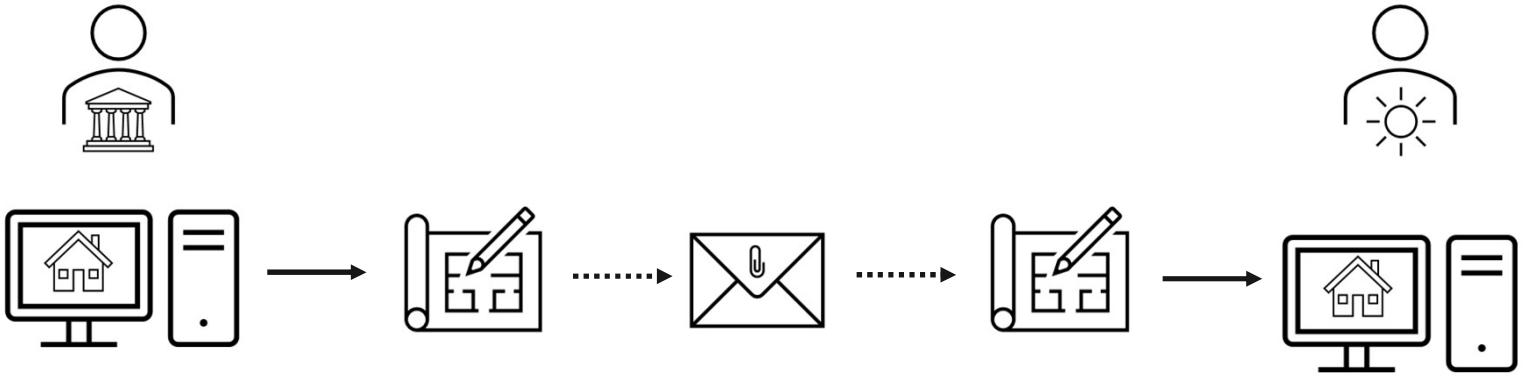
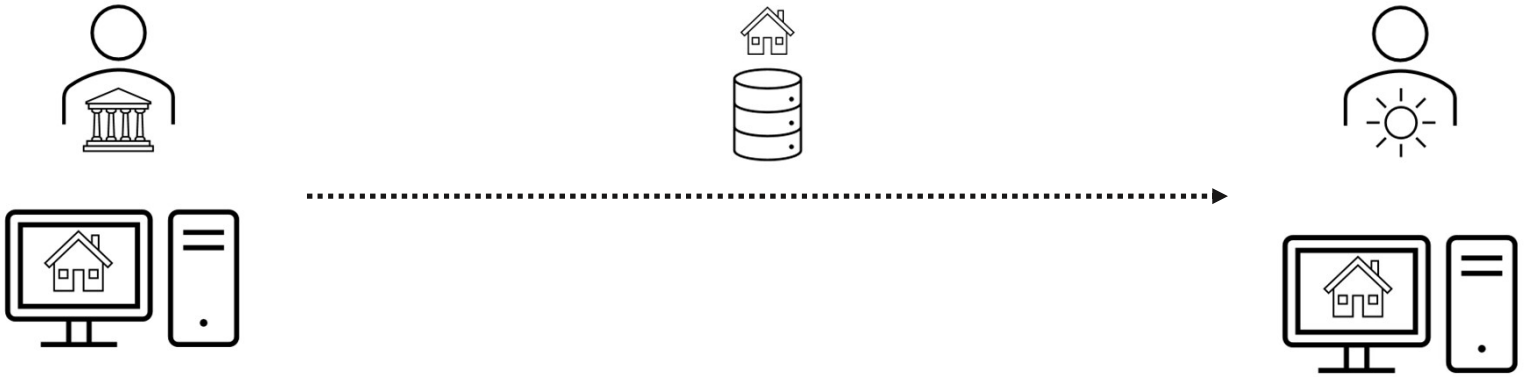
CORE WEEK 2 DAY 6

