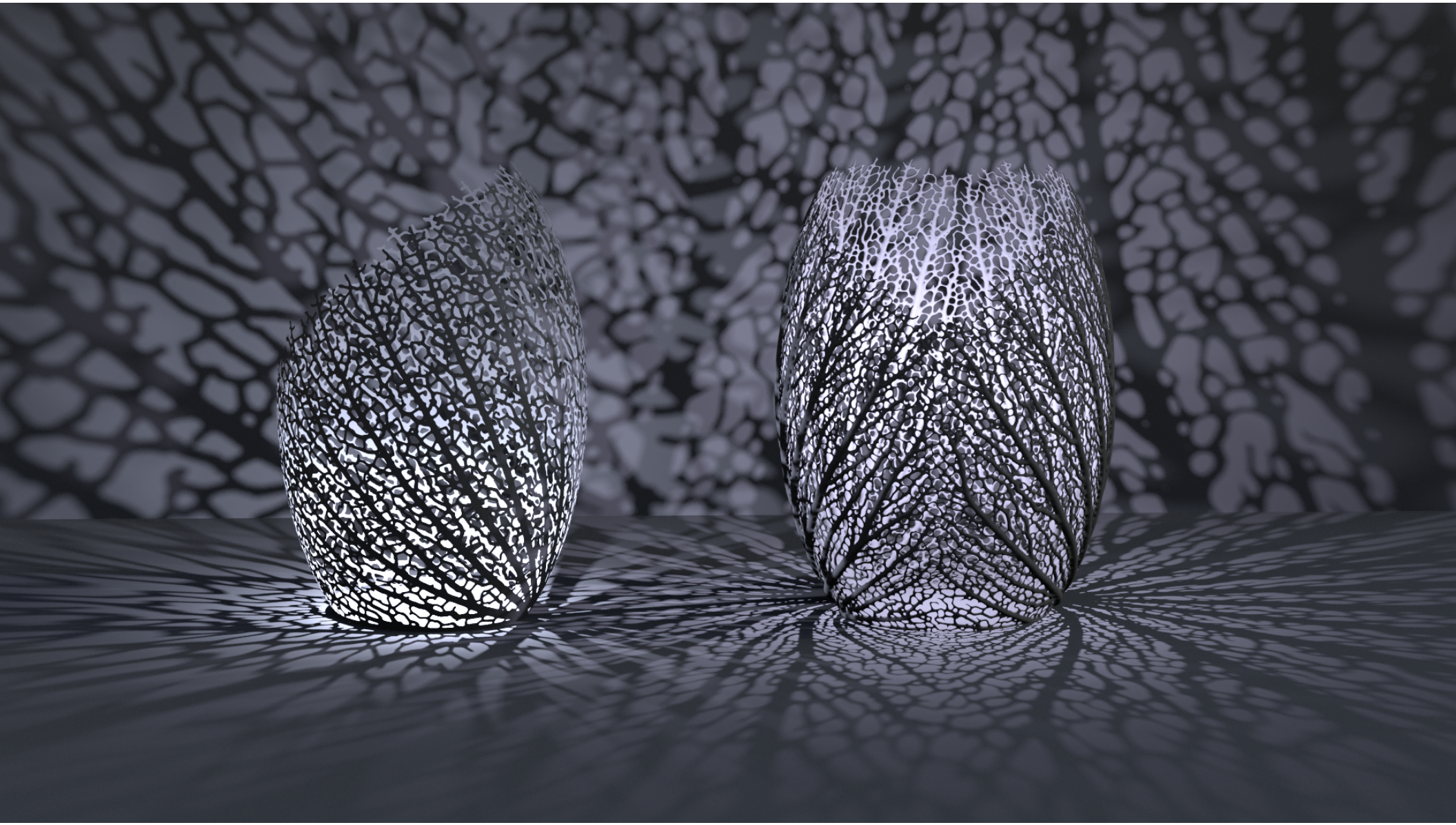
Computational Fabrication

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

Weekly Designer: Nervous System

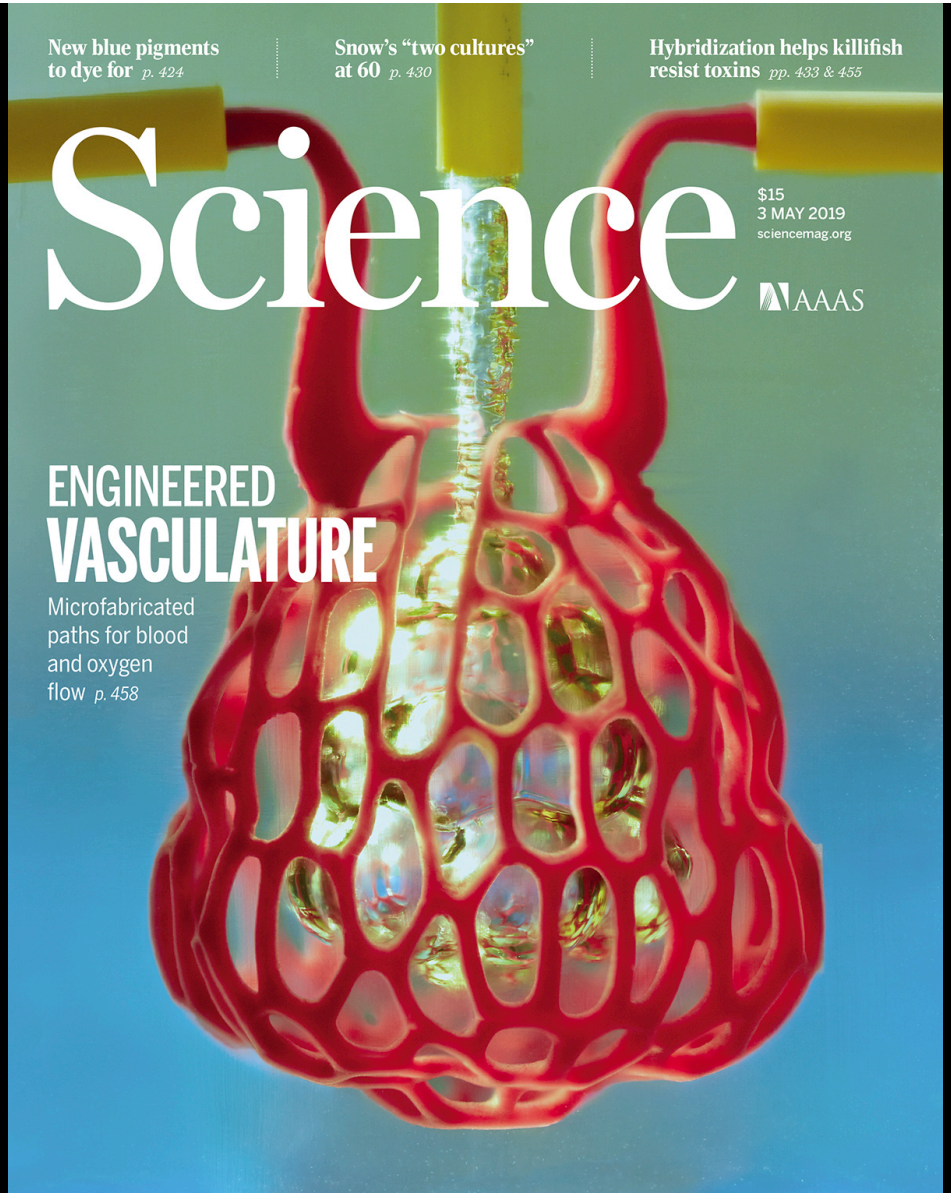
https://n-e-r-v-o-u-s.com/index.php



Nervous System

Nervous System


EXIT



https://n-e-r-v-o-u-s.com/blog/?p=8433

Data Driven Design

Data Driven Design

Design based on data

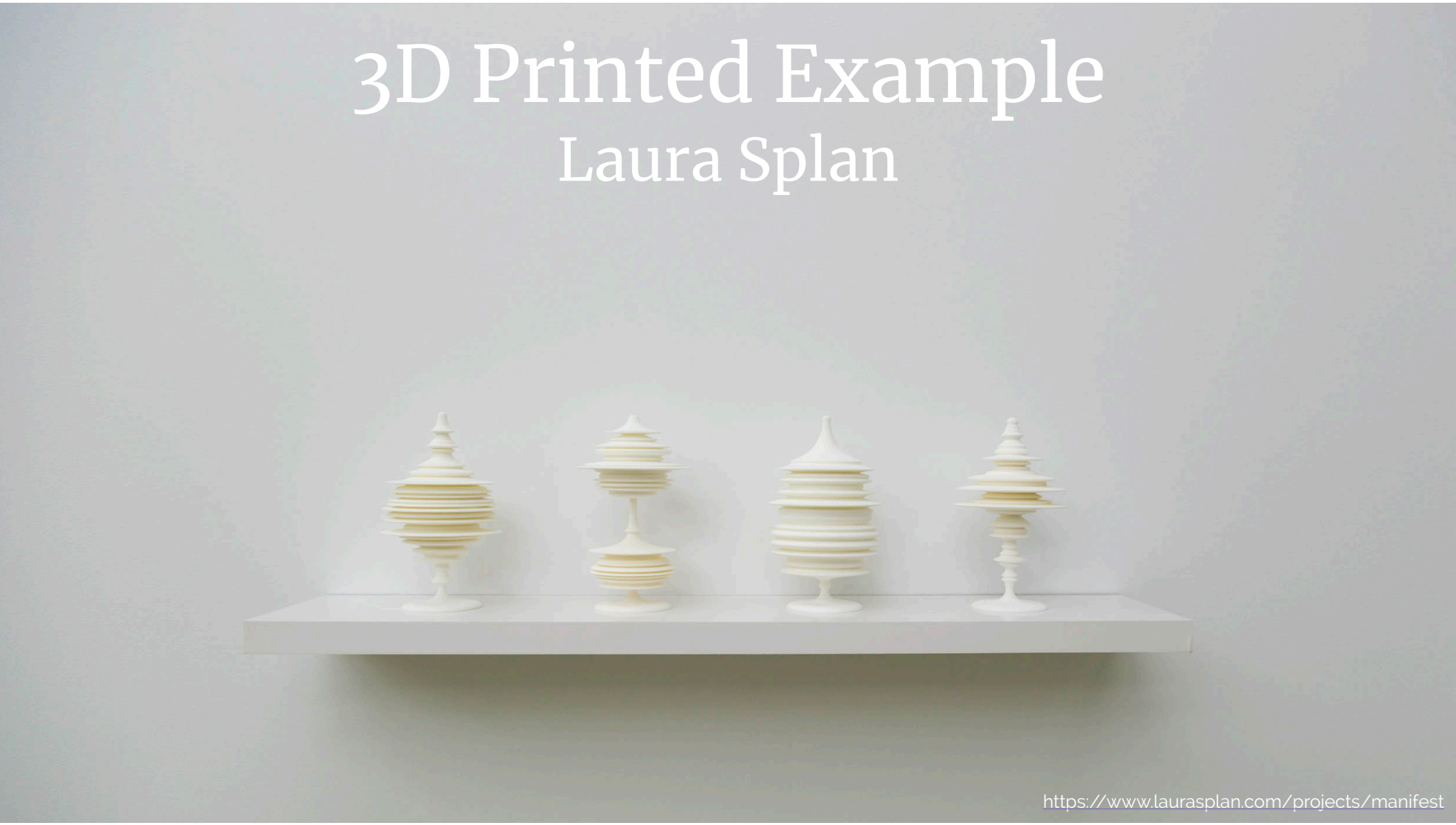
Data visualization

Data physicalization

Data visceralization

3D Printed Example

Laura Splan



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

We’ll start simply: weather

Download this sample data file:

https://handandmachine.org/classes/computational_fabrication/presentations/2024/data/weather_2024_week.csv

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

Hourly temperature (°F) and humidity (%)

DATE	HourlyDryBulbTemperature	HourlyRelativeHumidity
2024-09-08T00:52:00	69	38
2024-09-08T01:52:00	66	42
2024-09-08T02:52:00	66	42
2024-09-08T03:52:00	66	47
2024-09-08T04:52:00	64	48
2024-09-08T05:52:00	63	52
2024-09-08T06:52:00	66	50
2024-09-08T07:52:00	68	49
2024-09-08T08:52:00	71	46
2024-09-08T09:52:00	75	40
2024-09-08T10:52:00	77	36
2024-09-08T11:52:00	79	30
2024-09-08T12:52:00	81	25
2024-09-08T13:52:00	83	23
2024-09-08T14:52:00	83	24
2024-09-08T15:52:00	84	19
2024-09-08T16:52:00	84	21
2024-09-08T17:52:00	83	21
2024-09-08T18:52:00	81	23
2024-09-08T19:52:00	78	25
2024-09-08T20:52:00	71	30
2024-09-08T21:52:00	73	28
2024-09-08T22:52:00	70	32

Today

Open rhinoscript documentation

Import & parse .csv file

Plot data along z axis

Revolve plot to create a vessel

Create a solid vessel from revolved plot(s)

