



UGUI 性能优化技巧

侑虎科技（上海）有限公司

提纲

- UI开销分析
- HUD系统



开销分析

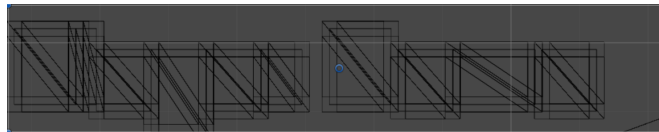
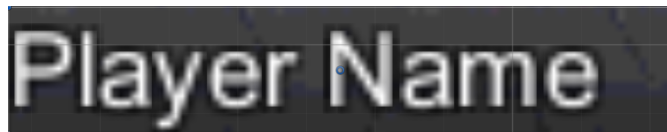
- [UI元素更新]
- [网格合并]
- 渲染
- [事件检测]



开销分析

- [UI元素更新]
 - Instantiate/GameObejct.Activate
 - RectTransform 的 Dimension 数值修改
 - Image/Text 的属性修改
 - Layout 属性修改

```
[SerializeField] private Color m_Color = Color.white;  
public Color color { get { return m_Color; } set { if (SetPropertyUtility.SetColor(ref m_Color, value)) SetVerticesDirty(); } }
```



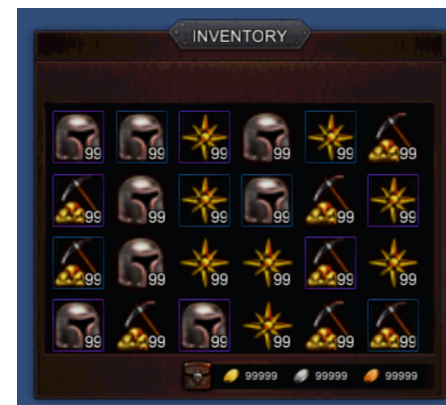
开销分析

- [UI元素更新]
 - Canvas.SendWillRenderCanvases()
 - (ScrollRect.LateUpdate())

Canvas.SendWillRenderCanvases()	56.1%	0.0%	1	56.4 KB	73.97	0.00
CanvasUpdateRegistry.PerformUpdate()	56.1%	0.8%	1	56.4 KB	73.97	1.10
Graphic.Rebuild()	43.9%	0.1%	414	5.8 KB	57.81	0.21
Text.UpdateGeometry()	20.5%	0.0%	84	80 B	27.09	0.10
Graphic.UpdateGeometry()	12.6%	0.7%	123	120 B	16.65	1.03
Graphic.UpdateMaterial()	10.5%	0.5%	207	5.6 KB	13.84	0.71
LayoutRebuilder.UnityEngine.UI.ICanvasElement.Rebuild()	9.1%	0.0%	6	50.2 KB	12.02	0.00
LayoutRebuilder.PerformLayoutCalculation()	5.0%	0.1%	4	47.8 KB	6.63	0.23
LayoutRebuilder.PerformLayoutControl()	4.0%	0.1%	4	2.3 KB	5.38	0.24

Text.UpdateGeometry()	20.5%	0.0%	84	80 B	27.09	0.10
Graphic.UpdateGeometry()	20.5%	0.6%	84	80 B	26.99	0.85
Outline.ModifyVertices()	13.7%	0.6%	81	0 B	18.07	0.80
Text.OnFillVBO()	5.2%	2.8%	84	0 B	6.91	3.80
Graphic.get_canvasRenderer()	0.2%	0.0%	84	80 B	0.34	0.11
CanvasRenderer.SetVertices()	0.1%	0.0%	84	0 B	0.21	0.03

Graphic.UpdateGeometry()	12.6%	0.7%	123	120 B	16.65	1.03
Image.OnFillVBO()	10.9%	0.8%	123	0 B	14.36	1.11
Image.GenerateSimpleSprite()	5.5%	0.7%	86	0 B	7.32	0.98
Image.GenerateSlicedSprite()	4.4%	1.5%	37	0 B	5.90	2.07
Image.get_overrideSprite()	0.0%	0.0%	123	0 B	0.02	0.02
Image.get_type()	0.0%	0.0%	123	0 B	0.00	0.00
Object.op_Equality()	0.0%	0.0%	123	0 B	0.00	0.00
Component.GetComponents()	0.2%	0.0%	123	0 B	0.26	0.00
ComponentListPool.Release()	0.1%	0.0%	123	0 B	0.26	0.00