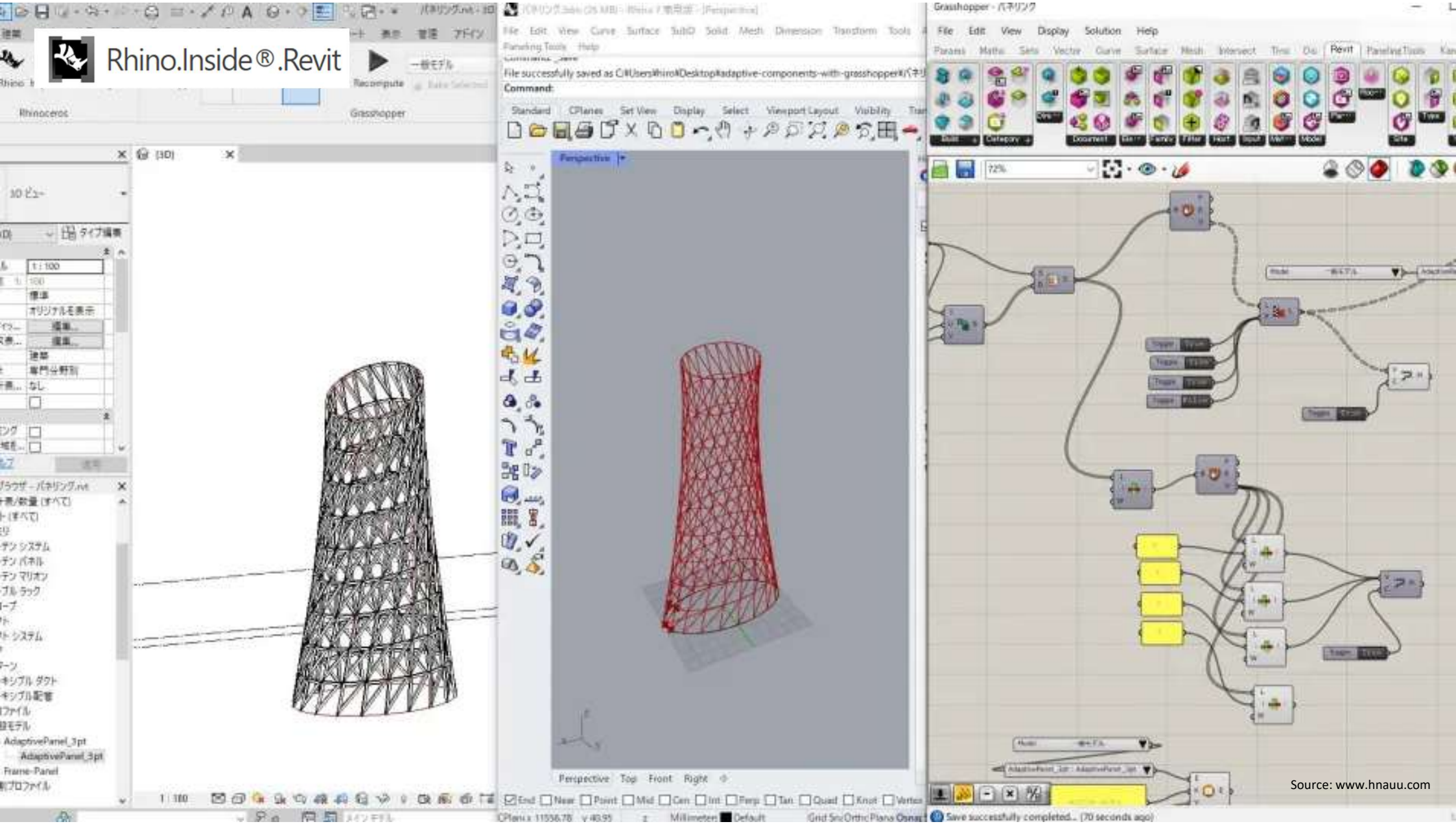
- Exchanging data (CSV / JSON)
- NumPy for analyses
- Exercise day 6

From exchanging drawings…



… to exchanging data



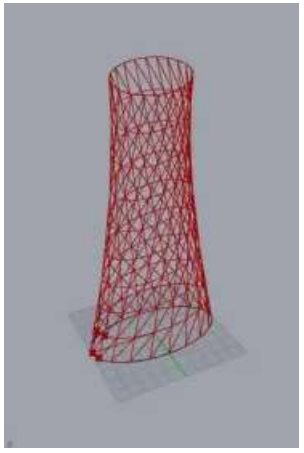

Rhino.Inside®.Revit
Rhinoceros
Grasshopper
Recompute
Grasshopper - パネリング
File Edit View Display Solution Help
Perspective
Perspective Top Front Right
Source: www.hnauu.com

SPECKLE

https://speckle.systems/features/connectors/

SPECKLE

Rhinoceros



Convert Rhino geo-metry to raw data

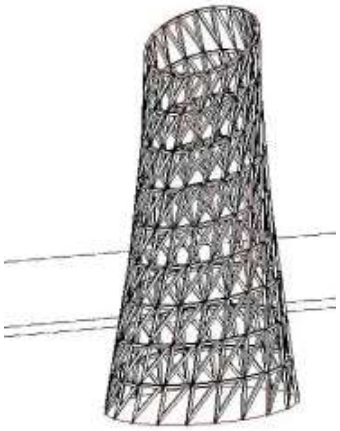
SampleJSON - Notepad

File Edit View


```
{
  "results": [
    {
      "mappings": [
        {
          "attributes": [
            {
              "sample[Name]": "ABC",
              "sample[Id]": 1,
              "sample[extraCredit]": 1
            },
            {
              "sample[Name]": "DEF",
              "sample[Id]": 2
            },
            {
              "sample[Name]": "xyz",
              "sample[Id]": 3,
              "sample[extraCredit]": 5
            }
          ]
        }
      ]
    }
  ]
}
```