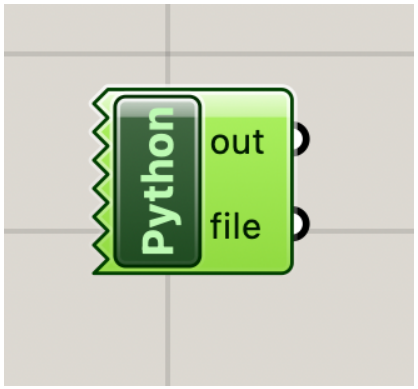
Working with data in Grasshopper

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)
```

Today

Open rhinoscript documentation

Import & parse .csv file

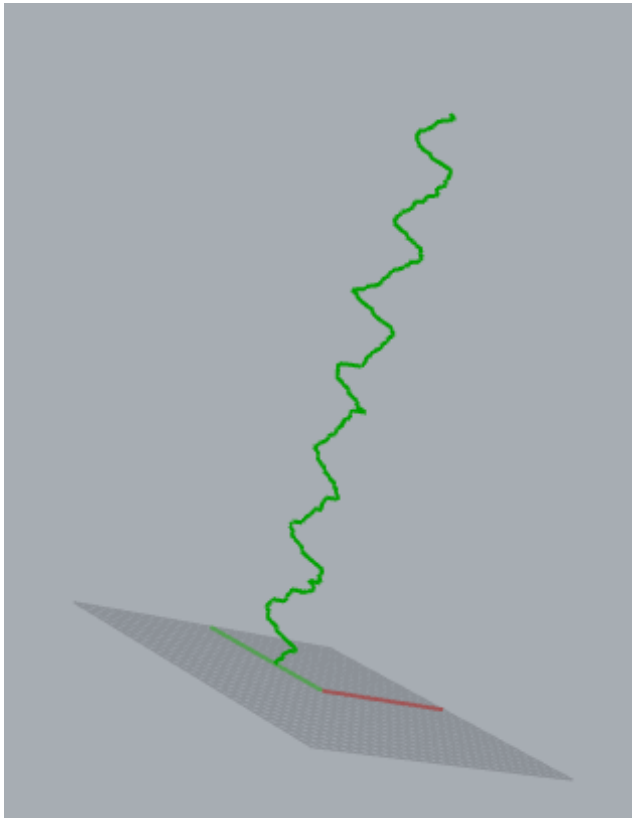
Plot data along z axis

Revolve plot to create a vessel

Create a solid vessel from revolved plot(s)

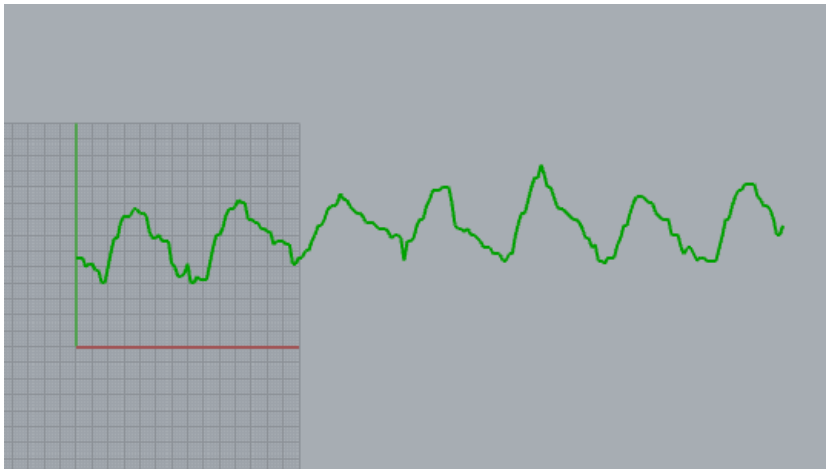
Reading data from a .csv file

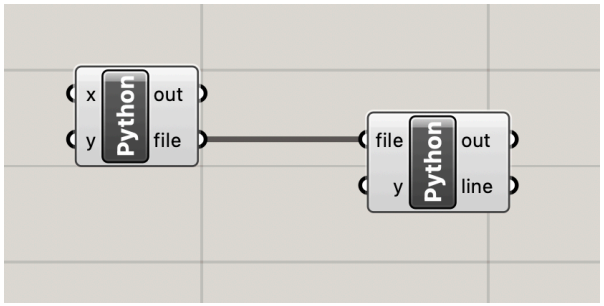
```
 1 import rhinoscriptsyntax as rs
 2 import csv
 3
 4 def data_parse(file):
 5     data = []
 6     with open(file) as file:
 7         reader = csv.reader(file)
 8         i = 0
 9         for row in reader:
10             if (i>0):
11                 temp = int(row[1])
12                 humid = 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
```



Plot data along x axis

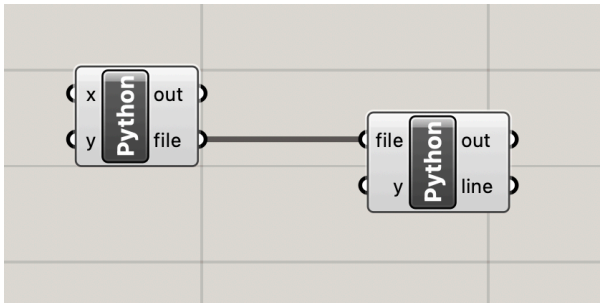
```
def plot(data):
    points = []
    for i in range (0, len(data)):
        point = rs.CreatePoint(data[i][0],data[i][1],0)
        points.append(point)
    line = rs.AddPolyline(points)
    curve = rs.AddCurve(points)
    return curve
```

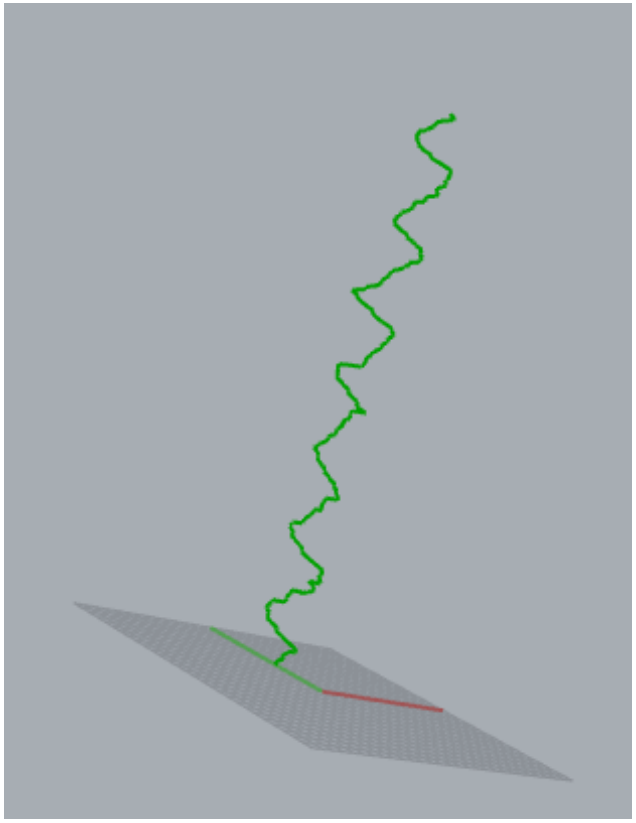




Plot data along z axis

