Grasshopper Level 1 Class:
Improving your workflow using parametric tools
Introduction

Instructors:
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Objectives:
The aim of this course is to improve your workflow with Grasshopper3D and to give you an overall understanding of parametric thinking. We will explore all the native tools of Grasshopper and their relationship to Rhinoceros as well as their data structure and general concepts such as data types, data matching and lists. Grasshopper is a visual programming platform, the course will take you on a journey through mathematics, algorithms and computer science and explain applied examples of concepts such as vector geometry and trigonometry. We will show examples from the real world and try to reproduce them to present you with real-life scenarios.

Audience-Friendly Class:
Although the GHL1 and GHL2 classes are based on a pre-defined schedule, they are always different depending on the audience and requests happening throughout. We will make sure that the class matches your expectation and ambitions with the software. Most importantly, we want you to leave the class inspired and ready to use and create with the software at all stages of design.
Please refer to the next page for more details about the day by day course breakdown but feel free to contact us for more bespoke training or to give us a heads up on what you would like to learn.

Prerequisites:
The class is aimed at complete beginners in Grasshopper and parametric thinking but it is preferable to have an intermediate level in Rhinoceros. Although Grasshopper is mostly used for design, the class is about parametric thinking and workflow and therefore is not addressed at a specific profession. Over the past several years of delivering GHL1 we have had architects, engineers, industrial designers, jewellery designers, contractors, project managers and artists attending the class.

Software & Plug-in:
Rhino 5.0 / Grasshopper3D
Overview - 3 Days Workshop

DAY 1

Introduction to Grasshopper

1. Parametric thinking and modelling introduction
2. Grasshopper interface, tools and basic setup
3. Workflow between Rhino and Grasshopper (referenced, internalised and baked)
4. Data Types and their parameters
5. Transformation Methods and Vector Geometry
6. List, Data Tree Structure and Data Matching

DAY 2

Data Tree Structure & Geometry

1. Number Sequences (Series, Range, Random)
2. Mathematical Expressions
3. Data Dynamic Remapping (Graph Mapper)
4. Curves, surfaces and points and their properties (domain, parameters)
5. Data Tree, Path, Items, Index and Matrix
6. Proximity Based Transformation (attractors)
7. Grids, Image Sampling

DAY 3

Surface Panelling & Information

1. Introduction to panelling for surfaces
2. Surface Mapping, Isotrim and box morph
3. Mesh Modelling and Topology
4. Data Visualization (Tags, Gradient Colours)
5. Communicating with Excel through CSV file
6. Introduction to Galapagos (genetic algorithm)
7. Q&A and Level 1 course recap
DAY1 - Introduction to Grasshopper

1. Parametric thinking and modelling introduction
This course will begin with an introduction to parametric design with several examples of projects built using Grasshopper. We'll introduce you to the key resources and community around the plugin for Rhino3D.

2. Grasshopper Interface, tools and Basic Setup
A detailed introduction to Grasshopper’s unique visual programming interface will be given including the canvas, tabs and menus.

3. Workflow between Rhino and Grasshopper
How to import geometry from Rhino and understanding the key vocabulary such as list, items, branches, path. We will see how to link the two platforms through referenced geometry and unlink them through internalising geometry.

4. Data Types and their parameters
Understanding the way Grasshopper reads data is crucial to using each components. We will look at inputs, outputs, data manipulation through flatten, graft, simplify, reverse.

5. Transformation Methods and Vector Geometry
Moving, rotating, orienting, using planes or points requires an understanding of vectors. We will see how vectors are being read and used in mathematics and within Grasshopper.

6. List, Data Tree Structure and Data Matching
Understanding the logic of data structure is essential for mastering Grasshopper. Students will begin to get familiar with basic data handling methods and matching techniques. We will cover the concept of Tree and List, as well as data visualization function.
DAY2 - Data Tree Structure & Geometry

1. Number Sequences (Series, Range, Random)
Being able to replicate operations, using a sequence of number, allows Grasshopper to generate multiple geometry at once. We will look at numbers in relation to lists and data matching.

2. Mathematical Expressions
Grasshopper uses mathematical concepts in most of its operations, we will show you how to use the mathematical expression editor to manipulate the data and create mathematical graphs.

3. Data Dynamic Remapping (graph mapper)
Number can be manipulated, scaled and remapped in a linear or non-linear way using the graph mapper tool. We will show you how to use mathematical graphs to alter geometry through rotation, scaling and movement.

4. Curves, surfaces and points and their properties (domain, parameters)
Curves, surfaces and points share properties but need to be understood in the context of 1D, 2D and 3D Space. We will look at the properties of NURBS curves and surfaces, their domain and reparameterization.

5. Data Tree, Path, Items, Index and Matrix
Data Tree structure is at the core of Grasshopper3D. We will show how trees can be manipulated through components such as Flip Matrix, List Item and Shift List.

6. Proximity Based Transformation (attractors)
We will use external geometry to influence the dimension of a series of objects in space based on distance.

7. Grids, Image Sampling
Using Data matching and grafting operations, we will create 2d and 3d grids and link them with images to create informed patterns.
DAY3 - Surface Panelling & Information

1. Introduction to Panelling for Surfaces
Surfaces can be subdivided into smaller panels and volumes. They can also be populated with components of all form through a process called replication using data trees. We will look at different ways of paneling a surface and controlling this process.

2. Surface Mapping, Isotrim and box morph
We will look at the properties of a surface and explain patterning principles on a surface. From a 3D freeform truss to a pyramidal hood reacting to curvature, we will explore several components geometry and the way they can be differentiated.

3. Mesh Modelling and Topology
Introduction to mesh modelling. Looking at the meshes properties such as their face topology we will look at the workflow behind mesh constructions in Grasshopper, comparing them with NURBS surfaces.

4. Data Visualization (Tags, Gradient Colours)
We will extract information from our models such as colour gradients, text tags defining dimensions and other properties.

5. Communicating with Excel through CSV file
The information behind our parametric model will be formatted and exported as a CSV file to Excel. To do so, we will look at string operations such as concatenation.

6. Introduction to Galapagos (genetic algorithm)
This will be our first iterative, or generative step within Grasshopper, we will look at how this evolutionary solver can solve geometrical problems based on a fitness criteria and genomes.

7. Q&A and Level 1 course recap
We will finish with a general question and answer session, going through all examples and reflecting together on how you will be able to use the tool for your own workflow.
Arthur Mamou-Mani (AA dip.)

Arthur is an Architect, director of Mamou-Mani and Fab.Pub and a lecturer at the University of Westminster and UCL-Bartlett. He has been working with Simply Rhino for the past five years, giving Grasshopper3D workshops to prestigious design and engineering companies including Heatherwick Studio and Foster + Partners. Arthur has also presented at numerous conferences including the TEDx, 3DPrintShow, Shape To Fabrication and Develop3D.

Ping-Hsiang Chen (AA dip.)

Ping-Hsiang is an architecture and computational designer specializing in the domain of parametric design and digital fabrication. He has been teaching Rhino and Grasshopper 3D workshops in the leading academic organizations such as Architectural Association School of Architecture, UCL-Bartlett, Shih Chein University, National Taiwan Technology and Science University, as well as professional design studios since 2010.