开销分析

- [UI元素更新]
 - Canvas.SendWillRenderCanvases()
 - CPU
 - 堆内存（主要在实例化是出现）
 - UpdateGeometry->OnFillVBO

```
var vbo = s_VboPool.Get();  
  
if (rectTransform != null && rectTransform.rect.width >= 0 && rectTransform.rect.height >= 0)  
    OnFillVBO(vbo);
```



```
private void PerformUpdate()  
{  
    // So MB's override the == operator for null equality, which checks  
    // if they are destroyed. This is fine if you are looking at a concrete  
    // mb, but in this case we are looking at a list of CanvasElement  
    // this won't forward the == operator to the MB, but just check if the  
    // interface is null. IsDestroyed will return if the backend is destroyed  
    m_LayoutRebuildQueue.RemoveAll(x => x == null || x.IsDestroyed());  
    m_GraphicRebuildQueue.RemoveAll(x => x == null || x.IsDestroyed());  
  
    m_PerformingLayoutUpdate = true;  
  
    m_LayoutRebuildQueue.Sort(s_SortLayoutFunction);  
    for (int i = 0; i <= (int)CanvasUpdate.PostLayout; i++)  
    {  
        for (int j = 0; j < m_LayoutRebuildQueue.Count; j++)  
        {  
            try  
            {  
                if (ObjectValidForUpdates(instance.m_LayoutRebuildQueue[j]))  
                    instance.m_LayoutRebuildQueue[j].Rebuild((CanvasUpdate));  
            }  
            catch (Exception e)  
            {  
                Debug.LogException(e, instance.m_LayoutRebuildQueue[j].transform);  
            }  
        }  
    }  
  
    instance.m_LayoutRebuildQueue.Clear();  
    m_PerformingLayoutUpdate = false;  
  
    m_PerformingGraphicUpdate = true;  
    for (var i = (int)CanvasUpdate.PreRender; i < (int)CanvasUpdate.MaxUpdateValue; i++)  
    {  
        for (var k = 0; k < instance.m_GraphicRebuildQueue.Count; k++)  
        {  
            try  
            {  
                var element = instance.m_GraphicRebuildQueue[k];  
                if (ObjectValidForUpdate(element))  
                    element.Rebuild((CanvasUpdate));  
            }  
            catch (Exception e)  
            {  
                Debug.LogException(e, instance.m_GraphicRebuildQueue[k].transform);  
            }  
        }  
    }  
  
    instance.m_GraphicRebuildQueue.Clear();  
    m_PerformingGraphicUpdate = false;  
}
```

▼ ScrollRect.LateUpdate()	73.8%	0.9%	1	1.6 MB	52.44	0.66	N/A	7.2%	0.0%	1	210.0 KB	5.14	0.00
▼ ScrollRect.EnsureLayoutHasRebuilt()	72.5%	0.0%	1	1.6 MB	51.57	0.00	N/A	0.3%	0.0%	1	0.8 MB	0.28	0.00
▼ Canvas.ForceUpdateCanvases()	72.5%	0.0%	1	1.6 MB	51.56	0.00	N/A	0.2%	0.2%	1	52.5 KB	0.17	0.15
▼ Canvas.SendWillRenderCanvases()	72.5%	0.0%	1	1.6 MB	51.56	0.00	N/A	0.2%	0.0%	1	420.0 KB	0.16	0.00
▼ CanvasUpdateRegistry.PerformUpdate()	72.5%	0.1%	1	1.6 MB	51.56	0.13	N/A	0.0%	0.0%	1	105.0 KB	0.03	0.00
▼ Graphic.Rebuild()	69.1%	0.0%	12	1.6 MB	49.09	0.00	N/A	0.0%	0.0%	1	0 B	0.01	0.00
▼ Text.UpdateGeometry()	61.6%	0.0%	2	1.6 MB	43.80	0.00	N/A	0.0%	0.0%	1	0 B	0.01	0.00
▼ Graphic.UpdateGeometry()	61.6%	0.0%	2	1.6 MB	43.79	0.02	N/A	0.0%	0.0%	1	0 B	0.01	0.00
▼ Text.OnFillVBO()	60.7%	46.7%	2	1.6 MB	43.14	33.22	N/A	0.0%	0.0%	1	0 B	0.01	0.01
► List`1.Add()	9.0%	0.6%	12396	1.6 MB	6.43	0.42	N/A	0.0%	0.0%	1	0 B	0.01	0.00
► TextGenerator.Populate()	2.8%	0.0%	2	0 B	1.99	0.00	N/A	0.0%	0.0%	1	0 B	0.01	0.00
► List`1.get_Item()	1.0%	0.3%	12396	0 B	0.74	0.27	N/A	0.0%	0.0%	1	0 B	0.01	0.00

