

# OpenGL ES 3.0<sup>™</sup>

## Programming Guide

*Second Edition*



**Dan Ginsburg** ■ **Budirijanto Purnomo**

With Earlier Contributions from **Dave Shreiner** and **Aaftab Munshi**

Foreword by **Neil Trevett**, President, Khronos Group

# OpenGL ES 3.0 Programming Guide 2nd Edition

**Khronos Group**



## **OpenGL ES 3.0 Programming Guide 2nd Edition:**

*The British National Bibliography* Arthur James Wells, 2009      Cocoa Design Patterns Erik Buck, Donald

Yacktman, 2009-09-01 Next time some kid shows up at my door asking for a code review this is the book that I am going to throw at him Aaron Hillegass founder of Big Nerd Ranch Inc and author of Cocoa Programming for Mac OS X Unlocking the Secrets of Cocoa and Its Object Oriented Frameworks Mac and iPhone developers are often overwhelmed by the breadth and sophistication of the Cocoa frameworks Although Cocoa is indeed huge once you understand the object oriented patterns it uses you'll find it remarkably elegant consistent and simple Cocoa Design Patterns begins with the mother of all patterns the Model View Controller MVC pattern which is central to all Mac and iPhone development Encouraged and in some cases enforced by Apple's tools it's important to have a firm grasp of MVC right from the start The book's midsection is a catalog of the essential design patterns you'll encounter in Cocoa including Fundamental patterns such as enumerators accessors and two stage creation Patterns that empower such as singleton delegates and the responder chain Patterns that hide complexity including bundles class clusters proxies and forwarding and controllers And that's not all of them Cocoa Design Patterns painstakingly isolates 28 design patterns accompanied with real world examples and sample code you can apply to your applications today The book wraps up with coverage of Core Data models AppKit views and a chapter on Bindings and Controllers Cocoa Design Patterns clearly defines the problems each pattern solves with a foundation in Objective C and the Cocoa frameworks and can be used by any Mac or iPhone developer

**OpenGL ES 3.0 Programming Guide** Dan Ginsburg, Budirijanto Purnomo, Dave Shreiner, Aaftab Munshi, 2014-02-28 OpenGL ES™ is the industry's leading software interface and graphics library for rendering sophisticated 3D graphics on handheld and embedded devices The newest version OpenGL ES 3.0 makes it possible to create stunning visuals for new games and apps without compromising device performance or battery life In the OpenGL ES™ 3.0 Programming Guide Second Edition the authors cover the entire API and Shading Language They carefully introduce OpenGL ES 3.0 features such as shadow mapping instancing multiple render targets uniform buffer objects texture compression program binaries and transform feedback Through detailed downloadable C based code examples you'll learn how to set up and program every aspect of the graphics pipeline Step by step you'll move from introductory techniques all the way to advanced per pixel lighting and particle systems Throughout you'll find cutting edge tips for optimizing performance maximizing efficiency with both the API and hardware and fully leveraging OpenGL ES 3.0 in a wide spectrum of applications All code has been built and tested on iOS 7 Android 4.3 Windows OpenGL ES 3.0 Emulation and Ubuntu Linux and the authors demonstrate how to build OpenGL ES code for each platform Coverage includes EGL API communicating with the native windowing system choosing configurations and creating rendering contexts and surfaces Shaders creating and attaching shader objects compiling shaders checking for compile errors creating linking and querying program objects and using source shaders and program binaries OpenGL ES Shading Language variables types

constructors structures arrays attributes uniform blocks I O variables precision qualifiers and invariance Geometry vertices and primitives inputting geometry into the pipeline and assembling it into primitives 2D 3D Cubemap Array texturing creation loading and rendering texture wrap modes filtering and formats compressed textures sampler objects immutable textures pixel unpack buffer objects and mipmapping Fragment shaders multitexturing fog alpha test and user clip planes Fragment operations scissor stencil and depth tests multisampling blending and dithering Framebuffer objects rendering to offscreen surfaces for advanced effects Advanced rendering per pixel lighting environment mapping particle systems image post processing procedural textures shadow mapping terrain and projective texturing Sync objects and fences synchronizing within host application and GPU execution This edition of the book includes a color insert of the OpenGL ES 3 0 API and OpenGL ES Shading Language 3 0 Reference Cards created by Khronos The reference cards contain a complete list of all of the functions in OpenGL ES 3 0 along with all of the types operators qualifiers built ins and functions in the OpenGL ES Shading Language

