

Vulkan Programming Guide The Official Guide To Learning Vulkan Opengl

The Great Escape for the Great War: the astonishing true story of two World War I prisoners who pulled off one of the most ingenious escapes of all time. “Fox unspools Jones and Hill’s delightfully elaborate scheme in nail-biting episodes that advance like a narrative Rube Goldberg machine.”—The New York Times Book Review Imprisoned in a remote Turkish POW camp during World War I, having survived a two-month forced march and a terrifying shootout in the desert, two British officers, Harry Jones and Cedric Hill, join forces to bamboozle their iron-fisted captors. To stave off despair and boredom, Jones takes a handmade Ouija board and fakes elaborate séances for his fellow prisoners. Word gets around, and one day an Ottoman official approaches Jones with a query: Could Jones contact the spirit world to find a vast treasure rumored to be buried nearby? Jones, a trained lawyer, and Hill, a brilliant magician, use the Ouija board—and their keen understanding of the psychology of deception—to build a trap for their captors that will ultimately lead them to freedom. A gripping nonfiction thriller, *The Confidence Men* is the story of one of the only known con games played for a good cause—and of a profound but unlikely friendship. Had it not been for “the Great War,” Jones, the Oxford-educated son of a British lord, and Hill, a mechanic on an Australian sheep ranch, would never have met. But in pain, loneliness, hunger, and isolation, they formed a powerful emotional and intellectual alliance that saved both of their lives. Margalit Fox brings her “nose for interesting facts, the ability to construct a taut narrative arc, and a Dickens-level gift for concisely conveying personality” (Kathryn Schulz, *New York*) to this tale of psychological strategy that is rife with cunning, danger, and moments of high farce that rival anything in *Catch-22*.

Shortlisted for the 2021 Booker Prize Longlisted for the 2021 National Book Award for Fiction A heartrending new novel from the Pulitzer Prize-winning and #1 *New York Times* best-selling author of *The Overstory*. Named one of the Most Anticipated Books of 2021 by *Newsweek*, *Los Angeles Times*, *New York Magazine*, *Chicago Tribune*, *BuzzFeed*, *BookPage*, *Goodreads*, *Literary Hub*, *The Millions*, *New Statesman*, and *Times of London* The astrobiologist Theo Byrne searches for life throughout the cosmos while single-handedly raising his unusual nine-year-old, Robin, following the death of his wife. Robin is a warm, kind boy who spends hours painting elaborate pictures of endangered animals. He’s also about to be expelled from third grade for smashing his friend in the face. As his son grows more troubled, Theo hopes to keep him off psychoactive drugs. He learns of an experimental neurofeedback treatment to bolster Robin’s emotional control, one that involves training the boy on the recorded patterns of his mother’s brain... With its soaring descriptions of the natural world, its tantalizing vision of life beyond, and its account of a father and son’s ferocious love, *Bewilderment* marks Richard Powers’s most intimate and moving novel. At its heart lies the question: How can we tell our children the truth about this beautiful, imperiled planet?

“Stylish, smart, and scary as hell.” —Chris Bohjalian, #1 *New York Times* bestselling author "A nightmarish white-knuckler." —O, *The Oprah Magazine* Oliver Park, a recovering addict from Indiana, finally has everything he ever wanted: sobriety and a loving, wealthy partner in Nathan, a prominent DC trauma surgeon. Despite their difference in age and disparate backgrounds, they’ve made a perfect life together. With everything to lose, Oliver shouldn’t be visiting Haus, a gay bathhouse. But through the entrance he goes, and it’s a line crossed. Inside, he follows a man into a private room, and it’s the final line. Whatever happens next, Nathan can never know. But then, everything goes wrong, terribly wrong, and Oliver barely escapes with his life. He races home in full-blown terror as the hand-shaped bruise grows dark on his neck. The truth will destroy Nathan and everything they have together, so Oliver does the thing he used to do so well: he lies. What follows is

a classic runaway-train narrative, full of the exquisite escalations, edge-of-your-seat thrills, and oh-my-god twists. P. J. Vernon's Bath Haus is a scintillating thriller with an emotional punch, perfect for readers curious for their next must-read novel.

Over 70 recipes that cover advanced techniques for 3D programming such as lighting, shading, textures, particle systems, and image processing with OpenGL 4.6 Key Features Explore techniques for implementing shadows using shadow maps and shadow volumes Learn to use GLSL features such as compute, geometry, and tessellation shaders Use GLSL to create a wide variety of modern, realistic visual effects Book Description OpenGL 4 Shading Language Cookbook, Third Edition provides easy-to-follow recipes that first walk you through the theory and background behind each technique, and then proceed to showcase and explain the GLSL and OpenGL code needed to implement them. The book begins by familiarizing you with beginner-level topics such as compiling and linking shader programs, saving and loading shader binaries (including SPIR-V), and using an OpenGL function loader library. We then proceed to cover basic lighting and shading effects. After that, you'll learn to use textures, produce shadows, and use geometry and tessellation shaders. Topics such as particle systems, screen-space ambient occlusion, deferred rendering, depth-based tessellation, and physically based rendering will help you tackle advanced topics. OpenGL 4 Shading Language Cookbook, Third Edition also covers advanced topics such as shadow techniques (including the two of the most common techniques: shadow maps and shadow volumes). You will learn how to use noise in shaders and how to use compute shaders. The book provides examples of modern shading techniques that can be used as a starting point for programmers to expand upon to produce modern, interactive, 3D computer-graphics applications. What you will learn Compile, debug, and communicate with shader programs Use compute shaders for physics, animation, and general computing Learn about features such as shader storage buffer objects and image load/store Utilize noise in shaders and learn how to use shaders in animations Use textures for various effects including cube maps for reflection or refraction Understand physically based reflection models and the SPIR-V Shader binary Learn how to create shadows using shadow maps or shadow volumes Create particle systems that simulate smoke, fire, and other effects Who this book is for If you are a graphics programmer looking to learn the GLSL shading language, this book is for you. A basic understanding of 3D graphics and programming experience with C++ are required.