开销分析

- [UI元素更新]

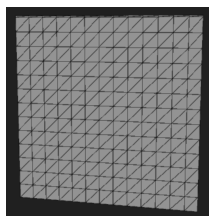
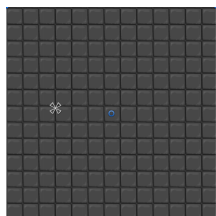
- 减少长文本 Text 的变动，慎用 UI/Effect。



BatchedMesh
36 verts, 18 tris uv,uv2,colors

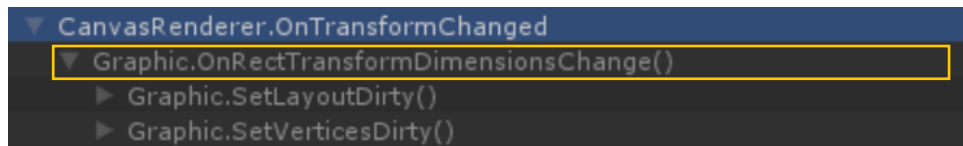
BatchedMesh
180 verts, 90 tris uv,uv2,colors

- 慎用 Tiled 类型的 Image。



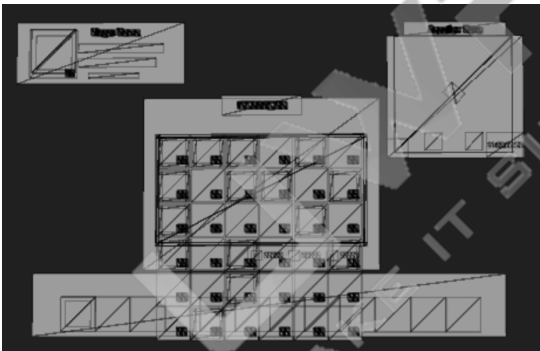
BatchedMesh
728 verts, 364 tris uv,uv2,colors

- 慎用 Pixel Perfect



开销分析

- [网格合并]
 - Canvas 为单位



- Canvas.BuildBatch

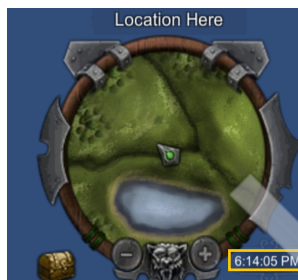
Canvas.BuildBatch	21.3%	0.0%	1	0 B	4.22	0.00
Canvas.GenerateBatchedMesh	21.3%	6.6%	1	0 B	4.22	1.32
Canvas.FillBatchMesh	13.6%	1.7%	1	0 B	2.69	0.34
Canvas.FillVerts	10.8%	10.8%	1	0 B	2.14	2.14
Canvas.DoIndices	0.9%	0.9%	1	0 B	0.19	0.19
Canvas.FillQuads	0.0%	0.0%	1	0 B	0.00	0.00
Canvas.BatchSort	0.9%	0.9%	1	0 B	0.19	0.19
Mesh.AwakeFromLoad	0.0%	0.0%	1	0 B	0.00	0.00
Not Saved (154)				0.7 MB		
Mesh (16)				0.5 MB		
BatchedMesh				489.0 KB	1	

开销分析

- [网格合并]

- 排除不需要的 `Canvas.SendWillRenderCanvases()`
- 动静分离，动态元素可按更新频率细分。

- 坐标、时间
- HUD 战斗提示
- 角色头顶信息
-



- 控制“动态 Canvas”中的元素数量（网格大小）。
- 慎用 `CanvasGroup` 的 Alpha 渐变。

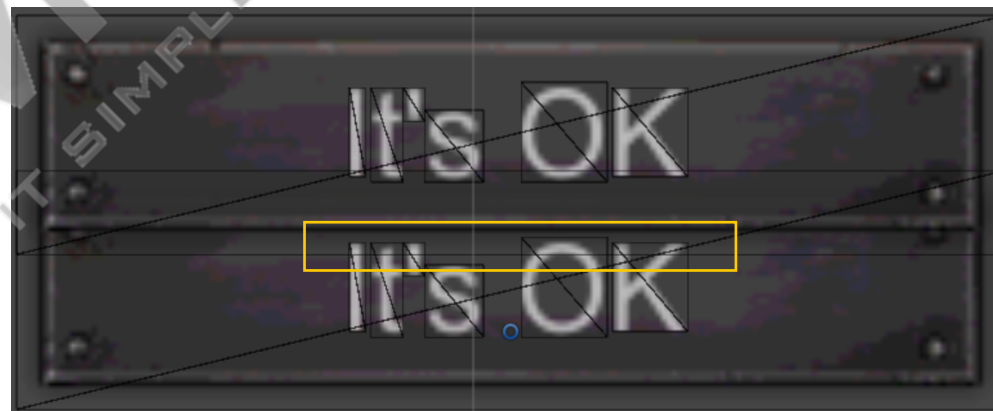
开销分析

- 渲染

- 按 Canvas 合并 Mesh (BatchedMesh)

