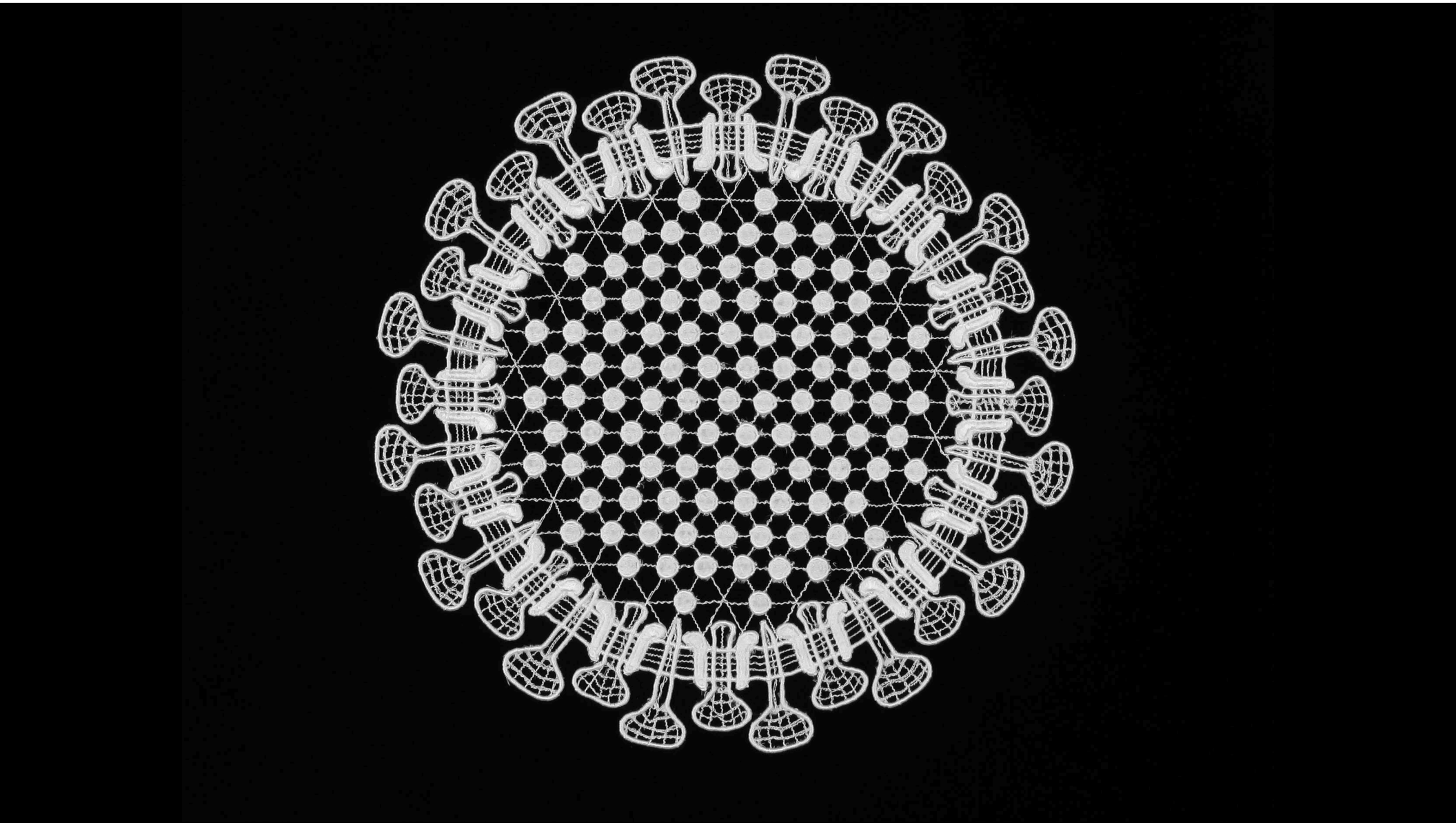
# Computational Fabrication

CS 491 and 591
Professor: Leah Buechley
https://handandmachine.cs.unm.edu/classes/Computational_Fabrication_Spring2021/

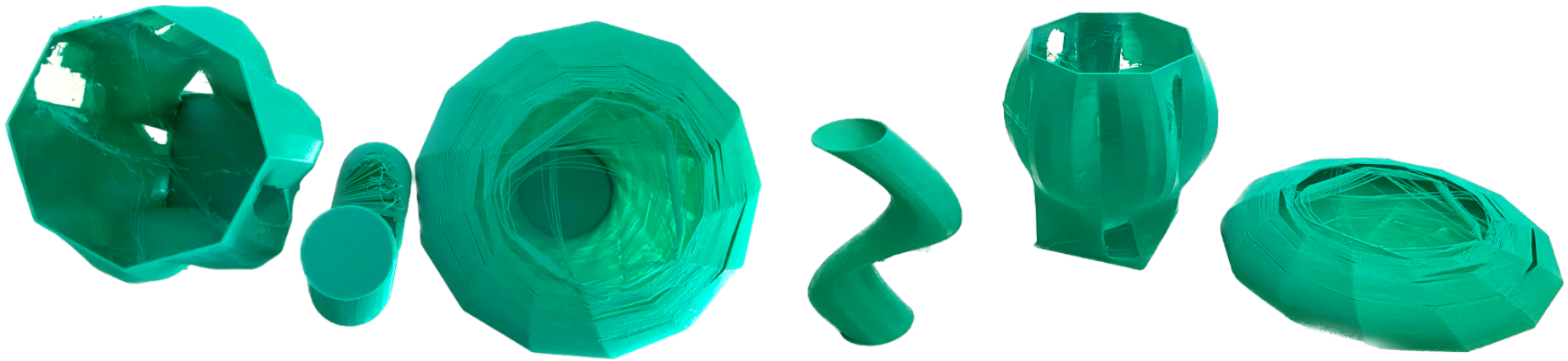
# Weekly Artist: Laura Splan

https://www.laurasplan.com/projects



questions?

# Troubleshooting 3D Printing

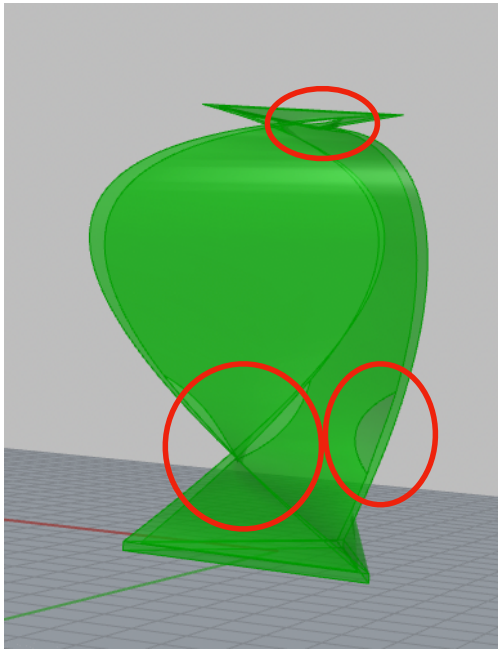


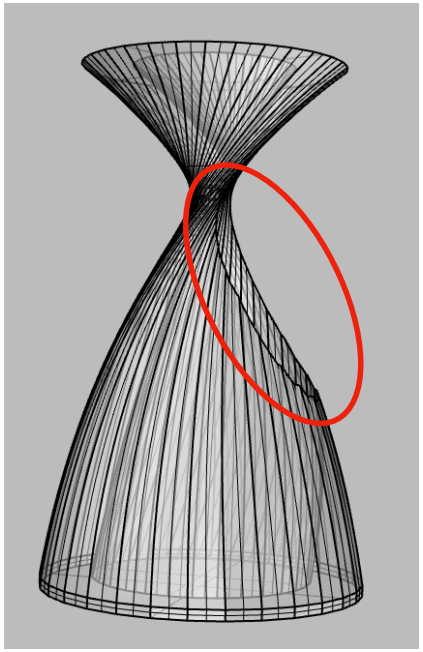
Thank you Erin!