The Definitive Vulkan™ Developer's Guide and Reference: Master the Next-Generation Specification for Cross-Platform Graphics The next generation of the OpenGL specification, Vulkan, has been redesigned from the ground up, giving applications direct control over GPU acceleration for unprecedented performance and predictability. Vulkan™ Programming Guide is the essential, authoritative reference to this new standard for experienced graphics programmers in all Vulkan environments. Vulkan API lead Graham Sellers (with contributions from language lead John Kessenich) presents example-rich introductions to the portable Vulkan API and the new SPIR-V shading language. The author introduces Vulkan, its goals, and the key concepts framing its API, and presents a complex rendering system that demonstrates both Vulkan's uniqueness and its exceptional power. You'll find authoritative coverage of topics ranging from drawing to memory, and threading to compute shaders. The author especially shows how to handle tasks such as synchronization, scheduling, and memory management that are now the developer's responsibility. Vulkan™ Programming Guide introduces powerful 3D development techniques for fields ranging from video games to medical imaging, and state-of-the-art approaches to solving challenging scientific compute problems. Whether you're upgrading from OpenGL or moving to open-standard graphics APIs for the first time, this guide will help you get the results and performance you're looking for. Coverage includes Extensively tested code examples to demonstrate Vulkan's capabilities and show how it differs from OpenGL Expert guidance on getting started and working with Vulkan's new memory system Thorough discussion of queues, commands,

moving data, and presentation Full explanations of the SPIR-V binary shading language and compute/graphics pipelines Detailed discussions of drawing commands, geometry and fragment processing, synchronization primitives, and reading Vulkan data into applications A complete case study application: deferred rendering using complex multi-pass architecture and multiple processing queues Appendixes presenting Vulkan functions and SPIR-V opcodes, as well as a complete Vulkan glossary Example code can be found here: Example code can be found here: <https://github.com/vulkanprogrammingguide/examples>

OpenGL is a powerful software interface used to produce high-quality computer generated images and interactive applications using 2D and 3D objects and color bitmaps and images. The OpenGL Programming Guide, Third Edition, provides definitive and comprehensive information on OpenGL and the OpenGL Utility Library. This book discusses all OpenGL functions and their syntax shows how to use those functions to create interactive applications and realistic color images. 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 third edition has been extensively updated to include the newest features of OpenGL, Version 1.2, including: *3D texture mapping *Multitexturing *

Master Metal: The Next-Generation Graphics and GPU Programming Platform for Apple Developers Metal enables Apple developers to maximize performance in demanding tasks like 3D graphics, games, scientific programming, visualization, and GPU-accelerated machine learning. Metal® Programming Guide is the authoritative, practical guide to Metal for all iOS programmers who are interested in graphics programming but don't know where to start. Pioneering Apple developer Janie Clayton covers everything from basic draw calls to advanced parallel computing, combining easy-to-understand conceptual explanations with well-tested Swift 4/Xcode 9 sample code (available for download at GitHub). Clayton introduces the essential Metal, graphics, and math concepts every graphics programmer needs to know. She also discusses key graphics-specific libraries, concepts, and Metal Classes, presenting techniques and examples you'll find valuable for both graphics and data processing. Clayton also provides coverage of the Metal Compute Pipeline, demonstrating practical GPU programming applications ranging from image processing to neural networking. Quickly get a basic Metal project running Work with Metal resources and memory management Learn how shaders are compiled and accessed by the CPU Program both 2D and 3D graphics with Metal Import 3D models and assets from Blender, Maya, and other programs Apply imported textures to model objects Use multipass rendering to efficiently implement computationally expensive techniques Leverage tessellation to reduce mesh detail Use the GPU for a wide spectrum of general-purpose computing applications Get started with the Metal Performance Shaders Framework

From the acclaimed Booker Prize-winning author comes a dazzling novel of family, love and love's disappointments Anna's aged mother is dying. Condemned by her children's pity to living, subjected to increasingly desperate medical interventions, she turns her focus to her hospital window, through which she escapes into visions of horror and delight. When Anna's finger vanishes and a few months later her knee disappears, Anna too feels the pull of the window. She begins to see that all around her, others are similarly vanishing, yet no one else notices. All Anna can do is keep her mother alive. But the window keeps opening wider, taking Anna and the reader ever deeper into an eerily beautiful story of grief and possibility, of loss and love and orange-bellied parrots. Hailed on publication in Australia as Richard Flanagan's greatest novel yet, *The Living Sea of Waking Dreams* is a rising ember storm illuminating what remains when the inferno beckons: one part

elegy, one part dream, one part hope.