```
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
```

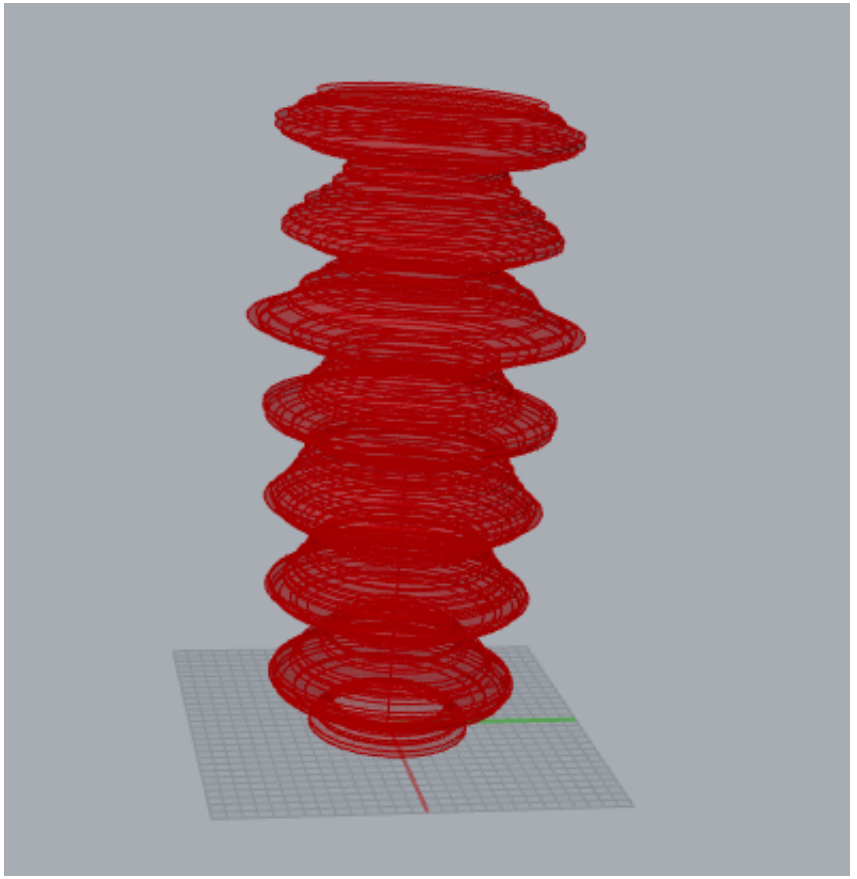




To generate 3D forms: Revolution

Revolve plot around z axis to create a vessel:
AddRevSrf

