

# Concepts

A collection of resources which outline ways of thinking in creative computation, computer science, and associated areas.

- **Planning**
- **Systems in art & design**
- **3D Geometry and Parametric Design**

# Planning

## Fundamentals

Variables: Declaration, Assignment, Reassignment

Typing: Strings, Integers/Floats, Boolean

Arithmetic - + \* /

## Conditional Logic / Control flow

- if else elseif
- boolean conditions and comparison operators ==
- logical operators && ||

## Iteration

- for while
- arrays

## Functions

## Other concepts

Coordinates (Cartesian/Polar)

Colour space / Additive Colour / RGBA / HSB

Pseudocode / Debugging / Logging

Data structures - JSON / XML / CSV

Objects

**Pseudoclassical** and other patterns (e.g. **IIFE**)

<https://addyosmani.com/resources/essentialjsdesignpatterns/book/>

Ternary statements

Development environment - Atom + plugins/extensions

Math functions - random, sine

map()

P5JS

pixel arrays

stroke, fill, other functions

library globals

# Systems in art & design

## Paul Rand

Paul-Rand.jpg

Eye-Bee-M-Poster.jpg

“ Another kind of definition is that **design is a system** of relationships between all of the aspects of the problem, which means the relationship between you and the piece of canvas, you and the eraser, you and the pen. The relationship between the elements proportions, which mean the relationship of sizes. I can go on all day. *Paul Rand*

## Bauhaus

Obj.Id\_74621\_web\_hoch.jpg

Bauhaus-Anni+Albers,+Tapestry,+1926-1964.jpg

josef-albers-never-before-f.jpg  
Joseph Albers

joseph-albers-homage-to-square-2.jpg  
Joseph Albers

## Swiss Style

Swiss 1

Swiss 2

## Linear Perspective

15th century experiments in Linear Perspective.

linear-perspective-header\_0328p\_d

Entrega\_de\_las\_llaves\_a\_San\_Pedro\_

vase-in-perspective.jpg

## Sol Lewitt - Instructions for making art

“ In conceptual art the idea or concept is the most important aspect of the work. When an artist uses a conceptual form of art, it means that all of the planning and decisions are made beforehand and the execution is a perfunctory affair. The idea becomes a machine that makes the art. *Sol LeWitt*

Variations of Incomplete Open Cubes

sol-lewitt-instructions-1972.jpg

# John Cage - Music of Changes and Chance

Music-of-changes-4-1.gif

34e9e9a994e5cda59d9940d6d0ce0d6c.png

# Kerry Strand - California Computer Products Inc

nt6-cd7b343bfb9b34d15d9352474098e622\_large.jpg

stand01.jpg

# John Albers - The Responsive Eye (1965) & Michael Noll

re2-c916bff9ad2a52de3c87bba89eee02eb\_large.jpg

Noll\_Fig72.jpg

“ an intellectual and active creative partner that, when fully exploited, could be used to produce wholly new forms and possible new aesthetic experiences

# Cybernetic Serendipity - Institute of Contemporary Art (1968)

cybernetic-serendipity-poster-web.jpg

bild.jpg

Gordon Pasque - Colloquy of Mobiles

1. **Catalogue**
2. **Critique**

“ Exemplary for the appeal of the great promises made early in the computer age, Cybernetic Serendipity epitomizes the dilemma much of media art faces today: its complicated relationship with the socio-economic environment, the difficulty of engaging with its own historicity and transcending mere techno-fetishism, and the all-too-familiar sense of a naïve, unbridled optimism with its inevitable pitfalls and false dawns. [link](#)

“ The utilization of scientific know-how, however, did not simply lead to a revalorization of the art object and the materials that could be made of it. On the contrary, the integration of technology engendered a growing interest that went

beyond a strictly object-oriented approach toward practices that focus on process, ideas and (inter-) actions. Concomitant with experiments in participation and interaction, with happenings, performances, land art and conceptual art, media art is often regarded as a conclusion of the dematerialization of the art object. [link](#)

## Digital Culture by Charlie Gere

Section on Art and Cybernetics from 1950s in Europe and the US.

## Project Cybersyn

141013\_r25584\_rd.jpg

### The Planning Machine

## Jack Burnham - System Esthetics

Software-s.jpg

“ Art that is transactional in that they deal with underlying structures of communication and energy exchange

1. <http://www.tate.org.uk/research/publications/tate-papers/05/all-systems-go-recovering-jack-burnhams-systems-aesthetics>
2. [https://monoskop.org/images/0/03/Burnham\\_Jack\\_1968\\_Systems\\_Esthetics\\_Artforum.pdf](https://monoskop.org/images/0/03/Burnham_Jack_1968_Systems_Esthetics_Artforum.pdf)
3. <http://www.tate.org.uk/whats-on/tate-modern/exhibition/open-systems>

# 3D Geometry and Parametric Design

This is an informal workshop experimenting with a method of generating 3D meshes from 2D images based on the RGB colour space and making this content viewable in low-fi VR headsets.

