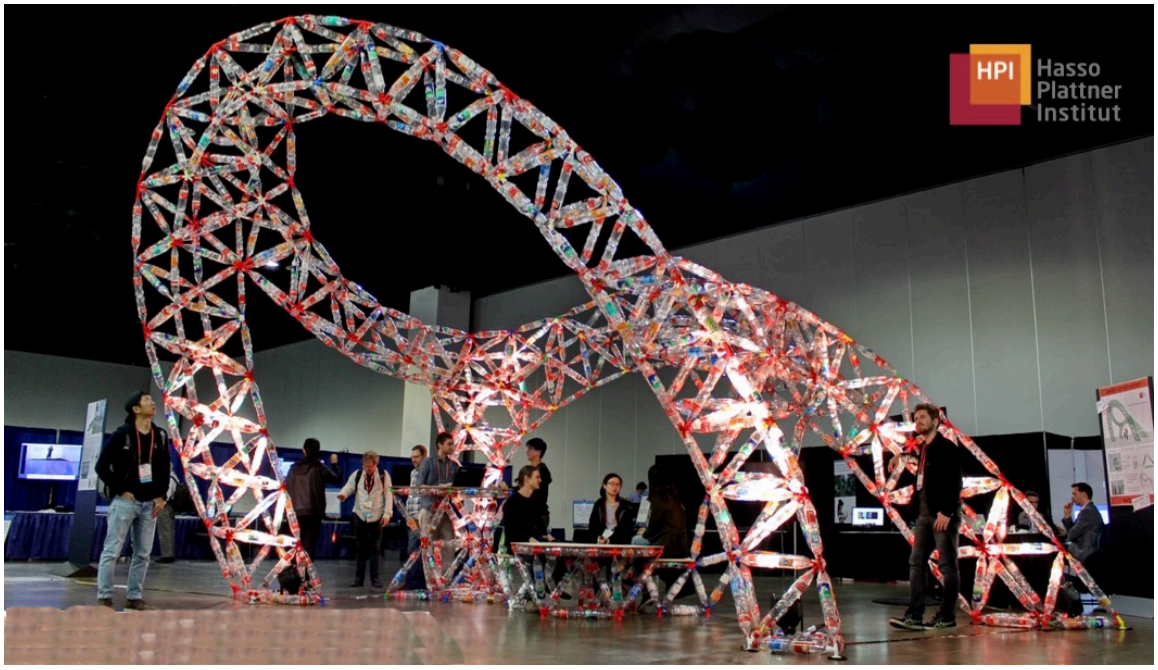
Engineering large physical structures

Objective

Today's personal fabrication technology, such as 3D printers and laser cutters allow users to make a wide range of designs. But what about large structures, such as houses, bridges, boats, robots, or tradeshow pavilions? On the one hand, this requires scaling fabrication, e.g., by including pre-made building materials, such as PVC pipes, metal beams, or even plastic bottles into the design. On the other hand, and more importantly, engineering large structures requires a deep understanding of the involved forces. A structure 10x larger will be subject to 1000x the forces; if it is supposed to support human weight, the involved forces may be 100.000x. Designing around such forces requires substantial engineering knowledge—or a very smart system, such as the one you will be building.

Background: proof-of-concept prototype

As a proof-of-concept, we already created a SketchUp Extension with a couple of thousand lines of Ruby that allows users to engineer and fabricate large structures, such as the one shown below. This particular one is made from PET bottles with 3D print, but any material or structure is equally good here. Now we would like to **"make this real",** such as add better tools, support output on different fabrication machines, simulate dynamic forces—and to make all this work in a web-based system. **This is where we need your help.**

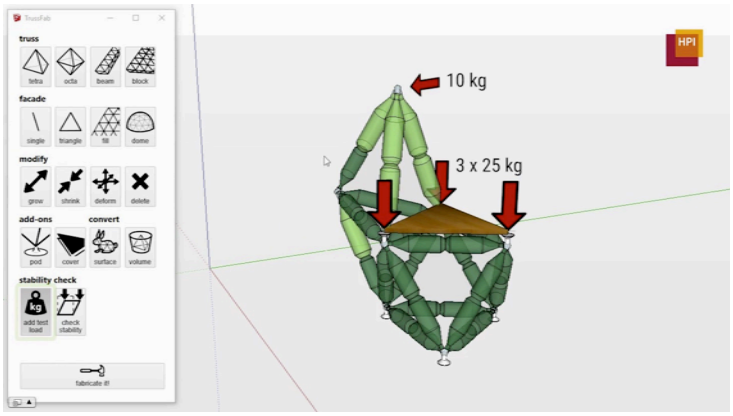


One design we made using our proof-of-concept Google SketchUp extension

The web-based system to build

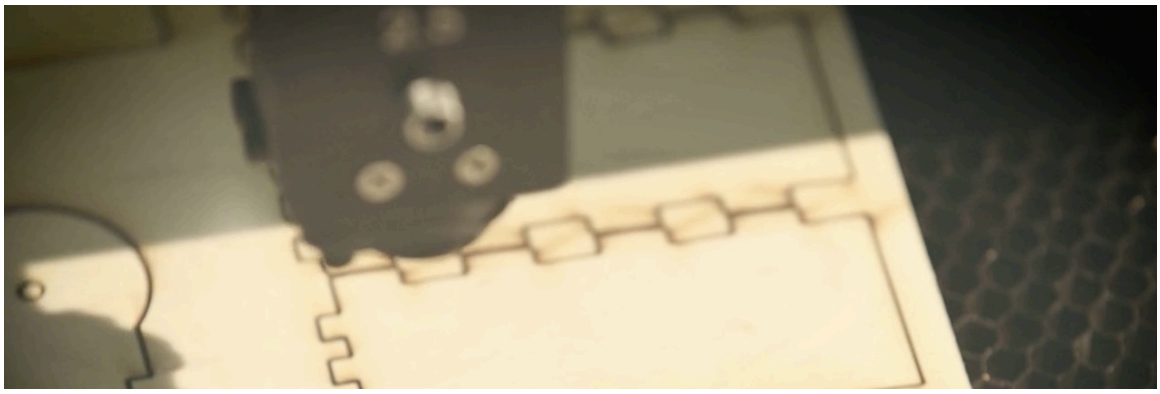
You will write a web-based system based on WebGL and NodeJS in coffee-script/JavaScript. As part of this you will develop an asset-based architecture

You will apply what you learned in the classes **building interactive devices** and especially **3D computer graphics.** While this project has some physical building aspects, the main focus will be on **software architecture and development.** On the algorithmic side, you will write **high performance physics simulations** to optimize construction, apply **graph theory algorithms** to generate geometry automatically, and write an **interactive WebGL application**.



External Partner

Your software will integrate with our software partner **kyub**, an HPI spin-out in progress that is creating software for laser cutters.



Group structure

5-8 students. Areas of responsibilities and specialization will be defined in the first week.

Questions?

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