

CHAPTER 82

Unity and Unreal Engine: A Comparative Study

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ABSTRACT

The gaming industry has witnessed rapid growth in recent decades, with game engines serving as the core technology behind interactive experiences. Game engines streamline the development process by offering pre-built systems for graphics rendering, physics, animation, audio, and artificial intelligence, allowing developers to focus more on creativity and gameplay design. Among the various engines available, Unity and Unreal Engine have emerged as the two most dominant and influential platforms. Unity is widely recognized for its ease of use, strong community support, and extensive cross-platform compatibility, making it an ideal choice for beginners, indie developers, and mobile or AR/VR applications. In contrast, Unreal Engine is renowned for its cutting-edge graphics, photorealism, and robust performance, positioning it as the preferred option for AAA game studios, large-scale projects, and industries such as film, architecture, and simulation. This paper presents a comparative study of Unity and Unreal Engine, analyzing their programming languages, visual scripting systems, rendering pipelines, performance, platform support, asset ecosystems, and licensing models. The objective of this study is to provide game developers, students, and researchers with a comprehensive understanding of the strengths and weaknesses of both engines, thereby aiding in the selection of the most suitable engine for different project scales and requirements.

Keywords: Game engines; Unity; Unreal engine.

1.0 Introduction

In the rapidly evolving world of game development and interactive media, game engines are crucial for turning creative ideas into immersive virtual experiences. Game engines are the heart and soul of the game development process. They have multiple customizations, libraries, plugins, and other tools that have helped games become more realistic and entertaining.

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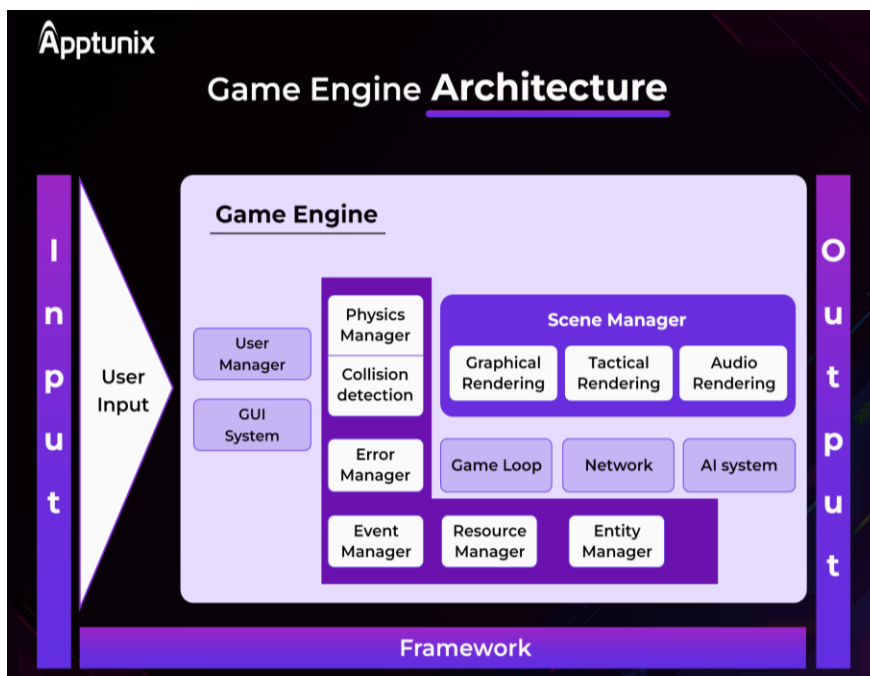
Today, Unity and Unreal Engine are recognized as two leading platforms among the vast array of available game engines. They have become industry powerhouses and continue to impress game developers with sophisticated asset creation. But how do you know which one is the right pick for a 3D team? What's better: Unity or Unreal engine?

Before we answer that, we should also look at what a game engine actually is. Read on and find out which engine suits your game development best.

2.0 What is a Game Engine?

A Game engine is a software framework designed to help developers create video games more efficiently. It provides a set of pre-built tools, libraries, and systems that handles the core functionalities of the game - so developers can focus on design, storytelling, and gameplay, rather than building everything from scratch.

