Unity Documentation

Table of Contents

Unity User Manual 2023.2 	•
Documentation versions	2
Offline documentation	3
Trademarks and terms of use	4
New in Unity 2023.2	5
Packages and feature sets	6
Released packages	7
2D Animation 	8
2D Aseprite Importer 	Ş
2D Pixel Perfect 	10
2D PSD Importer 	1′
2D SpriteShape 	12
2D Tilemap Extras 	13
Adaptive Performance 	14
Addressables 	15
Addressables for Android 	16
Ads Mediation 	17
Advertisement Legacy 	18
Al Navigation 	19
Alembic 	20
Analytics 	2′
Android Logcat 	22
Animation Rigging 	23
Apple ARKit XR Plugin 	24
AR Foundation 	25
Authentication 	26
Build Automation 	27
Burst 	28
CCD Management 	29

Cinemachine 	30
Cloud Diagnostics 	31
Cloud Save 	32
Code Coverage 	33
Collections 	34
Deployment 	35
Device Simulator Devices 	36
Economy 	37
Editor Coroutines 	38
FBX Exporter 	39
Friends 	40
Google ARCore XR Plugin 	41
In App Purchasing 	42
Input System 	43
iOS 14 Advertising Support 	44
JetBrains Rider Editor 	45
Leaderboards 	46
Live Capture 	47
Lobby 	48
Localization 	49
Magic Leap XR Plugin 	50
Matchmaker 	51
Mathematics 	52
Memory Profiler 	53
ML Agents 	54
Mobile Notifications 	55
Multiplayer Tools 	56
Netcode for GameObjects 	57
Oculus XR Plugin 	58
OpenXR Plugin 	59
Player Accounts 	60
Polybrush 	61
Post Processing 	62
ProBuilder 	63
Profile Analyzer 	64

Python Scripting 66	
Recorder 67	
Relay 68	
Remote Config 69	
Scriptable Build Pipeline 70	
Sequences 71	
Splines 72	
Sysroot Base 73	
Sysroot Linux x64 74	
System Metrics Mali 75	
Terrain Tools 76	
Test Framework 77	
Timeline 78	
Toolchain Linux x64 79	
Toolchain MacOS Linux x64 <td></td>	
Toolchain Win Linux x64 81	
Tutorial Authoring Tools 82	
Tutorial Framework 83	
Unity Distribution Portal 84	
Unity OpenXR Meta 85	
Unity Profiling Core API 86	
Unity Transport 87	
User Generated Content 88	
User Generated Content Bridge 89	
User Reporting 90	
Version Control 91	
Visual Scripting 92	
Visual Studio Editor 93	
WebGL Publisher 94	
XR Hands 95	
XR Interaction Toolkit 96	
XR Plugin Management 97	
ZivaRT Player 98	
Release candidates 99	

Pre-release packages	100
Cloud Code 	101
Entities 	102
Entities Graphics 	103
Havok Physics for Unity 	104
Moderation 	105
Multiplay 	106
Netcode for Entities 	107
Unity Logging 	108
Unity Physics 	109
Vivox 	110
Core packages	111
2D Sprite 	112
2D Tilemap Editor 	113
Core RP Library 	114
High Definition RP 	115
Shader Graph 	116
Unity Denoising 	117
Unity UI 	118
Universal RP 	119
Visual Effect Graph 	120
Built-in packages	121
Accessibility 	122
AI 	123
Android JNI 	124
Animation 	125
Asset Bundle 	126
Audio 	127
Cloth 	128
Director 	129
Image Conversion 	130
IMGUI 	131
JSONSerialize 	132
NVIDIA 	133
Particle System 	134

Physics 	135
Physics 2D 	136
Screen Capture 	137
Terrain 	138
Terrain Physics 	139
Tilemap 	140
UI 	141
UIElements 	142
Umbra 	143
Unity Analytics 	144
Unity Web Request 	145
Unity Web Request Asset Bundle	e 14∕6 :
Unity Web Request Audio 	147
Unity Web Request Texture 	148
Unity Web Request WWW 	149
Vehicles 	150
Video 	151
VR 	152
Wind 	153
XR 	154
Experimental packages	155
Packages by keywords 	156
Deprecated packages	157
Unity's Package Manager	158
How Unity works with packages	159
Concepts	160
Package types	161
Package states and lifecycle	162
Dependency and resolution	163
Global cache	164
Configuration	165
Solving network issues	166
Scoped registry authentication	167
Customize the global cache	168
Customize the asset package cache location	169

Using private repositories with HTTPS Git URLs	170
Using passphrase-protected SSH keys with SSH Git URLs	⊲⁄ ā\$
Loading SSH keys automatically on Windows (OpenSS	S H172 /a>
Loading SSH keys automatically on Windows (PuTT	'Y1)728a>
Loading SSH keys automatically on macOS<td>>174</td>	>174
Package Manager window	175
Access the Package Manager window	176
Navigation panel	177
List panel	178
Details panel	179
Features (details panel)	180
Finding packages and feature sets	181
Packages list context	182
Sorting the list	183
Filtering the list	184
Search box	185
Add and remove UPM packages or feature sets	186
Install a feature set from the Unity registry	187
Install a UPM package from a registry	188
Install a UPM package from the Asset Store	189
Install a UPM package from a local folder	190
Install a UPM package from a local tarball file	191
Install a UPM package from a Git URL	192
Install a UPM package by name	193
Remove a UPM package from a project	194
Switch to another version of a UPM package	195
Add and remove asset packages	196
Download and import an asset package	197
Update an asset package	198
Remove imported assets from a project	199
Delete an asset package from the cache	200
Disable a built-in package	201
Perform an action on multiple packages	202
Finding package documentation	203
Inspecting packages	204

Package Manifest window	205
· · · · · · · · · · · · · · · · · · ·	206
Scripting API for packages	
Accessing package assets	207
Scoped registries	208
Resolution and conflict	209
Lock files	210
Project manifest	211
Embedded dependencies	212
Git dependencies	213
Local folder or tarball paths	214
Troubleshooting	215
Diagnose network issues	216
Creating custom packages	217
Naming your package	218
Package layout	219
Adding tests to a package	220
Creating samples for packages	221
Package manifest	222
Versioning	223
Assembly definition and packages	224
Meeting legal requirements	225
Documenting your package	226
Sharing your package	227
Feature sets	228
2D feature set	229
3D Characters and Animation feature set	230
3D World Building feature set	231
AR feature set	232
Cinematic Studio feature set	233
Engineering feature set	234
Gameplay and Storytelling feature set	235
Mobile feature set	236
VR feature set	237
Install Unity	238
System requirements for Unity 2023.2	239

Install Unity from the command line	240
Install Unity offline without the Hub	241
Deploy Unity across your enterprise	242
Enable Unity installation by standard users (Windows)	243
Using Unity through web proxies	244
Enable automatic proxy configuration	245
Store credentials for automatic proxy configuration	∕2 46
Trusting the web proxy security certificate	247
Use environment variables to identify your web proxy	a 2 48
Create a command file to set environment variables and open appl	i 2al9 ons
Define exceptions on your web proxy	250
Licenses and activation	251
Licensing overview	252
License activation methods	253
Manage your license through the command line<td>>254</td>	>254
Manual license activation	255
Submit a license request from the Hub	256
Submit a license request from a command line and browser (V	√21557 ows)
a href='ManualActivationCmdMac'>Submit a license request from a command line and browser (mad	c 25 33 Linux)
License troubleshooting	259
Upgrade Unity	260
API updater	261
Upgrade to Unity 2023.2	262
Upgrade to Unity 2023.1	263
Upgrade to Unity 2022 LTS	264
Upgrade to Unity 2022.2	265
Upgrade to Unity 2022.1	266
Upgrade to Unity 2021 LTS	267
Upgrade to Unity 2020 LTS	268
Upgrading to Unity 2019 LTS	269
Create with Unity	270
2D or 3D projects	271
Unity's interface	272
The Project window	273

The Scene view

274

Overlays	275
Default Scene view overlay reference	276
Display or hide an overlay	277
Position an overlay	278
Manage overlay layouts	279
Create and manage overlay configurations	<22869
Cameras overlay	281
Create your own overlay	282
Position GameObjects	283
Grid snapping	284
Scene view navigation	285
Scene view Camera	286
Control a camera in first person	287
Pick and select GameObjects	288
Scene visibility	289
Scene view View Options toolbar	290
Gizmos menu	291
Scene view context menu	292
Custom Editor tools	293
The Game view	294
Device Simulator	295
Device Simulator introduction	296
The Simulator view	297
Simulated classes	298
Adding a device	299
Extending the device simulator	300
The Hierarchy window	301
The Inspector window	302
Working in the Inspector	303
Focused Inspectors	304
Editing properties	305
The Toolbar	306
The status bar	307
The Background Tasks window	308
Console Window	309

