: project work

**Module 5  ** *Recognition (compositionality, perceptual primitives)*

Tues 10/29 Seminar

Reading due:
*Recognition-by-Components, A Theory of Human Image Understanding* (Biederman 1987)

Thurs 10/31 Studio: project work

Tues 11/5 **Seminar: student presentations** (no pres. software + must include demos)

Reading due:
*Seeing faces is necessary for face-domain formation* (Livingstone 2017)
Paul Cézanne: The Process of Sight (Lehrer, excerpt from Proust Was a Neuroscientist)

Thurs 11/7  First project crit

Module 6  Art and Associative Recall

Tues 11/12  First project crit
Thurs 11/14  Lecture: Pawan Sinha
Tues 11/19  Seminar: student presentation (no pres. software + must include demos)
Reading due:
On the Perception of Probable Things: Neural Substrates of Associative Memory, Imagery, and Perception (Albright 2012)
Prologue: x 18³ and Excursus: Homage To The Square³ (Robert Irwin 1998) exhibition pamphlet, Dia Center for the Arts
Thurs 11/21  Second project crit

Preparing for Exhibition

Tues 11/26   Studio: project work + project write-up due
Thurs 11/28  No class: Thanksgiving Holiday
Tues 12/3    Final project check-in + writing due
Thurs 12/5   Studio: project installation work
Tues 12/10  Exhibition opening (evening): projects due + student talks

Grading and Evaluation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Final project</td>
<td>50</td>
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<tr>
<td>Studio work (35%)</td>
<td></td>
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<tr>
<td>Write-up detailing relevance to course material (15%)</td>
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<td>Student-led discussion (5% per question submission, 15% for presentation)</td>
<td>30</td>
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<tr>
<td>Experiment assignments (5% each)</td>
<td>10</td>
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<tr>
<td>Attendance/Class participation</td>
<td>10</td>
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Final project

- In the studio sessions, group work and demos early in the semester will foster and give way to individual final projects as the semester progresses. The final project is considered equivalent to a comprehensive exam and is due at the time of the exhibition opening: Tuesday, December 10, 2019. There will be no written final exam.
• The final project will be an individual artwork which communicates to others, in terms of experience, your interests and findings. The project will complement your discursive work in the course. Much time and attention will be given in class to the process of conceiving and creating these artworks. You are not expected to be or become an artist. We will learn about this in class, exploring the artistic method and creating together. Thus, your investment in the hands-on learning process, and not the success of the project as an artwork, will be the evaluation-measure of your studio work.
• Final projects may make use of a wide range of methods and media, e.g., LEDs, electronics and software; optical systems; material design and fabrication. Our process will emphasize project ideas and content; we will work together to choose media and surmount technical problems to realize artistic objectives. The MIT Museum Studio facility and staff will provide technical resources and support. Other shops/equipment will be used as needed.
• At key points in the semester, we will have one-on-one meetings. These will be opportunities for instructors to provide feedback on the student’s work and, equally, for students to provide feedback on course structure, content and the instruction. The first meeting will allow students to discuss project ideas with instructors.
• Students will submit a written assignment detailing their artistic approach to the project and its basis in course material. This statement will be published in the catalog accompanying the exhibition. The final project and accompanying write-up will together take the place of a final exam for the course.

Student-led discussion

Four student-led seminars will take the place of lectures over the course of the semester. During the second week of class, each student will sign up to participate in one of four presentation groups. The presentations will be discussion and visual demo-based, and may not be not slide-based (though may use digital material). The content of the discussions will be structured around questions submitted by all non-presenting course members by 5pm the Sunday before the seminar. Each student must submit (at least) one question extending or challenging a key idea in the reading. The student seminar facilitators will curate the submitted questions and use their presentation time to lead a structured discussion of the material by (a) briefly (~5 min) summarizing the readings, (b) engaging the class in discussion of the submitted questions (~45 min) (c) concluding by synthesizing the content of the live discussion and suggesting potential future avenues for investigation (~10 min). The presenting group is also responsible for creating (at least) one visual experience extending ideas from the reading, and engaging the rest of the class in this demo during their presentation. The presenting group must find independent time to prepare this demo. Studio facilities and staff will provide resources and support.

Attendance and Participation

Students are expected to attend all classes. If you must be absent, alert us in advance. Any unexcused absences will affect your final grade.
• Use of laptops, cell phones or other devices unrelated to the class is strictly forbidden.
• Come prepared to discuss and answer questions about all readings.
• Your grade for class participation is not calculated based on how much you speak, but rather how you contribute to a lively, useful, and sustained conversation both in and out of class.