Unity Software (Shanghai) Co. Ltd.

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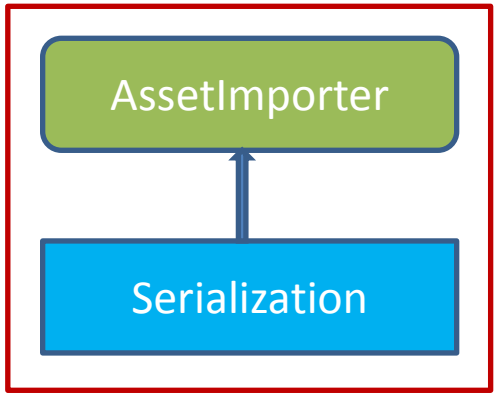
Main Topics

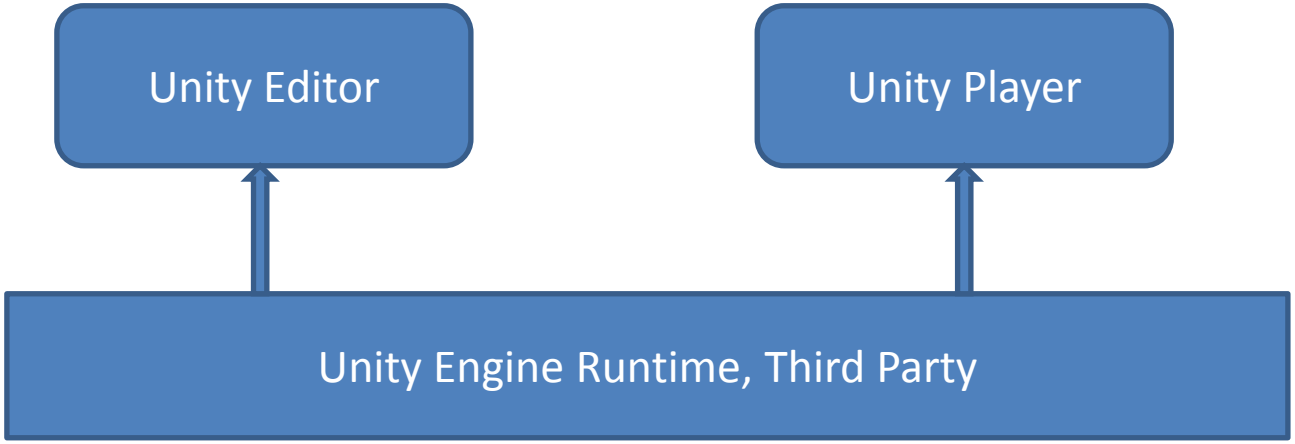
- **Unity Runtime System**
  - **Architecture**
  - **Workflow**
- **How to consider optimization**
  - **Graphics**
  - **Physics**
  - **Memory Usage**
  - **Scripting**
- **Where to compare to other engine**