I have been making a piece of software using openFrameworks to explore creating generative 3D meshes and also the challenge of quickly and easily getting 3D models into a lo-fi VR environment. During the workshop I will introduce you to the some basic concepts of 3D modelling and explain how this software can be used as a tool to explain generative design. Below is a screenshot of the software:

Screenshot-2017-06-15-09.29.44.png [Code available here.](#)

## Aims

- Achieve a basic understanding of concepts in 3D geometry
- Become familiar with the concept of parametric design
- Generate 3D meshes from found and created 2D images
- Import 3D meshes into **SketchFab**, an online platform for sharing and discovering 3D models.

## Pre-requisites

- Download Google Cardboard app for iPhone or Android
- Access to a computer

## Concepts in 3D geometry

We will examine some of the fundamental principles of 3D geometry that allow the computational representation of three dimensional shapes and allow us to understand how these can be created programatically.

Public Domain 3D Cow

## Glossary of Terms

- **Vertex** (singular) or **Vertices** (plural)  
One or more points in 3D space.
- **Cartesian Coordinates**  
A vertex is commonly located in 3D space using the Cartesian coordinate system. When positioning a point on you use the the **X**, **Y** and **Z** coordinates as show below:

3D Cartesian Coordinate

- **Primitives**

When joined together vertices make the basic building blocks of a 3D structure. The shapes formed are called primitives. Primitives can be points and lines but they become more useful when they form more complex shapes such as triangles or rectangles that can form a surface area. also known as a *face*.

- **Face**

As you can see from the the cow model each of the individual triangles is covered by a flat surface. Each one of these is a *face*, which combined make up the surface of the solid object.

- **Triangles**

To create a face you must have 3 or more vertices. This is why the triangle is the commonly used shape in 3D modelling. It is the most simple (or *primitive*) shape and can be used to represent the surface of a model.

- **Tessellation**

Tessellation is the process of filing a flat surface with shapes (or tiles) so that there are no gaps in that surface.

1-uniform_n11.svg.png	1-uniform_n5.svg.png	1-uniform_n1.svg.png
tessellation_texture_by_quipitory-d38nksj.png	5728579339_97f7895e02_b.jpg	

Graphics cards on computers work only work with triangles so any 3D shape you see on screen will have been converted in triangles at some point by the software or by the graphics card itself.

uT6do.jpg

### **Read more about tessellation**

## Parametric Design

“ The ground of parametric design is the generation of geometry from the definition of a family of initial parameters and the design of the formal relations they keep with each other.

## What is a parameter?

In maths it is the part of an equation that can be variable, creating change in the output/result. It follows this simple model:



<b>INPUT (PARAMETER)</b>	>	<b>EQUATION</b>	>	<b>OUTPUT</b>
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In programming and computation writing an algorithm follows this pattern. When an input parameter is changed the rules of the equation or algorithm produce a variety of possible outcomes. If there are multiple input parameters then those possible outcomes increase exponentially.

## Algorithms as a design partner

The project below is a study of algorithms on baroque and renaissance paintings. The artist, **David Quayola**, leaves behind the iconographic meaning of the pictures and uses the raw information (for example colour, shape and the relationships within these) to create new pieces. The informational nature of the pictures can be used in combination with algorithms to modify outputs. No doubt within the creative process there are ways to manually delve into the code to tweak parameters and therefore manipulate the possible outcomes.

<b>Quayola - Iconographies source</b>	<b>Quayola - Iconographies outcome</b>
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Parametric design is also used within architecture to functionally and creatively explore the possibilities in 3D spatial design. Combining formal rules (i.e. algorithms or equations) and making small variations to the input can produce huge and sometimes unexpected shifts in outcome.

berlin.jpg

As you can see from this Google search for parametric design (June, 2017) there is a recognisable style that is reminiscent of organic shapes and patterns. Without speculating on the functional or aesthetic value of this trajectory it is without doubt a function of designing with the aid of powerful computers that can model physical systems in nature that has enabled this. The relationship between parametric design and this type of outcome is that each of these designs would be partially determined by systems of rules in computation and part by the agency of designers, architects or artists. Google Image Search - Parametric Design

## Characteristics of Parametric Design

### 1. **Creating Composition Systems**

As a designer you often construct systems or 'grammars' that help to guide an outcome. This is the principle of parametric design however formalised into code and software.

### 2. **Variation**

Variation to a single parameter of a system (i.e. equation or algorithm) can create change in the output that is proportionally larger to the scale of the input. Increasing the number of parameters can again increase the variations of output exponentially! The challenge then becomes how to capture these outputs and make choices between them.

### 3. **Complexity**

Simple rules create complex outcomes. Also incorporating randomness into systems can increase the the variation of outcomes.

### 4. **Modelling physical systems**

The speed of calculations in modern computers means that simulation or modelling of physical systems is entirely possible and in doing so can become part of system of parametric design.

## The Software

### 1. **Download software**

### 2. **Download images**

How does the software work? Let's use it and find out.

Screenshot-2017-06-15-09.29.44.png

RGB Cube

If you want to recreate or learn from this yourself the code is **available here** and I would recommend following **this tutorial** for a grounding in 3D meshes in openFrameworks.

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## Further Reading / Watching:

- **Parametric Design Fundamentals YouTube series**
- **A History of Parametric Design**
- **What is Parametric Design?**
- **openFrameworks Book: Generating Meshes from 2D images** (This was an invaluable resource used for the creation of the software in this workshop)