Additional windows	310
Undo	311
Search in the Editor	312
Customizing your workspace	313
Unity shortcuts	314
Quickstart guides	315
3D game development quickstart guide	316
Creating a 3D game	317
Advanced best practice guides	318
Create Gameplay	319
Scenes	320
Creating, loading, and saving Scenes	321
Work with multiple scenes in Unity	322
Set up multiple scenes	323
Bake data in multiple scenes	324
Use scripts to edit multiple scenes	325
Scene Templates	326
Creating scene templates	327
Editing scene templates	328
Customizing new scene cre	eation29a:
Scene template settings	330
GameObjects	331
Transforms	332
Introduction to components	333
Use components	334
Primitive and placeholder objects	335
Types of 2D primitive GameObjects	336
Create components with scripts	337
Deactivate GameObjects	338
Tags	339
Static GameObjects	340
Save your work	341
Prefabs	342
Creating Prefabs	343
Editing a Prefab in Prefab Mode	344

Instance overrides	345
Editing a Prefab via its instances	346
Nested Prefabs	347
Prefab Variants	348
Overrides at multiple levels	349
Unused Overrides	350
Unpacking Prefab instances	351
Layers	352
Uses of layers in Unity	353
Create functional layers in Unity	354
Layer-based collision detection	355
Layers and layerMasks	356
Set a layerMask	357
Add a layer to a layerMask	358
Remove a layer from a layerMask	359
Constraints	360
Aim Constraints	361
Look At Constraints	362
Parent Constraints 	363
Position Constraints	364
Rotation Constraints	365
Scale Constraints	366
Rotation and orientation in Unity	367
Lights	368
Cameras	369
Cross-Platform Considerations	370
Publishing Builds	371
Reducing the file size of your build	372
Build Player Pipeline	373
Troubleshooting	374
Editor Features	375
2D and 3D mode settings	376
Preferences	377
Shortcuts Manager	378
Build Settings	379

Incremental build pipeline	380
Project Settings	381
Audio	382
Editor	383
Graphics	384
Package Manager	385
Physics	386
Physics 2D reference	387
Player	388
Splash Image Player settings	389
Preset Manager	390
Quality	391
Script Execution Order settings	392
Tags and Layers	393
Time	394
UI Toolkit project settings	395
Visual Studio C# integration	396
RenderDoc Integration	397
Editor analytics	398
Check For Updates	399
IME in Unity	400
Version Control	401
Version control integrations	402
Perforce Integration	403
Smart merge	404
Safe Mode	405
Command-line arguments	406
Unity Editor command line arguments	>407
Unity Standalone Player command line argume	n 4s08 /a>
Batch mode and built-in coroutine compatibility<!--</td--><td>a409</td>	a 4 09
Text-Based Scene Files	410
Format of Text Serialized files	411
UnityYAML	412
An Example of a YAML Scene File	413
YAML Class ID Reference	414

Troubleshoot the Editor	415
Analysis	416
Memory in Unity	417
Managed memory	418
Garbage collector overview	419
Incremental garbage collection	0442/Qa>
Disabling garbage collection<	<b 4a2≥1
Garbage collection best practices'	ti d@ \$
Native memory	423
Dynamic heap allocator	424
Bucket allocator	425
Dual thread allocator	426
Thread Local Storage (TLS) stack allocator	42 ₹
Thread-safe linear allocator<td>>428</td>	>428
Customize allocators	429
Profiler overview	430
Profiling your application	431
Common Profiler markers	432
The Profiler window	433
Asset Loading Profiler module	434
Audio Profiler module	435
CPU Usage Profiler module	436
File Access Profiler module	437
Global Illumination Profiler module	438
GPU Usage Profiler module	439
Highlights Profiler Module	440
Memory Profiler module	441
Physics Profiler module	442
Physics 2D Profiler module	443
Rendering Profiler module	444
UI and UI Details Profiler	445
Video Profiler module	446
Virtual Texturing Profiler module	447
Customizing the Profiler	448
Creating custom Profiler counters<td>>449</td>	>449

Creating Custom Profiler modules<th>>450</th>	>450
Profiler Module Editor	451
Creating a custom module details panel<	<b 452
Low-level native plug-in Profiler API	453
Profiling tools	454
Analyzing profiler traces	455
Log files	456
Understanding optimization in Unity	457
Asset auditing	458
Strings and text	459
The Resources folder	460
General Optimizations	a ≱ 61
Special optimizations<td>×462</td>	× 462
Asset loading metrics	463
Asset workflow	464
Importing assets	465
Importing assets simultaneously	466
Supported Asset Types	467
Built-in Importers	468
Scripted Importers	469
Importer Consistency	470
Text assets	471
Asset Metadata	472
The Asset Database	473
Refreshing the Asset Database	474
Customizing the Asset Database workflow	⁄4ā5
Batching with the AssetDatabase	476
Special folder names	477
Import Activity window	478
Presets	479
Supporting presets	480
Applying default presets to Assets by folder	481
AssetBundles	482
AssetBundle workflow	483
Preparing Assets for AssetBundles	484

AssetBundle Dependencies	485
Output of the Build	486
Using AssetBundles Natively	487
AssetBundle compression and caching	488
Patching with AssetBundles	489
Troubleshooting	490
AssetBundle Download Integrity and Security	491
Multi-Process AssetBundle Building (Experimental)	492
Scripting with Assets	493
Loading Resources at Runtime	494
Streaming Assets	495
a href='ModifyingSourceAssetsThroughScripting'>Modifying Source Assets Through Scriptin	n 49 6a:
Asset packages	497
Create and export asset packages	498
Importing local asset packages	499
Removing local asset packages	500
Archives	501
Input	502
Input Manager	503
Mobile device input	504
Mobile Keyboard	505
Unity XR Input	506
2D game development	507
Introduction to 2D	508
2D game development quickstart guide	509
Game perspectives for 2D games	510
Art styles for 2D games	511
Initial setup for 2D games	512
Creating a 2D game	513
2D Sorting	514
Work with sprites	515
Import images as sprites	516
Sort sprites	517
Sprite Renderer	518
Sprite Creator	519

Sprite Editor	520
Use the Sprite Editor	521
Automatic slicing	522
Resize polygons	523
Sprite Editor: Custom Outline	524
Sprite Editor: Custom Physics Shape	525
Sprite Editor: Secondary Textures	526
Sprite Editor Data Provider API	527
Sorting Groups	528
9-slicing Sprites 	529
Sprite Masks	530
Sprite Atlas	531
Sprite Atlas properties reference	532
Master and Variant Sprite Atlases	533
Variant Sprite Atlas	534
Sprite Atlas workflow	535
Preparing Sprite Atlases for distribution	536
Methods of distribution	537
Late Binding 	538
Resolving different Sprite Atlas scenarios	539
Sprite Packer Modes	540
Sprite Atlas V2	541
Sprite Shape Renderer	542
Tilemaps	543
Essential tilemap steps and tools	544
Active brush	545
Active brush shortcuts reference	546
Create Tilemaps	547
Create Tiles	548
Create a Tile Palette	549
Tile Palette editor tools	550
Using the Select tool	551
Select tiles with the Select tool	552
Grid Selection Properties reference	553
Modify Tilemap reference	554

Move selected tiles with the Move tool	555
Paint tiles with the Paint tool	556
Use the Box Fill tool to fill an area with duplicated tiles	s 85 7>
Select tiles on the tilemap or Tile Palette with the Pick to	o\$ 5/8 i>
Remove tiles from the tilemap with the Eraser tool<	/ ā5 9
Fill an empty area with tiles with the Flood Fill tool<	£60
Brush Picks	561
Introduction to Brush Picks	562
Tile Palette Brush Picks overlay reference<td>×563</td>	× 563
Using a Brush Pick	564
Create a Brush Pick asset	565
Customize a scriptable Brush's thumbnail<	/ 56 6
Tilemap Collider 2D component reference	567
Hexagonal Tilemaps	568
Isometric Tilemaps	569
a href='Tilemap-Isometric-SpritesImport'>Importing and preparing Sprites for an Isometric Til	€770 0p
Creating an Isometric Tilemap	571
Creating a Tile Palette for an Isometric Tilemap<!--</td--><td>a572</td>	a572
Tilemap Renderer Modes	573
Scriptable Brushes	574
Scriptable Tiles	575
TileBase	576
Tile	577
TileData	578
TileAnimationData	579
Other useful classes	580
Scriptable Tile example	581
Scriptable Brushes	582
GridBrushBase	583
GridBrushEditorBase<td>×584</td>	×584
TilemapEditorTool	585
Other useful classes	586
Scriptable Brush example	587
Tile Palette visual elements	588
Tilemap component reference	589

Grid component reference	590
Tilemap Renderer component reference	591
Tile asset reference	592
Tile Palette preferences reference	593
Tile Palette editor reference	594
Physics 2D Reference	595
Rigidbody 2D	596
Introduction to Rigidbody 2D	597
Rigidbody 2D body types	598
Body Type: Dynamic	599
Body Type: Kinematic	600
Body Type: Static	601
Rigidbody 2D properties: Simulated	602
Collider 2D	603
Circle Collider 2D component reference	604
Box Collider 2D component reference	605
Polygon Collider 2D component reference	606
Edge Collider 2D component reference	607
Capsule Collider 2D component reference	608
Composite Collider 2D component reference	a 6 09
Custom Collider 2D component reference	610
Physics Material 2D	611
2D joints	612
Constraints of 2D joints	613
Distance Joint 2D	614
Fixed Joint 2D	615
Friction Joint 2D	616
Hinge Joint 2D	617
Relative Joint 2D	618
Slider Joint 2D	619
Spring Joint 2D	620
Target Joint 2D	621
Wheel Joint 2D	622
Constant Force 2D	623
Fffectors 2D	624