**Game and Graphics Programming for iOS and Android with OpenGL ES 2.0** Romain Marucchi-Foino, 2012-01-18 Develop graphically sophisticated apps and games today The smart phone app market is progressively growing and there is new market gap to fill that requires more graphically sophisticated applications and games Game and Graphics Programming for iOS and Android with OpenGL ES 2 0 quickly gets you up to speed on understanding how powerful OpenGL ES 2 0 technology is in creating apps and games for amusement and effectiveness Leading you through the development of a real world mobile app with live code this text lets you work with all the best features and tools that Open GL ES 2 0 has to offer Provides a project template for iOS and Android platforms Delves into OpenGL features including drawing canvas geometry lighting effects character animation and more Offers explanation of full function 2D and 3D graphics on embedded systems Addresses the principal technology for hardware accelerated graphical rendering Game and Graphics Programming for iOS and Android with OpenGL ES 2 0 offers important need to know information if you re interested in striking a perfect balance between aesthetics and functionality in apps

*OpenGL ES 2.0 Programming Guide* Aaftab Munshi, Dan Ginsburg, Dave Shreiner, 2008-07-24 OpenGL ES 2 0 is the industry s leading software interface and graphics library for rendering sophisticated 3D graphics on handheld and embedded devices With OpenGL ES 2 0 the full programmability of shaders is now available on small and portable devices including cell phones PDAs consoles appliances and vehicles However OpenGL ES differs significantly from OpenGL Graphics programmers and mobile developers have had very little information about it until now In the OpenGL ES 2 0 Programming Guide three leading authorities on the Open GL ES 2 0 interface including the specification s editor provide start to finish guidance for maximizing the interface s value in a wide range of high performance applications The authors cover the entire API including Khronos ratified extensions Using detailed C based code examples they demonstrate how to set up and program every aspect of the graphics pipeline You ll move from introductory techniques all the way to advanced per pixel lighting particle systems

and performance optimization Coverage includes Shaders in depth creating shader objects compiling shaders checking for compile errors attaching shader objects to program objects and linking final program objects The OpenGL ES Shading Language variables types constructors structures arrays attributes uniforms varying precision qualifiers and invariance Inputting geometry into the graphics pipeline and assembling geometry into primitives Vertex shaders their special variables and their use in per vertex lighting skinning and other applications Using fragment shaders including examples of multitexturing fog alpha test and user clip planes Fragment operations scissor test stencil test depth test multisampling blending and dithering Advanced rendering per pixel lighting with normal maps environment mapping particle systems image post processing and projective texturing Real world programming challenges platform diversity C portability OpenKODE and platform specific shader binaries