Explore modern game programming and rendering techniques to build games using C++ programming language and its popular libraries

Key Features Learn how you can build basic 2D and complex 3D games with C++ Understand shadows, texturing, lighting, and rendering in 3D game development using OpenGL Uncover modern graphics programming techniques and GPU compute methods using the Vulkan API

Book Description Although numerous languages are currently being used to develop games, C++ remains the standard for fabricating expert libraries and tool chains for game development. This book introduces you to the world of game development with C++. C++ Game Development By Example starts by touching upon the basic concepts of math, programming, and computer graphics and creating a simple side-scrolling action 2D game. You'll build a solid foundation by studying basic game concepts such as creating game loops, rendering 2D game scenes using SFML, 2D sprite creation and animation, and collision detection. The book will help you advance to creating a 3D physics puzzle game using modern OpenGL and the Bullet physics engine. You'll understand the graphics pipeline, which entails creating 3D objects using vertex and index buffers and rendering them to the scene using vertex and fragment shaders. Finally, you'll create a basic project using the Vulkan library that'll help you get to grips with creating swap chains, image views, render passes, and frame buffers for building high-performance graphics in your games. By the end of this book, you'll be ready with 3 compelling projects created with SFML, the Vulkan API, and OpenGL, and you'll be able take your game and graphics programming skills to the next level. What you will learn

Understand shaders and how to write a basic vertex and fragment shader Build a Visual Studio project and add SFML to it Discover how to create sprite animations and a game character class Add sound effects and background music to your game Grasp how to integrate Vulkan into Visual Studio Create shaders and convert them to the SPIR-V binary format

Who this book is for If you're a developer keen to learn game development with C++ or get up to date with game development, this book is for you. Some knowledge of C++ programming is assumed.

This updated edition describes both the mathematical theory behind a modern photorealistic rendering system as well as its practical implementation. Through the ideas and software in this book, designers will learn to design and employ a full-featured rendering system for creating stunning imagery. Includes a companion site complete with source code for the rendering system described in the book, with support for Windows, OS X, and Linux.

OpenVX is the computer vision API adopted by many high-performance processor vendors. It is quickly becoming the preferred way to write fast and power-efficient code on embedded systems. OpenVX Programming Guidebook presents definitive information on OpenVX 1.2 and 1.3, the Neural Network, and other extensions as well as the OpenVX Safety Critical standard. This book gives a high-level overview of the OpenVX standard, its design principles, and overall

structure. It covers computer vision functions and the graph API, providing examples of usage for the majority of the functions. It is intended both for the first-time user of OpenVX and as a reference for experienced OpenVX developers. Get to grips with the OpenVX standard and gain insight why various options were chosen Start developing efficient OpenVX code instantly Understand design principles and use them to create robust code Develop consumer and industrial products that use computer vision to understand and interact with the real world

Thoroughly revised, this third edition focuses on modern techniques used to generate synthetic three-dimensional images in a fraction of a second. With the advent of programmable shaders, a wide variety of new algorithms have arisen and evolved over the past few years. This edition discusses current, practical rendering methods used in games and other applications. It also presents a solid theoretical framework and relevant mathematics for the field of interactive computer graphics, all in an approachable style. The authors have made the figures used in the book available for download for fair use.:Download Figures. Reviews Rendering has been a required reference for professional graphics practitioners for nearly a decade. This latest edition is as relevant as ever, covering topics from essential mathematical foundations to advanced techniques used by today's cutting edge games. -- Gabe Newell, President, Valve, May 2008 Rendering ... has been completely revised and revamped for its updated third edition, which focuses on modern techniques used to generate three-dimensional images in a fraction of the time old processes took. From practical rendering for games to math and details for better interactive applications, it's not to be missed. -- The Bookwatch, November 2008 You'll get brilliantly lucid explanations of concepts like vertex morphing and variance shadow mapping—as well as a new respect for the incredible craftsmanship that goes into today's PC games. -- Logan Decker, PC Gamer Magazine , February 2009

Using the new OpenCL (Open Computing Language) standard, you can write applications that access all available programming resources: CPUs, GPUs, and other processors such as DSPs and the Cell/B.E. processor. Already implemented by Apple, AMD, Intel, IBM, NVIDIA, and other leaders, OpenCL has outstanding potential for PCs, servers, handheld/embedded devices, high performance computing, and even cloud systems. This is the first comprehensive, authoritative, and practical guide to OpenCL 1.1 specifically for working developers and software architects. Written by five leading OpenCL authorities, OpenCL Programming Guide covers the entire specification. It reviews key use cases, shows how OpenCL can express a wide range of parallel algorithms, and offers complete reference material on both the API and OpenCL C programming language. Through complete case studies and downloadable code examples, the authors show how to write complex parallel programs that decompose workloads across many different devices. They also present all the essentials of OpenCL software performance optimization, including probing and adapting to

hardware. Coverage includes Understanding OpenCL's architecture, concepts, terminology, goals, and rationale Programming with OpenCL C and the runtime API Using buffers, sub-buffers, images, samplers, and events Sharing and synchronizing data with OpenGL and Microsoft's Direct3D Simplifying development with the C++ Wrapper API Using OpenCL Embedded Profiles to support devices ranging from cellphones to supercomputer nodes Case studies dealing with physics simulation; image and signal processing, such as image histograms, edge detection filters, Fast Fourier Transforms, and optical flow; math libraries, such as matrix multiplication and high-performance sparse matrix multiplication; and more Source code for this book is available at <https://code.google.com/p/openccl-book-samples/>