Area Effector 2D	625
Buoyancy Effector 2D	626
Point Effector 2D	627
Platform Effector 2D	628
Surface Effector 2D	629
Graphics	630
Render pipelines	631
Render pipelines introduction	632
Render pipeline feature comparison<td>>633</td>	>633
How to get, set, and configure the active render pip	e 6i64< /a>
Choosing and configuring a render pipeline and lighting s	s 6135 ion
Using the Built-in Render Pipeline	636
Graphics tiers	637
Rendering paths in the Built-in Render Pipeline	638
Forward rendering path	639
Deferred Shading rendering path	640
Vertex Lit Rendering Path	641
Rendering order in the Built-in Render Pipeline<td>>642</td>	>642
Extending the Built-in Render Pipeline with CommandB	u 6f4:3 s
Hardware requirements for the Built-in Render	P@deline
Example shaders for the Built-in Render Pipeline<	/262 45
Custom shader fundamentals	>646
Visualizing vertex data	647
Using the Universal Render Pipeline	648
Using the High Definition Render Pipeline	>649
Scriptable Render Pipeline fundamentals	650
Scriptable Render Pipeline introduction	- €5\$
rp-using-scriptable-render-context'>Scheduling and executing rendering commands in the Scripta	ıb 652 Render Pipe
Creating a custom render pipeline	653
href='srp-custom-getting-started'>Creating a custom render pipeline based on the Scriptable Ren	n 665 4Pipeline
pipeline-asset-and-render-pipeline-instance'>Creating a Render Pipeline Asset and Render Pipeli	n ẽ55 stance in a
Creating a simple render loop in a custom render p	ip @5i6 e
Cameras	657
Using more than one camera	658
Using Physical Cameras	659

Cameras and depth textures	660
Camera Tricks	661
Understanding the View Frustum	662
The Size of the Frustum at a Given Distance from the Can	m 6663
Rays from the Camera	664
Using an oblique frustum	665
Occlusion culling	666
Getting started with occlusion culling	667
Using occlusion culling with dynamic GameO	06/68cts
Occlusion culling and Scene loading	669
Occlusion Areas	670
Occlusion Portals	671
The Occlusion Culling window 	672
Occlusion culling additional resources<	<66753
CullingGroup API	674
Dynamic resolution	675
FrameTimingManager	676
Deep learning super sampling	677
Multi-display	678
Camera component	679
Lighting	680
Introduction to lighting	681
Light sources	682
Lights	683
Types of light	684
Using Lights	685
Light Modes	686
Light Mode: Realtime	687
Light Mode: Mixed	688
Light Mode: Baked	689
Cookies	690
Creating cookies for the Built-in Render	P69€line
Emissive materials	692
Ambient light	693
Shadows	694

Shadow mapping	695
Configuring shadows	696
Shadow Distance	697
Shadow Cascades	698
Shadow troubleshooting	699
The Lighting window	700
Lighting Settings Asset	701
Lighting Mode	702
Lighting Mode: Baked Indirect	703
Lighting Mode: Shadowmask	704
Lighting Mode: Subtractive	705
The Light Explorer window	706
Light Explorer extension	707
Lightmapping	708
The Progressive Lightmapper	709
The Progressive GPU Lightmapper	710
Lightmapping: Getting started	711
Preview lightmapping	712
Lightmap Parameters Asset	713
Directional Mode	714
Ambient occlusion	715
Lightmaps: Technical information	716
Lightmapping and shaders	717
Lightmap UVs introduction	718
Lightmap UVs introduction	719
Generating lightmap UVs<td>₃₮20</td>	₃₮20
Visualizing lightmap UVs	721
Fixing lightmap UV overlap	722
Lightmap seam stitching	723
Custom fall-off	724
Realtime Global Illumination using Enlighten	· 725
LOD and Enlighten Realtime Global Illumination	726
Light Probes	727
Light Probes: Technical information	>728
Light Probe Groups	729

Placing Light Probes using scripting	730
Light Probes for moving objects	731
Light Probes and the Mesh Renderer	732
Light Probes and Scene loading	733
Move Light Probes at runtime	734
Light Probe Proxy Volume component	735
Light Probes reference	736
Reflection Probes	737
Types of Reflection Probe	738
Using Reflection Probes	739
Advanced Reflection Probe Features	740
Reflection Probe performance	741
Reflection Probe	742
Precomputed lighting data	743
Generating lighting data	744
Lighting Data Asset	745
Global Illumination (GI) cache	746
Debug Draw Modes for lighting	747
Models	748
Creating models outside of Unity	749
Model file formats	750
Support for proprietary model file formats	s <i>₹.5</i> a1⊳
Preparing your model files for export	752
Creating models for optimal performance	a ≯ 53
Creating models for animation	754
Importing models into Unity	755
Importing a model	756
Importing a model with humanoid animations	757
Importing a model with non-humanoid (generic) animations	s <i>₹5</i> 58>
Model Import Settings window	759
Model tab	760
Rig tab	761
Avatar Mapping tab	762
Avatar Muscle & Settings tab	763
Avatar Mask window	764

Human Template window	765
Animation tab	766
Euler curve resampling	767
Extracting animation clips	768
Loop optimization on Animation clips	769
Curves	770
Events	771
Mask	772
Motion	773
Materials tab	774
SketchUp Import Settings window	775
SpeedTree Import Settings window	776
Model tab	777
Materials tab	778
Meshes	779
Meshes introduction	780
Mesh data	781
Mesh asset	782
Mesh components	783
Mesh Renderer component	784
Skinned Mesh Renderer component	785
Mesh Filter component	786
Text Mesh component (legacy)	787
Using meshes with C# scripts	788
Using the Mesh Class	789
Example: creating a quad	790
Level of Detail (LOD) for meshes	791
LOD Group	792
Importing LOD Meshes	793
Compressing mesh data	794
Loading texture and mesh data	795
Textures	796
Importing Textures	797
Texture Import Settings	798
Default Import Settings reference	799

Normal map Import Settings reference	800
Editor GUI and Legacy GUI Import Settings r	re 8e/1 ence
Sprite (2D and UI) Import Settings reference	802
Cursor Import Settings reference	803
Cookie Import Settings reference	804
Lightmap Import Settings reference	805
Directional Lightmap Import Settings referer	10 8 96a>
Shadowmask Import Settings reference 807	
Single Channel Import Settings reference	ı > 808
Texture formats	809
a href='class-TextureImporterOverride'>Recommended, default, and supported texture formats,	b %†0 atform
Mipmaps	811
Mipmaps introduction	812
The Mipmap Streaming system	813
The Mipmap Streaming system API	814
Streaming Controller component	815
Render Texture	816
Custom Render Textures	817
Movie Textures	818
3D textures	819
Texture arrays	820
Cubemaps	821
Cubemap arrays	822
Streaming Virtual Texturing	823
Streaming Virtual Texturing requirements and compa	at 82/4 ty
How Streaming Virtual Texturing works	825
Enabling Streaming Virtual Texturing in your project<!--</td--><td>a826</td>	a 8 26
Using Streaming Virtual Texturing in Shader Graph-	8227</td
Cache Management for Virtual Texturing	828
Marking textures as "Virtual Texturing Only"	829
Virtual Texturing error material	830
Sparse Textures	831
Loading texture and mesh data	832
Shaders	833

Shaders core concepts

834

Shaders introduction	835
The Shader class	836
Shader assets	837
Shader compilation	838
Asynchronous shader compilation<td>>839</td>	>839
Branching, variants, and keywords	840
Conditionals in shaders	841
Branching in shaders	842
Shader variants	843
Check how many shader variants you have<!--</td--><td>a844</td>	a 8 44
Shader keywords	845
Using shader keywords with C# scripts	846
Using shader keywords with the material Ins	p &¢₹ or
Shader variant stripping	848
Shader variant collections	849
How Unity loads and uses shaders	850
Replacing shaders at runtime	851
Compute shaders	852
Error and loading shaders	853
Built-in shaders	854
Standard Shader	855
Content and Context	856
Metallic vs. specular workflow	857
Make a material transparent	858
Standard Shader Material Inspector refere	:1 8559
Rendering Mode<!--</td--><td>a860</td>	a8 60
Albedo	861
Specular mode: Specular Properties	e 866 2/a>
Metallic mode: Metallic Proper	t y86/3 1>
Smoothness	864
Normal map (Bump mappir	1 63)65 a>
Heightmap	866
Occlusion Map	>867
Emission	868
Secondary Maps (Detail Maps) & Deta	ıi8 16/9 ask

The Fresnel Effect	870
Material charts	871
Make your own	872
Standard Particle Shaders	873
Autodesk Interactive shader	874
Legacy Shaders	875
Usage and Performance of Built-in Shaders	876
Normal Shader Family	877
Vertex-Lit	878
Diffuse	879
Specular	880
Bumped Diffuse	881
Bumped Specular	882
Parallax Diffuse	883
Parallax Bumped Specular	884
Decal	885
Diffuse Detail	886
Transparent Shader Family	887
Transparent Vertex-Lit	888
Transparent Diffuse	889
Transparent Specular	890
Transparent Bumped Diffuse	891
Transparent Bumped Specular	892
Transparent Parallax Diffuse	893
Transparent Parallax Specular	894
Transparent Cutout Shader Family<td>>895</td>	>895
Transparent Cutout Vertex-Lit	896
Transparent Cutout Diffuse	897
Transparent Cutout Specular	898
Transparent Cutout Bumped Diffuse	389 9
Transparent Cutout Bumped Specular	-2/0 6
Self-Illuminated Shader Family	901
Self-Illuminated Vertex-Lit	902
Self-Illuminated Diffuse	903
Self-Illuminated Specular	904

