

How to CAD (Computer-Aided Design) Almost Anything! HS Edition

HSSP Spring 2024 – AeroAstro/MechE Workshop

A compressed yet rewarding introduction to the mechanical design softwares Solidworks/Fusion 360, for beginners (no experience at all) and pro-users alike. Come learn how to CAD (computer-aided design) essentially almost anything!



Yes, this could be YOU at the end of the workshop! You'll be equipped with the tools to design cool looking things such as a bicycle, a chess set, a Chinese violin (Er Hu), a model train, a mug and even a Trumpet!

Workshop Details

Subject Title: How to CAD almost anything!

Prerequisites: Willingness to have fun and think outside the box!
Bringing a laptop computer is recommended, but not required. Please email the instructors if in need of a laptop!

Enrollment: 30 per cohort.

Attendance: Participants must attend all sessions.

Meeting Room: TBD.

Meeting Times: Saturdays 1:00pm – 2:30pm (Cohort 1) and 2:30pm – 4:00pm (Cohort 2). There are five sessions, starting on 03/02/24 until 04/06/24.

Notes:

- There is no class on 03/16/24!
- This workshop will teach either how to CAD using Solidworks or Fusion 360. The choice of software will depend on the classroom that the workshop gets assigned!

Instructors: Andy Eskenazi - AeroAstro PhD student (LAE), andyeske@mit.edu.
Natasha Stamler – MechE PhD student (DRL), stamlern@mit.edu.

Workshop Description

Ever wondered how are objects from our daily lives designed? How can we generate a computer 3D model of a mug, a bottle of Diet Coke, or a Saturn V rocket? What about designing the blades of a jet-engine? A test dummy? How about making an animation of a LEGO house building itself? Or making a realistic render of a bowl of fruit? In this workshop, you will learn the skills to design all of these, and much more!

Split into 5 1.5-hour long sessions, the first half of each session will be spent learning new Solidworks/Fusion 360 skills, while the second half will see the application of these new skills through in-class activities, with a focus on reverse engineering. In contrast to traditional mechanical design courses, this workshop places greater emphasis on the design process itself, understanding how we can plan and best leverage our available tools to arrive to our desired result. Thus, the sessions are less about following the instructions on an engineering drawing, but about independent thinking and strategizing, reverse engineering an object into a 3D model.

Through the workshop’s 5 sessions, the goal is for the student to:

- Have learned all the essential Solidworks/Fusion360 skills.
- Have built a design portfolio, in the form of a presentation (see **Workshop Portfolio (optional)** section below), to showcase all the different in-class projects and Solidworks/Fusion 360 skills mastered.
- Feel that it can take any object and exclaim, “I know how to CAD this!”.

Workshop Schedule (tentative)

Week	Date	Outline and Objectives
W1	S 03/02	<p>Session 1: Introduction to Solidworks/Fusion 360.</p> <p><u>Objective:</u> In this session, we’ll get ourselves acquainted with the Solidworks/Fusion 360 workspace, and start learning some of the most used tools. S1’s goals include:</p> <ul style="list-style-type: none">• Creating sketches (using basic shapes, construction lines, smart-dimensioning, sketch relationships) and understanding planes.• Understanding what it means for a sketch to be fully defined.• Locating and using the different elementary feature commands (boss extrude, boss cut, fillet, chamfer).• Editing sketches and features after creating them.• Coloring parts and changing material properties.

			<p><u>Session activity</u>: Using the tools learned on S1, we'll design a variety of items, including:</p> <ul style="list-style-type: none"> • A cake. • A pencil (using an engineering drawing). <p><u>To do (optional)</u>: Create a presentation (Powerpoint/Google Slides) and title it "Projects Portfolio". There, add 2 slides, one for each designed item, with pictures and a short description of the Solidworks/Fusion 360 skills employed to during the design process.</p> <p><u>Associated YouTube video/s</u>: "Getting Started with Solidworks" GSWSW-V1, "How to CAD Almost Anything" HTCAA-S1.</p>
W2	S	03/09	<p>Session 2: Splines, Sketch Pictures and some Geography!</p> <p><u>Objective</u>: In this session, we'll continue exploring some of the most powerful Solidworks tools. S2's goals include:</p> <ul style="list-style-type: none"> • Learning how to use the spline tool. • Learning how to add a picture and sketch on it. <p><u>Session activity</u>: Using the tools learned on S2, we'll design a variety of items, including:</p> <ul style="list-style-type: none"> • A 3D model of a topographical geographical map, such as the Big Island in Hawaii. • A keychain of your favorite logo. <p><u>To do (optional)</u>: Add 2 slides to the portfolio, one for each designed item, with pictures and a short description of the Solidworks skills employed to during the design process.</p> <p><u>Associated YouTube video/s</u>: GSWSW-V2, HTCAA-S2.</p>
W3	S	03/23	<p>Session 3: All about symmetry, patterns and planes (that don't fly)!</p> <p><u>Objective</u>: In this session, we'll focus our attention to symmetry, patterns and planes, and how we can leverage certain tools to simplify the design process. S3's goals include:</p> <ul style="list-style-type: none"> • Understanding how to create a sketch for a revolve. • Learning how to make use of the mirroring and circular patterns tools, both as a sketch and as a feature. • Learning how to create planes, at different angles. <p><u>Session activity</u>: Using the tools learned on S3, we'll design a variety of items, including:</p> <ul style="list-style-type: none"> • A fidget spinner! • A cube satellite.