Convert raw data to native Revit geometry

R RVT



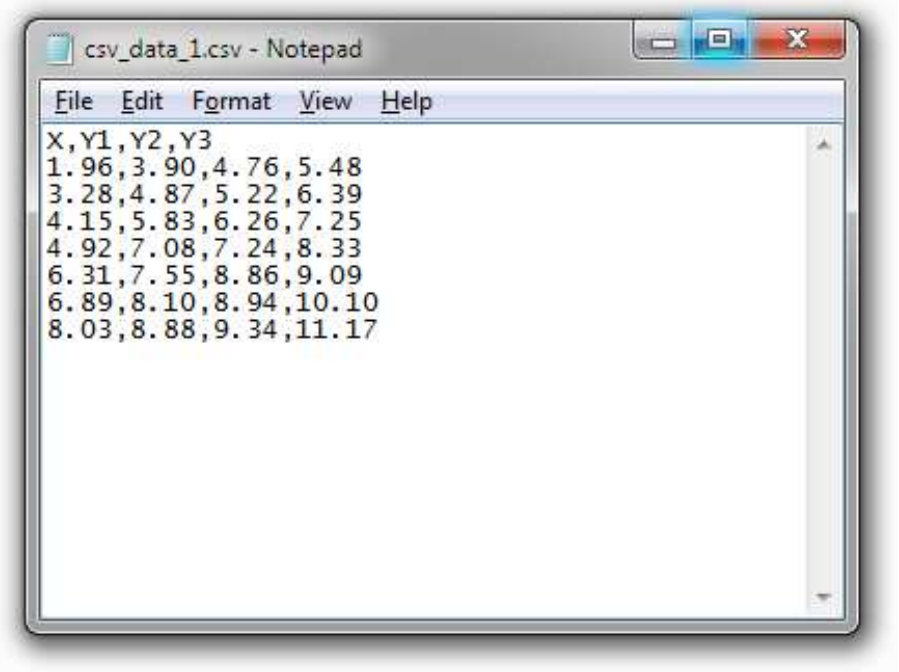
JSON

- Key-value storage (dictionaries) for nested structures, arrays, and complex objects
- Commonly used for hierarchical and semi-structured data
- Supports various data types

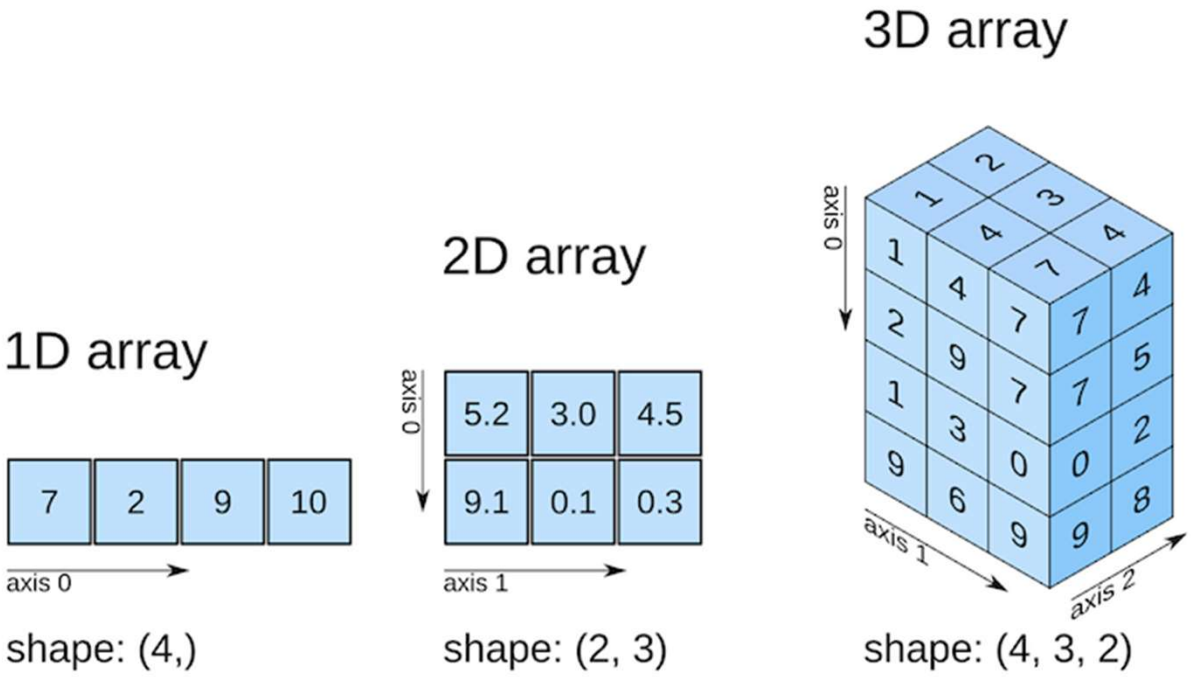
‘Dictionaries’ will be covered at a later point during the CORE course.