Self-Illuminated Normal mapped Diffuse	4985
Self-Illuminated Normal mapped Specular	290B>
Self-Illuminated Parallax Diffuse	907
Self-Illuminated Parallax Specular<td>a908</td>	a 9 08
Reflective Shader Family	909
Reflective Vertex-Lit	910
Reflective Diffuse	911
Reflective Specular	912
Reflective Bumped Diffuse	913
Reflective Bumped Specular	914
Reflective Parallax Diffuse	915
Reflective Parallax Specular	916
Reflective Normal Mapped Unlit	917
Reflective Normal mapped Vertex-lit-	<9a>8
Using Shader Graph	919
Writing shaders	920
Writing shaders overview	921
ShaderLab	922
ShaderLab: defining a Shader object	923
ShaderLab: defining material properties	924
ShaderLab: assigning a fallback	925
ShaderLab: assigning a custom editor	926
ShaderLab: defining a SubShader	927
ShaderLab: assigning tags to a SubShader	928
ShaderLab: assigning a LOD value to a SubShader<td>a929</td>	a 9 29
ShaderLab: defining a Pass	930
ShaderLab: assigning a name to a Pass	931
ShaderLab: assigning tags to a Pass	932
a href='shader-predefined-pass-tags-built-in'>ShaderLab: Predefined Pass tags in the Built-in R	ക്കൂള്ള Pipeline<
ShaderLab: adding shader programs	>934
ShaderLab: specifying package requirements<	/ 8 35
ShaderLab: commands	936
ShaderLab: grouping commands with the Category block<td>ı∌37</td>	ı ∌ 37
ShaderLab command: AlphaToMask	938
ShaderLab command: Blend	939

ShaderLab command: BlendOp	940
ShaderLab command: ColorMask	941
ShaderLab command: Conservative	942
ShaderLab command: Cull	943
ShaderLab command: Offset	944
ShaderLab command: Stencil	945
ShaderLab command: UsePass	946
ShaderLab command: GrabPass	947
ShaderLab command: ZClip	948
ShaderLab command: ZTest	949
ShaderLab command: ZWrite	950
ShaderLab legacy functionality	951
ShaderLab: legacy fog	952
ShaderLab: legacy lighting	953
ShaderLab: legacy alpha testing	954
ShaderLab: legacy texture combining	955
ShaderLab: legacy vertex data channel mapping<!--</td--><td>/2556</td>	/25 56
HLSL in Unity	957
Preprocessor directives in HLSL	958
include and include_with_pragmas directives in HI	.95 9/a>
Provide information to the shader compiler in HLSL	. 4/6 0
Targeting shader models and GPU features in HI	961 k/a:
Targeting graphics APIs and platforms in HLS	19623>
Declaring and using shader keywords in HLS	1963>
Shader semantics	964
Accessing shader properties in Cg/HLSL	965
Providing vertex data to vertex programs	966
Built-in shader include files	967
Built-in macros	968
Built-in shader helper functions	969
Built-in shader variables	970
Shader data types and precision	971
Using sampler states	972
GLSL in Unity	973
Example shaders	974

Writing Surface Shaders	975
Surface Shaders and rendering paths	976
Surface Shader examples	977
Custom lighting models in Surface Shaders<	/a 9 78
Surface Shader lighting examples<	:/a 9 79
Surface Shaders with DX11 / OpenGL Core Tess	se l923:0 on
Writing shaders for different graphics APIs	981
Understanding shader performance	982
Optimizing shader runtime performance	983
Debugging shaders using Visual Studi	0484
Debugging DirectX 12 shaders with PIX	> 985
Materials	986
Materials introduction	987
Material Inspector reference	988
Physically Based Rendering Material Validator	989
Using materials with C# scripts	990
Material Variants	991
Material Variant benefits and limitations	992
Material Variant inheritance	993
Create, modify, and apply Material Variants	994
Visual effects	995
Post-processing and full-screen effects	996
Particle systems	997
Choosing your particle system solution<td>> 998</td>	> 998
Built-in Particle System	999
Using the Built-in Particle System	1000
Particle System vertex streams and Standard Shader st	u 100001 t
Particle System GPU Instancing	1002
Particle System C# Job System integra	a 1 i003/a>
Components and Modules	1004
Particle System	1005
Particle System modules	1006
Main module	1007
Emission module	1008
Shape module	1009

Velocity over Lifetime module	1010
Noise module	1011
Limit Velocity over Lifetime module-	<!--8</b-->\$2
Inherit Velocity module	1013
Lifetime by Emitter Speed mod	∆1100 14.4 a>
Force over Lifetime module	1015
Color over Lifetime module	1016
Color by Speed module	1017
Size over Lifetime module	1018
Size by Speed module	1019
Rotation over Lifetime module	1020
Rotation by Speed module	1021
External Forces module	1022
Collision module	1023
Triggers module	1024
Sub Emitters module	1025
Texture Sheet Animation module	ab026
Lights module	1027
Trails module	1028
Custom Data module	1029
Renderer module	1030
Particle System Force Field	1031
Visual Effect Graph	1032
Project Settings - VFX	1033
Visual Effect Graph Asset	1034
Block Subgraph	1035
Operator Subgraph	1036
Visual Effect	1037
Property Binders	1038
Decals and projectors	1039
Projector component	1040
Lens flares and halos	1041
Flare asset	1042
Lens Flare component	1043
Flare Layer component	1044

Halo component	1045
Lines, trails, and billboards	1046
Line Renderer component	1047
Trail Renderer component	1048
Billboard Renderer component	1049
Billboard asset	1050
Sky	1051
Skyboxes	1052
Using skyboxes	1053
Skybox shaders	1054
6 Sided skybox	1055
Cubemap skybox	1056
Panoramic skybox	1057
Procedural skybox	1058
Skybox component reference	1059
Color	1060
Color space	1061
Linear or gamma workflow	/a1×062
Gamma Textures with linear rendering-	<b ta963
Working with linear Textures	1064
High dynamic range	1065
HDR color picker	1066
Graphics API support	1067
DirectX	1068
Metal	1069
Introduction to Metal	1070
Metal requirements and compatibility	/ <!--19</b-->3₹1
Debug Metal graphics	1072
Optimize Metal graphics	1073
OpenGLCore	1074
Graphics performance and profiling	1075
Graphics performance fundamentals<td>>1076</td>	>1076
Optimizing draw calls	1077
GPU instancing	1078
Creating shaders that support GPU instancing<	:/alx079

Draw call batching	1080
Static batching	1081
Dynamic batching	1082
Manually combining meshes	1083
Scriptable Render Pipeline Batcher	1084
BatchRendererGroup	1085
How BatchRendererGroup works	1086
Getting started with BatchRendererGroup-getting-started'>Getting started with BatchRendererGroup-getting-started	u ∮98 57>
Creating a renderer with BatchRendere	r G088 p
Initializing a BatchRendererGroup objec	t ⊲/2₀8 -9
Registering meshes and	m 1.999 0ials
Creating batches	1091
Creating draw command	s 409 2
DOTS Instancing shaders	1093
The Rendering Statistics window	1094
Debug frames in Unity	1095
Frame Debugger window reference	1096
Frame Debugger Event Hierarchy	∕4
Frame Debugger event information	on 498
World building	1099
Terrain	1100
Creating and editing Terrains	1101
Create Neighbor Terrains	1102
Terrain tools	1103
Raise or Lower Terrain	1104
Paint Holes	1105
Paint Texture	1106
Set Height	1107
Smooth Height	1108
Stamp Terrain	1109
Terrain Layers	1110
Brushes	1111
Trees	1112
SpeedTree	1113
Wind Zones	1114

Grass and other details	1115
Working with Heightmaps	1116
Terrain settings	1117
Using Terrain at runtime	1118
Terrain Tools	1119
Tree Editor	1120
Building Your First Tree	1121
Tree Basics	1122
Branch Group Properties	1123
Leaf Group Properties	1124
Physics	1125
Built-in 3D Physics	1126
Character control	1127
Introduction to character control	1128
Character Controller component reference<td>>1129</td>	> 1129
Rigidbody physics	1130
Introduction to rigid body physics 	1131
Configure Rigidbody Colliders 	1132
Apply constant force to a Rigidbody	1133
Apply interpolation to a Rigidbody	1134
Rigidbody component reference	1135
Constant Force component reference	1136
Collision	1137
Introduction to collision	1138
Collider types	1139
Introduction to collider types	1140
Interaction between collider types	1141
Collider shapes	1142
Introduction to collider shapes	1143
Primitive collider shapes	1144
Introduction to primitive collider shapes	⊲′a ≱5
Box collider component reference	1146
Sphere collider component reference	1147
Capsule collider component reference	1148
Mesh colliders	1149