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

Work through recipes to unlock the full potential of the next generation graphics API—Vulkan About This Book This book explores a wide range of modern graphics programming techniques and GPU compute methods to make the best use of the Vulkan API Learn techniques that can be applied to a wide range of platforms desktop, smartphones, and embedded devices Get an idea on the graphics engine with multi-platform support and learn exciting imaging processing and post-

processing techniques Who This Book Is For This book is ideal for developers who know C/C++ languages, have some basic familiarity with graphics programming, and now want to take advantage of the new Vulkan API in the process of building next generation computer graphics. Some basic familiarity of Vulkan would be useful to follow the recipes. OpenGL developers who want to take advantage of the Vulkan API will also find this book useful. What You Will Learn Work with Swapchain to present images on screen Create, submit, and synchronize operations processed by the hardware Create buffers and images, manage their memory, and upload data to them from CPU Explore descriptor sets and set up an interface between application and shaders Organize drawing operations into a set of render passes and subpasses Prepare graphics pipelines to draw 3D scenes and compute pipelines to perform mathematical calculations Implement geometry projection and tessellation, texturing, lighting, and post-processing techniques Write shaders in GLSL and convert them into SPIR-V assemblies Find out about and implement a collection of popular, advanced rendering techniques found in games and benchmarks In Detail Vulkan is the next generation graphics API released by the Khronos group. It is expected to be the successor to OpenGL and OpenGL ES, which it shares some similarities with such as its cross-platform capabilities, programmed pipeline stages, or nomenclature. Vulkan is a low-level API that gives developers much more control over the hardware, but also adds new responsibilities such as explicit memory and resources management. With it, though, Vulkan is expected to be much faster. This book is your guide to understanding Vulkan through a series of recipes. We start off by teaching you how to create instances in Vulkan and choose the device on which operations will be performed. You will then explore more complex topics such as command buffers, resources and memory management, pipelines, GLSL shaders, render passes, and more. Gradually, the book moves on to teach you advanced rendering techniques, how to draw 3D scenes, and how to improve the performance of your applications. By the end of the book, you will be familiar with the latest advanced techniques implemented with the Vulkan API, which can be used on a wide range of platforms. Style and approach This recipe-based guide will empower you to implement modern graphic programming techniques and help gain a solid understanding of the new Vulkan API.

When a small-town family is pushed to the brink, how far will they go to protect one of their own? An edgy, propulsive read about what we will do in the name of love and blood Tony has always looked out for his younger brother, Nick. So when he's called to a hospital bed where Nick is lying battered and bruised after a violent sexual assault, his protective instincts flare, and a white-hot rage begins to build. As a small-town New England lawyer, Tony's wife, Julia, has cases involving kids all the time. When Detective Rice gets assigned to this one, Julia feels they're in good hands. Especially because she senses that Rice, too, understands how things can quickly get complicated. Very complicated. After all, one moment Nick was having a drink with a handsome stranger; the next, he was at the center of an investigation threatening

to tear not only him, but his entire family, apart. And now his attacker, out on bail, is disputing Nick's version of what happened. As Julia tries to help her brother-in-law, she sees Tony's desire for revenge, to fix things for Nick, getting out of control. Tony is starting to scare her. And before long, she finds herself asking: does she really know what her husband is capable of? Or of what she herself is? Exploring elements of doubt, tragedy, suspense, and justice, *The Damage* is an all-consuming read that marks the explosive debut of an extraordinary new writer.

This book looks at the increasing interest in running microscopy processing algorithms on big image data by presenting the theoretical and architectural underpinnings of a web image processing pipeline (WIPP). Software-based methods and infrastructure components for processing big data microscopy experiments are presented to demonstrate how information processing of repetitive, laborious and tedious analysis can be automated with a user-friendly system. Interactions of web system components and their impact on computational scalability, provenance information gathering, interactive display, and computing are explained in a top-down presentation of technical details. *Web Microanalysis of Big Image Data* includes descriptions of WIPP functionalities, use cases, and components of the web software system (web server and client architecture, algorithms, and hardware-software dependencies). The book comes with test image collections and a web software system to increase the reader's understanding and to provide practical tools for conducting big image experiments. By providing educational materials and software tools at the intersection of microscopy image analyses and computational science, graduate students, postdoctoral students, and scientists will benefit from the practical experiences, as well as theoretical insights. Furthermore, the book provides software and test data, empowering students and scientists with tools to make discoveries with higher statistical significance. Once they become familiar with the web image processing components, they can extend and re-purpose the existing software to new types of analyses. Each chapter follows a top-down presentation, starting with a short introduction and a classification of related methods. Next, a description of the specific method used in accompanying software is presented. For several topics, examples of how the specific method is applied to a dataset (parameters, RAM requirements, CPU efficiency) are shown. Some tips are provided as practical suggestions to improve accuracy or computational performance.

Over 60 highly focused, practical recipes to maximize your OpenGL Shading language use.

Introduction to Computer Graphics with the Vulkan API provides a beginners guide to getting started developing graphical applications. The book focuses on the practical aspects with details regarding technical changes to previous generation approaches, such as, the shift towards more efficient multithreaded solutions. The book has been formatted and designed with sample program listings and support material, so whether or not you are currently an expert in computer graphics, actively working with an existing API (OpenGL or DirectX), or completely in the dark about this mysterious topic, this book has something for you. If you're an experienced developer, you'll find this book a light refresher to the subject, and if you're deciding whether or not to delve into graphics and the Vulkan API, this book may help you make that significant decision.