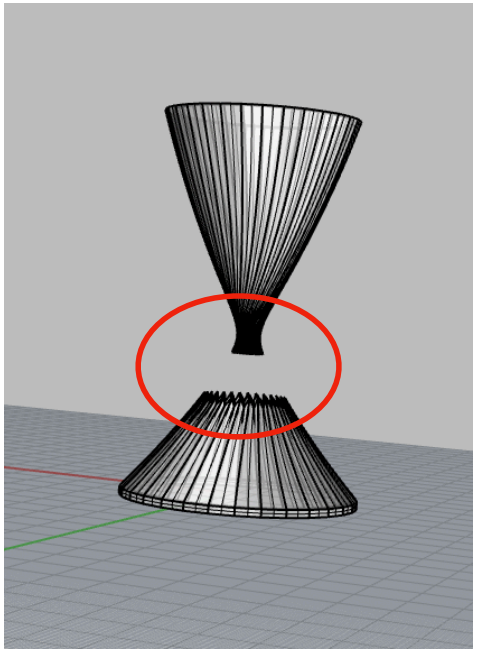
# Grasshopper & Rhino

# Grasshopper & Rhino

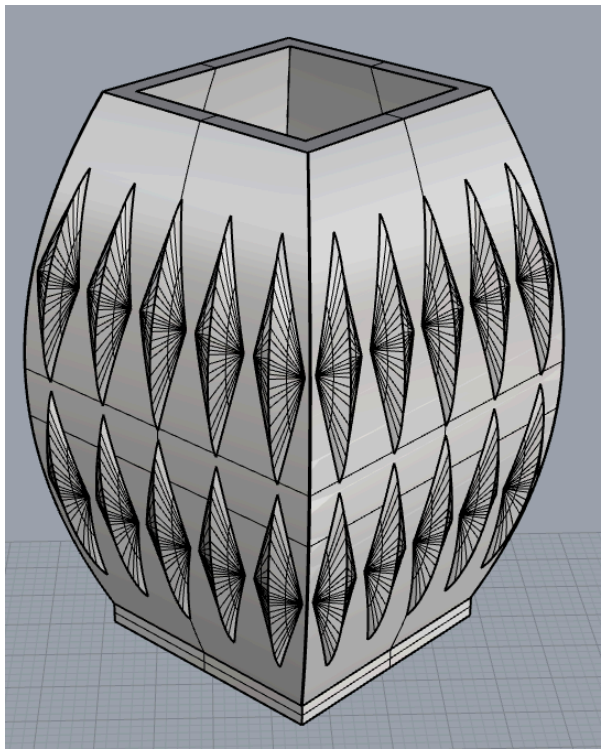
**Design:** Be aware of shape structure as you design. Look for holes, intersections, and other problems before baking and exporting.



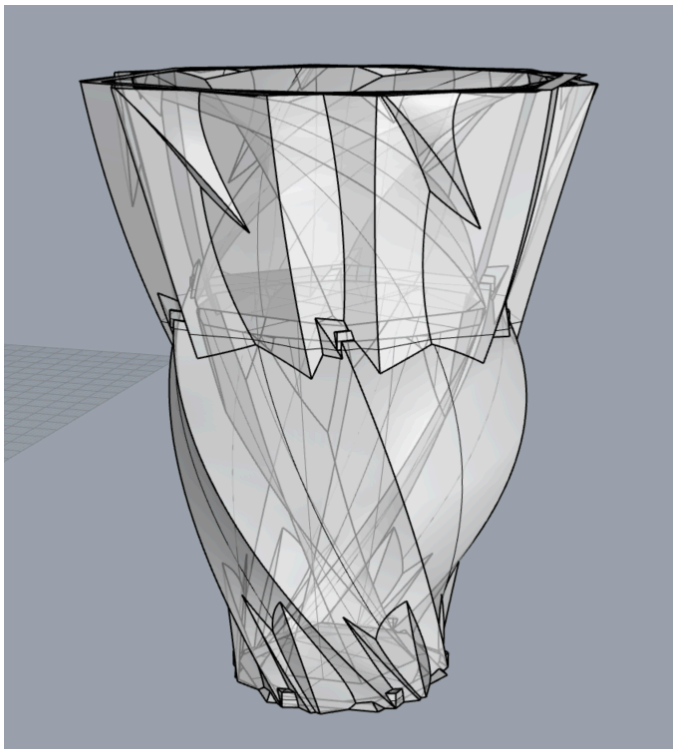




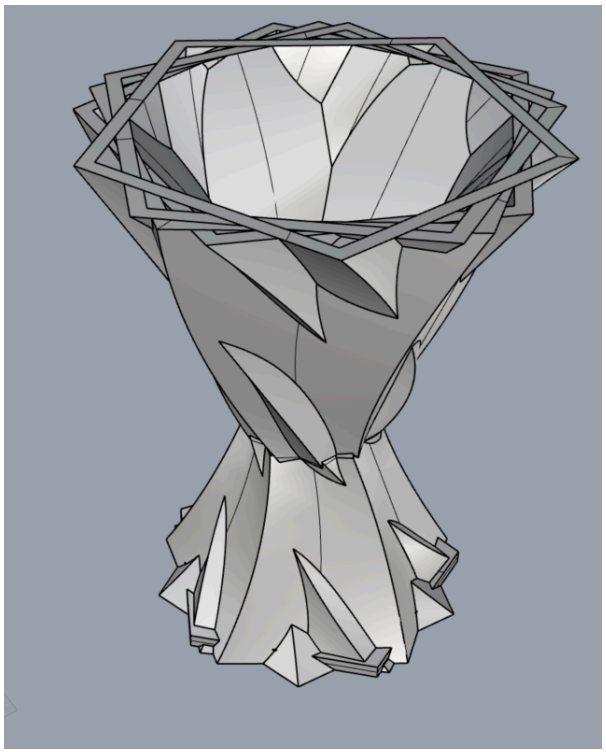
# Grasshopper & Rhino



Nate: extra (open) surfaces?