Mesh colliders	1150
Prepare a Mesh for Mesh colliders<!--</td--><td>a≯51</td>	a ≯51
Mesh collider component reference	1152
Wheel colliders	1153
Introduction to Wheel colliders	1154
Wheel collider friction	1155
Wheel collider suspension	1156
Create a car with Wheel colliders	1157
Wheel collider component reference	1158
Terrain colliders	1159
Introduction to Terrain colliders	1160
Terrain collider component reference	1161
Compound colliders	1162
Introduction to compound colliders<!--</td--><td>′a≯63</td>	′ a ≯63
Create a compound collider	1164
Collider surfaces	1165
Collider surface friction	1166
Collider surface bounciness	1167
How collider surface values combine	1168
Create and apply a custom Physic Material	4/1869
Physic Material asset reference	1170
Collider interactions	1171
Use collisions to trigger other events	′a \$72
OnCollision events	1173
OnTrigger events	1174
Create and configure a trigger collider-	⊲a ≆5
Example scripts for collider events<	/bb/76
Collision detection	1177
Choose a collision detection mode<td>ւ\$178</td>	ւ\$178
Discrete collision detection	1179
Continuous collision detection (CCD)<td>≯180</td>	≯ 180
Sweep-based CCD	1181
Speculative CCD	1182
Joints	1183
Introduction to joints	1184

Character Joint component reference	1185
Configurable Joint component reference	1186
Fixed Joint component reference	1187
Hinge Joint component reference	1188
Spring Joint component reference	1189
Articulations	1190
Introduction to physics articulations	1191
Articulation Body component reference	1192
Ragdoll physics	1193
Create a ragdoll	1194
Joint and Ragdoll stability	1195
Cloth	1196
Multi-scene physics	1197
Scripting	1198
Setting Up Your Scripting Environment	1199
Integrated development environment (IDE) support<td>>1200</td>	>1200
Debug C# code in Unity	1201
Stack trace logging	1202
Unit Testing	1203
Roslyn analyzers and source generators	1204
Scripting concepts	1205
Creating and Using Scripts	1206
Variables and the Inspector	1207
Instantiating Prefabs at run time	1208
Order of execution for event functions	1209
Event Functions	1210
Coroutines	1211
Namespaces	1212
Attributes	1213
UnityEvents	1214
Null Reference Exceptions	1215
Await support	1216
Important Classes 	1217
GameObject	1218
MonoBehaviour	1219

Object	1220
Transform	1221
Vectors	1222
Quaternion	1223
ScriptableObject	1224
Time and frame rate management	1225
Mathf	1226
Random	1227
Debug	1228
Gizmos and Handles	1229
Unity architecture	1230
Overview of .NET in Unity	1231
.NET profile support	1232
Stable scripting runtime: known limitations	1233
Referencing additional class library assemblies<	/ a 234
C# compiler	1235
Scripting backends	1236
Mono overview	1237
IL2CPP Overview	1238
Handling platform specific settings for IL2CPP additional-args'>Handling-IL2CPP additional	nta2399guments
Linux IL2CPP cross-compiler	1240
Windows Runtime support	1241
Managed stack traces with IL2CPP<td>ı≯242</td>	ı≯242
Scripting restrictions	1243
Managed code stripping	1244
The Unity linker	1245
Code reloading in the Unity Editor	1246
Configurable Enter Play Mode	1247
Domain Reloading	1248
Scene Reloading	1249
Details of disabling Domain and Scene Re	e lb26 0x/a>
Running Editor Script Code on Launch<td>ı≯251</td>	ı≯251
Script serialization	1252
Built-in serialization 	1253
Custom serialization	1254

Script serialization errors	1255
JSON Serialization	1256
Script compilation	1257
Special folders and script compilation order	ab258
Conditional Compilation	1259
Custom scripting symbols	1260
Assembly definitions	1261
Assembly Definition properties	- 1262
Assembly Definition Reference pro	ple21668s
Assembly Definition File Format	1264
Plug-ins	1265
Import and configure plug-ins 	1266
Managed plug-ins	1267
Native plug-ins	1268
Building plug-ins for desktop platforms	1269
Low-level native plug-in interface	1270
Low-level native plug-in rendering extensions'	engions
$<\!\!a\ href='LowLevelNativePluginShaderCompilerAccess'>\!\!Low-level\ native\ plug-in\ Shader\ compilerAccess'>\!\!Low-level\ native\ plug-in\ Shader\ compiler$	dı2ā/2 cess
Memory Manager API for low-level native	ed pMg-ins
IUnityMemoryManager API	fle£fe4 ence
Job system	1275
Job system overview	1276
Jobs overview	1277
Thread safe types	1278
Implement a custom native container	/ a 279
Copying NativeContainer structures<td>≯1280</td>	≯1280
Custom NativeContainer examp	142 <i>8</i> a>
Create and run a job	1282
Job dependencies	1283
Parallel jobs	1284
Unity Properties	1285
Property bags	1286
Property visitors	1287
Property paths	1288
Use `PropertyVisitor` to create a property visitor	n12/89

 Use low-level APIs to create a property visitor-	182≥90</th
UnityWebRequest	1291
Common operations: using the HLAPI	1292
a href='UnityWebRequest-RetrievingTextBinaryData'>Retrieving text or binary data from an HTTP	• \$292 er (GET)
Retrieving a Texture from an HTTP Server	(G294)
a href='UnityWebRequest-DownloadingAssetBundle'>Downloading an AssetBundle from an HTTF	o 1529√5 er (GET)
Sending a form to an HTTP server (POST) 4/29 6
Uploading raw data to an HTTP server (I	P 1∪219 7₹/a>
Advanced operations: Using the LLAPI	1298
Creating UnityWebRequests	s4 <i>12</i> 99
Creating UploadHandlers<td>a≯300</td>	a ≯ 300
Creating DownloadHandlers	s4/ 3 0-1
Multiplayer	1302
Audio	1303
Audio overview	1304
Audio files	1305
Tracker Modules	1306
Audio Mixer	1307
An overview of the concepts and Audio Mixer	1308
Specifics on the Audio Mixer window	1309
AudioGroup Inspector	1310
Overview of Usage and API	1311
Native audio plug-in SDK	1312
Develop a native DSP audio plug-in	1313
Customize the GUI for your audio plug-in 	1314
Use your native audio DSP plug-in and GUI in Unity	<!--3</b-->45
Example native audio plug-ins included in the SD	K1316
Audio Spatializer SDK	1317
Audio playlist randomization	1318
Audio Random Container reference	1319
Audio Random Container fundamentals	s4 <i>13</i> 220
Create a randomized playlist with the Audio Random Co	
Audio Profiler	1322
Ambisonic Audio	1323
Develop an ambisonic audio decoder<td>>1324</td>	>1324

Audio Reference	1325
Audio Clip	1326
Audio Listener	1327
Audio Source	1328
Audio Mixer	1329
Audio Filters	1330
Audio Low Pass Filter	1331
Audio High Pass Filter	1332
Audio Echo Filter	1333
Audio Distortion Filter	1334
Audio Reverb Filter	1335
Audio Chorus Filter	1336
Audio Effects	1337
Audio Low Pass Effect	1338
Audio High Pass Effect	1339
Audio Echo Effect	1340
Audio Flange Effect	1341
Audio Distortion Effect	1342
Audio Normalize Effect	1343
Audio Parametric Equalizer Effect	1344
Audio Pitch Shifter Effect	1345
Audio Chorus Effect	1346
Audio Compressor Effect	1347
Audio SFX Reverb Effect	1348
Audio Low Pass Simple Effect	1349
Audio High Pass Simple Effect	1350
Reverb Zones	1351
Microphone	1352
Audio Settings	1353
Video overview	1354
Video Player component	1355
Migrating from MovieTexture to VideoPlayer-MigratingFromMovieTexture'>Migrating from MovieTexture to VideoPlayer-MigratingFromMovieTexture'>Migrating from MovieTexture to VideoPlayer-MigratingFromMovieTexture'>Migrating from MovieTexture to VideoPlayer-MigratingFromMovieTexture'>Migrating from MovieTexture to VideoPlayer-Migrating from MovieTexture to VideoPlaye	a 1/&5 6/a>
Video Clips	1357
Video sources	1358
Video file compatibility	1359

Clock management with the Video Player component	1360
Understanding video files	1361
Video transparency support	1362
Panoramic video	1363
Animation	1364
Animation system overview	1365
Rotation in animations	1366
Animation Clips	1367
Animation from external sources	1368
Humanoid Avatars	1369
Animation Window Guide	1370
Using the Animation view	1371
Creating a new Animation Clip<!--</td--><td>a∖372</td>	a ∖ 372
Animating a GameObject	1373
Using Animation Curves	1374
Editing Curves	1375
Key manipulation in Dopeshee	et1 6376d e
Key manipulation in Curves mode	e k3ā ≯
GameObjects with Multiple Moving Parts	1378
Use Animation Events	1379
Animator Controllers	1380
The Animator Controller Asset	1381
The Animator Window	1382
Animation State Machines	1383
State Machine Basics	1384
Animation Parameters	1385
State Machine Transitions	1386
State Machine Behaviours	1387
Sub-State Machines	1388
Animation Layers	1389
Solo and Mute functionality	1390
Target Matching	1391
Inverse Kinematics	1392
Root Motion - how it works	1393
Tutorial: Scripting Root Motion for "in-place" humanoid anir	m1631804hs