In his first work of narrative nonfiction, Matthew Pearl, bestselling author of acclaimed novel *The Dante Club*, explores the little-known true story of the kidnapping of legendary pioneer Daniel Boone's daughter and the dramatic aftermath that rippled across the nation. On a quiet midsummer day in 1776, weeks after the signing of the Declaration of Independence, thirteen-year-old Jemima Boone and her friends Betsy and Fanny Callaway disappear near the Kentucky settlement of Boonesboro, the echoes of their faraway screams lingering on the air. A

Cherokee-Shawnee raiding party has taken the girls as the latest salvo in the blood feud between American Indians and the colonial settlers who have decimated native lands and resources. Hanging Maw, the raiders' leader, recognizes one of the captives as Jemima Boone, daughter of Kentucky's most influential pioneers, and realizes she could be a valuable pawn in the battle to drive the colonists out of the contested Kentucky territory for good. With Daniel Boone and his posse in pursuit, Hanging Maw devises a plan that could ultimately bring greater peace both to the tribes and the colonists. But after the girls find clever ways to create a trail of clues, the raiding party is ambushed by Boone and the rescuers in a battle with reverberations that nobody could predict. As Matthew Pearl reveals, the exciting story of Jemima Boone's kidnapping vividly illuminates the early days of America's westward expansion, and the violent and tragic clashes across cultural lines that ensue. In this enthralling narrative in the tradition of Candice Millard and David Grann, Matthew Pearl unearths a forgotten and dramatic series of events from early in the Revolutionary War that opens a window into America's transition from colony to nation, with the heavy moral costs incurred amid shocking new alliances and betrayals.

Build a 3D rendering engine from scratch while solving problems in a step-by-step way with the help of useful recipes Key Features Learn to integrate modern rendering techniques into a single performant 3D rendering engine Leverage Vulkan to render 3D content, use AZDO in OpenGL applications, and understand modern real-time rendering methods Implement a physically based rendering pipeline from scratch in Vulkan and OpenGL Book Description OpenGL is a popular cross-language, cross-platform application programming interface (API) used for rendering 2D and 3D graphics, while Vulkan is a low-overhead, cross-platform 3D graphics API that targets high-performance applications. 3D Graphics Rendering Cookbook helps you learn about modern graphics rendering algorithms and techniques using C++ programming along with OpenGL and Vulkan APIs. The book begins by setting up a development environment and takes you through the steps involved in building a 3D rendering engine with the help of basic, yet self-contained, recipes. Each recipe will enable you to incrementally add features to your codebase and show you how to integrate different 3D rendering techniques and algorithms into one large project. You'll also get to grips with core techniques such as physically based rendering, image-based rendering, and CPU/GPU geometry culling, to name a few. As you advance, you'll explore common techniques and solutions that will help you to work with large datasets for 2D and 3D rendering. Finally, you'll discover how to apply optimization techniques to build performant and feature-rich graphics applications. By the end of this 3D rendering book, you'll have gained an improved understanding of best practices used in modern graphics APIs and be able to create fast and versatile 3D rendering frameworks. What you will learn Improve the performance of legacy OpenGL applications Manage a substantial amount of content in real-time 3D rendering engines Discover how to debug and profile graphics applications Understand how to use the Approaching Zero Driver Overhead (AZDO) philosophy in OpenGL Integrate various rendering techniques into a single application Find out how to develop Vulkan applications Implement a physically based rendering pipeline from scratch Integrate a physics library with your rendering engine Who this book is for This book is for 3D graphics developers who are familiar with the mathematical fundamentals of 3D rendering and want to gain expertise in writing fast rendering engines with advanced techniques using C++ libraries and APIs. A solid understanding of C++ and basic linear algebra, as well as experience in creating custom 3D applications without using premade rendering engines is required.

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.

Beginning and experienced programmers will use this comprehensive guide to persistent memory programming. You will understand how persistent memory brings together several new software/hardware requirements, and offers great promise for better performance and faster application startup times—a huge leap forward in byte-addressable capacity compared with current DRAM offerings. This revolutionary new technology gives applications significant performance and capacity improvements over existing technologies. It requires a new way of thinking and developing, which makes this highly disruptive to the IT/computing industry. The full spectrum of industry sectors that will benefit from this technology include, but are not limited to, in-memory and traditional databases, AI, analytics, HPC, virtualization, and big data. Programming Persistent Memory describes the technology and why it is exciting the industry. It covers the operating system and hardware requirements as well as how to create development environments using emulated or real persistent memory hardware. The book explains fundamental concepts; provides an introduction to persistent memory programming APIs for C, C++, JavaScript, and other languages; discusses RMDA with persistent memory; reviews security features; and presents many examples. Source code and examples that you can run on your own systems are included. What You'll Learn Understand what persistent memory is, what it does, and the value it brings to the industry Become familiar with the operating system and hardware requirements to use persistent memory Know the fundamentals of persistent memory programming: why it is different from current programming methods, and what developers need to keep in mind when programming for persistence Look at persistent memory application development by example using the Persistent Memory Development Kit (PMDK) Design and optimize data structures for persistent memory Study how real-world applications are modified to leverage persistent memory Utilize the tools available for persistent memory programming, application performance profiling, and debugging Who This Book Is

For C, C++, Java, and Python developers, but will also be useful to software, cloud, and hardware architects across a broad spectrum of sectors, including cloud service providers, independent software vendors, high performance compute, artificial intelligence, data analytics, big data, etc.