A game engine's architecture organizes core components—rendering, physics, audio, and AI—into modules, providing reusable tools for developers. It simplifies development by handling complex technical tasks, letting developers focus on game logic and design, often using principles like abstraction, encapsulation, and ECS patterns.



This paper investigates the strengths and weaknesses of each engine to provide a clearer understanding of their roles in game development.

3.0 Unity Game Engine: Overview

Unity is one of the most popular and versatile real-time 3D development platforms in the world. It is widely used for creating video games, mobile apps, AR/VR experiences, simulations, and interactive media. It powers 84 percent of the top 100 games and over 60 percent of the top-grossing VR Steam experiences. Unity offers a suite of tools for developers, including graphics, VR and AR capabilities, animation tools, and more. By offering resources to teach users about the platform's source code, Unity makes coding more accessible.

Developed by Unity Technologies Founded in 2004. First release: Unity 1.0 launched in 2005 at Apple's Worldwide Developer Conference. It was initially a mac-only engine.



Unity was released in 2005 as a Mac-only game engine to make game development easier for small teams. It soon expanded to Windows, mobile (iOS & Android), and consoles. In 2010 Unity Asset Store boosted development with ready-made assets. Over time, Unity added VR/AR support, improved graphics pipelines (URP & HDRP), and performance tools, while also expanding beyond gaming into film, architecture, automotive, and education. Today, Unity is widely used for 2D, 3D, mobile, and XR projects, known for its ease of use, flexibility, and cross-platform support.

Unity uses C# for scripting, with Visual Studio or Rider as IDEs. It also includes Visual Scripting (Bolt) for non-programmers, allowing complex game logic to be created without writing code.

4.0 Unreal Engine: Overview

Unreal Engine is one of the most advanced and widely used real-time 3D game engines in the world. Developed by Epic Games, it has become a cornerstone of the video game industry as well as other creative industries such as film, architecture, automotive, and virtual reality. Known for its high-quality graphics, realistic physics, and flexibility, Unreal Engine empowers developers, designers, and artists to create immersive experiences across platforms.

Developed by Epic Games, In 1995: Development begins, In 1998: Unreal Engine 1 is released.



It is primarily written in C++ but also supports Blueprints Visual Scripting, which allows even non-programmers to design complex systems with ease. The engine is available free of charge, with royalty payments required only if a product earns over \$1 million USD in revenue. Highly versatile, Unreal Engine runs on a wide range of platforms including PC, consoles, mobile devices, augmented reality (AR), virtual reality (VR), and cloud-based environments, making it one of the most flexible and widely adopted engines in the industry.

Unity v/s Unreal: Detailed Comparison

- **Programming Language:**
 - Unity: Unity uses C#, which is beginner-friendly and easy to learn. It also includes Visual Scripting (Bolt) for non-programmers
 - Unreal Engine: Unreal Engine relies on C++ and also provides Blueprints, a visual scripting system for non-programmers.
- **Graphics and Visuals: -**
 - Unity: Unity uses different render pipelines to control graphics. Unity supports good, scalable visuals through Universal Render Pipeline (URP) and High-Definition Render Pipeline (HDRP), suitable for mobile and desktop games. Unity has improved its graphics capabilities but is generally less powerful than Unreal Engine in photorealism.
 - Unreal Engine: Unreal Engine is the gold standard for high-quality graphics, offering advanced rendering, real-time lighting, and particle effects for top-tier visuals. For this it uses a single, advanced rendering system with Nanite for virtualized geometry and Lumen for real-time global illumination. It delivers photorealistic graphics across all platforms without the need for separate pipelines like Unity.
- **Ease of Use**
 - Unity: Unity offers an intuitive interface, extensive tutorials, and a large supportive community, making it highly accessible for beginners and smaller development teams. Its gentle learning curve, especially for developers familiar with C#, allows users to start creating games quickly.
 - Unreal Engine: Unreal Engine has a steeper learning curve due to its complexity and reliance on C++, which can be challenging for newcomers. However, the Blueprint visual scripting system provides a more accessible entry point for non-programmers, allowing them to design complex game mechanics without writing code.