Blend Trees	1395
1D Blending	1396
2D Blending	1397
Direct Blending	1398
Additional Blend Tree Options	1399
Work with blend shapes	1400
Animator Override Controllers	1401
Retargeting of Humanoid animations	1402
Performance and optimization	1403
Animation Reference	1404
Animator component	1405
Animator Controller	1406
Creating an AnimatorController	1407
Animation States	1408
Animation transitions	1409
Animation FAQ	1410
Playables API	1411
The PlayableGraph	1412
ScriptPlayable and PlayableBehaviour	1413
Playables Examples	1414
A Glossary of animation terms	1415
Legacy Animation system	1416
Animation	1417
Animation Scripting (Legacy)	1418
User interface (UI)	1419
Comparison of UI systems in Unity	1420
UI Toolkit	1421
Get started with UI Toolkit	1422
UI Builder	1423
UI Builder interface overview	1424
Get started with UI Builder	1425
Work with elements	1426
Use UXML instances as templates	1427
Style UI with UI Builder	1428
Assign USS variables in UI Builder<td>₃≯429</td>	₃≯429

Test UI	1430
Structure UI	1431
The visual tree	1432
Introduction to visual elements and the visual tree<td>>1433</td>	>1433
Panels	1434
Draw order	1435
Coordinate and position systems	/ a ≱36
Structure UI with UXML	1437
Introduction to UXML	1438
Add styles to UXML	1439
Reuse UXML files	1440
Reference other files from UXML<!--</td--><td>′al≯41</td>	′al≯41
Load UXML and USS C# scripts	1442
Instantiate UXML from C# scripts	1443
Find visual elements with UQuery	1444
Structure UI with C# scripts	1445
Custom controls	1446
Create a custom control	1447
Customize UXML tag names and attributes'	u 1ek% a
Bind custom controls to data	1449
Define a namespace prefix	1450
Best practices for managing eleme	n t 45 /a>
Encapsulate UXML documents with logic<	<11a452
UXML elements reference	1453
UXML element BindableElement	/ a ≯54
UXML element VisualElement	1455
UXML element BoundsField	1456
UXML element BoundsIntField	>1457
UXML element Box	1458
UXML element Button	1459
UXML element ColorField	1460
UXML element CurveField	1461
UXML element DoubleField	1462
UXML element DropdownField	>1463
UXML element EnumField	1464

UXIVIL element EnumFlagsFleid	1≯4 65
UXML element FloatField	1466
UXML element Foldout	1467
UXML element GradientField	1468
UXML element GroupBox	1469
UXML element Hash128Field	1470
UXML element HelpBox	1471
UXML element IMGUIContainer	a\$472
UXML element Image	1473
UXML element InspectorElement	/ a ≱74
UXML element IntegerField	1475
UXML element Label	1476
UXML element LayerField	1477
UXML element LayerMaskField<td>≱478</td>	≱ 478
UXML element LongField	1479
UXML element ListView	1480
UXML element MaskField	1481
UXML element MinMaxSlider	1482
UXML element MultiColumnListView'>	:1 1/483 >
UXML element MultiColumnTreeVi	i ew&4 a>
UXML element ObjectField	1485
UXML element PopupWindow	1486
UXML element ProgressBar	1487
UXML element PropertyField	1488
UXML element RadioButton	1489
UXML element RadioButtonGroup-	∜49 0
UXML element RectField	1491
UXML element RectIntField	1492
UXML element RepeatButton	1493
$<\!\!a\ href='UIE-uxml-element-RenderingLayerMaskField'>\!\!UXML\ element\ RenderingLayerMaskField'>\!\!UXML\ element\ Rendering\ element\ Rendering\ element\ R$	ı skii9i& ld
UXML element ScrollView	1495
UXML element Scroller	1496
UXML element Slider	1497
UXML element SliderInt	1498
UXML element Tab	1499

UXML element TabView	1500
UXML element TagField	1501
UXML element TextElement	1502
UXML element TextField	1503
UXML element TemplateContainer	r4 <i>5</i> 504
UXML element Toggle	1505
UXML element ToggleButtonGroup	01-5506
UXML element Toolbar	1507
UXML element ToolbarBreadcrum	b1630/8>
UXML element ToolbarButton	1509
UXML element ToolbarMenu	1510
UXML element ToolbarPopupSear	'd 15F 1i e ld
UXML element ToolbarSearchField	d145d2
UXML element ToolbarSpacer	1513
UXML element ToolbarToggle	1514
UXML element TreeView	1515
UXML element TwoPaneSplitView	⊲⁄ā \$6
UXML element UnsignedLongField	d\$56137
UXML element UnsignedIntegerField'>UXML element UnsignedIntegerField	e 1d 54/ & >
UXML element Vector2Field	1519
UXML element Vector2IntField<td>>1520</td>	>1520
UXML element Vector3Field	1521
UXML element Vector3IntField<td>>1522</td>	>1522
UXML element Vector4Field	1523
Structure UI examples	1524
Create list and tree views	1525
Create a complex list view	1526
Create a list view runtime UI	1527
Wrap content inside a scroll view<!--</td--><td>a1+528</td>	a1+528
Create a tabbed menu	1529
Create a pop-up window	1530
Use Toggle to create a conditional UI	1531
Create a custom control with two attribu	t @5 32a>
Create a slide toggle custom control	1533
Create a bindable custom control	⁄ a≶ 34

Create a custom style for a custom co**⋔চ∂চ** ='UIE-create-drag-and-drop-list-treeview-between-windows'>Create a drag-and-drop list and tree vi**∉ড∂**টেetween windows'>Create an aspect ratio custom contr**ob∂/ā**>

· · · · · · · · · · · · · · · · · · ·	
Style UI	1538
Introduction to USS	1539
USS selectors	1540
Type selectors	1541
Name selectors	1542
Class selectors	1543
Universal selectors	1544
Descendant selectors	1545
Child selectors	1546
Multiple selectors	1547
Selector lists	1548
Pseudo-classes	1549
Selector precedence	1550
USS properties	1551
USS data types	1552
USS common properties	1553
Position element with the layout engine	1554
Relative and absolute positioning-example 	g 5/5 5
Set background images	1556
Image import settings	1557
USS transform	1558
USS transition	1559
USS properties reference	1560
USS color keywords	1561
USS custom properties (variables)	1562
Create USS variables	1563
Introduction to USS built-in variables	1564
USS built-in variable references<td>≯565</td>	≯565
Apply styles in C# scripts	1566
Best practices for USS	1567
Theme Style Sheet (TSS)	1568
Apply masking effects in UI Toolkit	1569

UI Toolkit Debugger	1570
Control behavior with events	1571
Dispatch events	1572
Capture the pointer with a manipulator	1573
Handle event callbacks and value changes	1574
Focus order of elements	1575
Respond to events with custom control	s <i>ŧ5</i> a7∕6
Manipulators	1577
Synthesize and send events	1578
Event reference	1579
Capture events	1580
Change events	1581
Click events	1582
Command events	1583
Drag-and-drop events	1584
Layout events	1585
Focus events	1586
Input events	1587
Keyboard events	1588
Mouse events	1589
Navigation events	1590
Panel events	1591
Pointer events	1592
Tooltip event	1593
Transition events	1594
Contextual menu events	1595
IMGUI events	1596
Event examples	1597
Create a simple transition with UI Builder and C# scr	i ∮t5 9&a>
Create a drag-and-drop UI inside a custom Editor v	w115@9 w
Create a drag-and-drop UI to drag between Editor windows'>	i n1d600/0 s
Create a transition event	1601
Create looping transitions	1602
UI Renderer	1603
Generate 2D visual content	1604

Create a pie chart in the Editor and runtime UI	1605
Use Vector API to create a radial progress ind	li t606
Use Mesh API to create a radial progress indicator<td>a1607</td>	a 1 607
Parallel tessellation	1608
Data binding	1609
Comparison of the binding systems	1610
Runtime data binding	1611
Get started with runtime binding	1612
Create a runtime binding in C# scripts	- 1613
Define a data source for runtime bind	d in6gl-4 /a>
Define binding mode and update trigge	r146a1.5
Convert data types	1616
Define logging levels	1617
Create custom binding types	1618
Create a custom binding to bind USS sel	eto6149s
SerializedObject data binding	1620
Introduction to SerializedObject data binding	1621
Bindable elements reference	1622
Bindable data types and fields	·1623
Binding system implementation details	s 1624
Binding examples	1625
Bind with binding path in C# script	>1626
Bind without the binding path	1627
Bind with UXML and C# script	·1628
Create a binding with the Inspecto	r46229
Bind to nested properties	1630
Bind to a UXML template	1631
Receive callbacks when a bound property cha	a fig82< /a>
Receive callbacks when any bound properties'	p t638e s change
Bind to a list with ListView	1634
Bind to a list without ListView	1635
Bind a custom control 	1636
Bind a custom control to custom data type	e k63 ≯
Support for Editor UI	1638