**OpenGL Programming Guide : the Official Guide to Learning OpenGL, Version 4.3**, 2013 OpenGL Programming Guide Dave Shreiner, 2010 OpenGL is a powerful software interface used to produce high quality computer generated images and interactive applications using 2D and 3D objects bitmaps and color images The OpenGL Programming Guide Seventh Edition provides definitive and comprehensive information on OpenGL and the OpenGL Utility Library The previous edition covered OpenGL through Version 2.1 This seventh edition of the best selling red book describes the latest features of OpenGL Versions 3.0 and 3.1 You will find clear explanations of OpenGL functionality and many basic computer graphics techniques such as building and rendering 3D models interactively viewing objects from different perspective points and using shading lighting and texturing effects for greater realism In addition this book provides in depth coverage of advanced techniques including texture mapping antialiasing fog and atmospheric effects NURBS image processing and more The text also explores other key topics such as enhancing performance OpenGL extensions and cross platform techniques This seventh edition has been updated to include the newest features of OpenGL Versions 3.0 and 3.1 including Using framebuffer objects for off screen rendering and texture updates Examples of the various new buffer object types including uniform buffer objects transform feedback buffers and vertex array objects Using texture arrays to increase performance when using numerous textures Efficient rendering using primitive restart and conditional rendering Discussion of OpenGL's deprecation mechanism and how to verify your programs for future versions of OpenGL This edition continues the discussion of the OpenGL Shading Language GLSL and explains the mechanics of using this language to create complex graphics effects and boost the computational power of OpenGL The OpenGL Technical Library provides tutorial and reference books for OpenGL The Library enables programmers to gain a practical understanding of OpenGL and shows them how to unlock its full potential Originally developed by SGI the Library continues to evolve under the auspices of the Khronos OpenGL ARB Working Group an industry consortium responsible for guiding the evolution of OpenGL and related technologies

**OpenGL Programming Guide** Dave Shreiner, Graham Sellers, John Kessenich, Bill Licea-Kane, 2013-03-19 Includes Complete Coverage of the OpenGL Shading Language Today's OpenGL

software interface enables programmers to produce extraordinarily high quality computer generated images and interactive applications using 2D and 3D objects color images and programmable shaders OpenGL Programming Guide The Official Guide to Learning OpenGL Version 4.3 Eighth Edition has been almost completely rewritten and provides definitive comprehensive information on OpenGL and the OpenGL Shading Language This edition of the best selling Red Book describes the features through OpenGL version 4.3 It also includes updated information and techniques formerly covered in OpenGL Shading Language the Orange Book For the first time this guide completely integrates shader techniques alongside classic functioncentric techniques Extensive new text and code are presented demonstrating the latest in OpenGL programming techniques OpenGL Programming Guide Eighth Edition provides clear explanations of OpenGL functionality and techniques including processing geometric objects with vertex tessellation and geometry shaders using geometric transformations and viewing matrices working with pixels and texture maps through fragment shaders and advanced data techniques using framebuffer objects and compute shaders New OpenGL features covered in this edition include Best practices and sample code for taking full advantage of shaders and the entire shading pipeline including geometry and tessellation shaders Integration of general computation into the rendering pipeline via compute shaders Techniques for binding multiple shader programs at once during application execution Latest GLSL features for doing advanced shading techniques Additional new techniques for optimizing graphics program performance [Book Review Index](#) ,2006 Every 3rd issue is a quarterly cumulation [OpenGL Programming Guide](#) Dave Shreiner,The Khronos OpenGL ARB Working,2009-07-21 Please note that this title's color insert referred to as Plates within the text is not available for this digital product OpenGL is a powerful software interface used to produce high quality computer generated images and interactive applications using 2D and 3D objects bitmaps and color images The OpenGL Programming Guide Seventh Edition provides definitive and comprehensive information on OpenGL and the OpenGL Utility Library The previous edition covered OpenGL through Version 2.1 This seventh edition of the best selling red book describes the latest features of OpenGL Versions 3.0 and 3.1 You will find clear explanations of OpenGL functionality and many basic computer graphics techniques such as building and rendering 3D models interactively viewing objects from different perspective points and using shading lighting and texturing effects for greater realism In addition this book provides in depth coverage of advanced techniques including texture mapping antialiasing fog and atmospheric effects NURBS image processing and more The text also explores other key topics such as enhancing performance OpenGL extensions and cross platform techniques This seventh edition has been updated to include the newest features of OpenGL Versions 3.0 and 3.1 including Using framebuffer objects for off screen rendering and texture updates Examples of the various new buffer object types including uniform buffer objects transform feedback buffers and vertex array objects Using texture arrays to increase performance when using numerous textures Efficient rendering using primitive restart and conditional rendering Discussion of OpenGL's deprecation