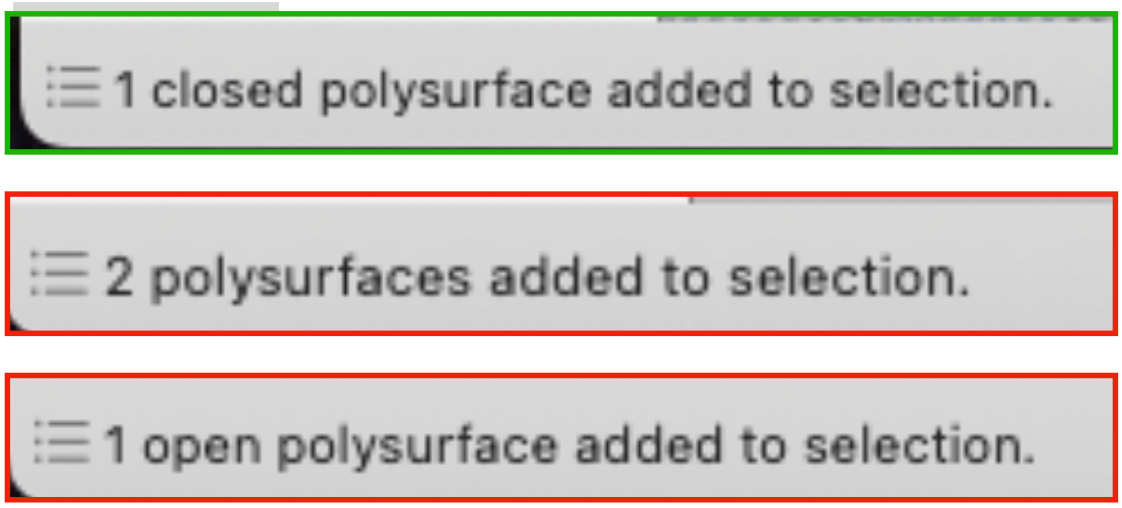
Raneem: complex intersections

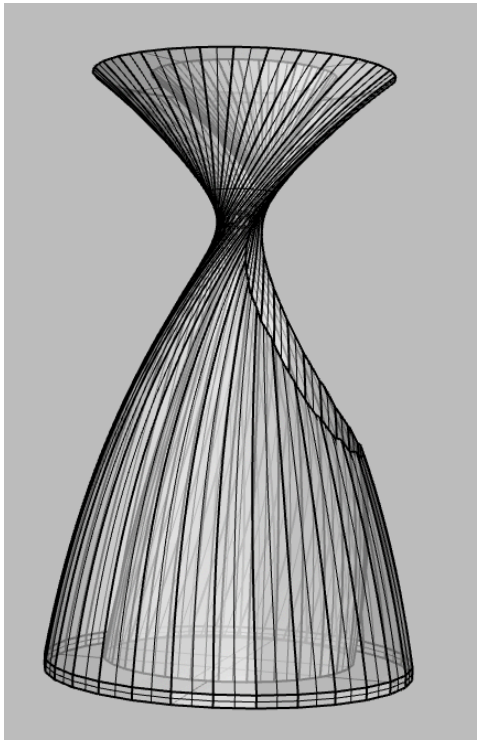


Raneem: many solids

# Rhino

**Closed Polysurface:** Make sure your artifact is a single solid (closed polysurface) before exporting.



**Good wall thickness**: If your wall is too thin the print can fail later.

questions?

# Cura

# You Can Adjust These Settings (*Carefully)*

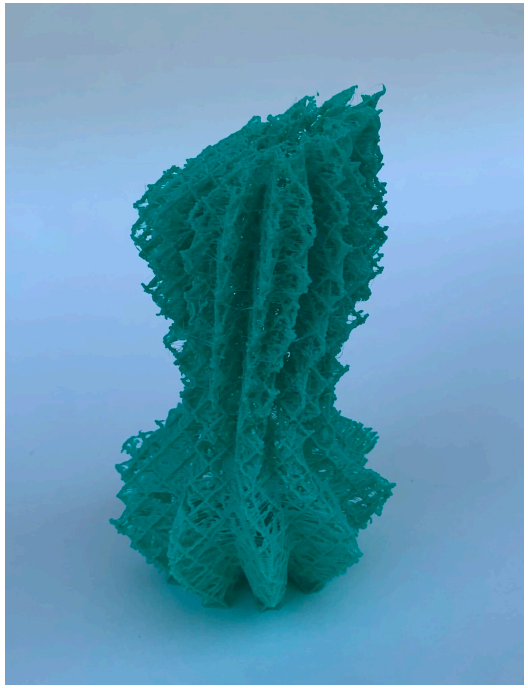
**Walls:** the wall is the solid outer layer of your print, not the wall of your vessel. Increase thickness to make smoother or more stable. No outer wall = strange print.

**Infill:** decrease to speed up (but weaken) print. Increase to strengthen (but slow down) print. Can change infill patterns.

**Support:** turn off and on. Can help you print parts with extreme overhang. Avoid using if you can. Good support angle: 60 degrees (default is 45)

**Build Plate Adhesion:** experiment & find what works. Can give you a heads up about adhesion issues.

# Cura

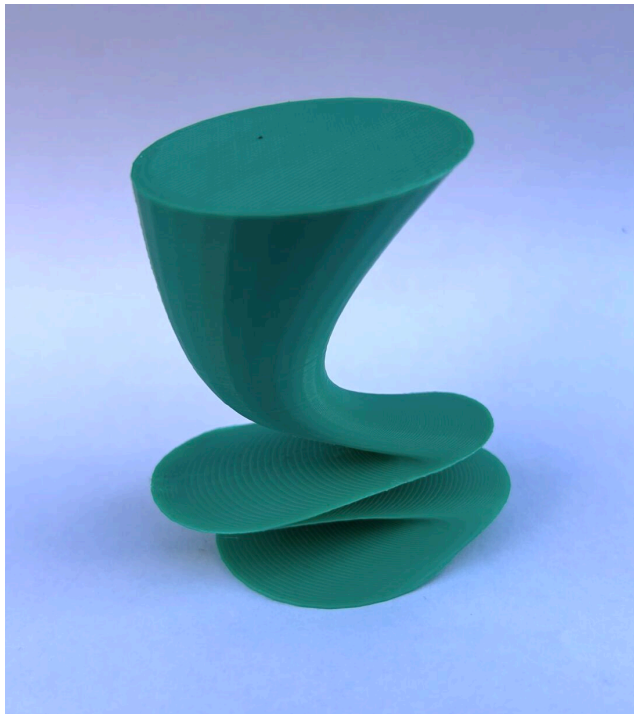


Lauren: vessel without walls. infill only

Lin: dramatic overhang

Erin: dramatic overhang + very thin walls (Rhino GH)