LONGLISTED FOR THE 2021 NATIONAL BOOK AWARD IN FICTION NATIONAL BESTSELLER ONE OF BARACK OBAMA'S FAVORITE SUMMER READS "One of the best novels I've read in 2021." – Dwight Garner, The New York Times "A perfect novel—taut and seductive." —Brandon Taylor, author of Real Life and Filthy Animals "Intimacies is a haunting, precise, and morally astute novel that reads like a psychological thriller.... Katie Kitamura is a wonder." —Dana Spiotta, author of Wayward and Eat the Document A novel from the author of A Separation, an electrifying story about a woman caught between many truths. An interpreter has come to The Hague to escape New York and work at the International Court. A woman of many languages and identities, she is looking for a place to finally call home. She's drawn into simmering personal dramas: her lover, Adriaan, is separated from his wife but still entangled in his marriage. Her friend Jana witnesses a seemingly random act of violence, a crime the interpreter becomes increasingly obsessed with as she befriends the victim's sister. And she's pulled into an explosive political controversy when she's asked to interpret for a former president accused of war crimes. A woman of quiet passion, she confronts power, love, and violence, both in her personal intimacies and in her work at the Court. She is soon pushed to the precipice, where betrayal and heartbreak threaten to overwhelm her, forcing her to decide what she wants from her life.

The author offers exploration of self and practical guidance dealing with the dark side of personality based on Jung's concept of "shadow," or the forbidden and unacceptable feelings and behaviors each of us experience.

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. 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 This invaluable textbook presents a comprehensive introduction to modern competitive programming. The text highlights how competitive programming has proven to be an excellent way to learn algorithms, by encouraging the design of algorithms that actually work, stimulating the improvement of programming and debugging skills, and reinforcing the type of thinking required to solve problems in a competitive setting. The book contains many "folklore" algorithm design tricks that are known by experienced competitive programmers, yet which have previously only been formally discussed in online forums and blog posts. Topics and features: reviews the features of the C++ programming language, and

describes how to create efficient algorithms that can quickly process large data sets; discusses sorting algorithms and binary search, and examines a selection of data structures of the C++ standard library; introduces the algorithm design technique of dynamic programming, and investigates elementary graph algorithms; covers such advanced algorithm design topics as bit-parallelism and amortized analysis, and presents a focus on efficiently processing array range queries; surveys specialized algorithms for trees, and discusses the mathematical topics that are relevant in competitive programming; examines advanced graph techniques, geometric algorithms, and string techniques; describes a selection of more advanced topics, including square root algorithms and dynamic programming optimization. This easy-to-follow guide is an ideal reference for all students wishing to learn algorithms, and practice for programming contests. Knowledge of the basics of programming is assumed, but previous background in algorithm design or programming contests is not necessary. Due to the broad range of topics covered at various levels of difficulty, this book is suitable for both beginners and more experienced readers.

NEW YORK TIMES BEST SELLER • A TODAY SHOW #READWITHJENNA BOOK CLUB PICK! • The moving story of an undocumented child living in poverty in the richest country in the world—an incandescent debut from an astonishing new talent “Heartrending, unvarnished, and powerfully courageous, this account of growing up undocumented in America will never leave you.” —Gish Jen, author of *The Resisters* In Chinese, the word for America, *Mei Guo*, translates directly to “beautiful country.” Yet when seven-year-old Qian arrives in New York City in 1994 full of curiosity, she is overwhelmed by crushing fear and scarcity. In China, Qian’s parents were professors; in America, her family is “illegal” and it will require all the determination and small joys they can muster to survive. In Chinatown, Qian’s parents labor in sweatshops. Instead of laughing at her jokes, they fight constantly, taking out the stress of their new life on one another. Shunned by her classmates and teachers for her limited English, Qian takes refuge in the library and masters the language through books, coming to think of *The Berenstain Bears* as her first American friends. And where there is delight to be found, Qian relishes it: her first bite of gloriously greasy pizza, weekly “shopping days,” when Qian finds small treasures in the trash lining Brooklyn’s streets, and a magical Christmas visit to Rockefeller Center—confirmation that the New York City she saw in movies does exist after all. But then Qian’s headstrong Ma Ma collapses, revealing an illness that she has kept secret for months for fear of the cost and scrutiny of a doctor’s visit. As Ba Ba retreats further inward, Qian has little to hold onto beyond his constant refrain: Whatever happens, say that you were born here, that you’ve always lived here. Inhabiting her childhood perspective with exquisite lyric clarity and unforgettable charm and strength, Qian Julie Wang has penned an essential American story about a family fracturing under the weight of invisibility, and a girl coming of age in the shadows, who never stops seeking the light.