```
curve = plot(data)
axis = rs.AddLine([0,0,0],[0,0,1])
outerSurface = rs.AddRevSrf(curve,axis)
```

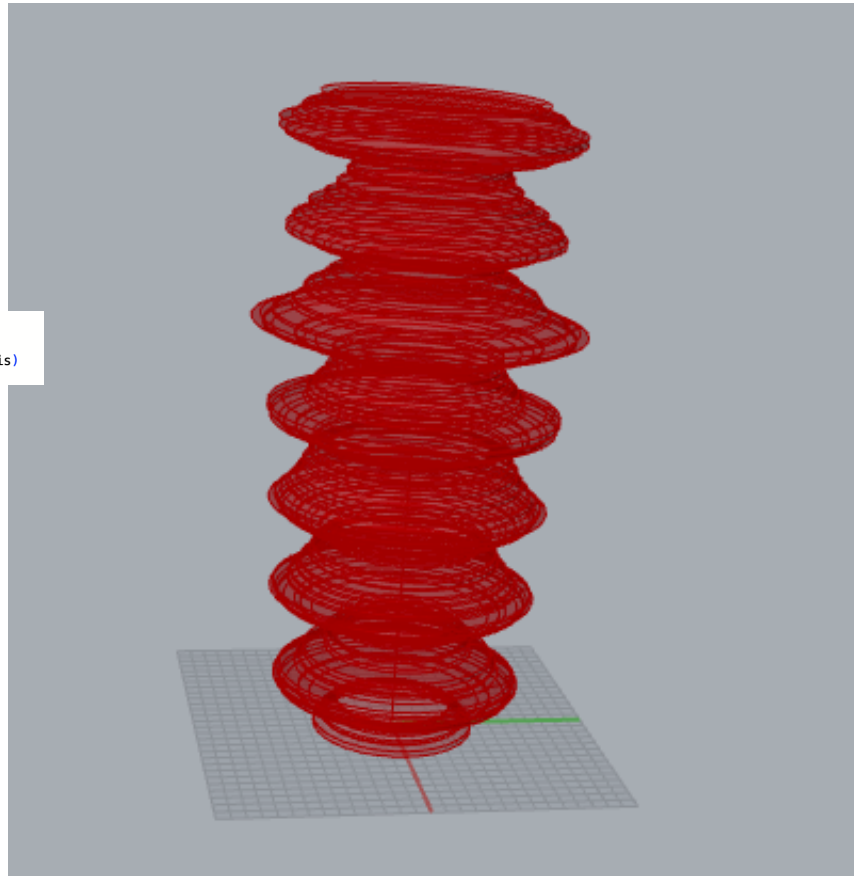


To generate 3D forms: Revolution

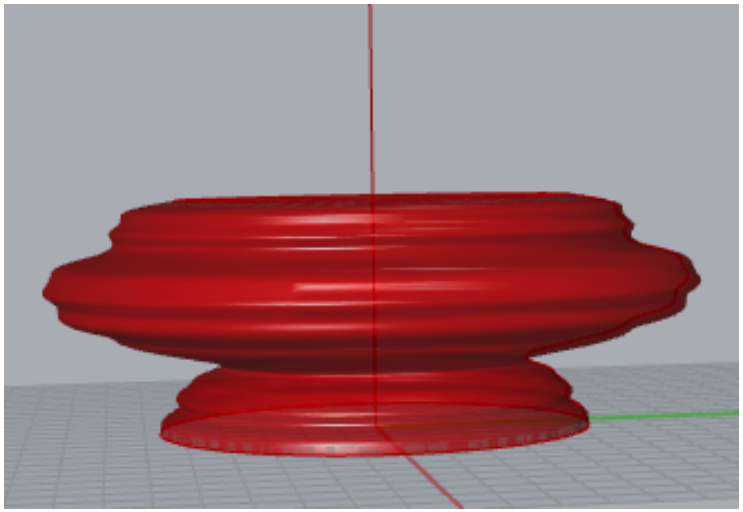
Revolve plot around z axis to create a vessel:
AddRevSrf

Then, more advanced:
Add interactive scaling:
ScaleObject
Add data range selection input

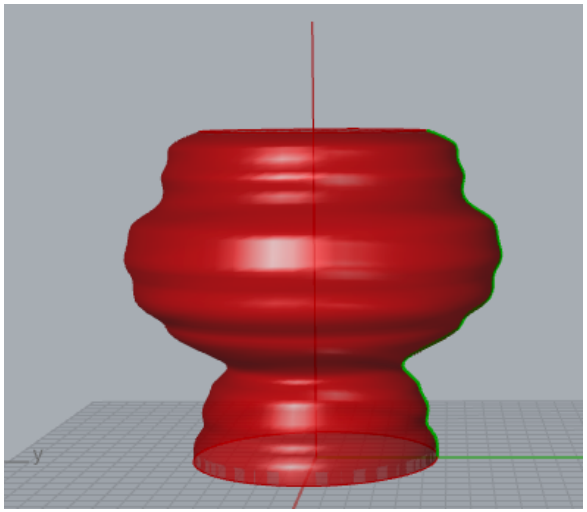
```
curve = plot(data)
axis = rs.AddLine([0,0,0],[0,0,1])
outerSurface = rs.AddRevSrf(curve,axis)
```



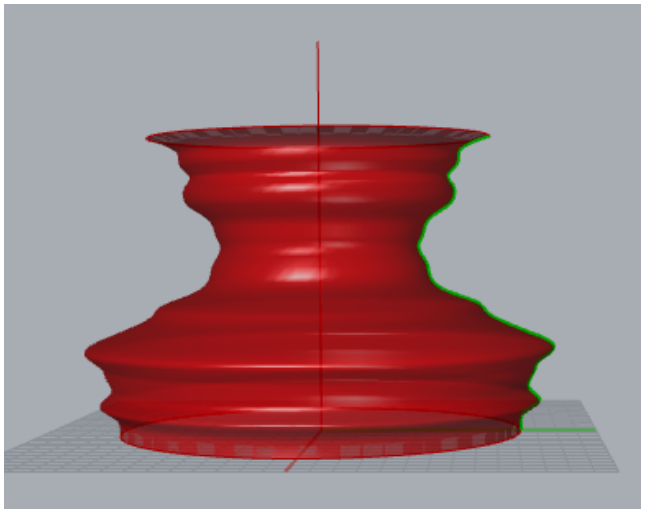
1 day of data



temperature



temperature, same data
"stretched" in z



humidity

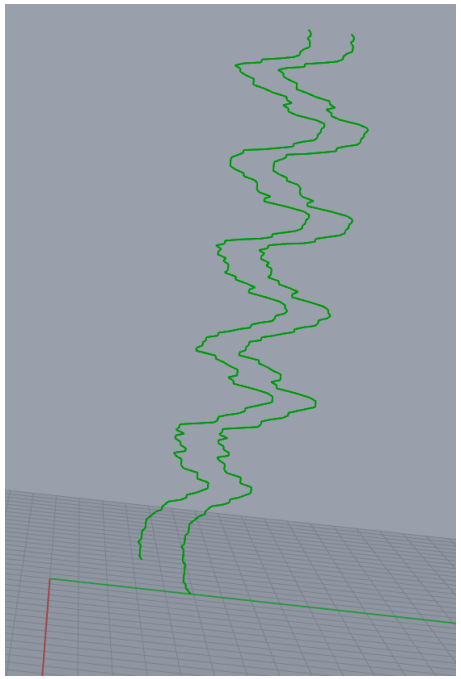
Create a vase with a bottom