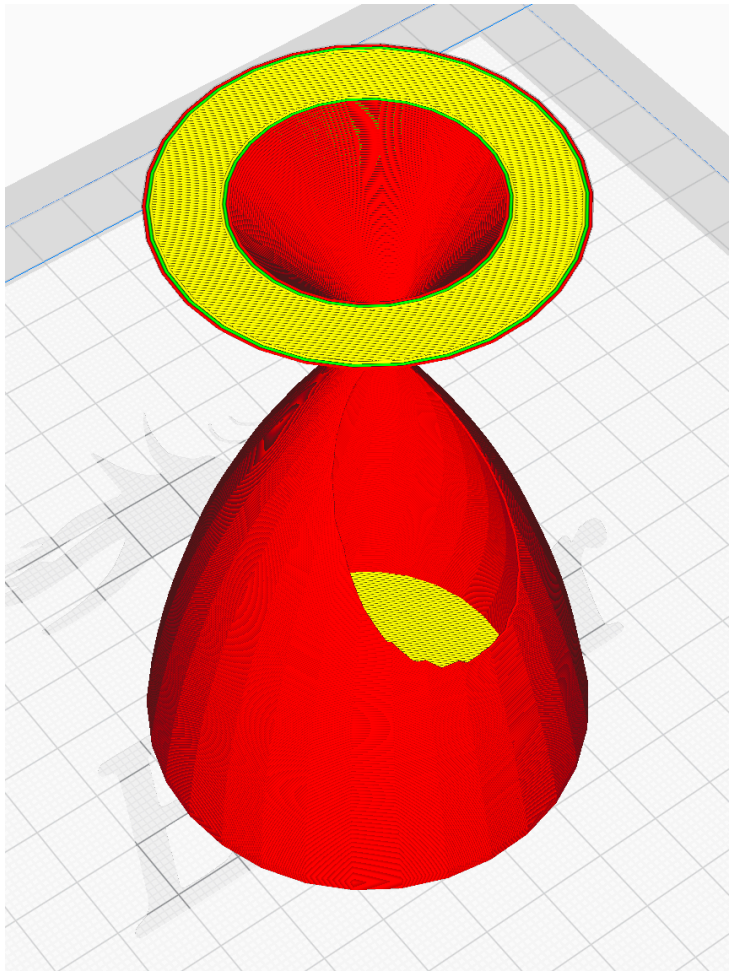
# Comparison: wall thickness matters



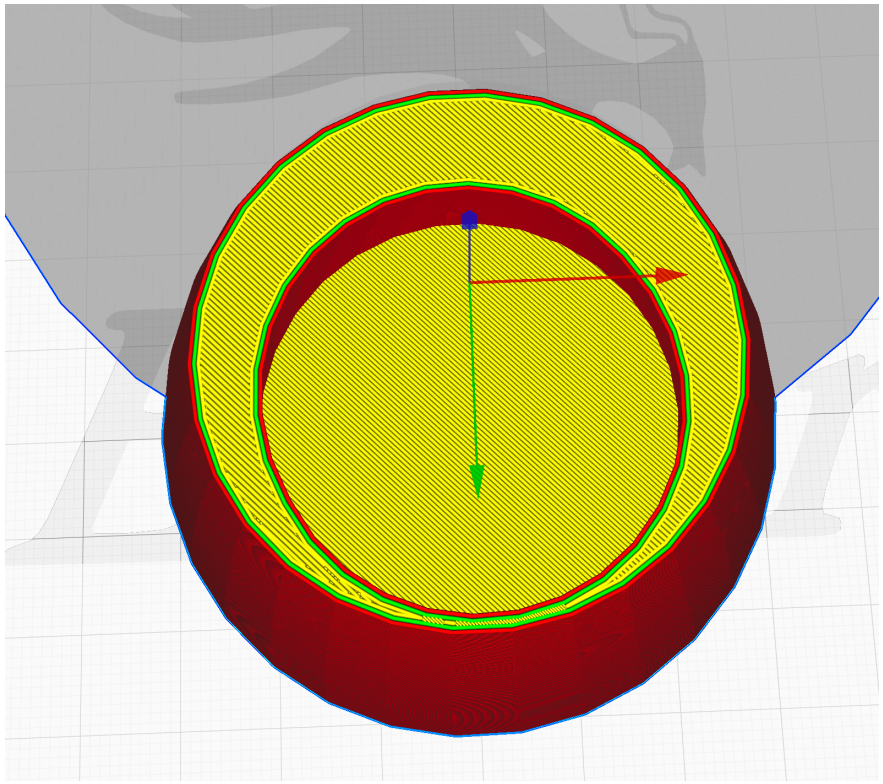
Daniel: dramatic overhang
solid

Erin: dramatic overhang
hollow

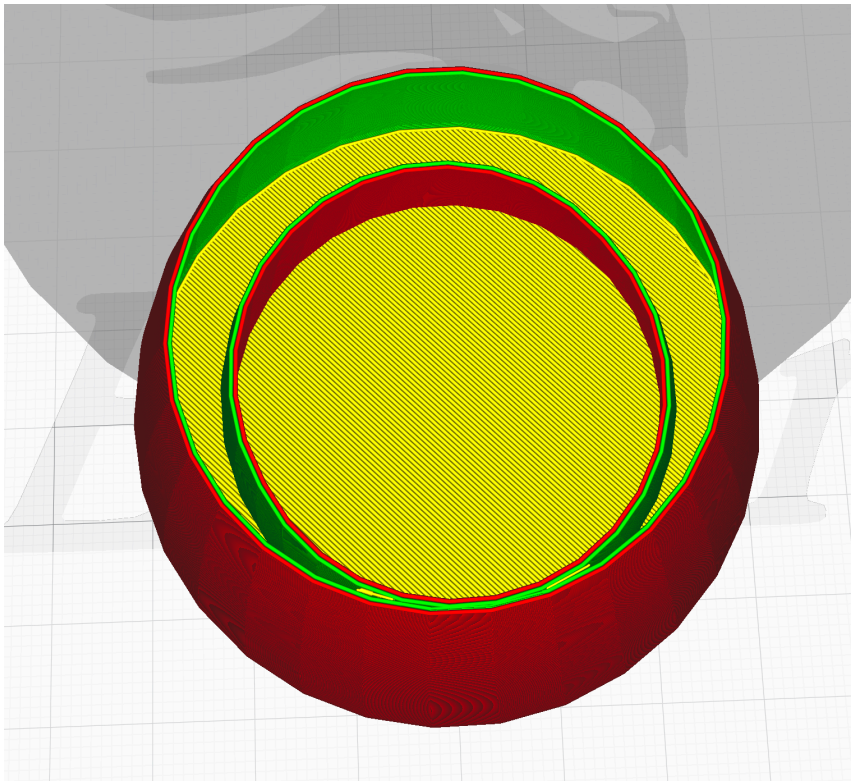
# Always Preview Before Printing



# Preview Again After Any Setting Adjustment



12 hours: 100% infill



3 hours: no infill

questions?

# Printer

# A Few Possible Problems

**Print doesn't stick to bed**

- Poor bed leveling. Need to re-level print bed.
- Try adding a skirt or a raft in Cura
- Try a glue stick :)

**Uneven/weird/insufficient extrusion**

- Clogged nozzle. Clean nozzle. Replace nozzle if problem persists
- Filament feed issue. Make sure filament isn't twisted. Make sure filament roll isn't stuck.

**Print collapse**

- Excessive overhangs in part. Try adding support.
- Clogged nozzle. Clean nozzle

questions?

# Data Driven Design

# Large Assignment 3: Data Physicalization

## Due Dates

**Assignment :** 9am, Tuesday October 10
**Initial comments:** 9am, Thursday October 12
**Comment responses:** 9am, Tuesday October 17

## Description

The purpose of this assignment is to explore how we can “visualize” or “physicalize” data in three dimensions. You will create a family of at least three forms that explore a dataset. These forms can be any type of form you wish. You should find and explore a new dataset, one that is different than the ones we have explored in class. Each vessel should be at least 2.5 inches (6.5cm) tall and 1.5 (4cm) inches in diameter. Plan ahead. Expect each print to take at least 10 hours.

**What to Hand In**
Create a post on this website that documents the work that you did. Your post should include:

- Dataset. Provide a link to your dataset. Describe how and why you chose your dataset. Describe any data cleaning and filtering that you had to do.