CSV

- Plain text storage separated by delimiters
- Commonly used for tabular data (two-dimensional tables)
- All values are treated as strings: floats, integers, dates, etc need to be converted back to their respective data types



NumPy: working with arrays



NumPy: working with arrays

Lists:

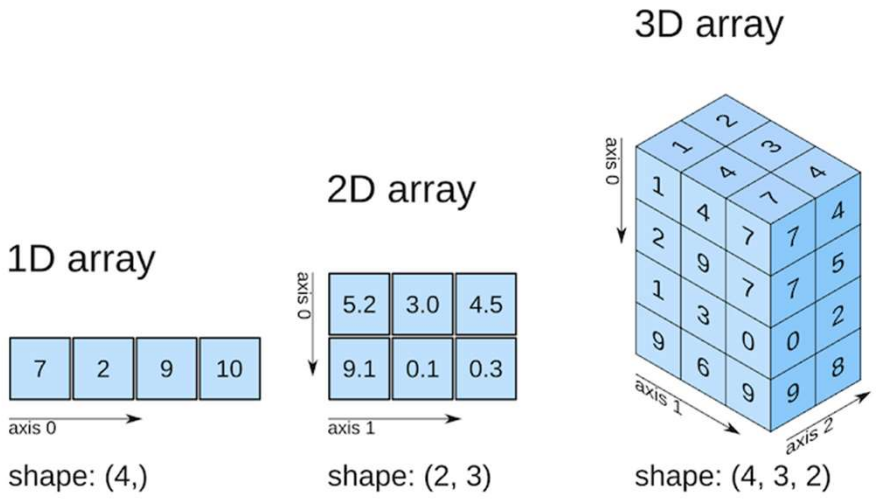
- Inbuilt data structure of python.
- Store elements of different types in the list.
- We can even nest lists with other data structures like lists, dictionaries, tuples, etc.

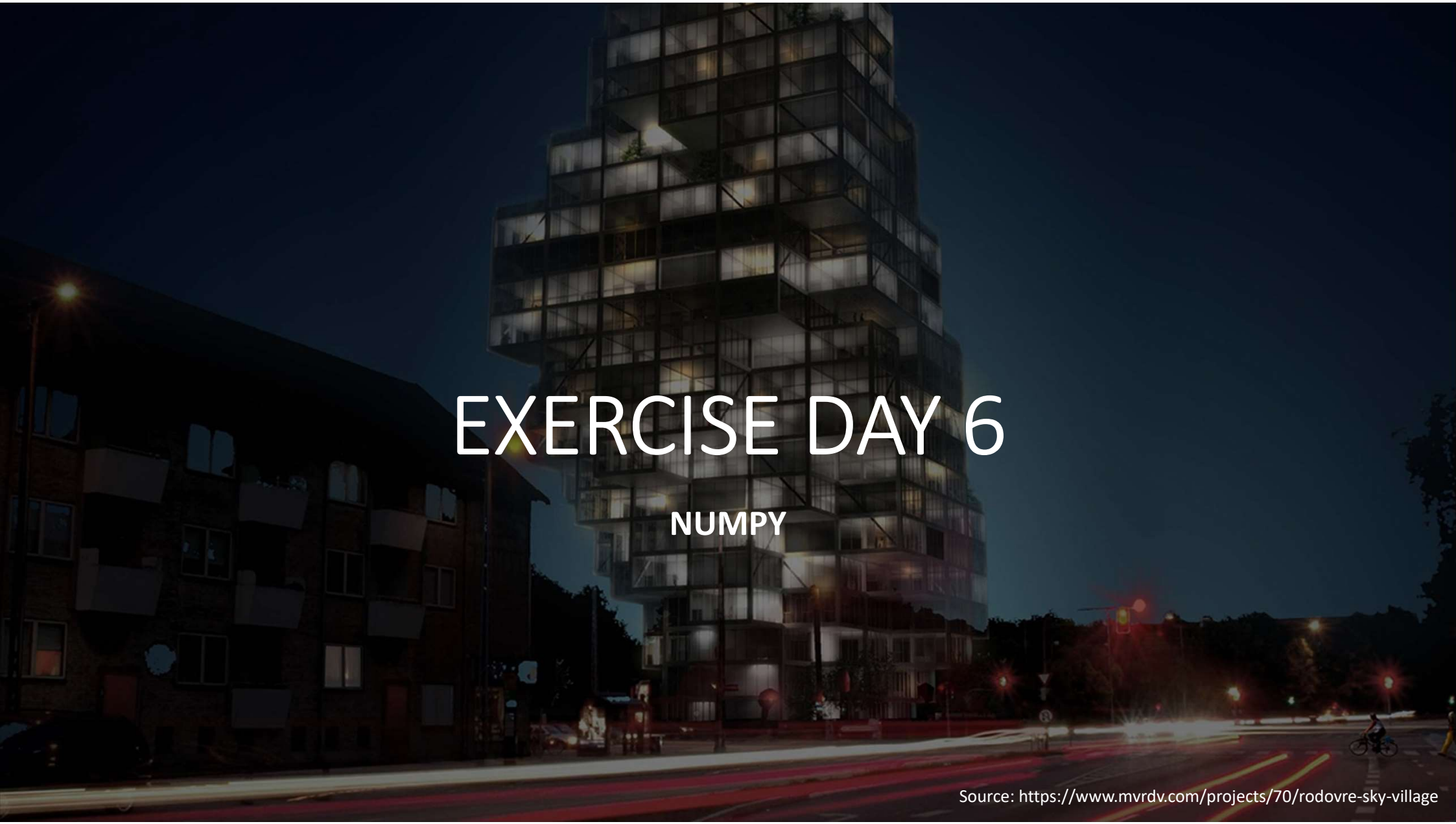
Array:

- Not the in-built data structure readily available in Python: needs to be imported from the 'array' or 'numpy' module.
- Stores homogeneous arrays only.
- Multi-dimensional arrays are possible (but, again, all values should be of the same type)

NumPy: working with arrays

- Up to **50x faster** than Python lists (because of 'locality of reference')
- **Numerical computation tools** like mathematical functions, random number generators, linear algebra routines, Fourier transforms and more
- **Basis for Pandas**





EXERCISE DAY 6

NUMPY

Source: https://www.mvrdv.com/projects/70/rodovre-sky-village

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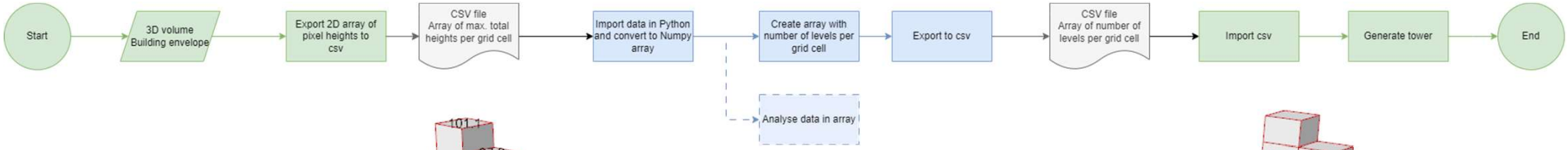
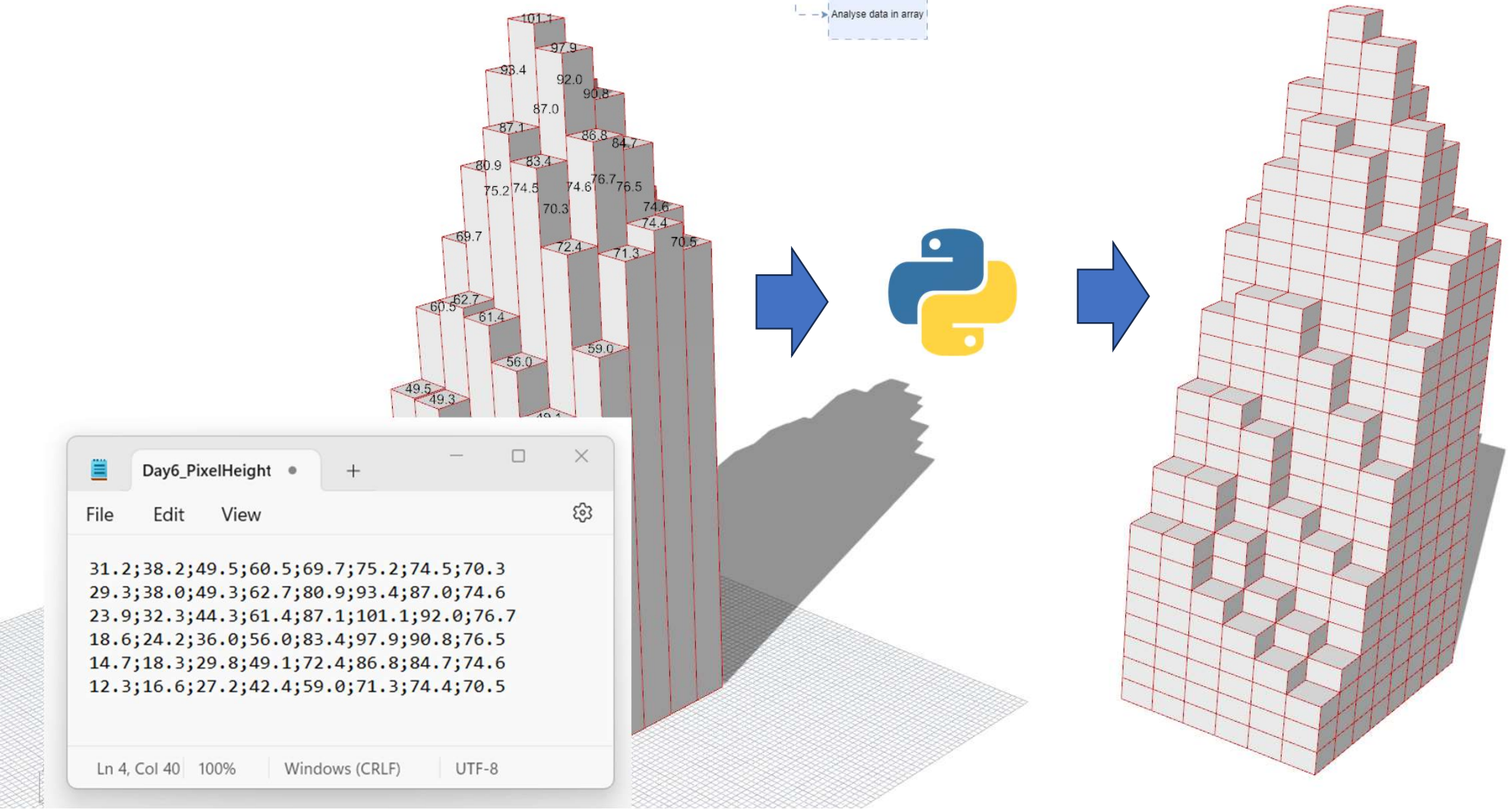
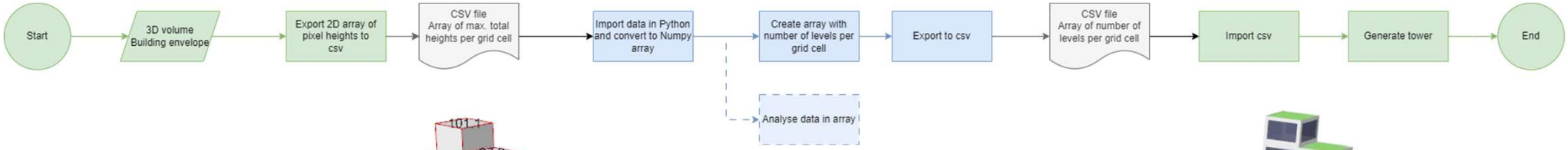

Start
3D volume Building envelope
Export 2D array of pixel heights to csv
CSV file Array of max. total heights per grid cell
Import data in Python and convert to Numpy array
Create array with number of levels per grid cell
Export to csv
CSV file Array of number of levels per grid cell
Import csv
Generate tower
End
Analyse data in array


101.1
97.9
93.4
92.0
90.8
87.0
87.1
86.8
84.7
80.9
83.4
76.7
75.2
74.5
74.6
76.5
70.3
74.6
74.4
69.7
72.4
71.3
70.5
62.7
60.5
61.4
59.0
56.0
49.5
49.3

