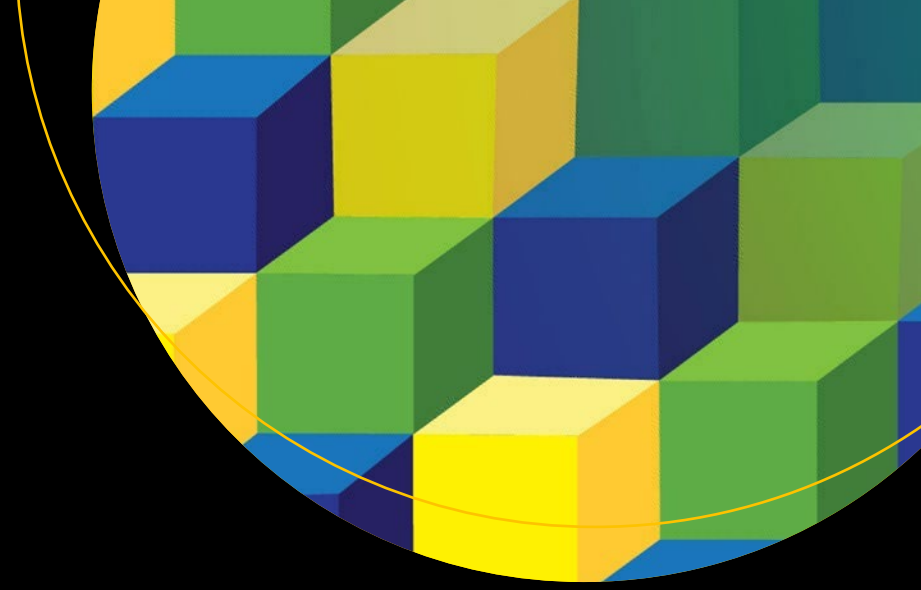

The Blender Python API

Precision 3D Modeling and Add-on Development

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Printed on acid-free paper

For my teachers and colleagues at the University of Virginia Department of Statistics.

Contents at a Glance

Contents

About the Author

Chris Conlan began his career as an independent data scientist specializing in trading algorithms. He obtained his degree in statistics from the University of Virginia where he established himself as an expert in automated trading. His passion for intuitive data visualization introduced him to various 3D modeling and virtual reality suites that he hopes to better integrate into the lives of data scientists. He is currently managing development of private technology companies in high-frequency Forex, machine vision, and precision 3D modeling.

About the Technical Reviewer

Justin Mancusi attended the University of Virginia, where he obtained degrees in computer science and mathematics. In the past, he has worked as an independent consultant at the intersection of computing and statistics. He is experienced in a breadth of computational topics including advanced optimization, computational statistics, and stochastic processes.

Introduction

This text details the development and use of 3D modeling tools in Blender's Python API. We challenge the perception of Blender as purely an artist's tool by building precise data-driven models. Simultaneously, we teach you how aid and enable artists by deploying custom tools in the familiar Blender environment.

The knowledge presented in this text is the result of a deep understanding of not only Blender's documentation and source code, but also of the source code of add-ons written by Blender's core developers. The author has discovered many useful functionalities that are, as of the time of writing, undocumented. Thankfully, we as users can stay on the cutting edge by listening to and learning from those developers. This text unifies well-documented introductory material and undocumented advanced material to create a powerful reference.

This book is packed with code examples and screenshots of powerful scripts and add-ons. We include scripts to automate precise tasks that would otherwise be very difficult to implement by hand. In addition, we build add-ons that augment Blender's existing functionalities with new tools, objects, and customization options.

Definitions

3D modeling is the art of manipulating data to create 3D representations of objects and environments. 3D artists use the following tools and techniques to build 3D models.

- *Manual modeling* involves the artist interacting with a software interface. This can be:
  - Using a 3D modeling suite (Blender, Maya, or 3ds Max) to create and edit objects by hand
  - Playing video games with 3D building elements (Minecraft, Fallout 4, or Sims)
  - Manually inputting data into a 3D object file (.obj, .stl, or .glTF)
- *Automated Modeling* involves algorithmically generating 3D models. This can be:
  - Procedural generation of environments and characters in video games
  - Generating detailed models of buildings from architectural specifications
  - Producing 3D-printed art from fractal algorithms

- *Primitives* are the basic building blocks of 3D models. Though there are no strict rules on what constitutes a primitive, these can be:
  - Simple closed shapes like planes, cubes, and pyramids
  - Simple curved shapes like spheres, cylinders, and cones
  - Complex shapes like tori (plural of torus), Bezier curves, Nurbs surfaces

3D models are data representations of objects and environments. 3D models have the following components.

- *Data formats* allow models to differentiate and specialize by application. Every type of 3D model has a format by which it is specified. These include:
  - Suite-specific formats like .blend for Blender, .3ds for 3ds Max, and .ma for Maya
  - Renderer-specific formats like .babylon for BabylonJS, .json geometry descriptor for 3JS, and .glsl for OpenGL shaders
  - Minimalistic interchange formats like .obj and .stl
- *Vertices and faces* define the points and the surfaces connecting those points in 3D space.
  - Vertices are triplets of real numbers 3D space, or traditional (x, y, z) coordinates of each point of the object.
  - Faces are triplets of integers, where (i, j, k) represents the triangle in 3D space formed by the i-th, j-th, and k-th vertex.

Prerequisite Knowledge for This Book

This book covers Blender version 2.78c running Python 3.5.2. Most examples run on Blender 2.70 and greater, and the concepts apply to Blender generally. Nonetheless, it is recommended that readers use Blender 2.78c to best follow along. As we discuss the history and development of Blender and the Python language, we will point out programming practices that are not likely to work on past and future versions.

We assume a basic working knowledge of Blender and Python 3. Familiarity with any version of Blender 2.60 or greater is sufficient. Similarly, pure Python 2 programmers will have no problem following along.

Material Overview

This text introduces knowledge and sequentially builds on it to create more and more complete and complex software solutions. We introduce and discuss the following major topics.

Chapter 1: The Blender Interface

There are many individual interfaces that make up Blender. The core interfaces are highly scriptable because almost every possible user interaction is tied directly to a Python function. We establish some familiarity with those parts of the interface especially important for Python programming.

The Blender interface will act as both the deployment and development environment for your software. We discuss unique considerations for programming and testing Python while remaining in the Blender interface.