

# Vision in Art and Neuroscience

Fall 2022

U: 9.72 G: 9.720

TR 3-5

10-150

Course website: [vision.mit.edu](http://vision.mit.edu)

Instructors :

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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, lectures, discussion, and project-based work, the course will explore the neural and computational mechanisms of vision and their parallel manifestations in visual art. Working together, we will translate different levels of the visual processing hierarchy into the domain of experience, using the power of the interaction of light and simple materials to foreground visual perception in experience. The course is divided into one seminar-style lecture and one session of studio instruction per week. Each student will have access to studio materials and equipment for creating and documenting visual experiences. Students will be expected to share their work processes with the class and to contribute to the content, design, and installation of a group exhibition of individual final projects. Your final project and the collaborative exhibition will replace a final exam.

## 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, and video documents by the team, as well as invited guests. Carefully chosen readings and student presentations will fuel discussions. Studio hours during the first weeks are spent in a dark room where students will be guided through experiments visualizing fundamental interactions of light and vision. Processes of visual perception and artistic creation are treated in parallel, making use of the fact that both are constructive. As the semester progresses, studio sessions will serve preparation of individual final projects for exhibition. The seminar will be divided into six modules that build, one upon the next, to introduce principles of vision neuroscience and their parallels in the creation of visual art. Toward the end of the semester, we will collaboratively design, install and open a public exhibition of projects in the Compton Gallery.

Thurs. 9/8      Course introduction

## Module 1 *The origins of structure in perception & art*

Tues 9/13 Seminar

Reading due:

*Perception Viewed as An Inverse Problem* (Pizlo 2000)

*Bayesian Models of Object Perception* (Kersten and Yuille 2003)

Thurs 9/15 Studio demos, discussion and experimentation

## Module 2 *Early (low and intermediate-level) visual processing*

Tues 9/20 Lecture and discussion: Pawan Sinha

Reading due: *Receptive Fields Primer* (Lennie 2003)

Thurs 9/22 Studio demos, discussion and experimentation

Tues 9/27 Seminar

Reading due:

*Points* (Koenderink 2017)

*Theory of Edge Detection* (Marr/Hildreth 1980)

*What Line Drawings Tell Us About the Visual Brain* (Cavanagh/Sayim 2011)

Thurs 9/29 Studio demos/early project development

## Module 3 *Binocular vision: depth and motion perception*

Tues 10/4 Lecture and discussion: Pawan Sinha

Thurs 10/6 Studio demos, discussion and experimentation

Tues 10/11 holiday—no class

Thurs 10/13 Seminar: student presentation

Reading due:

*Perceived Lightness Depends On Perceived Spatial Arrangement* (Gilchrist 1977)

*Why We See Things The Way We Do: Evidence For A Wholly Empirical Strategy of Vision*

(Purves et al. 2001)

*Pictorial Space* (Koenderink 2012)

## Module 4 *Color and light*

Tues 10/18 Guest lecture: TBD

Reading due: #*TheDress: Categorical Perception of an Ambiguous Color Image*

(Conway/Lafer-Sousa 2017)

Thurs 10/20 Individual progress meetings & project proposal discussion

Tues 10/25 project proposal due (1 page write-up incl. preliminary material list)

Seminar: student presentation

Reading due:

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

*Perception of Three-Dimensional Shape Influences Color Perception Through Mutual*

*Illumination* (Bloj et al. 1999)

Thurs 10/27 Studio: project work

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

Tues 11/1 Guest lecture: Daniel Kersten

Reading due:

*TBD* (Kersten)

Thurs 11/3 Studio: 1st critique

Tues 11/8 Seminar: student presentation

Reading due:

*Seeing faces is necessary for face-domain formation* (Livingstone 2017)

*Paul Cézanne: The Process of Sight, excerpt Proust Was a Neuroscientist* (Lehrer 2007)

*How to Create Objects With Your Mind: From Object-based Attention To Attention-based Objects* (Ongchoco/Scholl 2019)

Thurs 11/10

## Module 6 *Art and Associative Recall*

Tues 11/15 Lecture and discussion: Pawan Sinha

Reading due: TBD

Thurs 11/17 Studio: 2nd critique

Tues 11/22 Seminar: student presentation

Reading due:

*Associative Learning Mechanisms in Vision, excerpt Visual Memory* (eds. Luck/Hollingworth 2008)

Thurs 11/24 Thanksgiving Day Holiday

### *Preparing for Exhibition*

Tues 11/29 project write-up and exhibit label due

Thurs 12/1 Project work

Tues 12/6 Project work

Thurs 12/8 Project work

Tues. 12/13 last day of classes/exhibition opening

## Grading and Evaluation

Activity	Percentage
Final project	50
<i>Studio work (35%)</i>	
<i>Write-up detailing relevance to course material (15%)</i>	
Participation	
<i>Student-led discussions, question submissions, presentations, critiques</i>	20
Assignments	20
Attendance	10

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 13, 2022. There will be no written final exam.
- The final project will be an individual artwork which communicates to others, in terms of perceptual experiences, 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 explore artistic methods and creation together. Thus, your investment in the hands-on learning process—not the success of the project as an artwork—will be the evaluation-measure of your studio work.
- Final projects are wide open in terms of equipment, software, techniques. The project will be your original concept and lead. We will work with you to solve artistic and technical challenges, using studio methods and resources.
- At a key point in the semester, we will have a one-on-one meeting. This will be an opportunity for us (instructors) to provide feedback on your work and, equally, for you to provide feedback on course structure, content and the instruction.
- Students will submit a two-part written assignment, 1. A project write-up detailing their artistic approach to the project and its intellectual basis in the course material and 2. Exhibit label text (100 words) drawn from the project write-up. The exhibit label and image of the project in development will be published in the catalog accompanying the exhibition.

### Student-led experiences/discussions

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. These presentations are not slide talks, but demo-led, visual events that translate one or more key concepts into visual experiences that the entire class can explore and intellectually interpret. The presenting group is responsible for creating (at least) one visual experience extending ideas from the reading, and engaging the rest of the class in the demo(s) during their presentation. The presenting group must find independent time to prepare the demo(s). Studio facilities and staff are available to provide resources and support.

The presentations will be structured around questions submitted by all non-presenting course members by 5pm the Sunday before the seminar. Each student is required to submit (at least) one question extending or challenging a key idea in the reading. The student seminar facilitators will curate the submitted questions in structuring their presentation. Each group will use their presentation time to lead a structured discussion of the material by (a) briefly summarizing the readings, (b) engaging the class in discussion/experiences based on the submitted questions (c) concluding by synthesizing the content of the live discussion and suggesting potential future avenues for investigation.

## 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.

- Participation grades will be based on contributions to seminar discussions and engagement in the individual and group, hands-on work in the studio sessions.
- The participation grade is not based on quantity, but quality of contribution to a lively, useful, and sustained discussion and community of learning.
- Studio sessions will often involve visual presentations of prepared work. It is expected that this work will be ready to show by the start of class.
- If you experience concerns or difficulties participating, accessing materials, working in-person for any reason, please reach out right away, e.g., via email, or using the pseudonymous Threads tool. We are here to create this semester together, and will be flexible and open to any necessary adjustments.
- In the spirit of a flexible semester, we are prepared to update schedules and expectations given whatever challenges this fall may bring, for any one or all of us. We are approaching this semester with the mindset of building a community of practice, which functions in both physical and virtual classrooms, as needed.
- Your observations, ideas and leadership are important in creating a good learning environment, course and class experience. We're looking forward to working with you this semester.