Create a custom Editor window with C# script@29>

Create a Custom Inspector	1640
View data persistence	1641
Support for runtime UI	1642
Get started with runtime UI	1643
Render UI in the Game view	1644
Panel Settings properties reference	1645
Runtime UI event system	1646
Performance consideration for runtime	1.6147 a>
e-usage-hints-to-reduce-draw-calls-and-geometry-regeneration'>Use usage hints to reduce draw of	al 648 nd geometr
Control textures of the dynamic at	i la64<i>9</i>a>
Platform and mesh considerations	1650
FAQ for input and event systems with UI Too	ki65/a>
Work with text	1652
Get started with text 	1653
Style text with USS	1654
Style text with rich text tags	1655
Supported rich text tags	1656
Font assets	1657
Introduction to font assets	1658
Font Asset properties reference	1659
Font Asset Creator properties reference	₃ \$660
Text effects	1661
Style sheets	1662
Include sprites in text	1663
Sprite Asset properties reference	1664
Color gradients	1665
Panel Text Settings assets	1666
Fallback font	1667
Examples	1668
Migration guides	1669
Migrate from Unity UI (uGUI) to UI Toolkit	/ a \$70
Migrate from Immediate Mode GUI (IMGUI) to UI Toolk	(i 1 -6/ā\$
Unity UI 	1672
Canvas	1673
BasicLayout	1674

Visual Components	1675
Interaction Components	1676
Animation Integration	1677
Auto Layout	1678
Rich Text	1679
Event System	1680
Messaging System	1681
Input Modules	1682
Supported Events	1683
Raycasters	1684
UI Reference	1685
Rect Transform	1686
Canvas Components	1687
Canvas	1688
Canvas Scaler	1689
Canvas Group	1690
Canvas Renderer	1691
Visual Components	1692
Text	1693
Image	1694
Raw Image	1695
Mask	1696
RectMask2D	1697
UI Effect Components	1698
Shadow	1699
Outline	1700
Position as UV1	1701
Interaction Components	1702
Selectable Base Class	1703
Transition Options	1704
Navigation Options	1705
Button	1706
Toggle	1707
Toggle Group	1708
Slider	1709

Scrollbar	1710
Dropdown	1711
Input Field	1712
Scroll Rect	1713
Auto Layout	1714
Layout Element	1715
Content Size Fitter	1716
Aspect Ratio Fitter	1717
Horizontal Layout Group	1718
Vertical Layout Group	1719
Grid Layout Group	1720
Event System Reference	1721
Event System Manager	1722
Graphic Raycaster	1723
Panel Event Handler	1724
Panel Raycaster	1725
Physics Raycaster	1726
Physics 2D Raycaster	1727
Standalone Input Module	1728
Touch Input Module	1729
Event Trigger	1730
Font assets	1731
UI How Tos	1732
Designing UI for Multiple Resolutions	1733
Making UI elements fit the size of their content<	:/bZ34
Creating a World Space UI	1735
Creating UI elements from scripting<td>≯1736</td>	≯ 1736
Creating Screen Transitions	1737
Immediate Mode GUI (IMGUI)	1738
IMGUI Basics	1739
Controls	1740
Customization	1741
IMGUI Layout Modes	1742
Extending IMGUI	1743
GUI Skin (IMGUI System)	1744

GUI Style (IMGUI System)	1745
Extending the Editor with IMGUI	1746
Editor Windows	1747
Property Drawers	1748
Custom Editors	1749
TreeView	1750
Unity Services	1751
Setting up your project for Unity services	1752
Using the developer dashboard	1753
Unity Organizations	1754
Subscriptions and seats	1755
Managing your Organization	1756
Managing your Organization's Proj	e t75 √/a
Transfer a Project to a new Organization	1758
Unity Ads	1759
Unity Analytics	1760
Unity Cloud Content Delivery	1761
Unity Build Automation (formerly Cloud Build)	1762
i">¿Unity IAP	1763
Setting up Unity IAP	1764
Configuring for Apple App Store and Mac App St	o 167-6∕5 a>
Configuring for Google Play Store	1766
Configuring for Windows Store	1767
Configuration for the Amazon Appstore<!--</td--><td>a\$768</td>	a \$768
Cross Platform Guide	1769
Codeless IAP	1770
Defining products	1771
Subscription Product support	1772
Initialization	1773
Browsing Product Metadata	1774
Initiating Purchases	1775
Processing Purchases	1776
Handling purchase failures	1777
Restoring Transactions	1778
i">¿Purchase Receipts	1779

Receipt validation	1780
Store Extensions	1781
nref='UnityIAPCrossStoreInstallationIssues'>Cross-store installation issues with Android in-app	pulr@Base stores </td
Store Guides	1783
iOS & Mac App Stores	1784
Universal Windows Platform	1785
Google Play	1786
Amazon Appstore and Amazon Undergro	un d 133 7re
Implementing a Store	1788
Initialization	1789
Retrieving products	1790
Handling purchases	1791
Store Modules	1792
Registering your store	1793
Store Configuration	1794
Store Extensions	1795
Unity Cloud Diagnostics	1796
Unity Integrations	1797
Multiplayer services	1798
Unity Distribution Portal	1799
Getting started with UDP	1800
Distributing your game with UDP	1801
Implementing IAP products	1802
Testing your game in the UDP sandbox	1803
Managing and publishing your game on the UDP of	con \$∂0 4k/a>
Using UDP with other services	1805
Using Firebase with UDP builds	1806
UDP reference	1807
UDP API	1808
UDP SDK data collection	1809
UDP troubleshooting	1810
Unity Accelerator	1811
XR	1812
Overview	1813

XR packages

1814

AR development in Unity	1815
VR development in Unity	1816
XR architecture	1817
XR Project set up	1818
Choose XR provider plug-ins	1819
Create an XR project	1820
Set up an XR scene	1821
XR input options	1822
XR Origin	1823
XR Plug-in Management settings	1824
Run an XR application	1825
XR graphics 	1826
Universal Render Pipeline compatibility in	XR<18627
Stereo rendering	1828
Single-pass instanced rendering and custom shad	lers4/ 8 229
VR frame timing 	1830
XR audio	1831
Audio Spatializers	1832
XR API reference	1833
Unity XR SDK	1834
Provider setup	1835
Creating an XR provider	1836
UnitySubsystemsManifest.jsor	ı
Runtime discovery and activation of subsystem	s
Subsystems	1839
XR SDK Input subsystem	1840
XR SDK Display subsystem	1841
XR SDK Meshing subsystem	1842
Interfaces	1843
XR SDK PreInit interface	1844
XR SDK Stats interface	1845
Unity's Asset Store	1846
Asset Store packages	1847
Purchase or download a package from the Asset S	Store 48/448-
Finding your Asset Store packages	1849

Using labels to organize My Assets	1850
Publishing to the Asset Store	1851
Creating your Publisher Account	1852
Creating a new package draft	1853
Deleting a package draft	1854
Uploading assets to your package	1855
Filling in the package details	1856
Submitting your package for approval	1857
Viewing the status of your Asset Store submissions	- 1858
Collecting revenue	1859
Providing support to your customers	1860
Adding tags to published packages	1861
Connecting your account to Google Analytics	1862
Promoting your Assets	1863
Refunding your customers	1864
Upgrading packages	1865
Deprecating your Assets	1866
Issuing vouchers	1867
Managing your publishing team	1868
Asset Store Publisher portal	1869
Verified Solutions	1870
Decentralized technology Verified Solutions	1871
Platform development 	1872
Using Unity as a Library in other applications	1873
Deep linking	1874
Xcode frame debugger Unity integration	ı≯875
Android	1876
Introducing Android	1877
Android requirements and compatibil	it 1∕87/68 >
Gradle for Android	1879
Android App Manifest	1880
Unity Launcher Manifest	1881
Unity Library Manifest	1882
How Unity builds Android applications	6 4/88 3
Getting started with Android	1884

Android environment setup	1885
Android Player settings	1886
Android keystores	1887
Keystore Manager window reference	1888
Create a new keystore	1889
Add keys to a keystore	1890
Load a keystore	1891
Developing for Android	1892
Android mobile scripting	1893
Input for Android devices	1894
Android application size restrictions<	/al>895
Introduction to asset splitting	1896
APK expansion files	1897
APK expansion files in Unity	a≱898
Manually install an APK expansion fi	1d-8/999
Host APK expansion files	1900
Play Asset Delivery	1901
Asset packs in Unity	1902
Set up Play Asset Delivery	1903
Create a custom asset pack	a≯904
Manage asset packs at runtime	1905
Graphics for Android	1906
Screen configuration	1907
Single-pass stereo rendering for Andr	'01 90/3 a
Framebuffer orientation	1909
Testing and debugging	1910
Debug on Android devices<!--</td--><td>a1911</td>	a 1 911
Android symbols	1912
Simulate an Android device	1913
Profile on an Android device<td>>1914</td>	>1914
Unity Remote	1915
Application patching	1916
Optimization for Android	1917
Android thread configuration	1918
Optimize application startup times<	-/ <u>\$</u> Q10