Now that PC users have entered the realm of programmable hardware, graphics programmers can create 3D images and animations comparable to those produced by RenderMan's procedural programs—but in real time. Here is a book that will bring this cutting-edge technology to your computer. Beginning with the mathematical basics of vertex and pixel shaders, and building to detailed accounts of programmable shader operations, *Real-Time Shader Programming* provides the foundation and techniques necessary for replicating popular cinema-style 3D graphics as well as creating your own real-time procedural shaders. A compelling writing style, color illustrations throughout, and scores of online resources make *Real-Time Shader Programming* an indispensable tutorial/reference for the game developer, graphics programmer, game artist, or visualization programmer, to create countless real-time 3D effects. * Contains a complete reference of the low-level shader language for both DirectX 8 and DirectX 9 * Provides an interactive shader demonstration tool (RenderMonkey™) for testing and experimenting * Maintains an updated version of the detailed shader reference section at www.directx.com * Teaches the latest shader programming techniques for high-performance real-time 3D graphics

Thoroughly updated, this fourth edition focuses on modern techniques used to generate synthetic three-dimensional images in a fraction of a second. With the advent of programmable shaders, a wide variety of new algorithms have arisen and evolved over the past few years. This edition discusses current, practical rendering methods used in games and o 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

"This book is a message from autistic people to their parents, friends, teachers, coworkers and doctors showing what life is like on the spectrum. It's also my love letter to autistic people. For too long, we have been forced to navigate a world where all the road signs are written in another language." With a reporter's eye and an insider's perspective, Eric Garcia shows what it's like to be autistic across America. Garcia began writing about autism because he was frustrated by the media's coverage of it; the myths that the disorder is caused by vaccines, the narrow portrayals of autistic people as white men working in Silicon Valley. His own life as an autistic person didn't look anything like that. He is Latino, a graduate of the University of North Carolina, and works as a journalist covering politics in Washington D.C. Garcia realized he needed to put into writing what so many autistic people have been saying for years; autism is a part of their identity, they don't need to be fixed. In *We're Not Broken*, Garcia uses his own life as a springboard to discuss the social and policy gaps that exist in supporting those on the spectrum. From education to healthcare, he explores how autistic people wrestle with systems that were not built with them in mind. At the same time, he shares the experiences of all types of autistic people, from those with higher support needs, to autistic people of color, to those in the LGBTQ community. In doing so, Garcia gives his community a platform to articulate their own needs, rather than having others speak for them, which has been the standard for far too long.

OpenGL® SuperBible, Fifth Edition is the definitive programmer's guide, tutorial, and reference for the world's leading 3D API for real-time computer graphics, OpenGL 3.3. The best all-around introduction to OpenGL for developers at all levels of experience, it clearly explains both the API and essential associated programming concepts. Readers will find up-to-date, hands-on guidance on all facets of modern OpenGL development, including transformations, texture mapping, shaders, advanced buffers, geometry management, and much more. Fully revised to reflect ARB's latest official specification (3.3), this edition also contains a new start-to-finish tutorial on OpenGL for the iPhone, iPod touch, and iPad. Coverage includes A practical introduction to the essentials of real-time 3D graphics Core OpenGL 3.3 techniques for rendering, transformations, and texturing Writing your own shaders, with examples to get you started Cross-platform OpenGL: Windows (including Windows 7), Mac OS X, GNU/Linux, UNIX, and embedded systems OpenGL programming for iPhone, iPod touch, and iPad: step-by-step guidance and complete example programs Advanced buffer techniques, including full-definition rendering with floating point buffers and textures Fragment operations: controlling the end of the graphics pipeline Advanced shader usage and geometry management A fully

updated API reference, now based on the official ARB (Core) OpenGL 3.3 manual pages New bonus materials and sample code on a companion Web site, www.starstonesoftware.com/OpenGL Part of the OpenGL Technical Library—The official knowledge resource for OpenGL developers 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.

One of the Washington Post's 20 Books to Read This Summer A riveting history of the epic orbital flight that put America back into the space race. If the United States couldn't catch up to the Soviets in space, how could it compete with them on Earth? That was the question facing John F. Kennedy at the height of the Cold War—a perilous time when the Soviet Union built the wall in Berlin, tested nuclear bombs more destructive than any in history, and beat the United States to every major milestone in space. The race to the heavens seemed a race for survival—and America was losing. On February 20, 1962, when John Glenn blasted into orbit aboard Friendship 7, his mission was not only to circle the planet; it was to calm the fears of the free world and renew America's sense of self-belief. Mercury Rising re-creates the tension and excitement of a flight that shifted the momentum of the space race and put the United States on the path to the moon. Drawing on new archival sources, personal interviews, and previously unpublished notes by Glenn himself, Mercury Rising reveals how the astronaut's heroics lifted the nation's hopes in what Kennedy called the "hour of maximum danger."

The next generation specification of OpenGL, Vulkan has been redesigned from the ground up, giving applications direct control over GPU acceleration for unprecedented performance and predictability. Vulkan Programming Guide is the essential, authoritative reference to this new standard, for graphics programmers at all levels of experience, in any Vulkan environment, on any platform. written by Vulkan language lead John Kessenich and Vulkan API lead Graham Sellers, this guide offers comprehensive, example-rich introductions to both the new portable Vulkan API and the new SPIR-V shading language. Kessenich and Sellers cover everything from drawing to memory, threading to compute shaders. Throughout, they present realistic sample code, and explain everything you need to know and do to get it to work. You'll learn powerful techniques you can use for 3D application development in fields ranging from videogames to medical imaging -- as well as techniques for solving many of today's most challenging scientific compute problems. Whether you're upgrading from OpenGL or moving to open-standard graphics APIs for the first time, this guide will help you get the results and performance you're looking for.

