

ECAADe 2023 – Workshop Proposal

Workshop: Build and Train Your Own 3D AI-Generative Design Tool

1 Background

Terms like *Deep Learning*, *AI*, or *Neural Networks* have been dominating public discourse over the last months. In multiple creative fields generative AI tools such as *DALL-E 2*, *Midjourney*, *ChatGPT*, etc. have left their mark and will most likely transform those industries. Architects and researchers have started to explore possibilities of how they can implement those tools into their discipline.

Most of those generative tools, and their implementations have been limited to 2D (pixel based) or text outputs. 3D outputs, especially those tailored for architectural design, are rare. The main reason is a lack of proper 3D datasets, required to train generative AI tools. This has hampered the development of 3D generative architectural applications.

This workshop will explore methods of creating a custom, large enough 3D dataset usable to train one's own generative deep neural network. To do so we will use state of the art 3D parametric software tools (Grasshopper and/or Houdini FX). We will use these datasets to train our own generative deep learning neural network *ArchiNET*. Participants in the workshop will have trained their own custom AI based design tools which will be able to synthesize new 3D outputs.

2 Workshop Overview and Output

The workshop will be broken into two main parts (each part for one of the two workshop days):

Part 1: Generation of custom datasets (Houdini FX and/or Grasshopper):

We will be using parametric design tools to create custom datasets usable to train our own generative deep learning network. Workshop participants will first learn about important principles regarding the training of neural networks and the creation of adequate datasets (for example usable 3D data representations). Each workshop participant will create their own unique dataset. We will combine those individual datasets and use those to train neural networks. The trained network will be based on the *PyTorch* deep learning library and will be able to generate hybrids and complex combinations of those individual datasets.

Part 2: Training the neural network and generating new outputs (ArchiNET/Python)

The combined datasets will be used to train our own *ArchiNET*. After training the participants will learn how to generate new output and convert their generated output back into 3D mesh data. Participants will be encouraged to explore different dataset combinations and investigate their resulting generative outputs. Participants will present their generated hybrids to the group.

3 Required Skills, Hardware, Software

We will use either *Grasshopper* and/or *Houdini FX* to generate the datasets (final software still to be determined). Some basic knowledge of parametric design would be recommended. As we will see, even very simple parametric scripts can be used to train neural networks that can produce complex outputs.

Will provide the participants with *ArchiNET* which is a custom *Python* script. *Google Colab* will be used to train and execute *ArchiNET*. The free version of *Google Colab* can be used for this workshop. However, we would recommend buying a few compute-units (100 compute-units for €11 should be more than enough) to do training of more complex models. *Python* knowledge is not required to run the script. Since *Google Colab* runs in the cloud, participants only need a laptop that can run the parametric design software. (Maybe we can use computer rooms at the TU Graz, then it would be optional for participants to bring their own laptops.)

4 Bullet Points:

- Number of Workshop Participants: around 12
- Space Requirements: Space with beamer – Maybe computer room at TU Graz
- Workshop length: 2 days – with presentation at the end of day two.
- Workshop leaders: Adam Sebastyen (Institute of Architecture and Media), Ozan Özdenizci (Institute of Theoretical Computer Science).

5 Acknowledgments:

The workshop is supported by the Graz Center for Machine Learning (GraML) and is a cooperation between the Institute of Architecture and Media and the Institute of Theoretical Computer Science at the TU Graz.