

OpenGL[®]

Programming Guide

Ninth Edition

*The Official Guide to Learning
OpenGL[®], Version 4.5 with SPIR-V*



John Kessenich • Graham Sellers • Dave Shreiner

The Khronos OpenGL ARB Working Group

OpenGL Programming Guide Red

**John Kessenich, Graham Sellers, Dave
Shreiner**



OpenGL Programming Guide Red :

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

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 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 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,OpenGL Architecture Review Board,2008 OpenGL Programming Guide Sixth Edition OpenGL is a powerful software interface used to produce high quality computergenerated images and interactive applications using 2D and 3D objects bitmaps and color images The OpenGL Programming Guide Sixth Edition provides definitive and comprehensive information on OpenGL and the OpenGL Utility Library The previous edition covered OpenGL through Version 2 0 This sixth edition of the best selling red book describes the latest features of OpenGL Version 2 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 sixth edition has been updated to include the newest features of OpenGL Version 2 1 including Using server side pixel buffer objects for fast pixel rectangle download and retrieval Discussion of the sRGB texture format Expanded discussion of the OpenGL Shading Language 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 OpenGL Architecture Review Board ARB Steering Group now part of the Khronos Group an industry consortium responsible for guiding the evolution of OpenGL and related technologies *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, 2016

WebGL Programming Guide Kouichi Matsuda, Rodger Lea, 2013-07-04

Using WebGL you can create sophisticated interactive 3D graphics inside web browsers without plug-ins. WebGL makes it possible to build a new generation of 3D web games, user interfaces, and information visualization solutions that will run on any standard web browser and on PCs, smartphones, tablets, game consoles, or other devices. *WebGL Programming Guide* will help you get started quickly with interactive WebGL 3D programming even if you have no prior knowledge of HTML5, JavaScript, 3D graphics, mathematics, or OpenGL. You'll learn step by step through realistic examples, building your skills as you move from simple to complex solutions for building visually appealing web pages and 3D applications with WebGL. Media 3D graphics and WebGL pioneers Dr. Kouichi Matsuda and Dr. Rodger Lea offer easy-to-understand tutorials on key aspects of WebGL, plus 100 downloadable sample programs, each demonstrating a specific WebGL topic. You'll move from basic techniques such as rendering, animating, and texturing triangles all the way to advanced techniques such as fogging, shadowing, shader switching, and displaying 3D models generated by Blender or other authoring tools. This book won't just teach you WebGL best practices; it will give you a library of code to jumpstart your own projects. Coverage includes WebGL's origin, core concepts, features, advantages, and integration with other web standards. How and basic WebGL functions work together to deliver 3D graphics. Shader development with OpenGL ES Shading Language (GLSL). ES 3D scene drawing, representing user views, controlling space, volume clipping, object creation, and perspective. Achieving greater realism through lighting and hierarchical objects. Advanced techniques: object manipulation, heads-up displays, alpha blending, shader switching, and more. Valuable reference appendixes covering key issues ranging from coordinate systems to matrices and shader loading to web browser settings. This is the newest text in the OpenGL Technical Library, Addison-Wesley's definitive collection of programming guides and reference manuals for OpenGL and its related technologies. The Library enables programmers to gain a practical understanding of OpenGL and the other Khronos application programming libraries, including OpenGL ES and OpenCL. All of the technologies in the OpenGL Technical Library evolve under the auspices of the Khronos Group, the industry consortium guiding the evolution of modern open standards media APIs.

Computer Graphics Through OpenGL Sumanta Guha, 2014-08-06

From geometric primitives to animation to 3D modeling to lighting, shading, and texturing. *Computer Graphics Through OpenGL: From Theory to Experiments*, Second Edition, presents a comprehensive introduction to computer graphics that uses an active learning style to teach key concepts. Equally emphasizing theory and practice, the book provides an understanding not only of the principles of 3D computer graphics but

also the use of the OpenGL Application Programming Interface API to code 3D scenes and animation including games and movies The undergraduate core of the book is a one semester sequence taking the student from zero knowledge of computer graphics to a mastery of the fundamental concepts with the ability to code applications using fourth generation OpenGL The remaining chapters explore more advanced topics including the structure of curves and surfaces and the application of projective spaces and transformations New to the Second Edition 30 more programs 50 more experiments and 50 more exercises Two new chapters on OpenGL 4 3 shaders and the programmable pipeline Coverage of Vertex buffer and array objects Occlusion culling and queries and conditional rendering Texture matrices Multitexturing and texture combining Multisampling Point sprites Image and pixel manipulation Pixel buffer objects Shadow mapping Web Resource The book s website at www.sumantaguha.com provides program source code that runs on various platforms It includes a guide to installing OpenGL and executing the programs special software to help run the experiments and figures from the book The site also contains an instructor s manual with solutions to 100 problems for qualifying instructors only

