Exploring the Arts with *Mathematica*

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Abstract

Mathematica is one of the quickest ways to get from ideas to prototypes in any domain, whether mathematical, graphical, formal, structural, linguistic, or musical. Its extremely high-level programming and interface constructs enable you to quickly turn concepts into virtual objects that you can explore interactively, and its breadth of functionality means that you are unlikely to run into roadblocks, regardless of where your explorations take you. This workshop is an introduction to *Mathematica* for anyone who wonders how it might help him or her explore ideas in the arts more effectively.

Mathematica

Mathematica is a technical computing system widely used in diverse applications from teaching calculus and designing games to engineering custom gear geometries and trading financial derivatives. In spite of its name, *Mathematica* is much more than just mathematics. It is useful for exploring ideas in the arts, whether they are graphical, musical, structural, or lie at the intersection of multiple domains.

Mathematica's strength is exploration. Because it is an exceptionally high-level language, you can cover ground quickly with a minimum of keystrokes and program components. Its breadth of functionality means that regardless of where your exploration takes you, *Mathematica* is likely to offer the functionality you need to get to where you want to go. The single most important function for exploration with *Mathematica* is its `Manipulate` command, which makes it trivially easy to attach an interactive interface to a concept. The Wolfram Demonstrations Project [1] contains thousands of examples of such interfaces.
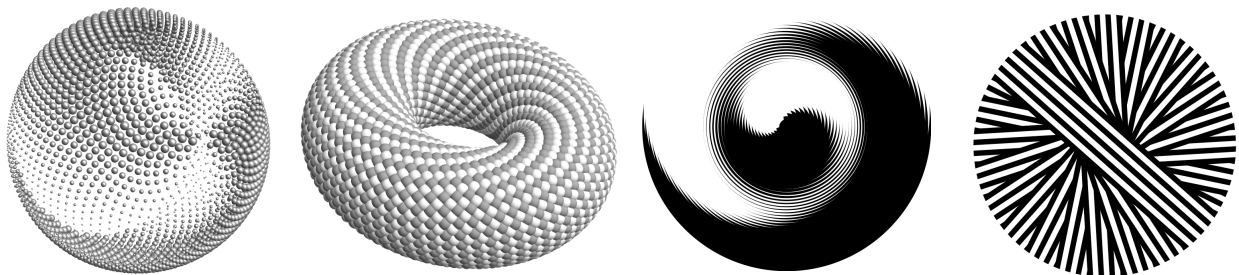

Figure 1: *Some structural and graphical explorations.*

The Workshop

This workshop is intended for those without *Mathematica* experience who want to learn how *Mathematica* can be used to explore ideas in the arts interactively. It requires basic familiarity with programming concepts. Participants must supply their own computers; trial versions of *Mathematica* will be provided for installation on participants' machines at the start of the workshop. By the end of the workshop, participants should have a basic understanding of *Mathematica* syntax and what is required to take an idea from concept to working prototype.

The focus of the workshop will be on *Mathematica's* `Manipulate` command, the central function for constructing interactive interfaces. Almost any concept can be trivially wrapped with a `Manipulate` interface for immediate interactive exploration. By incrementally elaborating the interface and the embedded concept, one can progress quickly from an initial idea to a non-trivial prototype.

The workshop will begin with an introduction to *Mathematica* in the arts, followed by a brief tutorial on how to use *Mathematica* for interactive explorations. The bulk of the workshop will consist of hands-on exploration by the participants, with interludes to answer questions of general interest as they arise. A collection of examples and code fragments will be provided, which participants can assemble and modify without needing extensive knowledge of *Mathematica* syntax and programming.

These topics in graphics, 3D structures, and music will make up the core of the workshop:

Graphical phenomena from parameterized corporate logos. Because corporate logos often distill a single graphical idea in compelling form, they are ideal points of departure for exploration of diverse graphical phenomena. Interactive exploration of seemingly simple parameterized logos can lead quickly to surprising discoveries.

Phyllotaxic structures on arbitrary surfaces of revolution. The arrangement of seeds in a sunflower head is a familiar pattern, but how does that arrangement generalize to non-planar surfaces such as spheres, tori, and arbitrary surfaces of revolution? Numerical integration plays a perhaps surprising role in implementing a general solution. Variations in size and color of the "seeds" on surfaces lead to a rich world of textured surfaces.

Polyrhythmic structures. Two beats against three, three against five, five against eight: are all examples of polyrhythms. Explore basic rhythmic structures as well as the effects upon them of varying tempo, timbre, and accent.

Workshop Presenter

The workshop will be led by Christopher Carlson, lead interactive graphics developer at Wolfram Research for over 18 years. Before joining Wolfram Research, Carlson completed graduate degrees in Design and Architecture at Carnegie Mellon University. He has had a long-standing interest in the exploration of graphic phenomena by computer.

References

[1] The Wolfram Demonstrations Project, demonstrations.wolfram.com .