Game Engine Features, A Look at Unity and Unreal Engine 4

Unreal Engine

> *"Unreal Engine is a complete suite of development tools for anyone working with real-time technology. From design visualizations and cinematic experiences to high-quality games across PC, console, mobile, VR, and AR, Unreal Engine gives you everything you need to start, ship, grow, and stand out from the crowd".*

Unreal Engine's website contains a features list that is all very well described and thought out. However, if someone is not huge on reading, it is a lot to cover. Here I give the features list, with a short layman's terms description for most every listed feature

Pipeline Integration

- **FBX, USD, and Alembic support**
- **Python scripting**
- **Data conversion**
- **Visual Dataprep**
- **LiDAR**
- **Shotgun Integration**

These features allow users to work in parallel, at the same time, on the same project. They can create their own user interfaces and their own recipes for making effects. The use of LiDAR allows for true to life creation with the use of data clouds and map points. This is notably used in a Ubisoft game that features the Notre Dame cathedral. UE4 can read USD files without a complete import and write back changes that can be seen upon reloading. Datasmith allows for non destructive importing.

World Building

- **The Unreal Editor**
- **Scalable foliage**
- **Asset optimization**
- **Mesh editing tools**
- **Landscape and terrain tools**

UE4 is available for Windows, Linux, and MacOS. UE has automatic processes to make your life easier. It can auto generate levels of detail along with geometries and their meshes and textures. Meshes are editable and UE offers its own mesh editing tools. With scalable foliage and landscape tools, UE4 allows for large scale environment creation with layers of meshes,

textures, skyboxes, and more. Think of it as one big photoshop project, with layers and layers of different details, but 3D.

Animation

- **Character Animation Tools**
- **Animation Blueprints**
- **Live Link data streaming**
- **Take Recorder**
- **Sequencer**

Unreal Engine 4 has blueprints specifically made for animation that feature a Skeletal Mesh, along with state machines, kinematics, ragdoll effects, blend spaces, and more. All of this allows users to create a well animated character that is fully customizable to their liking within the engine. It also supports Live Link data streaming, which is a plugin that allows users to stream real time data directly to the engine from performance capture systems. Nonlinear cinematic editing and animation in real time lets the editing be fully collaborative and lets artists work in parallel on the same project, all at once.

Rendering, Lighting, and Materials

- **Forward Rendering**
- **Flexible Material Editor**
- **Photoreal rasterizing and ray tracing in real time**
- **Virtual Texturing**
- **Post-process and screen-space effects**
- **Color-accurate final output**
- **High-quality media output**
- **Advanced Shading models**

These features allow all lighting and shading to be as true to life as the creator is willing to make it. With material editors, texturing, and ray tracing, lighting effects can be taken to a whole new level, having subtleties that go far with making lighting look realistic. With two methods of Virtual Texturing and forward rendering, visuals can be rendered and loaded with optimal respects to the user's CPU and GPU, and all materials can be edited. Color accuracy, anti-aliasing, and post process effects act as a high quality end-of-project render and effects filter, to give your project whatever ambience or mood you desire.

Simulation and Effects

- **Niagara particles and visual effects**
- **Clothing tools**
- **Chaos physics and destruction system**
- **Strand-based hair and fur**

With its chaos physics and destruction system, users can shatter, demolish, and break large scale scenes in high quality, supporting many materials - cloth, stone, hair, metal - and integrates Niagara for particle/visual effects like smoke, dust, water, and all the complicated lighting that goes along. Give clothes realistic physics with varying degrees of application, and give hair and fur a whole new true to life physical performance in a combination of Niagara and Chaos.

Gameplay and Interactivity Authoring

- **Robust multiplayer framework**
- **Advanced AI**
- **Unreal Motion Graphics UI Designer**
- **Variant manager**
- **Blueprint visual scripting system**

UE displays mastery in decades of tested and tried multiplayer frameworks across multiple platforms. Advanced AI allows for characters to be controlled via blueprints or behavior trees and have increased spatial awareness and the ability to optimally and dynamically navigate real time mesh updates. Users can create their own in game user interfaces, and create and edit variants of assets. Blueprint visual scripting allows for prototyping content without actually having to alter the code yourself.

Integrated Media Support

- **Professional video I/O support and playback**
- **Unreal Audio Engine**
- **Media framework**

Unreal supports 4K UHD video and audio at high bit & frame rates, enabling integration of AR and CG into live broadcasts. It also offers a large number of audio tools to help capture that perfect sound. Videos can be played within the engine and can be controlled via C++ or blueprints, and supports Apple ProRes formats on windows.

