

# SP.248 NEET Ways of Thinking

New Engineering  
Education  
Transformation program

Dr. Rea Lavi  
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# NEET threads <https://neet.mit.edu/threads>



## Autonomous Machines

Design, build, and deploy mechanical systems, software, and autonomy algorithms for real-world autonomous machines and robots.



## Climate & Sustainability Systems

Work on groundbreaking research projects with real-world impact and develop strong bonds with a diverse group of climate-conscious students.



## Living Machines

Discover, build and engineer living systems for broad applications in biotechnology and medical devices.



## Digital Cities

Build the cities of the future by immersing scholars in the emerging intersections of computer science and urban planning.

*Aims to cultivate the essential skills, knowledge, and qualities engineers of the future will need to address the formidable challenges posed by the 21st century*

# NEET program overview

## Key points

- Began in 2017 (AM & LM)
- Open to all MIT sophomores
- Extra-curricular, cross-departmental endeavor with a focus on integrative, project-centric learning
- Fall 2022: 262 registered students across sophomore, junior, and senior years at MIT
- >20 different majors represented

## Core principles

- Focus on preparation for developing new technologies
- Prepare students to become makers and discoverers, with engineering fundamentals applicable to both research and in practical careers
- Be constructed around the way students learn best and must be both effective and engaging for the current era
- **Empower students to think more effectively and learn more effectively by themselves (ways of thinking)**

# SP.248 learning objectives

Understand key concepts about Algorithmic Thinking, Creative Thinking, Systems Thinking, and Making

Be able to relate these concepts to specific methods, tools and techniques of problem-solving and design

Be able to apply methods, tools and techniques to novel challenges

# Case-based learning (CBL)

- Originated in professional education, specifically in medicine, business, and law, and has since also been applied in science and engineering education.
- Helps students develop conceptual understanding and thinking skills as they work through and reflect on the process of solving cases.
- When afforded more autonomy, CBL affords students with active learning opportunities for application, reflection, and teamwork.
- Studies in STEM education have shown that active learning facilitates students' development of a wide variety of skills.

# SP.248 challenges (cases)

*Well-structured problem*

Algorithmic thinking in autonomous machines

- Formulate a search strategy for a minibot looking for balls on a grid using Scratch (NEET AM students give feedback)

Systems thinking in living machines

- Design a microfluidic device for drug delivery experiments (mini-lecture about microfluidics)

Systems thinking in climate & sustainability systems

- Describe and suggest improvements to the design of a clean energy system (maker space visit)

Creative thinking in digital cities

- Generate and refine ideas for making Cambridge more cyclist-friendly (mini-lecture about urban planning)

Synthetic assignment  
(algorithmic, creative, & systems thinking)

- Conceive and design a method or tool to help first-year students at MIT choose the right major for them

*Ill-structured problem*

*Well-structured problem*

Making

- Cast and mold a wooden figurine in plaster (tutorial video and home kit)

# Problem structuredness



# SP.248 Ways of Thinking

## Algorithmic thinking

- The ability to work through a well-defined problem to achieve a specified goal by:
  - articulating and combining sequential, conditional, and/or iterative operations in reference to data and events.

## Creative thinking

- The ability to generate novel and useful ideas, solutions, or products.
  - Novelty: being rare within a particular group, uncommon, or unique.
  - Usefulness: utility, adaptiveness to reality, effectiveness, or valuability.

## Systems thinking

- A skill or set of skills enabling the identification, understanding, prediction, and improvement of every aspect of a technological system:
  - its outcome, function, structure, and behavior,
  - and the way these aspects interrelate within the system.



# Course assignments

Type	Conditions	Description	Number
Preparation	Individual Out of class	Reading an introduction about a NEET Way of Thinking and responding to questions about it.	4
Application	Team/individual In and out of class	Applying a method, tool, or technique learned in class to a given challenge.	13 12 team 1 individual
Reflection	Individual Out of class	Self-rating on the NEET Ways of Thinking.  Providing real-world examples of exhibiting the NEET Ways of Thinking.	4



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