# Data Driven Design

Design based on data

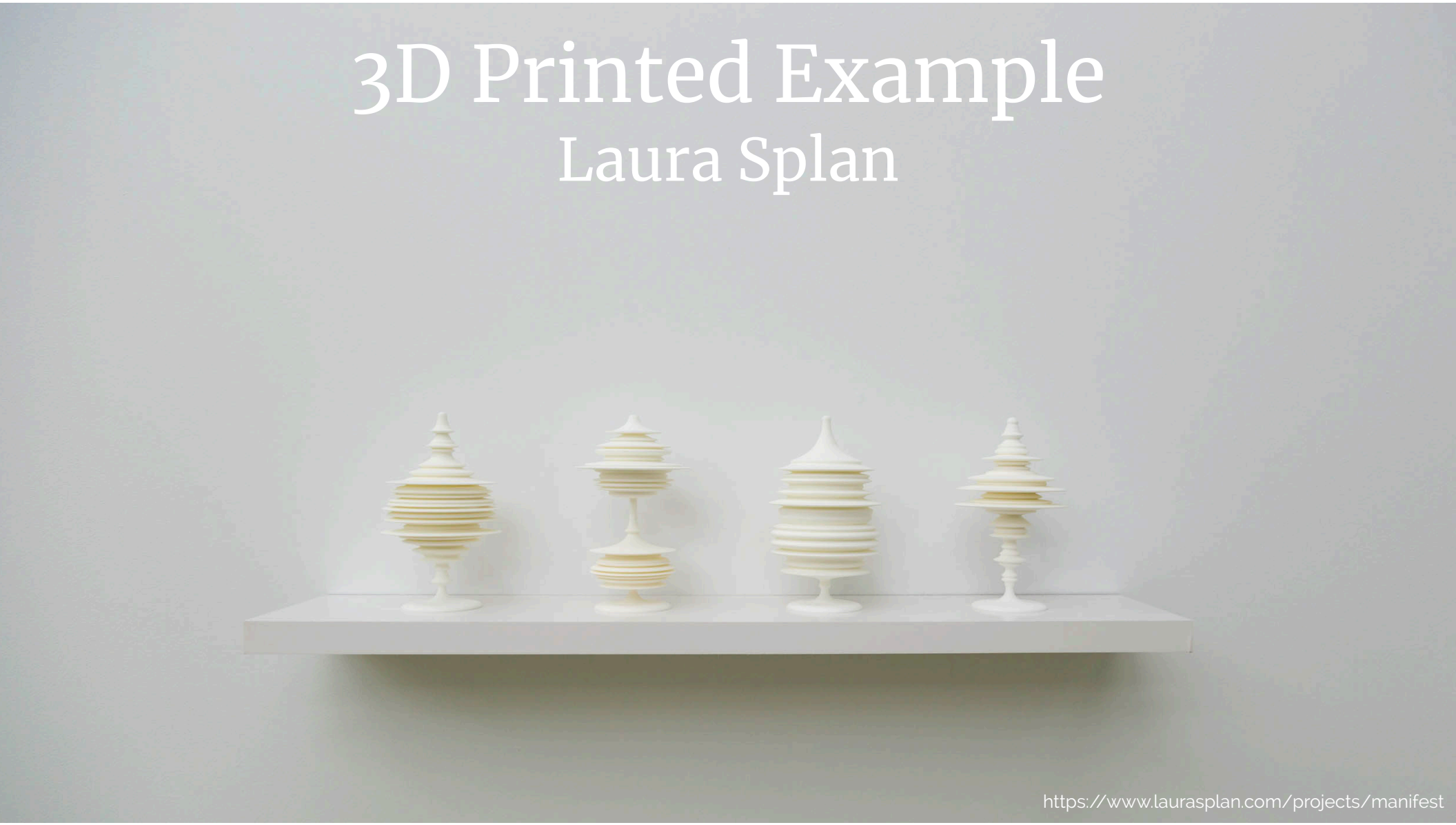
Data visualization

Data physicalization

Data visceralization

# 3D Printed Example

## Laura Splan



https://www.laurasplan.com/projects/manifest

# Where to get data?

Tons of data is available, some great sources:

Weather, via NOAA: https://www.ncei.noaa.gov/maps/lcd/

US Governmental data: https://www.data.gov/

City of Albuquerque data: https://www.cabq.gov/abq-data/

Forest Service data: https://data.fs.usda.gov/geodata/edw/datasets.php

US Geological Society (GIS data): https://www.usgs.gov/the-national-map-data-delivery/gis-data-download

Audubon Bird data: https://www.audubon.org/conservation/science/christmas-bird-count

# Student Loan Data

Federal

**Department of Education**

There is no description for this organization

**Publisher**

Office of Federal Student Aid (FSA)

**Contact**

Tara Marini

**Share on Social Sites**

## National Student Loan Data System

**Metadata Updated:** August 12, 2023

The National Student Loan Data System (NSLDS) is the national database of information about loans and grants awarded to students under Title IV of the Higher Education Act (HEA) of 1965. NSLDS provides a centralized, integrated view of Title IV loans and grants during their complete life cycle, from aid approval through disbursement, repayment, deferment, delinquency, and closure.

## Access & Use Information

**Public:** This dataset is intended for public access and use.

**License:** Creative Commons CCZero

## Downloads & Resources

DATA **1617FedSchoolCodeList.xlsx**

Federal School Code List

Download

# ABQ Food Safety, 2023 😬

| FACILITY_NAME | SITE_ADDRESS | ZIP | PHONE | INSPECTION_DESC |
|---|---|---|---|---|
| 21ST CENTURY PUBLIC ACADEMY | 4300 CUTLER AV NE | 87110 | 5052540280 | HIGH RISK |
| 66 DINER | 1405 CENTRAL AV NE | 87106 | 5052471421 | HIGH RISK |
| ACE LEADERSHIP SCHOOL | 1240 BELLAMAH AV NW | 87104 | 5052424733 | HIGH RISK |
| ALBERTSONS 939 | 12201 ACADEMY RD NE | 87108 | 5052757000 | HIGH RISK |
| ALBUQUERQUE CITY LIMITS REST. | 3211 COORS BLVD SW #F4 | 87121 | 5058738959 | HIGH RISK |
| ALEBRIJES FOOD LLC | 520 LOUISIANA BLVD SE | 87108 | 5057301698 | HIGH RISK |
| AMADEOS PIZZA & SUBS | 809 98TH ST SW | 87121 | 5058732035 | HIGH RISK |
| ANNAPURNA | 5939 4TH ST NW | 87107 | 5052542424 | HIGH RISK |
| ANNAPURNA CHAI HOUSE | 2201 SILVER SE | 87106 | 5052622424 | HIGH RISK |
| ANNAPURNA CHAI HOUSE | 2201 SILVER SE | 87106 | 5052622424 | HIGH RISK |
| APPLEBEES GRILL AND BAR 6406 | 2711 COORS BLVD NW | 87120 | 5053526544 | HIGH RISK |
| ARBYS | 5800 MENAUL BLVD NE | 87110 | 5052928803 | HIGH RISK |
| ARIANA HALAL MARKET | 1401 SAN MATEO BLVD NE | 87110 | 5052551325 | HIGH RISK |
| ARROYO DEL OSO GOLF COURSE | 7001 OSUNA RD NE | 87109 | | HIGH RISK |
| ASIAN PEAR | 8101 SAN PEDRO DR NE STE D | 87113 | 5057669405 | HIGH RISK |
| AY MI MEXICO RESTAURANT LLC | 5015 MENAUL BLVD NE | 87110 | 5055036012 | HIGH RISK |
| AYVAZ PIZZA LLC DBA PIZZA HUT | 2916 SAN MATEO BLVD NE | 87110 | 2104082447 | HIGH RISK |
| BJS RESTAURANT AND BREWHOUSE | 2100 LOUISIANA BLVD NE | 87110 | | HIGH RISK |
| BJS RESTAURANT AND BREWHOUSE | 2100 LOUISIANA BLVD NE | 87110 | | HIGH RISK |
| BLAKES 06 | 1640 GIBSON BLVD SE | 87107 | 5059675565 | HIGH RISK |
| BLAKES LOTABURGER | 4121 COORS BLVD NW | 87107 | 5055511890 | HIGH RISK |
| BLAKES LOTABURGER | 2301 CARLISLE BLVD NE | 87110 | 5058809628 | HIGH RISK |
| BLAKES LOTABURGER 2 | 2529 WASHINGTON BLVD NE | 87110 | 5058883141 | HIGH RISK |
| BLAKES LOTABURGER 24 | 3806 MONTGOMERY BLVD NE | 87109 | 5058837615 | HIGH RISK |
| BLAKES LOTABURGER 24 | 3806 MONTGOMERY BLVD NE | 87109 | 5058837615 | HIGH RISK |
| BUFFALO WILD WINGS 613 | 1700 TOWNE CENTER LN SE | 87106 | 5052479464 | HIGH RISK |