Game state hinting	1920
Optimize for user preferences<!--</td--><td>a1+921</td>	a1+921
Create and use plug-ins in Android	1922
Android plug-in types	1923
Android Library Projects and Android Archive plug-in	n \$9:24>
nref='android-library-project-and-aar-plugins-introducing'>Introducing Android Library Projects and	Aln 92215 id Archive
Import an Android Library Project	a\$926
Import an Android Archive plug-in	1927
JAR plug-ins	1928
Native plug-ins for Android	1929
Introducing native plug-ins for Andro	oild 93 /0>
Create a native plug-in for Android	∕ a 931
Import a native plug-in for Android<!--</td--><td>/al:932</td>	/al:932
Call native plug-in for Android code<td>a≯933</td>	a ≯ 933
Java and Kotlin source plug-ins	1934
Call Java and Kotlin plug-in code from C	#1 935 pts
Integrating Unity into Android applications	1936
Android application entry points	1937
The Activity application entry point	/ a 938
Activity requirements and com	n p@@ ility
Extend the default Unity activity	1940
Create a custom activity	1941
Specify Android Player command-line a	a flguff2 ents
The GameActivity application entry	p 1097413 :/a>
GameActivity requirements are	n dl9x44 mpatibility </td
Modify GameActivity bri	d gs15 ode
Update the GameActiv	it ly9itt 6ary
Set the application entry point for your Android ap	pligation
Deep linking on Android	1948
Device features and permissions	⊲1894 9
Android permissions in Unity	1950
Declare permissions for an application	a\$951
Request runtime permissions	1952
Handle Android crashes	1953
Quit a Unity Android application	1954

Building and delivering for Android	1955
Gradle templates	1956
Modify Gradle project files	1957
Modify the Gradle project files for a Unity	/1⊒056 ication
Modify Gradle project files with Gradle to	e 119 5 9 ate files
ef='android-modify-gradle-project-files-agp'>Modify Gradle project files with the Android Project Co	n 196 0ration Mana
Modify Gradle project files with Android-studio'>	d 1916 11Studio
Android Templates Upgrader window refe	r te9162
Android Build Settings	1963
Build your application for Android	1964
Export an Android project	1965
Optimize distribution size	1966
Digital distribution services for Android	1967
Delivering to Google Play	1968
ChromeOS	1969
Requirements and compatible	o ill9i7€ /a>
Getting started with ChromeOS 	- 1971
android-ChromeOS-preparing-your-development-environment'>Preparing your development envi	r d១ក្ ណent for Chro
ChromeOS Player Settings	1973
Developing for ChromeOS 	1974
Support user input on ChromeOS dev	i ¢035 /a>
Debugging on a ChromeOS device<td>≯976</td>	≯976
Build for ChromeOS	1977
Dedicated Server	1978
Introduction to Dedicated Server	1979
Get started with Dedicated Server	1980
Dedicated Server requirements	1981
Dedicated Server Player settings	1982
Dedicated Server optimizations	1983
Build your application for Dedicated Server 	1984
Dedicated Server AssetBundles	1985
Desktop headless mode	1986
iOS	1987

Introducing iOS

iOS requirements and compatibility</a\$989

1988

How Unity builds iOS applications	- 1990
Structure of a Unity Xcode Project	1991
Getting started with iOS	1992
iOS environment setup	1993
iOS Player settings	1994
Developing for iOS	1995
iOS Scripting	1996
Input for iOS devices	1997
iOS input overview	1998
Game Controller support	1999
Detect Game Controllers	2000
Handle Game Controller input<td>>2001</td>	>2001
Unity's Device Simulator for iOS	2002
Unity Remote	2003
Managed stack traces on iOS	2004
Optimize performance for iOS	2005
Optimize for mobile	2006
Measure performance with the built-in profiler	a22007
Optimize the size of the iOS Player<td>2008</td>	2 008
Native plug-ins for iOS	2009
Create a native plug-in for iOS	2010
Use your native plug-in for iOS	2011
Call native plug-ins for iOS	2012
Callback from native code	2013
Automated plug-in integration-	<2a0.44
Bonjour browser sample	2015
Integrating Unity into native iOS applications	2016
Deep linking on iOS	2017
iOS authorizations in Unity	2018
Preparing your application for In-App Purchases	(124017) 9
Social API	2020
Troubleshooting on iOS devices	2021
Reporting crash bugs on iOS	2022
Building and delivering for iOS	2023
Build an iOS application	2024

iOS build settings	2025
App thinning	2026
On-demand resources	2027
App slicing	2028
Apple's privacy manifest policy requirement	1 2822
Linux	2030
Linux Player settings	2031
Linux Build Settings	2032
Troubleshooting the Linux Editor issues	2033
macOS	2034
macOS player settings	2035
macOS development	2036
Deep linking for macOS	2037
Use IL2CPP with macOS	2038
Build and distribute a macOS application	2039
Build a macOS application	2040
macOS build settings	2041
Code sign and notarize your macOS application	120242
Code sign your application	2043
Notarize with Xcode and command-line tools<	/ 2 944
Notarize with altool	2045
Deliver applications to the Mac App Store	2/04 6
tvOS	2047
Requirements and compatibility	2048
tvOS Player Settings	2049
Developing for tvOS	2050
Supporting input devices on tvOS	2051
Setting up app navigation from the Unity	2052a>
Debugging Your Application	2053
Building your application for tvOS	2054
Web	2055
Web introduction 	2056
Web browser compatibility	2057
Technical limitations	2058
Web prerequisites	2059

Web development	2060
Web Player settings	2061
Interaction with browser scripting<	/22062
Code examples: Call JavaScript and C/C++/C# funct	io2n036i3n Unity
Set up your JavaScript plug-in	2064
Call JavaScript functions from Unity C# se	c r2/016 5/a>
Call Unity C# script functions from JavaS	c 2i066 /a>
Call C/C++/C# functions from Unity C# s	c ı2∤016 7
Compile a static library as a Unity plug-i	n 2026 8
Create callbacks between Unity C#, JavaScript, and	C2069/C# code </td
Replace deprecated browser interaction	c2001750
Web native plug-ins for Emscripten-	2071</td
Memory in Unity Web	2072
Cache behavior in Web	2073
Web graphics	2074
Audio in Web	2075
Video playback in Web	2076
Texture compression in Web	2077
Embedded resources in Web	2078
Input in Web	2079
Configure a Web Canvas size	2080
Web browser access to device features<!--</td--><td>a2081</td>	a 2 081
Web networking	2082
Cursor locking and full-screen mode in Web<td>>2083</td>	>2083
Web performance considerations	2084
Debug and troubleshoot Web builds	2085
Build and distribute a Web application	2086
Web Build Settings	2087
Build your Web application	2088
Optimize your Web build	2089
Recommended Graphics settings to optimize your \	№090 uild
Recommended Player settings to optimize your We	:b 2091t d
Recommended Quality settings to optimize your We	eb20912d
Use C# code to enable optimization settings	s ∕209 3
Optimize Web platform for mobile	2094

Reduce load times with AssetBundles	2095
Distribution size and code stripping-	<20096
Web templates	2097
Deploy a Web application	2098
Server configuration code samples	s2099
Windows	2100
Integrating Unity into Windows applications	2101
Windows Player settings	2102
Develop for Windows	2103
Visual Studio project generation for Windows'	121/19 4
i">¿Windows debugging	2105
Windows integrity control	2106
Windows Player: IL2CPP Scripting Bac	12e11007
Windows Build Settings	2108
Universal Windows Platform	2109
Introduction to Universal Windows Platform	2110
UWP requirements and compatibility<	: /2₃ \$11
Integrate Unity into UWP applications	2112
Get started with Universal Windows Platform	2113
Set up your environment for UWP	2114
UWP Player settings	2115
Develop for Universal Windows Platform	2116
Use deep linking on UWP	2117
Connect the profiler to UWP	2118
UWP scripting symbols	2119
IL2CPP scripting backend for UWP	2120
Use UWP plug-ins with IL2CPP	2121
Use managed UWP plug-ins	2122
Call and implement native UWP plug-ins<td>£123</td>	£ 123
Author native UWP plug-ins	2124
Use P/Invoke	2125
Debug UWP applications with IL2CPP	2126
Debug C# code	2127
Debug generated C++ code	2128
WinRT API in C# scripts for UWP	2129

AppCallbacks class reference	2130	
Command line arguments for UWP	<2d≥31	
Association launching for UWP<td>>2132</td>	>2132	
Build and deliver for Universal Windows Platform	<2a3 3	
UWP build settings	2134	
Generate your Visual Studio C++ solut	i 0∕11⊲⁄ā >	
Package a UWP app in Visual Studio	2136	
Deploy a UWP application	2137	
Deploy a Windows or UWP app with the Windows DevicℒP‰tal		
Unity Search	2139	
Search usage	2140	
Filter searches	2141	
Search query operators	2142	
The Index Manager	2143	
Search tables	2144	
Search Providers	2145	
Search Project Assets	2146	
Search the current Scene	2147	
Search the Unity main menu	2148	
Search Object Picker	2149	
Search Settings and Preferences	2150	
Help Search Provider	2151	
The calculator	2152	
Search for files	2153	
Execute API methods	2154	
Search for packages	2155	
Search the Unity Asset Store	2156	
Search saved queries	2157	
Additional Search filters	2158	
Search expressions	2159	
Functions reference	2160	
Creating a custom Search Provider	2161	
The SearchProvider class	2162	
Registering a Search Provider	2163	
Performing a search	2164	

Registering an Action Handler	2165
Glossary	2166