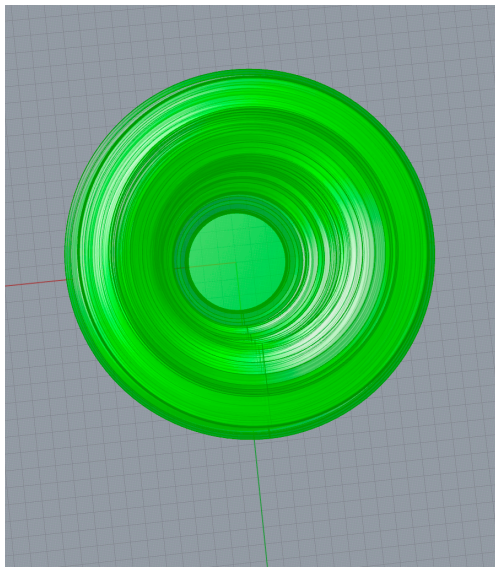
Generate two plots

Offset inner plot by a thickness.

Adjust the starting z point for the inner plot (P_i) so that it starts above the outer plot (P_o).

Revolve both plots. Cap both revolved surfaces. Subtract inner solid from outer solid.





Create a vase with a bottom

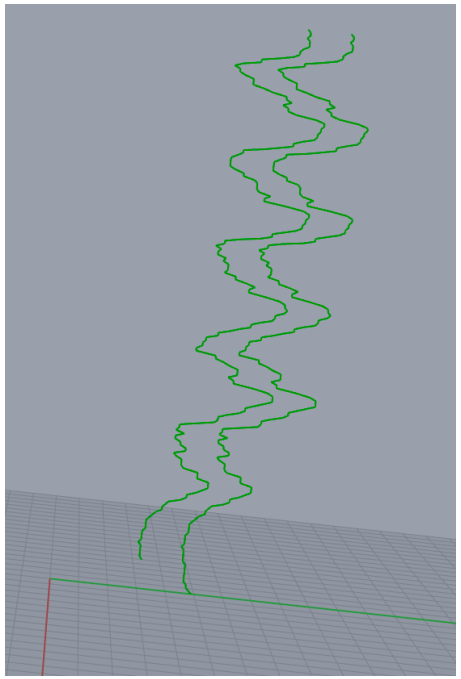
```
def plot(data, offset=0, start=0, end=False):
    points=[]
    if (end==False):
        end = len(data)
    for i in range(0,end):
        z = i
        x = data[i][1]
        point = rs.CreatePoint(x-offset,0,z)
        points.append(point)
    curve = rs.AddPolyline(points)
    curve = rs.AddCurve(points)
    return curve