# Squirrels in Central Park 🐿️

NYC OpenData

Home Data About Learn Alerts Contact Us Blog Sign In

← Back to Primer ⇄ Switch to Grid View

Search

| Specific Location *specific_location* | Running *running* | Chasing *chasing* | Climbing *climbing* | Eating *eating* | Foraging *foraging* |
|---|---|---|---|---|---|
| | False | False | False | False | False |
| | False | False | False | False | True |
| hopped over fence and chased # 6 aro… | True | True | False | False | False |
| | False | False | False | False | True |
| | False | False | False | True | False |
| Between ground & tree | False | False | False | True | True |
| | False | False | True | True | False |
| | False | False | False | True | False |
| | False | False | False | True | False |
| | True | False | False | | |
| Ran up tree | True | False | True | | |
| near Strawberry Fields | False | False | False | | |
| | False | False | False | | |

https://data.cityofnewyork.us/Environment/2018-Central-Park-Squirrel-Census-Squirrel-Data/vfnx-vebw

## 2018 Central Park Squirrel Census - Squirrel Data

Environment

The Squirrel Census (https://www.thesquirrelcensus.com/) is a multimedia science, design, and storytelling project focusing on the Eastern gray (Sciurus carolinensis). They count squirrels and present their findings to the public. This table contains squirrel data for each of the 3,023 sightings, including location coordinates, age, primary and secondary fur color, elevation,

More

We’ll start simply: weather

# Download this sample data file:

https://handandmachine.org/classes/computational_fabrication/data/weather_2023_week.csv

source: https://www.ncei.noaa.gov/maps/lcd/

National Centers for Environmental Information
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

# Local Climatological Data

Layers | Results

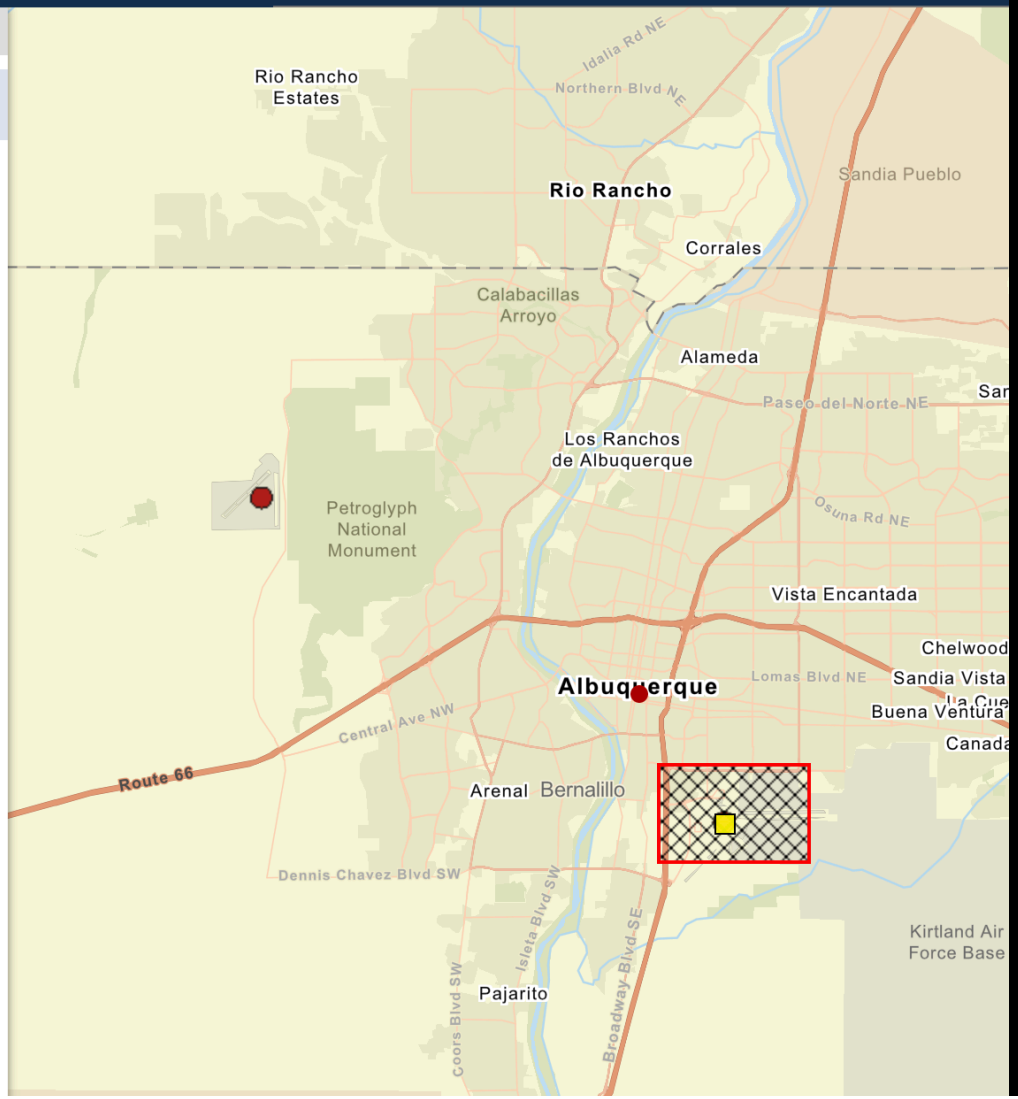
Select All | Download Station List

**ALBUQUERQUE INTERNATIONAL AIR...**

View Station Details

**Station ID:** WBAN:23050

**Period of Record:** 1941-06-30 to 2023-09-25



# Hourly temperature (°F) and humidity (%)

| DATE | Temperature | Humidity |
|---|---|---|
| 2023-01-01T00:52:00 | 40 | 77 |
| 2023-01-01T01:52:00 | 40 | 77 |
| 2023-01-01T02:00:00 | 40 | 77 |
| 2023-01-01T02:52:00 | 38 | 79 |
| 2023-01-01T03:52:00 | 40 | 77 |
| 2023-01-01T04:52:00 | 41 | 73 |
| 2023-01-01T05:00:00 | 41 | 73 |
| 2023-01-01T05:52:00 | 40 | 79 |
| 2023-01-01T06:52:00 | 39 | 82 |
| 2023-01-01T07:52:00 | 36 | 89 |
| 2023-01-01T08:00:00 | 36 | 89 |
| 2023-01-01T08:52:00 | 40 | 79 |
| 2023-01-01T09:52:00 | 41 | 79 |
| 2023-01-01T10:52:00 | 43 | 74 |
| 2023-01-01T11:00:00 | 43 | 74 |