Understand Unity Runtime System

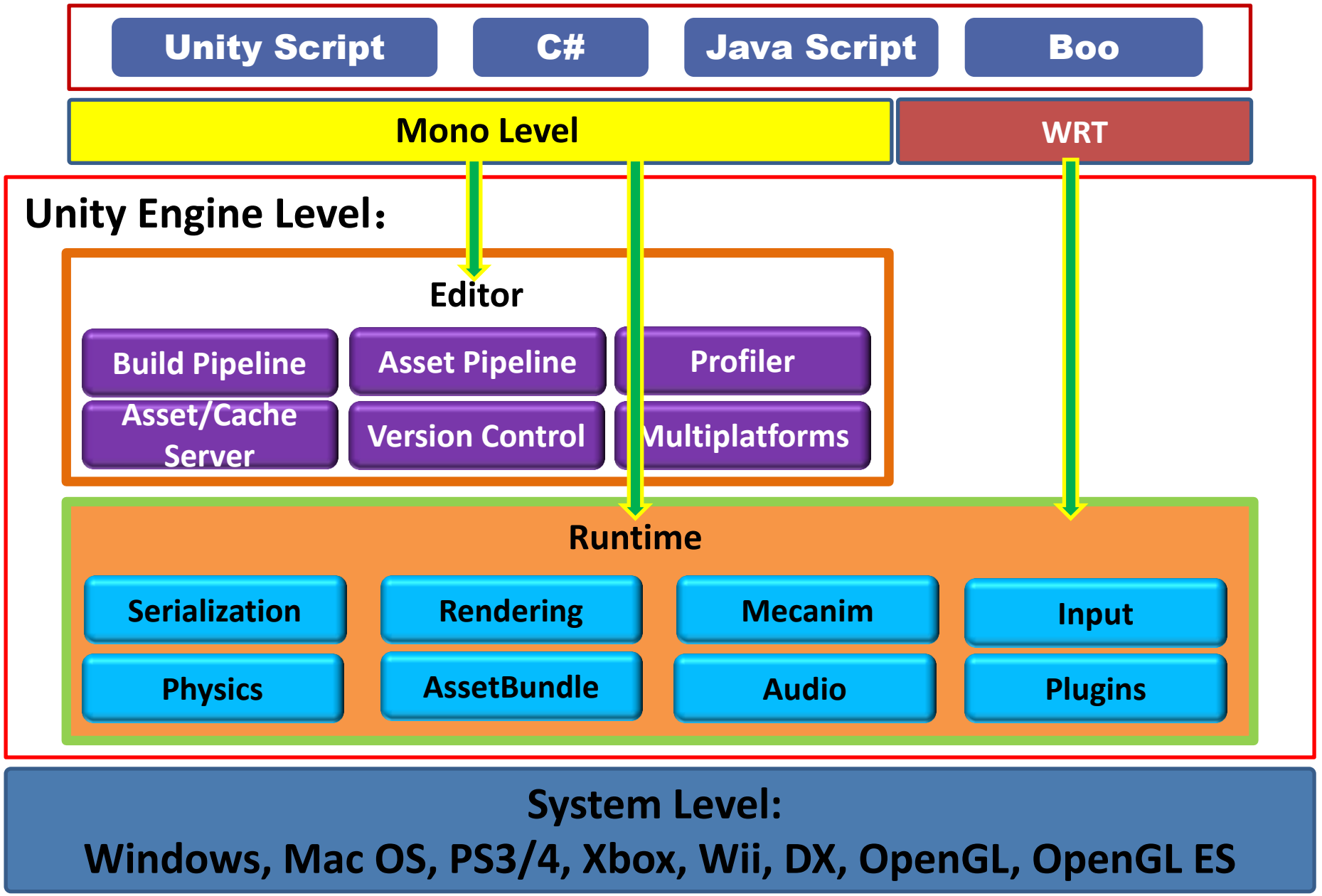
Unity Editor – Based on

- Mono (MonoGenerated)
- Src – Editor C/C++
- AssetImporter/AssetDatabase





Understand Unity Runtime System