data = dataParse(file)

outerCurve = plot(data)
axis = rs.AddLine([0,0,0],[0,0,1])
outerSurface = rs.AddRevSrf(outerCurve,axis)
rs.CapPlanarHoles(outerSurface)

innerCurve = plot(data, offset=2, start=2)
innerSurface = rs.AddRevSrf(innerCurve,axis)
rs.CapPlanarHoles(innerSurface)

dataVessel = rs.BooleanDifference(outerSurface,innerSurface)
```

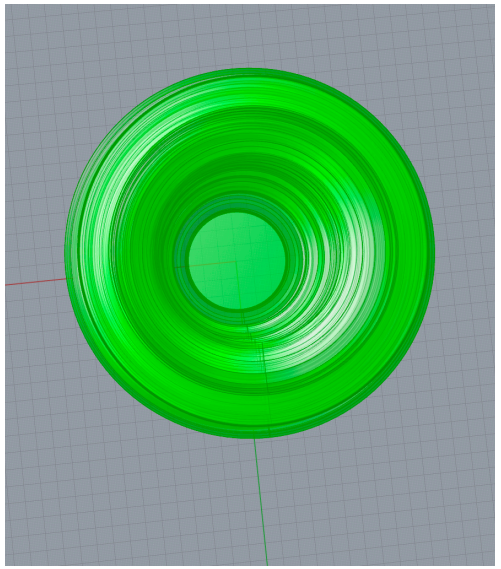
modified plot function

outer solid

inner solid

final vessel





Considerations
when working with data…

Data Cleaning: raw data is a mess

STATION	DATE	HourlyDryBul	HourlyPrecip	HourlyPreser	HourlyPressu	HourlyPressu	HourlyRelativ	HourlySeaLev	HourlySkyCo	H
72365023050	2024-09-08T00:52:00	69	0				38	29.98	FEW:02 220	
72365023050	2024-09-08T01:52:00	66	0		0	3	42	30	FEW:02 220	
72365023050	2024-09-08T02:00:00	66			0	3	42	30		
72365023050	2024-09-08T02:52:00	66	0				42	30	CLR:00	
72365023050	2024-09-08T03:52:00	66	0				47	30.01	FEW:02 220	
72365023050	2024-09-08T04:52:00	64	0		-0.03	3	48	30.03	SCT:04 220	
72365023050	2024-09-08T05:00:00	64			-0.03	3	48	30.03		
72365023050	2024-09-08T05:52:00	63	0				52	30.05	FEW:02 150	
72365023050	2024-09-08T06:52:00	66	0				50	30.07	FEW:02 150	
72365023050	2024-09-08T07:52:00	68	0		-0.03	1	49	30.09	FEW:02 150	
72365023050	2024-09-08T08:00:00	68			-0.03	1	49	30.09		
72365023050	2024-09-08T08:52:00	71	0				46	30.09	FEW:02 250	
72365023050	2024-09-08T09:52:00	75	0				40	30.07	FEW:02 250	
72365023050	2024-09-08T10:52:00	77	0		0.02	8	36	30.05	FEW:02 130	
72365023050	2024-09-08T11:00:00	77			0.02	8	36	30.05		
72365023050	2024-09-08T11:52:00	79	0				30	30.01	FEW:02 130	
72365023050	2024-09-08T12:52:00	81	0				25	29.98	FEW:02 130	
72365023050	2024-09-08T13:52:00	83	0		0.08	8	23	29.95	FEW:02 120	
72365023050	2024-09-08T14:00:00	83			0.08	8	23	29.95		

Raw weather data downloaded from NOAA site.

Data Cleaning: raw data is a mess

note: irregular sampling rate

STATION	DATE	HourlyDryBul	HourlyPrecip	HourlyPreser	HourlyPressu	HourlyPressu	HourlyRelativ	HourlySeaLev	HourlySkyCo	H