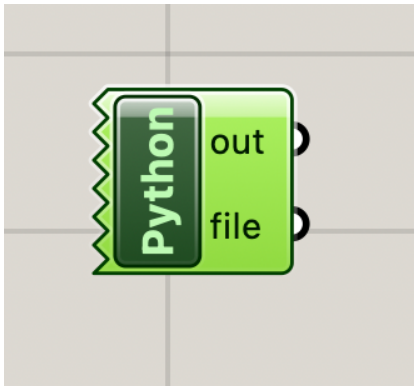
# Working with data in Grasshopper

# Importing Files in Grasshopper

Drag out a Python scripting block and add the statements below. See link on website schedule.

Grasshopper Python Script Editor

```
1 import rhinoscriptsyntax as rs
2
3 filter = "CSV file (*.csv)|*.csv|*.txt|All Files (*.*)|*.*||"
4 file = rs.OpenFileName("Open Point File", filter)
```




```
import rhinoscriptsyntax as rs

filter = "CSV file (*.csv)|*.csv|*.txt|All Files (*.*)|*.*||"
file = rs.OpenFileName("Open Point File", filter)
```

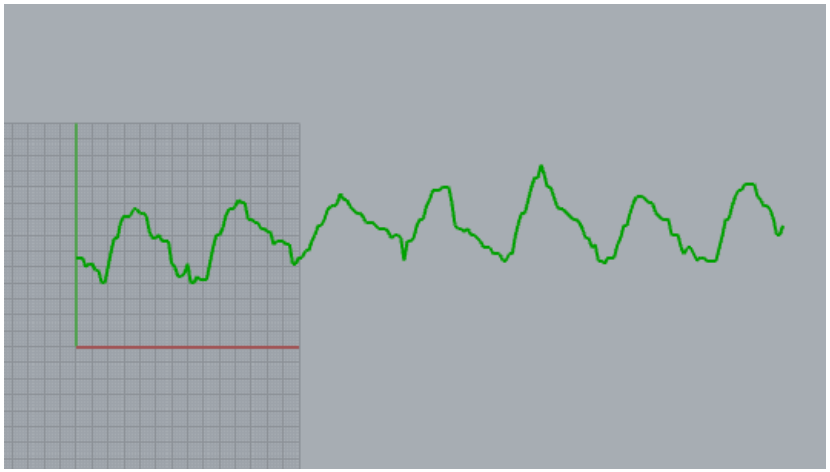
# Reading data from a .csv file

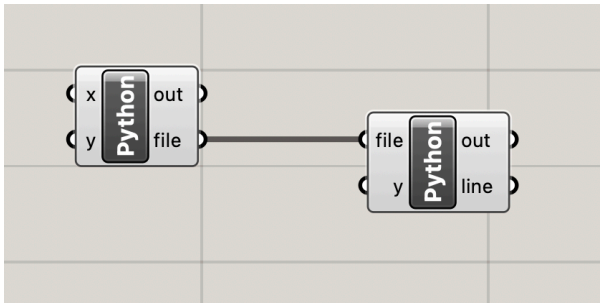
```
1 import rhinoscriptsyntax as rs
2 import csv
3
4 def data_parse(file):
5     data = []
6     with open(file) as file:
7         reader = csv.reader(file)
8         i = 0
9         for row in reader:
10            if (i>0):
11                temp = int(row[1])
12                humid = int(row[2])
13                data_row = [i-1,temp,humid]
14                data.append(data_row)
15            i = i+1
16    file.close()
17    return data
```

questions?

# Plot data along x axis

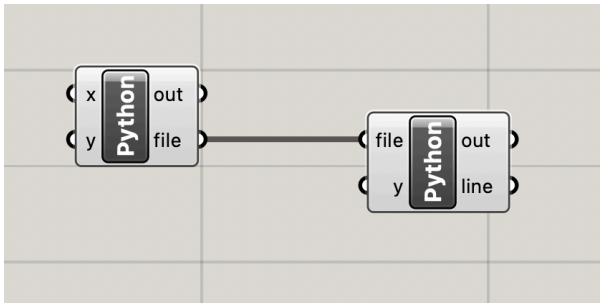
```
def plot(data):
    points = []
    for i in range (0, len(data)):
        point = rs.CreatePoint(data[i][0],data[i][1],0)
        points.append(point)
    line = rs.AddPolyline(points)
    curve = rs.AddCurve(points)
    return curve
```

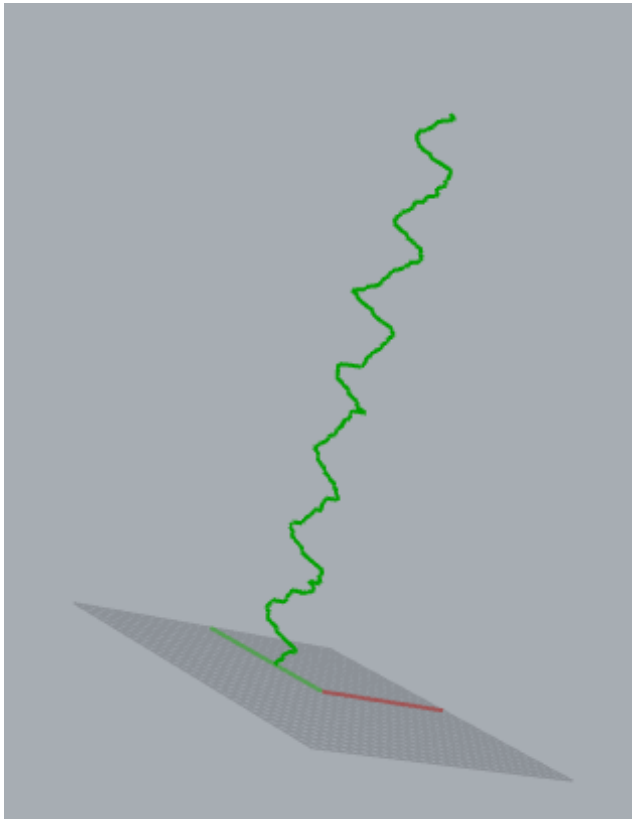




# Plot data along z axis

```
def plot(data):
    points = []
    for i in range (0, len(data)):
        point = rs.CreatePoint(data[i][1],0,data[i][0])
        points.append(point)
    line = rs.AddPolyline(points)
    curve = rs.AddCurve(points)
    return curve
```