	<p><u>To do(optional)</u>: Add 2 slides to the portfolio, one for each designed item, with pictures and a short description of the Solidworks skills employed to during the design process.</p> <p><u>Associated YouTube video/s</u>: GSWSW-V3 and GSWSW-V4, HTCAA-S3.</p>
W4	<p>Session 4: Loft, not lift!</p> <p><u>Objective</u>: In this session, we'll explore two very powerful Solidworks/Fusion 360 tools, loft and sweep. These tools allow us to create complicated looking geometries, like the body of a 747 or the surface of an apple. S4's goals include:</p> <ul style="list-style-type: none"> • Learning how to use the lofting and sweep command. • Continuing to master previously explored tools, such as revolve, linear/circular patterns and plane creation. <p><u>Session activity</u>: Using the tools learned on S4, we'll design a variety of items, including:</p> <ul style="list-style-type: none"> • A banana, in honor of the banana lounge (using various plane cuts, splines and lofts). • A snowman. <p><u>To do (optional)</u>: Add 2 slides to the portfolio, one for each designed item, with pictures and a short description of the Solidworks skills employed to during the design process.</p> <p><u>Associated YouTube video/s</u>: GSWSW-V6, GSWSW-V9, HTCAA-S4, HTCAA-S5.</p>
	<p>Session 5: Living in a world made from plastic bricks!</p> <p><u>Objective</u>: In this session, we'll move towards one of the most powerful features within Solidworks/Fusion 360, which is that of making assemblies and engineering drawings! S5's goals include:</p> <ul style="list-style-type: none"> • Learning how to make an assembly of multiple parts. • Learning (time-permitting) how to make an exploded view of an assembly and subsequently animating it. • Learning how to create an engineering drawing of a part. • Exploring the best-practices of drawing creation, including different formats and information to be conveyed (such as tolerancing, material properties). <p><u>Session activity</u>: Using the tools learned on S5, we'll design a variety of items, including:</p> <ul style="list-style-type: none"> • A 20x20 LEGO base plate. • A standard 2x4 LEGO block. • An engineering drawings of the 2x4 LEGO block. • A simple LEGO house assembly.

	<p><u>To do (optional)</u>: Add 4 slides to the portfolio, one for each designed item, with pictures and a short description of the Solidworks skills employed to during the design process.</p> <p><u>Associated YouTube video/s</u>: GSWSW-V5, GSWSW-V11, GSWSW-V10.</p>
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Portfolio Presentation Submission Deadline (optional)!

Su	04/07	<p><u>To do (optional)</u>: Send a PDF of the presentation by email to andyeske@mit.edu and stamlern@mit.edu before midnight, EST time on 04/07. That way the instructors can provide feedback on all the great work done throughout the workshop!</p>
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Workshop Portfolio (optional)

“How to CAD almost anything!” is a purely project-based workshop, with most, if not all the projects taking place as session activities. As a result, the workshop does not have any form of “homework”, other than additional work that the student is willing to put to expand on the in-class activities. However, as mentioned above, one of the purposes of this workshop is for the student to build a portfolio of projects, one which can be used to showcase its 3D-modeling skills. Hence, as an optional workshop activity, the student will be able to create a portfolio presentation, consisting of the slides made during/after each session. Although this is an ungraded activity, the student is encouraged to be creative and use this as an opportunity to showcase its learnings! Feel free to include screenshots from the Solidworks/Fusion 360 workspace, rendered images, animations, engineering drawings or anything deemed appropriate. Additionally, including one last slide with thoughts about the workshop and recommendations to make it even better next time would be greatly appreciated!