mechanism and how to verify your programs for future versions of OpenGL This edition continues the discussion of the OpenGL Shading Language GLSL and explains the mechanics of using this language to create complex graphics effects and boost the computational power of OpenGL The OpenGL Technical Library provides tutorial and reference books for OpenGL The Library enables programmers to gain a practical understanding of OpenGL and shows them how to unlock its full potential Originally developed by SGI the Library continues to evolve under the auspices of the Khronos OpenGL ARB Working Group an industry consortium responsible for guiding the evolution of OpenGL and related technologies

OpenGL® ES 2.0 Programming Guide Aaftab Munshi,Dave Shreiner,Dan Ginsburg,2008 OpenGL ES 2 0 is the industry s leading software interface and graphics library for rendering sophisticated 3D graphics on handheld and embedded devices With OpenGL ES 2 0 the full programmability of shaders is now available on small and portable devices including cell phones PDAs consoles appliances and vehicles However OpenGL ES differs significantly from OpenGL Graphics programmers and mobile developers have had very little information about it until now In the OpenGL ES 2 0 Programming Guide three leading authorities on the Open GL ES 2 0 interface including the specification s editor provide start to finish guidance for maximizing the interface s value in a wide range of high performance applications The authors cover the entire API including Khronos ratified extensions Using detailed C based code examples they demonstrate how to set up and program every aspect of the graphics pipeline You ll move from introductory techniques all the way to advanced per pixel lighting particle systems and performance optimization Coverage includes Shaders in depth creating shader objects compiling shaders checking for compile errors attaching shader objects to program objects and linking final program objects The OpenGL ES Shading Language variables types constructors structures arrays attributes uniforms varying precision qualifiers and invariance Inputting geometry into the graphics pipeline and assembling geometry into primitives Vertex shaders their special variables and their use in per vertex lighting skinning and other applications Using fragment shaders including examples of multitexturing fog alpha test and user clip planes Fragment operations scissor test stencil test depth test multisampling blending and dithering Advanced rendering per pixel lighting with normal maps environment mapping particle systems image post processing and projective texturing Real world programming challenges platform diversity C portability OpenKODE and platform specific shader binaries

**OpenGL ES 2.0 Programming Guide** Aaftab,Aaftab Munshi,Dave Shreiner,Dan Ginsburg,2008 *Business Publication Advertising Source* ,1997-02 *PC Magazine* ,1998 *OpenGL Programming Guide* John Kessenich,Graham Sellers,Dave Shreiner,2016-07-25 Complete Coverage of OpenGL 4 5 the Latest Version Includes 4 5 4 4 SPIR V and Extensions The latest version of today s leading worldwide standard for computer graphics OpenGL 4 5 delivers significant improvements in application efficiency flexibility and performance OpenGL 4 5 is an exceptionally mature and robust platform for programming high quality computer generated images and interactive applications using 2D and 3D objects color images and shaders OpenGL Programming Guide Ninth Edition presents