Day6_PixelHeight
File
Edit
View
31.2;38.2;49.5;60.5;69.7;75.2;74.5;70.3
29.3;38.0;49.3;62.7;80.9;93.4;87.0;74.6
23.9;32.3;44.3;61.4;87.1;101.1;92.0;76.7
18.6;24.2;36.0;56.0;83.4;97.9;90.8;76.5
14.7;18.3;29.8;49.1;72.4;86.8;84.7;74.6
12.3;16.6;27.2;42.4;59.0;71.3;74.4;70.5
Ln 4, Col 40
100%
Windows (CRLF)
UTF-8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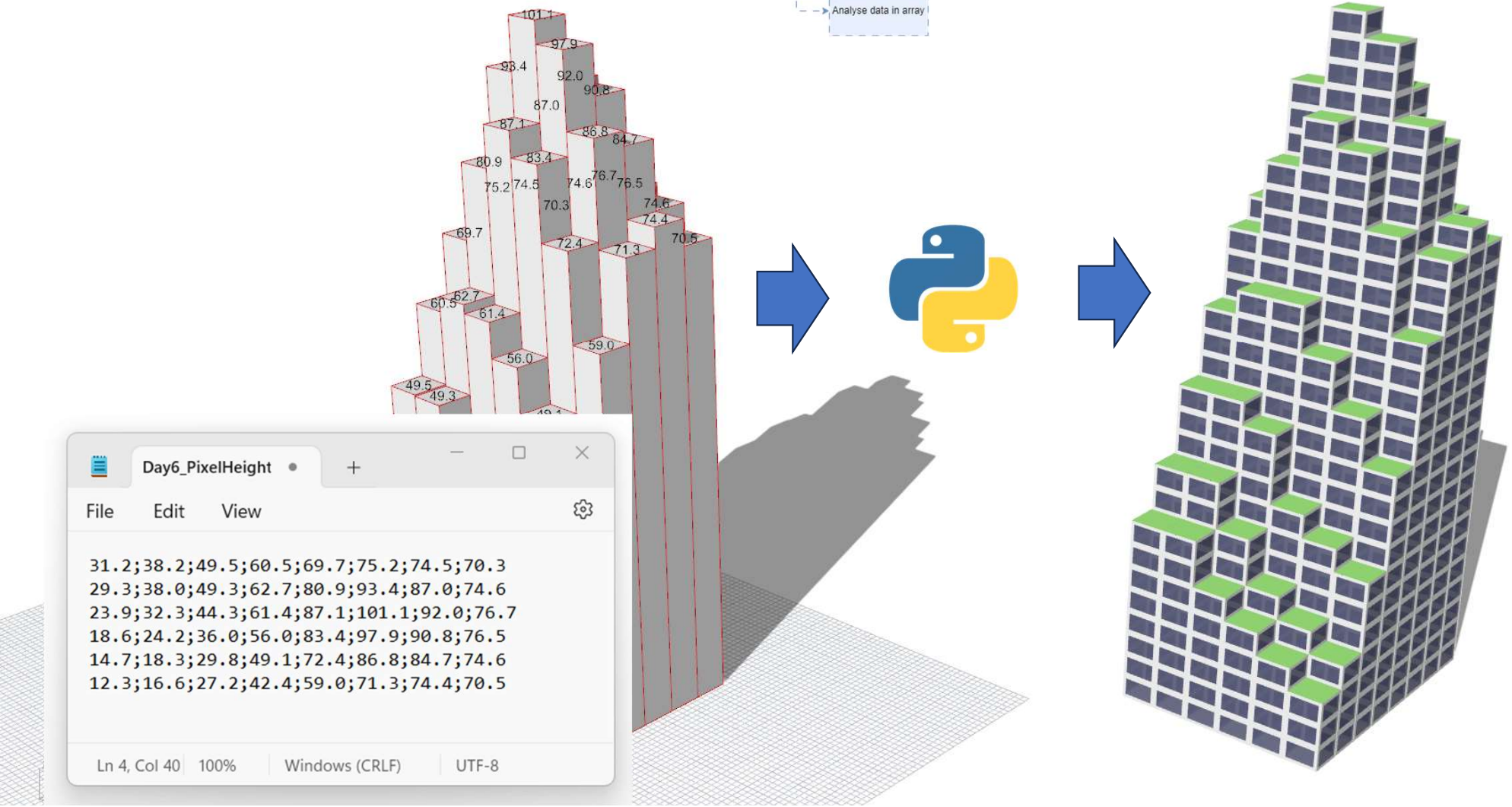
101.1
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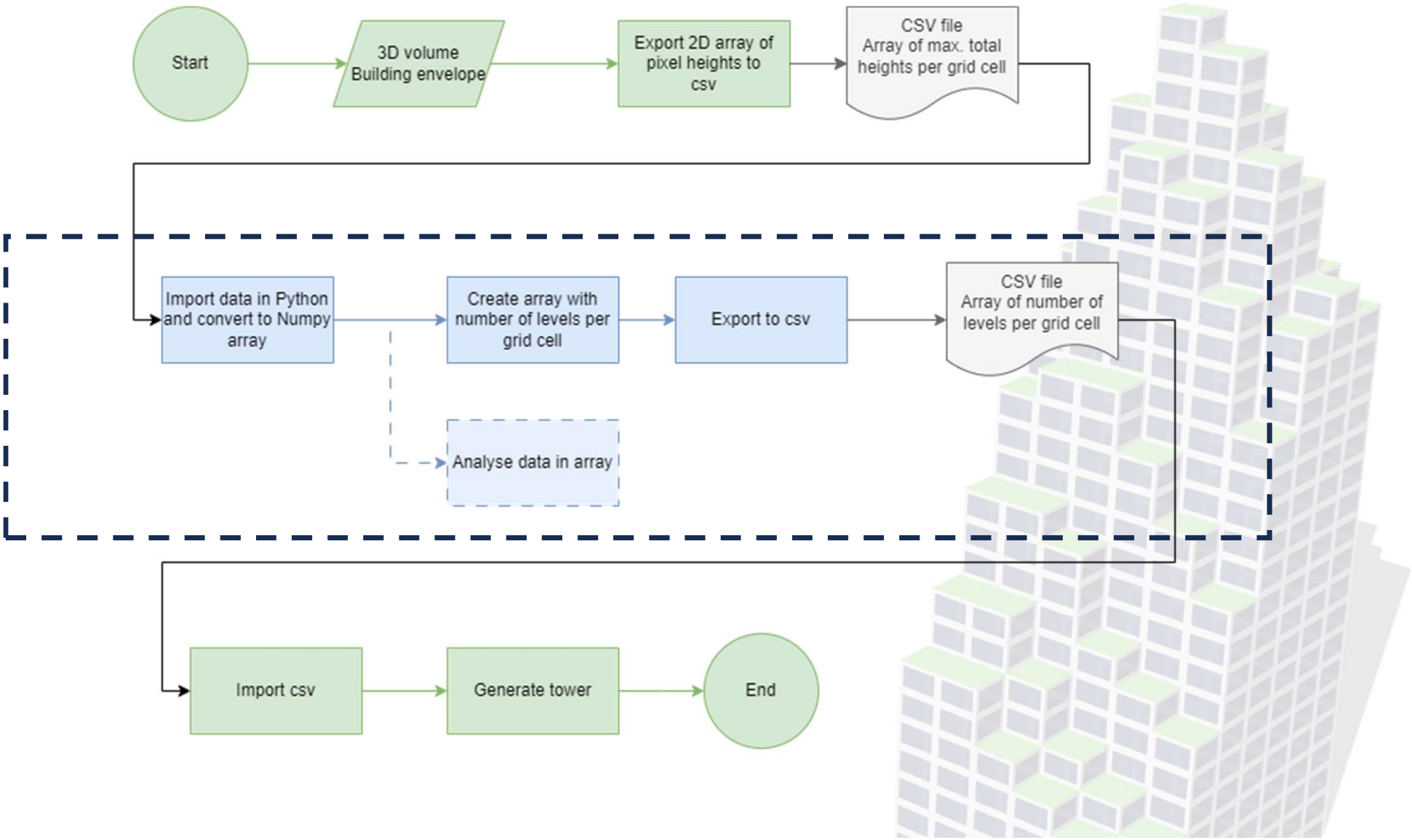
Ln 4, Col 40
100%
Windows (CRLF)
UTF-8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Exercise day 6