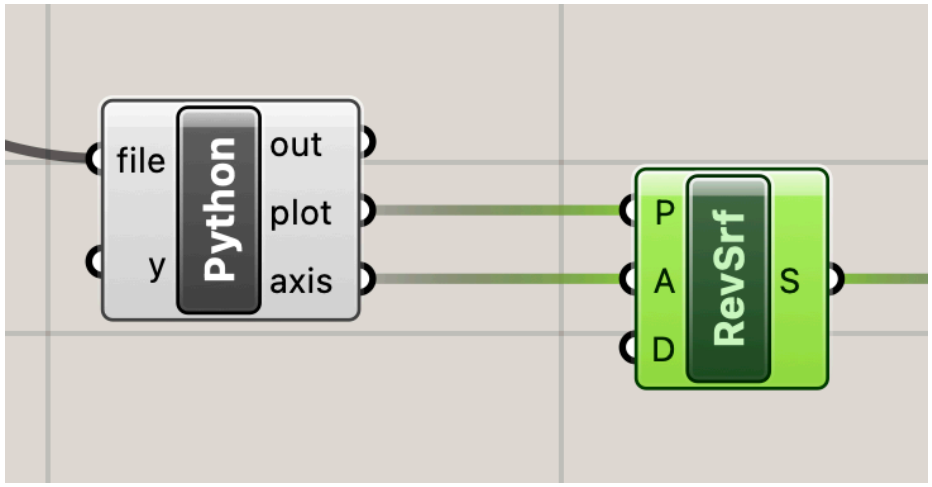



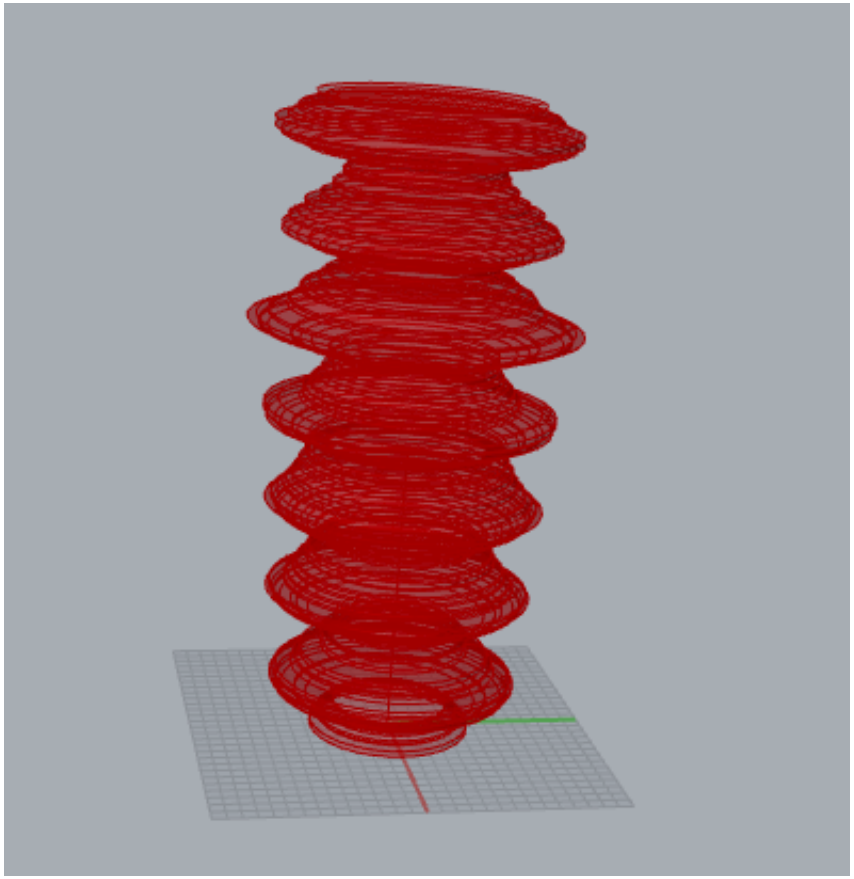
questions?

# To generate 3D forms: Revolution

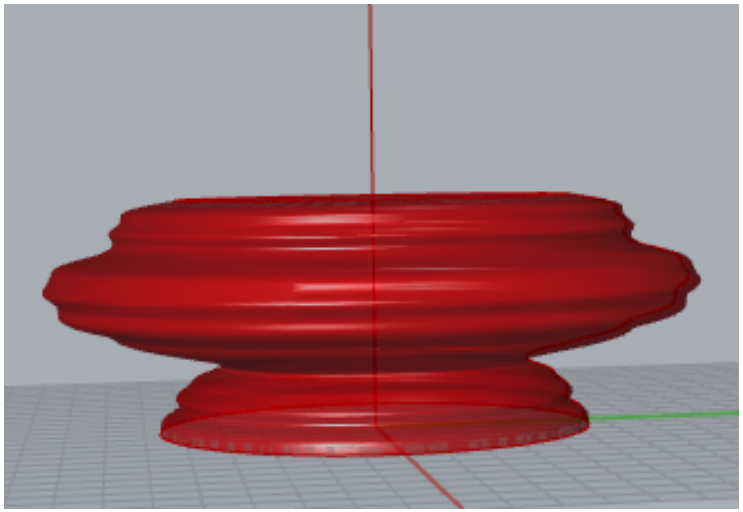
Spins a curve around an axis to generate a surface.

```
28 data = data_parse(file)
29 plot = plot(data)
30 axis = rs.AddLine(rs.CreatePoint(0,0,0), rs.CreatePoint(0,0,1))
```

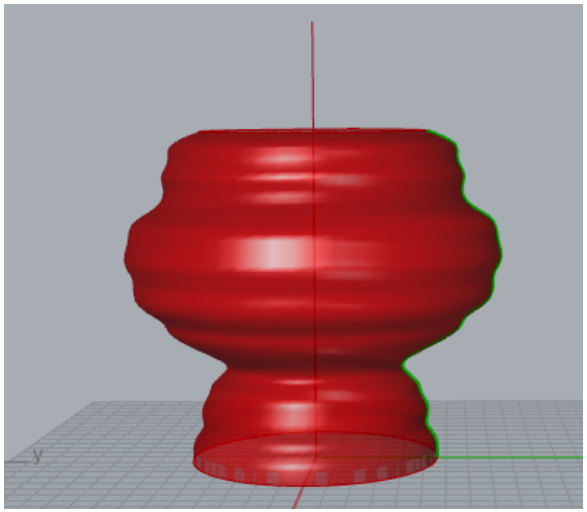


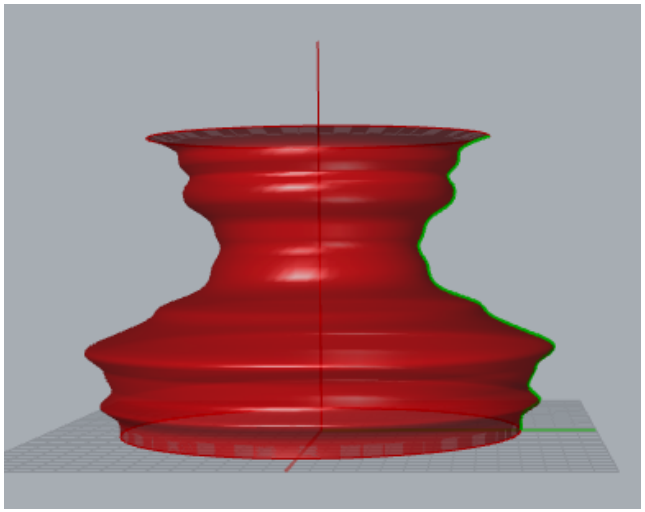
# 1 day of data



temperature



temperature, same data
"stretched" in z



humidity

questions?

# Thank you!

CS 491 and 591
Professor: Leah Buechley
https://handandmachine.cs.unm.edu/classes/Computational_Fabrication_Spring2021/