

# Spaces

## Tier 1 - Cartesian Coordinate Spaces

Space	Dim.	Why It's Core	Aliases	Translation Vector	What It Means
UV Space	2D	Texture sampling, blending, animation, atlases, UI masking	Texture space, Texcoord space, 2D UVs	(0.5, 0.5)	The center of a texture or sprite (50% across U and V)
Object Space	3D	Local mesh space — used in modeling, rigging, deformation	Local space, Model space, Mesh space	(1, 0, 0)	1 unit to the right of the object's pivot (local X axis)
World Space	3D	Scene-level effects, decals, VFX, projection, positioning	Global space, Scene space, Absolute space	(10, 2, -5)	A point 10 units right, 2 up, 5 back from world origin
Camera Space	3D	Needed for physical camera simulation, lighting, billboard, fresnel	View space, Eye space, View-relative space	(0, 0, -3)	A point 3 units in front of the camera
Screen Space	2D	UI layout, screen shaders, post-process FX tied to resolution	Pixel space, Raster space, Framebuffer space	(1920, 1080)	Bottom-right corner of a 1920x1080 screen
Viewport Space	2D	Resolution-independent layout, fullscreen FX, responsive shaders	Normalized screen space, 0-1 screen space, Screen UVs	(0.25, 0.75)	25% from the left, 75% from the bottom of the screen (normalized)

Space	Dim.	Why It's Core	Aliases	Translation Vector	What It Means
Tangent Space	3D	Local shading basis — used for normal maps, decals, and detail lighting	Surface space, Texture tangent space, TBN space	(0, 0, 1)	A direction pointing "out" from the surface (local Z axis)
Bone Space	3D	Used in rigging, skinning, animation — defines how vertices are deformed	Joint space, Skinning space, Bind pose space	(0, 1.2, 0)	A vertex 1.2 units above a bone's local origin (e.g., a joint's Y axis)

Space	Origin
UV Space	Bottom-left of the texture → (0, 0) in UV coords
Object Space	The pivot point of the object (usually center or base in modeling)
World Space	The global scene origin — Unity's (0, 0, 0) in the world
Camera Space	The camera's position → camera is at (0, 0, 0) and looks down -Z
Screen Space	Bottom-left of the screen (0,0) in Unity (unless it's top-left in other systems)
Viewport Space	Bottom-left of screen in normalized space → (0.0, 0.0)
Tangent Space	The origin is the current surface point, defined per-fragment or per-vertex
Bone Space	The origin is the base of the bone/joint — local to that bone

## Tier 2

Space	Dim.	Why It's Useful	Also Known As / Aliases	Example Vector	What It Means
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<b>Clip Space</b>	4D	Final stage before rasterization; output of MVP transform in vertex shader	Homogeneous clip space, Post-projection space	$(-1, 1, 0.5, 1)$	Top-left corner of screen in clip space (with depth = 0.5)
<b>NDC Space</b>	3D	Screen-aligned normalized coords after perspective divide	Normalized Device Coordinates	$(0, 0, 0.5)$	Center of screen in normalized screen space (Z = 0.5 depth)
<b>Local-to-Parent</b>	3D	Relative transforms for procedural rigs or hierarchy animation	Parent-relative space, Local hierarchy space	$(0, 1, 0)$	1 unit above the parent bone or object
<b>Bone Bind Pose Space</b>	3D	Base pose of mesh before animation; used to calculate skin deformation	Inverse bind space, Rest pose	$(0.2, 0.5, 0)$	Original vertex position relative to its joint's bind pose
<b>Camera-Relative Space</b>	3D	Used for large-world precision, eye-relative motion, and virtual cameras	Eye-relative, Floating origin space	$(0, 0, -50000)$	A point 50,000 units in front of the camera — used for planetary scale scenes
<b>Screen UV Space</b>	2D	For fullscreen shaders and distortion FX	NDC → UV, Normalized screen space	$(0.5, 0.5)$	Center of the screen (used in post-processing and image effects)
<b>Spherical / Polar Space</b>	2D/3D	Custom projections, procedural effects, panorama/fisheye mapping	Angular space, Radial coordinates	$(\theta = 1.57, r = 3)$	A point 3 units away at 90° from the origin (polar coordinates)

Revision #2

Created 30 March 2025 22:44:03 by victor

Updated 31 March 2025 00:30:41 by victor