- **Load a csv file** and create a two-dimensional numpy array (similar to a “list of lists”)
- Use the numpy library to **analyse the data**. There are various ways to achieve to the same results: try to explore multiple methods!
- **Generate an array** that contains the number of levels, rather than the height of each pixel and **export it to a csv** file in order to load it in Grasshopper.
- Extra: **Use Hops to create a component** that directly streams the data between Grasshopper and Python (i.e. without using csv files). Make sure all relevant variables are accessible from the GH environment.

Exercise day 6:

- Load a csv file and create a two-dimensional numpy array (similar to a “list of lists”)
- Use the numpy array to analyse the data set, e.g.:
  - How many rooms are there in the roombook? And how many attributes does each room have?
  - What is the total gross floor area (GFA) of all the rooms in the roombook?
  - How many *different* rooms are there in cluster X? How many *total* rooms are there?
  - What is the total gross floor area?
  - There are some mistakes in the roombook.
    - Does width*depth always match NIA? How many rooms are incorrect? What are the discrepancies in total GFA? Can you output a list of mistakes with faulty rooms?
    - Does the GFAperroom*n_rooms match GFA_rooms?
    - How many rooms are wrong in total?
  - Is the length*width for each room in the roombook always equal to the GFA? How many rooms are incorrect? Can you output a list of mistakes with faulty rooms?
  - Add a column called NIA (net internal area) to the numpy array.

There are multiple methods to do these analyses: try to explore multiple ways!