This updated bestseller provides an introduction to programming interactive computer graphics, with an emphasis on game development using DirectX 12. The book is divided into three main parts: basic mathematical tools, fundamental tasks in Direct3D, and techniques and special effects. It shows how to use new Direct12 features such as command lists, pipeline state objects, descriptor heaps and tables, and explicit resource management to reduce CPU overhead and increase scalability across multiple CPU cores. The book covers modern special effects and techniques such as hardware tessellation, writing compute shaders, ambient occlusion, reflections, normal and displacement mapping, shadow rendering, and character animation. Includes a companion DVD with code and figures. eBook Customers: Companion files are available for downloading with order number/proof of purchase by writing to the publisher at info@merclearning.com. FEATURES: • Provides an introduction to programming interactive computer graphics, with an emphasis on game development using DirectX 12 • Uses new Direct3D 12 features to reduce CPU overhead and take advantage of multiple CPU cores • Contains detailed explanations of popular real-time game effects • Includes a DVD with source code and all the images (including 4-color) from the book • Learn advance rendering techniques such as ambient occlusion, real-time reflections, normal and displacement mapping, shadow rendering, programming the geometry shader, and character animation • Covers a mathematics review and 3D rendering fundamentals such as lighting, texturing, blending and stenciling • Use the end-of-chapter exercises to test understanding and provide experience with DirectX 12

Discover how to build impressive 3D graphics with the next-generation graphics API—Vulkan About This Book Get started with the Vulkan API and its programming techniques using the easy-to-follow examples to create stunning 3D graphics Understand memory management in Vulkan and implement image and buffer resources Get hands-on with the drawing process and synchronization, and render a 3D graphics scene with the Vulkan graphics pipeline Who This Book Is For This book is ideal for graphic programmers who want to get up and running with Vulkan. It's also great for programmers who have experience with OpenGL and other graphic APIs who want to take advantage of next generation APIs. A good knowledge of C/C++ is expected. What You Will Learn Learn fundamentals of Vulkan programing model to harness the power of modern GPU devices. Implement device, command buffer and queues to get connected with the physical hardware. Explore various validation layers and learn how to use it for debugging Vulkan application. Get a grip on memory management to control host and device memory operations. Understand and implement buffer and image resource types in Vulkan. Define drawing operations in the Render pass and implement graphics pipeline. Manage GLSL shader using SPIR-V and update the shader resources with descriptor sets and push constants. Learn the drawing process, manage resources with synchronization objects and render 3D scene output on screen with Swapchain. Bring

realism to your rendered 3D scene with textures, and implement linear and optimal textures In Detail Vulkan, the next generation graphics and compute API, is the latest offering by Khronos. This API is the successor of OpenGL and unlike OpenGL, it offers great flexibility and high performance capabilities to control modern GPU devices. With this book, you'll get great insights into the workings of Vulkan and how you can make stunning graphics run with minimum hardware requirements. We begin with a brief introduction to the Vulkan system and show you its distinct features with the successor to the OpenGL API. First, you will see how to establish a connection with hardware devices to query the available queues, memory types, and capabilities offered. Vulkan is verbose, so before diving deep into programming, you'll get to grips with debugging techniques so even first-timers can overcome error traps using Vulkan's layer and extension features. You'll get a grip on command buffers and acquire the knowledge to record various operation commands into command buffer and submit it to a proper queue for GPU processing. We'll take a detailed look at memory management and demonstrate the use of buffer and image resources to create drawing textures and image views for the presentation engine and vertex buffers to store geometry information. You'll get a brief overview of SPIR-V, the new way to manage shaders, and you'll define the drawing operations as a single unit of work in the Render pass with the help of attachments and subpasses. You'll also create frame buffers and build a solid graphics pipeline, as well as making use of the synchronizing mechanism to manage GPU and CPU hand-shaking. By the end, you'll know everything you need to know to get your hands dirty with the coolest Graphics API on the block. Style and approach This book takes a practical approach to guide you through the Vulkan API, and you will get to build an application throughout the course of the book. Since you are expected to be familiar with C/C++, there is not much hand-holding throughout the course of the book.

Computer Graphics from Scratch demystifies the algorithms used in modern graphics software and guides beginners through building photorealistic 3D renders. Computer graphics programming books are often math-heavy and intimidating for newcomers. Not this one. Computer Graphics from Scratch takes a simpler approach by keeping the math to a minimum and focusing on only one aspect of computer graphics, 3D rendering. You'll build two complete, fully functional renderers: a raytracer, which simulates rays of light as they bounce off objects, and a rasterizer, which converts 3D models into 2D pixels. As you progress you'll learn how to create realistic reflections and shadows, and how to render a scene from any point of view. Pseudocode examples throughout make it easy to write your renderers in any language, and links to live JavaScript demos of each algorithm invite you to explore further on your own. Learn how to:

- Use perspective projection to draw 3D objects on a 2D plane
- Simulate the way rays of light interact with surfaces
- Add mirror-like reflections and cast shadows to objects
- Render a scene from any camera position using clipping planes

Use flat, Gouraud, and Phong shading to mimic real surface lighting • Paint texture details onto basic shapes to create realistic-looking objects Whether you're an aspiring graphics engineer or a novice programmer curious about how graphics algorithms work, Gabriel Gambetta's simple, clear explanations will quickly put computer graphics concepts and rendering techniques within your reach. All you need is basic coding knowledge and high school math. Computer Graphics from Scratch will cover the rest.

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