definitive comprehensive information on OpenGL 4.5, 4.4 SPIR V, OpenGL extensions and the OpenGL Shading Language. It will serve you for as long as you write or maintain OpenGL code. This edition of the best selling Red Book fully integrates shader techniques alongside classic function centric approaches and contains extensive code examples that demonstrate modern techniques. Starting with the fundamentals its wide ranging coverage includes drawing color pixels, fragments, transformations, textures, framebuffers, light and shadow and memory techniques for advanced rendering and nongraphical applications. It also offers discussions of all shader stages including thorough explorations of tessellation, geometric and compute shaders. New coverage in this edition includes Thorough coverage of OpenGL 4.5 Direct State Access (DSA) which overhauls the OpenGL programming model and how applications access objects. Deeper discussions and more examples of shader functionality and GPU processing reflecting industry trends to move functionality onto graphics processors. Demonstrations and examples of key features based on community feedback and suggestions. Updated appendixes covering the latest OpenGL libraries, related APIs, functions, variables, formats and debugging and profiling techniques. *OpenGL Programming Guide* Mason Woo, Jackie Neider, Tom Davis, OpenGL Architecture Review Board, 1997. Explaining how graphics programs using Release 1.1 the latest release of OpenGL, this book presents the overall structure of OpenGL and discusses in detail every OpenGL feature including the new features introduced in Release 1.1. Numerous programming examples in C show how to use OpenGL functions. Also includes 16 pages of full color examples. **OpenGL ES 2 for Android** Kevin Brothaler, 2013-06-26. Printed in full color. Android is booming like never before with millions of devices shipping every day. It's never been a better time to learn how to create your own 3D games and live wallpaper for Android. You'll find out all about shaders and the OpenGL pipeline and discover the power of OpenGL ES 2.0 which is much more feature rich than its predecessor. If you can program in Java and you have a creative vision that you'd like to share with the world then this is the book for you. This book will teach you everything you need to know to create compelling graphics on Android. You'll learn the basics of OpenGL by building a simple game of air hockey and along the way you'll see how to initialize OpenGL and program the graphics pipeline using shaders. Each lesson builds upon the one before it as you add colors, shading, 3D projections, touch interaction and more. Then you'll find out how to turn your idea into a live wallpaper that can run on the home screen. You'll learn about more advanced effects involving particles, lighting models and the depth buffer. You'll understand what to look for when debugging your program and what to watch out for when deploying to the market. OpenGL can be somewhat of a dark art to the uninitiated. As you read this book you'll learn each new concept from first principles. You won't just learn about a feature you'll also understand how it works and why it works the way it does. Everything you learn is forward compatible with the just released OpenGL ES 3 and you can even apply these techniques to other platforms such as iOS or HTML5 WebGL. *OpenGL Programming Guide* Dave Shreiner, OpenGL Architecture Review Board, 2008. [Learning OpenGL ES for iOS](#) Erik Buck, 2012-07-31. Get Started Fast with Modern OpenGL ES Graphics Programming for iPhone, iPod touch and iPad.



OpenGL ES technology underlies the user interface and graphical capabilities of Apple's iPhone iPod touch and iPad as well as devices ranging from video game consoles and aircraft cockpit displays to non Apple smartphones In this friendly thorough introduction Erik M Buck shows how to make the most of Open GL ES in Apple's iOS environment This highly anticipated title focuses on modern efficient approaches that use the newest versions of OpenGL ES helping you avoid the irrelevant obsolete and misleading techniques that litter the Internet Buck embraces Objective C and Cocoa Touch showing how to leverage Apple's powerful elegant GLKit framework to maximize your productivity achieve tight platform integration and deliver exceptionally polished apps If you've written C or C++ code and know object oriented programming basics this title brings together everything you need to fully master OpenGL ES graphics for iOS including downloadable examples specifically designed to jumpstart your own projects Coverage includes Understanding core OpenGL ES computer graphics concepts and iOS graphics architecture Integrating Cocoa Touch with OpenGL ES to leverage the power of Apple's platform Creating textures from start to finish opacity blending multi texturing and compression Simulating ambient diffuse and specular light Using transformations to render 3D geometric objects from any point of view Animating scenes by controlling time through application logic Partitioning data to draw expansive outdoor scenes with rolling terrain Detecting and handling user interaction with 3D geometry Implementing special effects ranging from skyboxes to particles and billboards Systematically optimizing graphics performance Understanding the essential linear algebra concepts used in computer graphics Designing and constructing a complete simulation that incorporates everything you've learned

**OpenGL ES 3.2 Reference Guide** Khronos Group,

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