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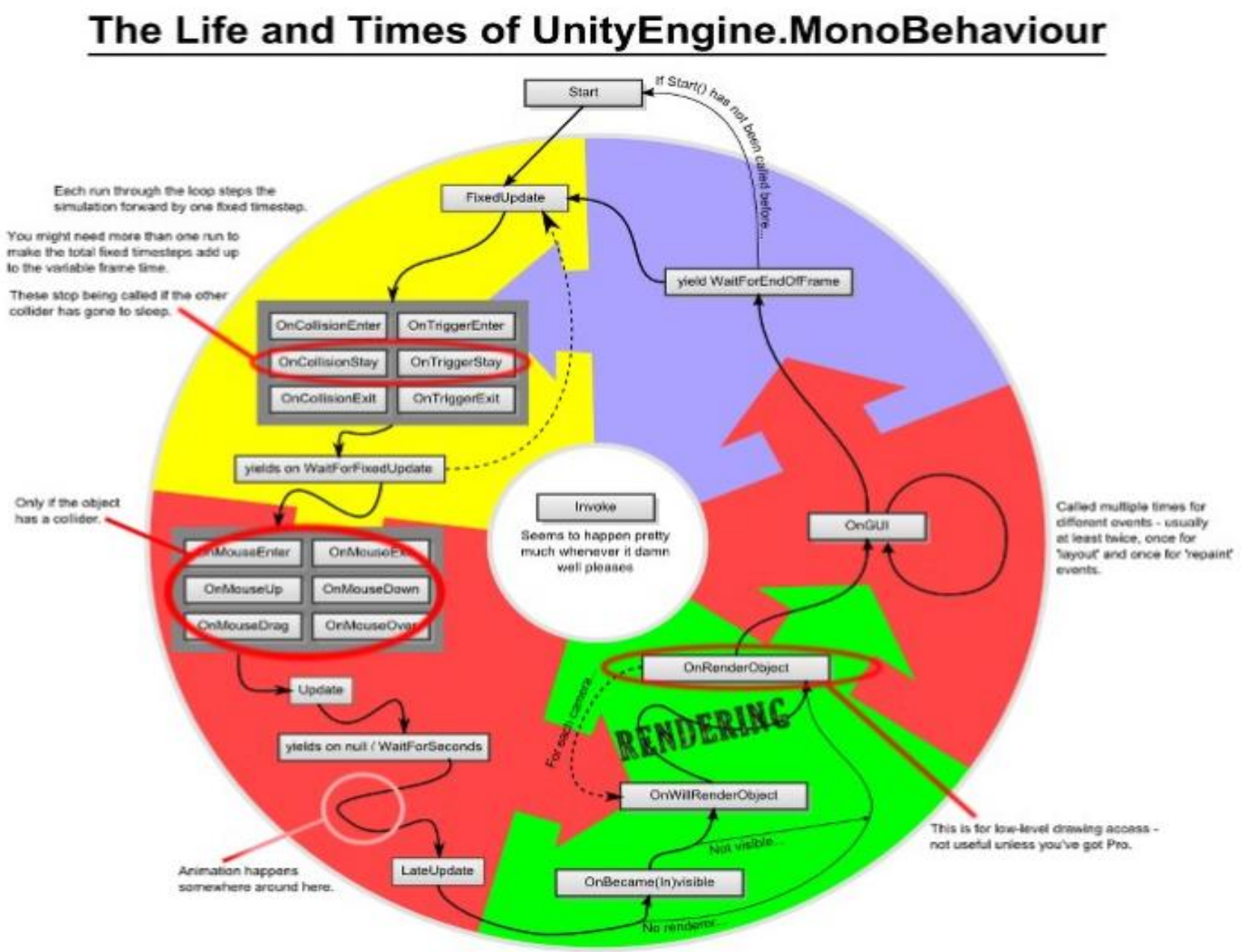

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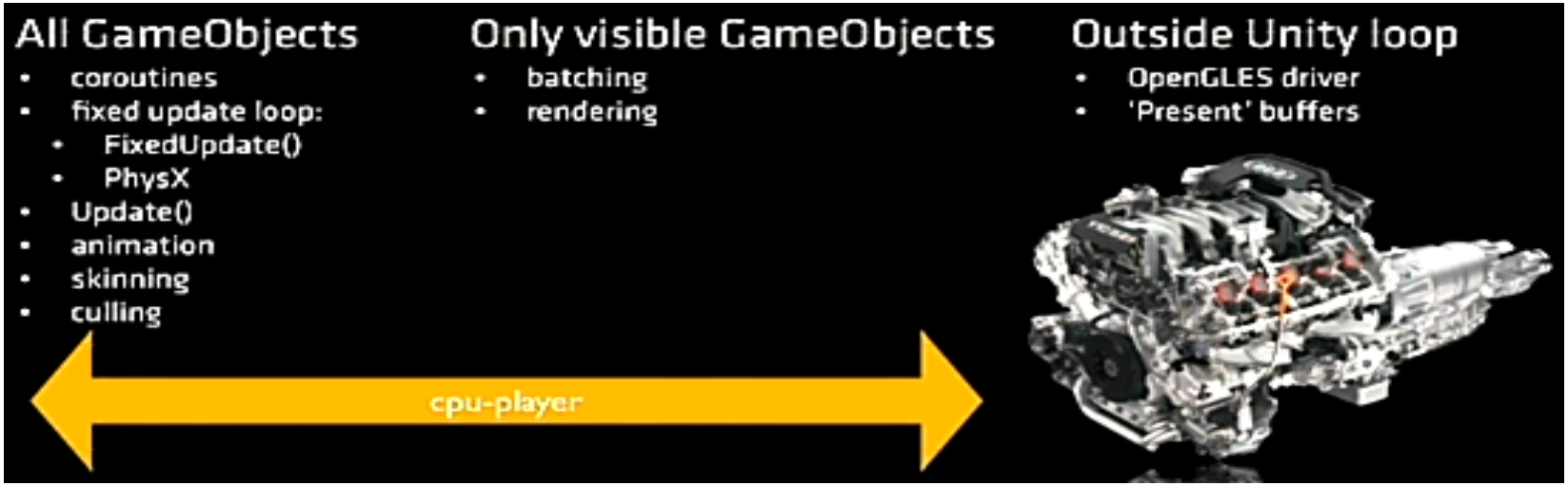
Understand Unity runtime