Platform Support and On-set Tools

- **Multi-platform development**
- **VR, AR, and MR (XR) support**
- **Pixel Streaming**
- **Remote control protocols**
- **Efficient multi-display rendering**
- **Virtual Scouting for filmmakers**
- **Virtual Camera plugin**

From Windows to Xbox, Playstation to the Switch, VR to AR, Unreal Engine 4 supports them all. Unreal works with a large amount of platforms, as well as most every variant of VR/AR that is

available today. Pixel streaming allows users to host on cloud-based GPU, while multi-display rendering lets them render real time content at any resolution on more than one display. Virtual Scouting allows users to explore the world and locations through VR, and cinematographers can drive cameras in the engine using iPads.

Content

- **Quixel Megascans**
- **Industry-specific templates**
- **Marketplace ecosystem**
- **Sample projects**

Quixel Megascans is a library that is full of real-world scans of 3D and 2D assets that is available for free with every UE license. Templates are available depending on what style project you plan on creating, with industry specific options (like architecture). The marketplace offers huge quantities of templates, projects, assets, textures, shapes, and more that vary in price.

Developer Tools

- **Full access to C++ source code**
- **Seamless Perforce Integration**
- **C++ API**
- **Profiling and Performance**

Developers have complete access to UE's C++ source code, which is constantly maintained and updated through GitHub, and the C++ API extends UE functionality even further with live coding. UE has tools that optimize your project to prevent bottle-necking and improve real time performance.

Unity

Animation and Cinematic

- **Animation**
- **2D rigging IK**
- **2D animation**
- **Cinemachine**

Unity offers both 2D and 3D animation, with 2D rigging IK calculating for positions and rotations of chains of bones for your animations' skeletons. Cinemachine is an editing suite for animation that includes tools for dynamic, smart, codeless cameras and allows you to create and experiment with camera behaviors in real time.

Audio and Video 2D

- **Audio components/mixer**
- **Spatializer**
- **DSPGraph audio framework**
- **Video player**

Unity's audio has full 3D spatial sound, real time mixing with hierarchies, and more. The Audio Spatializer SDK is an extension of a plugin that lets you change the way audio is transmitting in the surrounding space, letting you alter what you hear from the left, right, center, back, etc. While the DSPGraph audio framework is technically listed under DOTS, I am including it here as it is a low end audio mixer that acts as a drag and drop audio graph. The component called Video player lets you attach a video file directly to a GameObject's texture.

Data-Oriented Technology Stack (DOTS)

- **C# Job System**
- **Burst compiler**
- **Entity component system**
- **Unity physics and Havok physics**

DOTS lets user create and iterate faster with C#. Both Unity and Havok physics are based off of DOTS framework, meaning they use the same data protocol. This means you can transition your projects physics from one to another without having to completely rebuild your project. Unity is a lightweight customizable physics while Havok offers high end physics with much more complexity.

Editor

- **Package Manager**
- **HUB**
- **Asset database**
- **Prefabs**

The Unity HUB is an application that allows users to manage both Unity projects and installations. The package is a window that contains both assets and tools. The asset database converts data from an asset's source file into a format that can be used in game or in real-time applications, while the Prefab system lets you create, configure, and store GameObjects along with their properties, child classes, components, and assets into what is then called a reusable asset.

Effects, Lighting, Rendering

- **Particle System**
- **Visual effect graph**
- **Global Illumination (GI)**
- **Progressive lightmapper**
- **Reflection probes**
- **Render pipelines**
- **Post processing**
- **Shaders**
- **Ray tracing**

Ray tracing allows for excellent lighting and pulls from information that the user cannot always see. This however, requires a powerful GPU, and thus is not an option for everyone, much less for anyone who has an average PC. Reflection proves are like cameras that capture a spherical view of its surroundings and is stored in a cube map that's available for objects with reflective surfaces. Unity's particle system component can simulate clouds, flame, liquid, smoke, etc. by generating and animating large amounts of small 2D images. Unity offers a wide variety of meshes, materials, shaders, and textures that can be applied to objects within a project. With options available for rendering, post processing is made easy by applying fullscreen filters and effects to a camera's image buffer.

Programming Tools and Optimization

- **C#**
- **APIs and IDE support**
- **Version control**
- **Unity test framework**

- **Unity profiler**
- **Frame Debugger**

Unity allows full access to the Unity Engine and Unity Editor APIs, both of which are in easy to read C#. Unity also has integrated development environment support, which is software that provides tools to easier develop other software. The Unity Test Framework allows users to test their code in Edit and Play mode alike, as well as on alternate platforms.

WorldBuilding and 2D

- **Tilemap and terrain**
- **Brushes**
- **Sprite Shape**
- **2D World building**

Tilemap is a component that handles tiel assets for making 2D levels. Sprite tools also allow for optimal 2D sprite animation and physics. Unity comes with a built-in set of terrain features that let users add landscapes to their game, as well as customizing their own terrains using tools and brushes.