Python Game Programming By Example Alejandro Rodas de Paz, Joseph Howse, 2015-09-28 A pragmatic guide for developing your own games with Python About This Book Strengthen your fundamentals of game programming with Python language Seven hands on games to create 2D and 3D games rapidly from scratch Illustrative guide to explore the different GUI libraries for building your games Who This Book Is For If you have ever wanted to create casual games in Python and you would like to explore various GUI technologies that this language offers this is the book for you This title is intended for beginners to Python with little or no knowledge of game development and it covers step by step how to build seven different games from the well known Space Invaders to a classical 3D platformer What You Will Learn Take advantage of Python s clean syntax to build games quickly Discover distinct frameworks for developing graphical applications Implement non player characters NPCs with autonomous and seemingly intelligent behaviors Design and code some popular games like Pong and tower defense Compose maps and levels for your sprite based games in an easy manner Modularize and apply object oriented principles during the design of your games Exploit libraries like Chimpunk2D cocos2d and Tkinter Create natural user interfaces NUIs using a camera and computer vision algorithms to interpret the player s real world actions In Detail With a growing interest in learning to program game development is an appealing topic for getting started with coding From geometry to basic Artificial Intelligence algorithms there are plenty of concepts that can be applied in almost every game Python is a widely used general purpose high level programming language It provides constructs intended to enable clear programs on both a small and large scale It is the third most popular language whose grammatical syntax is not predominantly based on C Python is also very easy to code and is also highly flexible which is exactly what is required for game development The user friendliness of this language allows beginners to code games without too much effort or training Python also works with very little code and in most cases uses the use cases approach reserving lengthy explicit coding for outliers and exceptions

making game development an achievable feat Python Game Programming by Example enables readers to develop cool and popular games in Python without having in depth programming knowledge of Python The book includes seven hands on projects developed with several well known Python packages as well as a comprehensive explanation about the theory and design of each game It will teach readers about the techniques of game design and coding of some popular games like Pong and tower defense Thereafter it will allow readers to add levels of complexities to make the games more fun and realistic using 3D At the end of the book you will have added several GUI libraries like Chimpunk2D cocos2d and Tkinter in your tool belt as well as a handful of recipes and algorithms for developing games with Python Style and approach This book is an example based guide that will teach you to build games using Python This book follows a step by step approach as it is aimed at beginners who would like to get started with basic game development By the end of this book you will be competent game developers with good knowledge of programming in Python

Real-Time Volume Graphics Klaus Engel,Markus

Hadwiger,Joe Kniss,Christof Rezk-Salama,Daniel Weiskopf,2006-07-21 Based on course notes of SIGGRAPH course teaching techniques for real time rendering of volumetric data and effects covers both applications in scientific visualization and real time rendering Starts with the basics texture based ray casting and then improves and expands the algorithms incrementally Book includes source code algorithms diagr

Pro Android 3 Sayed Hashimi,Satya Komatineni,Dave MacLean,2011-08-19

Pro Android 3 starts with the basics giving you a firm foundation in Android development It then builds on this foundation to teach you how to build real world and fun mobile applications using the new Android 3.0 SDK This book covers advanced concepts in detail including maps geocoding services live folders drag and drop touchscreens and the new Android 3.0 features fragments and ActionBar Pro Android 3 is uniquely comprehensive it covers sensors text to speech OpenGL live widgets search and the audio and video APIs Using the code heavy tutorials and expert advice you ll quickly be able to build cool mobile apps and run them on dozens of Android based smartphones You ll explore and use the Android APIs including those for media sensors and long running services And you ll check out what s new with Android 3.0 including the improved UI across all Android platforms drag and drop fragment dialogs and more giving you the knowledge to create stunning cutting edge apps while keeping you agile enough to respond to changes in the future