- When start design the project, allocate the available budget
- Profiling at anytime (pay more attention at each development stage)



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Optimization in graphics

Graphics

- GPU – Reduce Fill-rate
  - no alpha test
- CPU – Reduce Draw call
  - Static & Dynamic Batching
- Culling
- LOD
- Shader
  - Use mobile shader
- Texture
  - Size, import settings, compress
- Lighting
  - Light map, light probes, reflection probes (5.0)

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Optimization in physics

Physics

- Prefer primitive colliders over meshes
  - Avoid Mesh Collider
- Tweak Time.fixedDeltaTime

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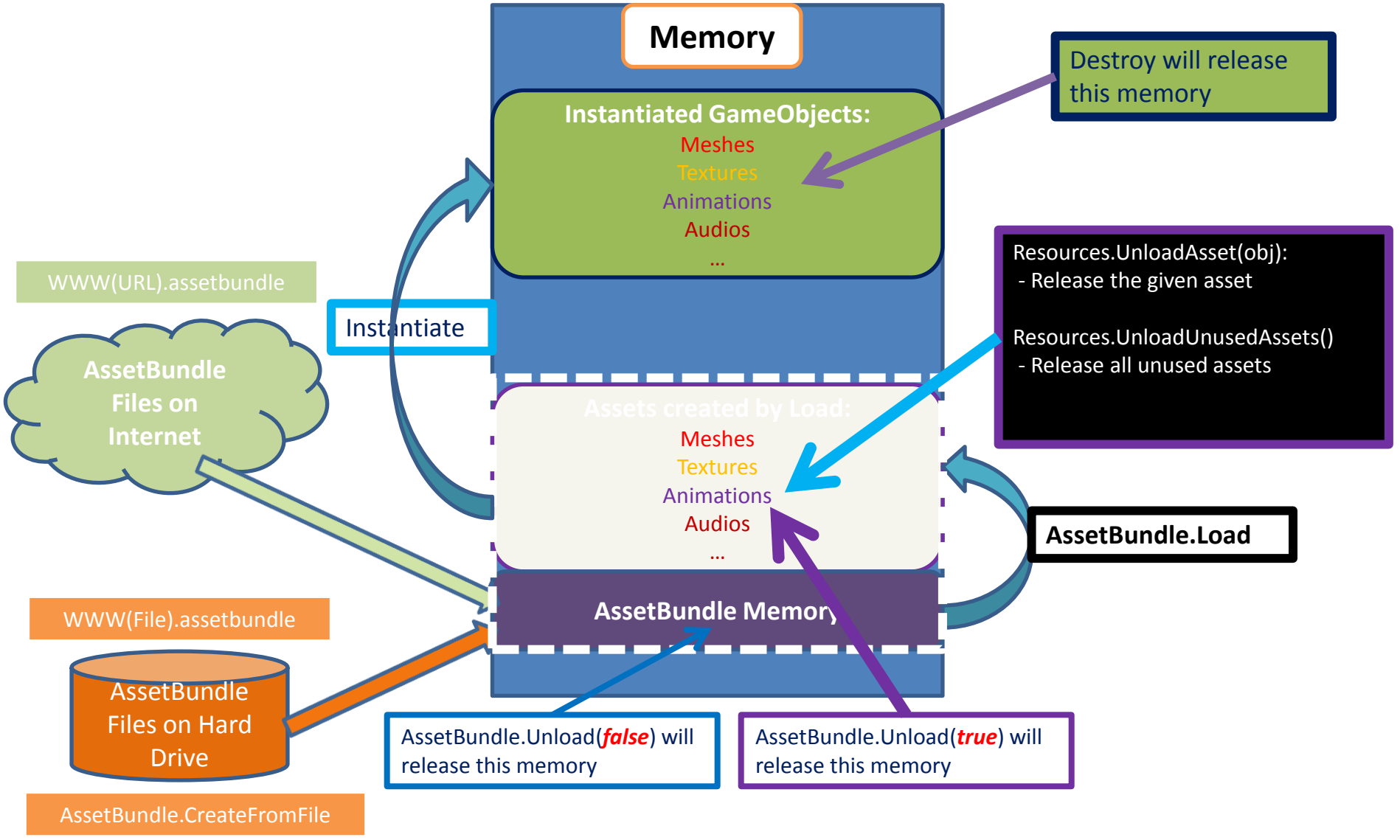
Optimization in memory usage