- Asset Support
 - Unity: Unity's Asset Store offers thousands of assets, plugins, and templates, enabling rapid prototyping and faster development, especially for indie and mobile projects.
 - Unreal Engine: Unreal Engine's Marketplace, on the other hand, provides high-quality, professional-grade assets that are well-suited for AAA games and large-scale projects, giving developers tools for detailed and realistic environments.
- Community and Support
 - Unity: Unity has a large, active community with numerous forums, tutorials, and third-party resources, along with a comprehensive Asset Store offering assets and tools to support development.
 - Unreal Engine: Unreal Engine also has a strong community and extensive official documentation. Epic Games provides regular updates, tutorials, and support through the Unreal Marketplace, ensuring developers have access to professional-grade resources and ongoing guidance.
- Performance
 - Unity: Unity is optimized for lightweight builds and moderate resource-intensive games, performing well across a wide range of projects, especially mobile and indie titles. However, for highly complex and resource-intensive games, it may not match the performance levels of Unreal Engine.
 - Unreal Engine: Unreal Engine, in contrast, is built for high-end, resource-intensive applications, using C++ and advanced optimization tools to handle large-scale environments, detailed graphics, and AAA-quality games without compromising visual fidelity.
- Platform Support
 - Unity: Unity offers support for over 25 platforms, including PC, consoles, mobile devices, VR/AR headsets, and WebGL, offering flexibility for developers across different systems
 - Unreal Engine: Unreal Engine also supports multiple platforms but excels in virtual production and cinematic workflows, making it preferred for high-end projects.
- Project Scale
 - Unity: Unity is ideal for mobile games, 2D/3D indie projects, and AR/VR applications, suited to small to medium-scale projects.
 - Unreal Engine: Unreal Engine is better for AAA games, large open-world projects, films, and complex simulations, leveraging its advanced graphics and high-performance capabilities.
- Licensing and Cost
 - Unity: Unity offers a free version with sufficient features for many projects. The Pro version, which includes additional features and services, requires a subscription fee.
 - Unreal Engine: Unreal Engine is free to use, but there are royalty fees (5%) on gross

revenue after the first \$1 million earned by a game. This can be a significant cost consideration for successful commercial projects.

Table 1: Comparison Table

Features	Unity Engine	Unreal Engine
Programming language	Use c#	Use c++
Visual Scripting	Bolt (less mature)	Blueprint (mature, deeply integrated)
Graphics	Scalable (URP/HDRP); less photorealistic	High-end, photorealistic (Nanite & Lumen)
Key Strength	Accessibility, cross-platform, rapid prototyping	Photorealism, scalability, deep customization
Ease of Uses	Beginner-friendly, fast to learn, large community	Steeper learning curve, Blueprints simplify for non-programmers
Assets	Large, beginner-focused	smaller, but high-quality assets
Performance	Optimized for mobile/indie games; moderate resource usage	Handles high-end, resource-intensive, AAA projects efficiently
Project Scale	Small to medium: mobile, 2D/3D indie, AR/VR	Large-scale: AAA games, open-world, films, simulations
Cost	Free; Pro version subscription for extra features	Free; 5% royalty after \$1M revenue

5.0 Conclusion

Unity and Unreal Engine both stand as industry-leading game engines, each with distinct strengths tailored to different project needs. Both are excellent platforms for game development, but the right choice depends on project needs and developer preferences.

Unity is best suited for beginners, indie developers, and mobile or AR/VR projects due to its ease of use, large community support, and cross-platform flexibility. In contrast, Unreal Engine dominates in high-end graphics, large-scale environments, and cinematic production, making it the engine of choice for AAA games, films, and simulations.

While Unity emphasizes accessibility and rapid prototyping, Unreal excels in delivering photorealism and performance for resource-intensive applications. Ultimately, the choice between Unity and Unreal depends on the project's scale, target platform, and development goals. Developers aiming for lightweight, scalable projects may prefer Unity, whereas teams focused on realism, immersive worlds, and cinematic experiences may find Unreal Engine more suitable. Both engines continue to evolve and shape the future of interactive media, ensuring that developers have powerful tools to bring their creative visions to life.

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