Pro Android 2 Sayed

Hashimi,Satya Komatineni,Dave MacLean,2010-08-04 Pro Android 2 shows how to build real world and fun mobile applications using Google s latest Android software development kit This new edition is updated for Android 2 covering everything from the fundamentals of building applications for embedded devices to advanced concepts such as custom 3D components OpenGL and touchscreens including gestures While other Android development guides simply discuss topics Pro Android 2 offers the combination of expert insight and real sample applications that work Discover the design and architecture of the Android SDK through practical examples and how to build mobile applications using the Android SDK Explore and use the Android APIs including those for media and Wi Fi Learn about Android 2 s integrated local and web

search handwriting gesture UI Google Translate and text to speech features Pro Android 2 dives deep providing you with all the knowledge and techniques you need to build mobile applications ranging from games to Google apps including add ons to Google Docs You ll be able to extend and run the new Google Chrome APIs on the G1 the G2 and other next generation Google phones and Android enabled devices

OpenGL Programming Guide ,2007 NET Gunther Lenz,Thomas Moeller,2004 bull There are many books on Software Engineering and many books on NET but this is the first to bring them together bull The authors use an extended case study with each chapter building on the previous one involving readers at every stage bull By the end the reader has created a really cool working imaging application while learning best practices of software development in NET

Shader Fouad Sabry,2024-05-13 What is Shader In computer graphics a shader is a computer program that calculates the appropriate levels of light darkness and color during the rendering of a 3D scene a process known as shading Shaders have evolved to perform a variety of specialized functions in computer graphics special effects and video post processing as well as general purpose computing on graphics processing units How you will benefit I Insights and validations about the following topics Chapter 1 Shader Chapter 2 OpenGL Chapter 3 Direct3D Chapter 4 High Level Shader Language Chapter 5 OpenGL ES Chapter 6 Graphics pipeline Chapter 7 Shading language Chapter 8 Software rendering Chapter 9 OpenGL Shading Language Chapter 10 Computer graphics lighting II Answering the public top questions about shader III Real world examples for the usage of shader in many fields Who this book is for Professionals undergraduate and graduate students enthusiasts hobbyists and those who want to go beyond basic knowledge or information for any kind of Shader

Creating Games Morgan McGuire,Odest Chadwicke Jenkins,2008-12-23 Creating Games offers a comprehensive overview of the technology content and mechanics of game design It emphasizes the broad view of a games team and teaches you enough about your teammates areas so that you can work effectively with them The authors have included many worksheets and exercises to help get your small indie team off the ground Special features Exercises at the end of each chapter combine comprehension tests with problems that help the reader interact with the material Worksheet exercises provide creative activities to help project teams generate new ideas and then structure them in a modified version of the format of a game industry design document Pointers to the best resources for digging deeper into each specialized area of game development Website with worksheets figures from the book and teacher materials including study guides lecture presentations syllabi supplemental exercises and assessment materials

OpenGL Programming for Windows 95 and Windows NT Ron Fosner,1997 Ron Fosner provides tips and teaches techniques enabling Windows programmers to optimize OpenGL performance on the Windows platform Topics include model and view matrices bitmaps and texturing and manipulating OpenGL objects Numerous programming examples in C are provided

Parallel Processing and Applied Mathematics Roman Wyrzykowski,2004-04-26 This book constitutes the thoroughly refereed post proceedings of the 5th International Conference on Parallel Processing and Applied Mathematics PPAM 2003 held in

Czestochowa Poland in September 2003 The 149 papers presented were carefully selected and improved during two rounds of reviewing and revision The papers are organized in topical sections on parallel and distributed architectures scheduling and load balancing performance analysis and prediction parallel and distributed non numerical algorithms parallel and distributed programming tools and environments applications evolutionary computing soft computing data and knowledge management numerical methods and their applications multi dimensional systems grid computing heterogeneous platforms high performance numerical computation large scale scientific computation and bioinformatics applications

Openscenegraph 3.0 Rui Wang,Xuelel Qian,2010-12-14 Create high performance virtual reality applications with OpenSceneGraph one of the best 3D graphics engines

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Opengl Programming Guide Red Introduction

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