- Memory usage in Unity
  - Code
  - Managed Heap
  - Native Heap
- Profiling memory usage
- Scripts Library
- Mono memory – managed heap
- Unity internal memory – Native Heap
- GC.Collect
- GameObject pool

Optimization in memory usage

Memory management & optimization – load/unload AssetBundle

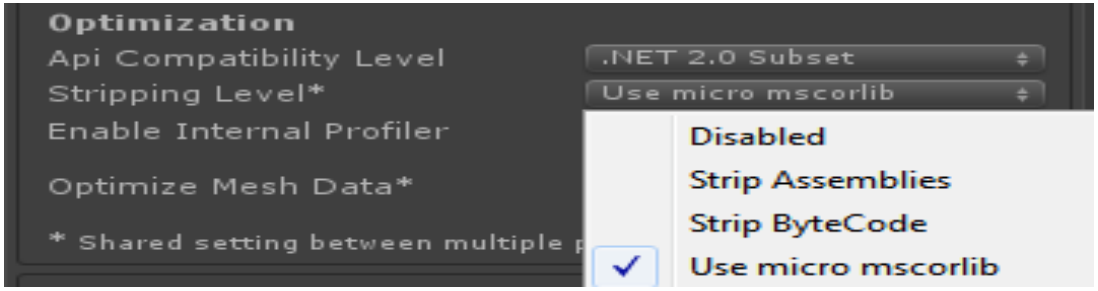


Optimization in memory usage

Scripts Library

- Reduce lib size – this will reduce the final build size
- In Player Settings – Select .NET 2.0 Subset

- In Player Settings – Select Use micro mscorlib



- Note:
  - Handle crash (windows or devices) or compiling errors (Xcode)
  - Some functions are not supported by Subset and micro (System.Xml)

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Scripting Basic in Unity

- Languages Supported
- Mono / WRT – JIT & AOT
- MonoBehaviour
- MonoDevelop
- Script as Component
- Create Script
- Script class hierarchy
  - Namespaces: UnityEngine, UnityEditor,
  - Hierarchy
    - Object->ScriptableObject->……
    - Object->GameObject->……
    - Object->Component->Behaviour->MonoHehaviour->……

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Script performance optimization

- Avoid expensive API functions
- Ray casting
- Caching game object and components
- Low level code consideration
- Restrict dynamic typing
- Culling script execution
- Don not update if not necessary

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Script performance optimization

- **Profiler**
  - **Find where is the major performance issue**
  - **Profiler.BeginSample() / Profiler.EndSample()**
- **Avoid Expensive Functions**
  - **GameObject.Find/FindWithTag**
  - **Object.FindObjectOfType**
- **Update Efficiently**
  - **DON'T override Update, if don't need it**
  - **DON'T update every frame, if not necessary**
- **Low-Level Code**
  - **String, Math, ……**

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Scripting Internal in Unity

- **Mono**
  - **WinRT (for wp8 and WSA)**
  - **JIT & AOT**
  - **Check compatibility:** http://docs.unity3d.com/412/Documentation/ScriptReference/MonoCompatibility.html
- **GC**
- **Exception**
- **Debugging**
- **Native Interop**
- **Example**
- **IL2CPP – future in 5.0**

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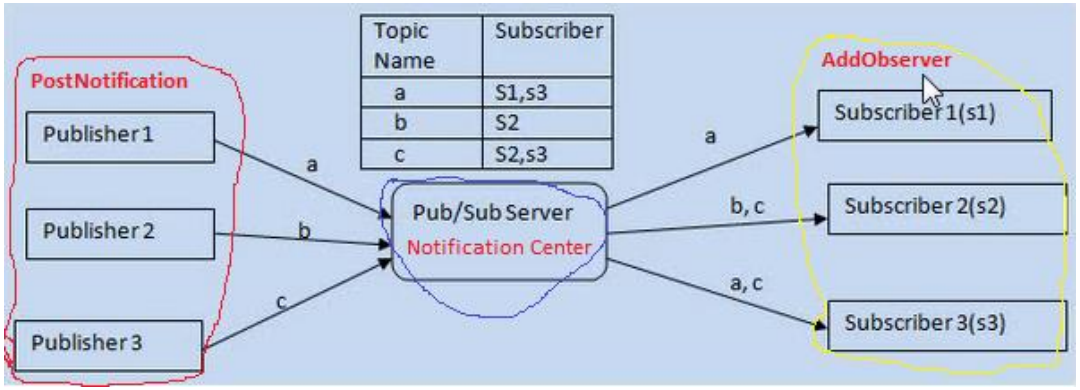
Simple Programming Practices