72365023050	2024-09-08T00:52:00	69	0				38	29.98	FEW:02 220	
72365023050	2024-09-08T01:52:00	66	0		0	3	42	30	FEW:02 220	
72365023050	2024-09-08T02:00:00	66			0	3	42	30		
72365023050	2024-09-08T02:52:00	66	0				42	30	CLR:00	
72365023050	2024-09-08T03:52:00	66	0				47	30.01	FEW:02 220	
72365023050	2024-09-08T04:52:00	64	0		-0.03	3	48	30.03	SCT:04 220	
72365023050	2024-09-08T05:00:00	64			-0.03	3	48	30.03		
72365023050	2024-09-08T05:52:00	63	0				52	30.05	FEW:02 150	
72365023050	2024-09-08T06:52:00	66	0				50	30.07	FEW:02 150	
72365023050	2024-09-08T07:52:00	68	0		-0.03	1	49	30.09	FEW:02 150	
72365023050	2024-09-08T08:00:00	68			-0.03	1	49	30.09		
72365023050	2024-09-08T08:52:00	71	0				46	30.09	FEW:02 250	
72365023050	2024-09-08T09:52:00	75	0				40	30.07	FEW:02 250	
72365023050	2024-09-08T10:52:00	77	0		0.02	8	36	30.05	FEW:02 130	
72365023050	2024-09-08T11:00:00	77			0.02	8	36	30.05		
72365023050	2024-09-08T11:52:00	79	0				30	30.01	FEW:02 130	
72365023050	2024-09-08T12:52:00	81	0				25	29.98	FEW:02 130	
72365023050	2024-09-08T13:52:00	83	0		0.08	8	23	29.95	FEW:02 120	
72365023050	2024-09-08T14:00:00	83			0.08	8	23	29.95		

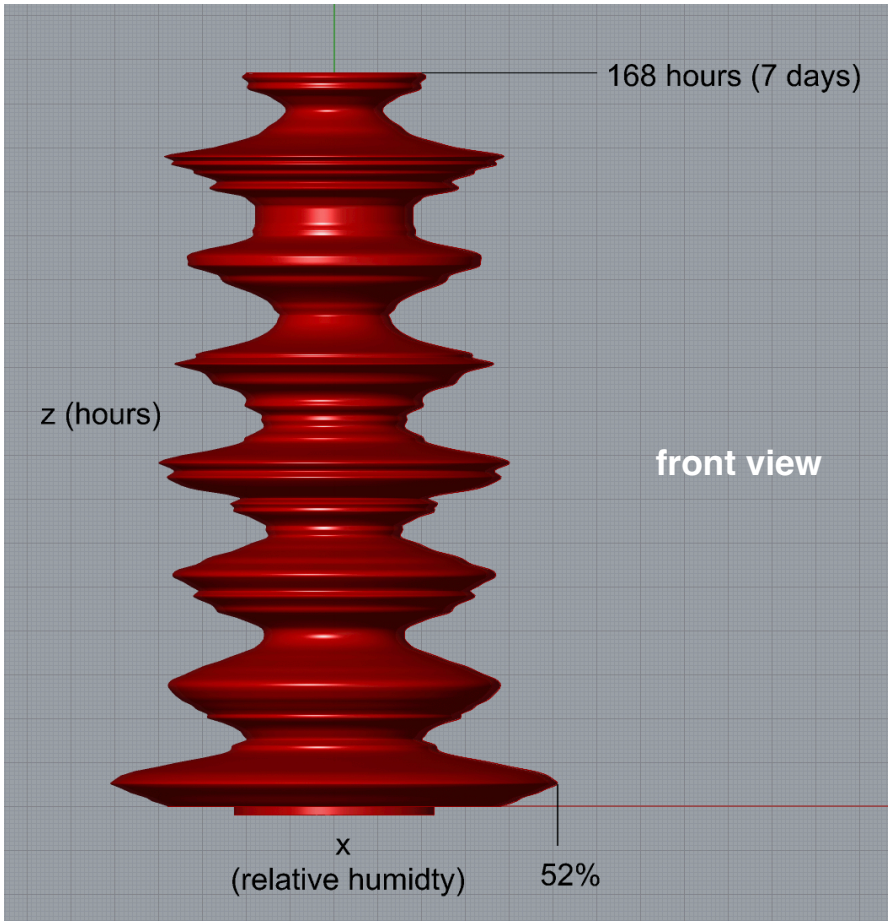
Raw weather data downloaded from NOAA site.

Mapping Data Units to Design

There must be a meaningful mapping from data units to design units. You need to understand this mapping. In plot at right:
1 hour = 1mm in z
1% relative humidity = 1mm in x

If you change the scale of your design, for visualization purposes, you need to keep track of what that means for your mapping.

You must clean your data to insure that the data sampling rate is meaningful. In the class weather example, I had to delete some data to create a data set with a regular sampling rate of 1 reading/hour



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 😬

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

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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

Thank you!

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