- **String – Use StringBuilder**

Simple Programming Practices

- **Communication Center – with loose connection**
- **How it work**



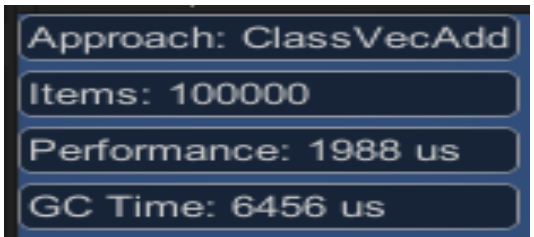
  - **Subscribe a message**
    - function AddObserver (observer, name: String, sender)
  - **Send a notification**
    - function PostNotification (aSender, aName: String, aData)
- **Advantage -**
- **Disadvantage -**

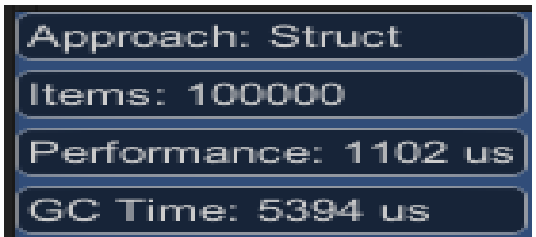
Simple Programming Practices

- **Basic Performance Test**
  - **Class vs. Struct definitions**

```
public class ClassVecAddApproach : Approach
{
    class Character
    {
        public string Name;
        public Vector3 Position;
    }

    Character[] characters;

    public override void Setup (int length)
    {
        characters = new Character[length];
        for (int i =0; i < characters.Length; i++)
            characters[i] = new Character()
        {
            Name = "Character " + i
        };
    }

    public override void Update (Vector3 vec)
    {
        for (int i =0; i < characters.Length; i++)
        {
            characters[i].Position += vec;
        }
    }
}
```

```
public class StructApproach : Approach
{
    struct Character
    {
        public string Name;
        public Vector3 Position;
    }

    Character[] characters;

    public override void Setup (int length)
    {
        characters = new Character[length];
        for (int i =0; i < characters.Length; i++)
            characters[i].Name = "Character " + i;
    }

    public override void Update (Vector3 vec)
    {
        for (int i =0; i < characters.Length; i++)
        {
            Vector3 v = characters[i].Position;
            v.x += vec.x;
            v.y += vec.y;
            v.z += vec.z;
            characters[i].Position = v;
        }
    }
}
```





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The Future of Scripting In Unity – IL2CPP

- **What is IL2CPP?**
  - **AOT**
  - **VM**
- **Why IL2CPP?**
  - **C# runtime performance still lags behind C/C++**
  - **The latest .NET features are not supported in Unity's current version of Mono**
  - **A large amount of effort is required for porting, maintaining, and feature parity between platforms**
  - **Garbage collection can cause stuttering**
- **Benefits**
  - **Resolve above issues**
- **What's NOT**
  - **Such as System.Reflection.Emit**

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Comparison with others

- **Compare Unity with UDK**
  - **Pricing: Heating up**
  - **Easy of use: Unity is easy to use**
  - **Graphics: Unity keeps improving the rendering quality**
  - **Physics: UDK has good cloth simulation**
  - **Scripting: UDK – visual editing, Unity will have it**
  - **Platforms: UDK - on PC, Unity - on PC and Mac**
  - **Importing: Unity is easy**
  - **Asset management:**
  - **Community & learning: UDK – good tutorial, Unity – larger community**
  - **Games**

Are there so many "pit" in Unity?

- **The Largest PIT：Do not fully understand Unity**

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Q & A

To win a Unity Pro License:

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