BatchedMesh	5.2 KB	1
BatchedMesh	5.2 KB	1

- 渲染顺序重排



- UI元素按渲染顺序及Atlas 分成小组 (Submesh)

BatchedMesh
3940 verts, 1970 tris, 48 submeshes uv,uv2,colors

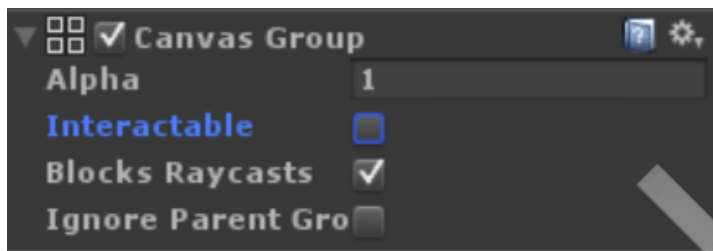
开销分析

- 渲染
 - 合理规划 Atlas
 - 同时同地
 - 适当冗余
 - 尽可能合并静态UI元素
 - 确保静态
 - 去除空 Sprite
 - 改变“增大检测区域”的方式
 - Mask -> RectMask 2D

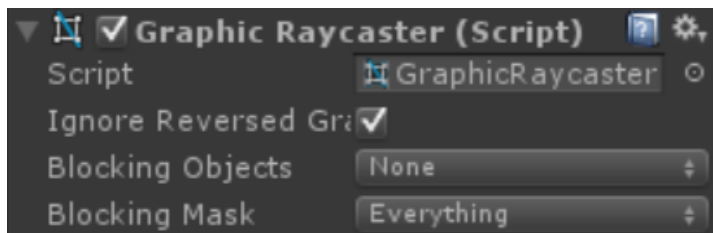


开销分析

- 事件检测
 - 过滤不需要检测的 Canvas
 - CanvasGroup (Interactable)

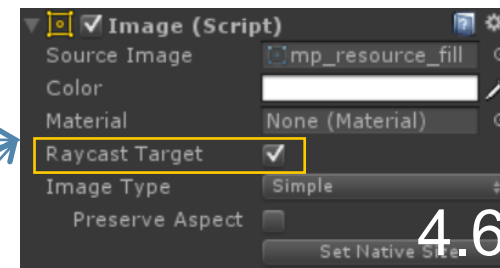
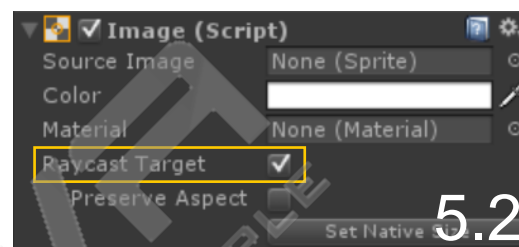


- GraphicRaycaster (Enable)



开销分析

- 事件检测
 - 引入 Unity 5.2 的优化方法

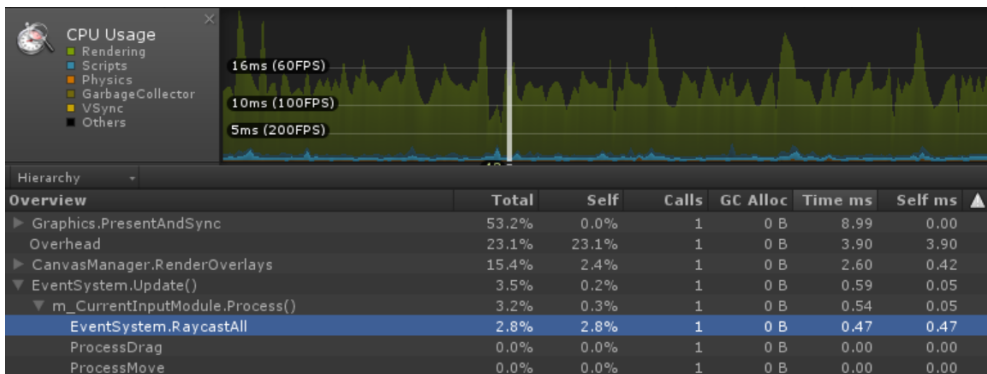
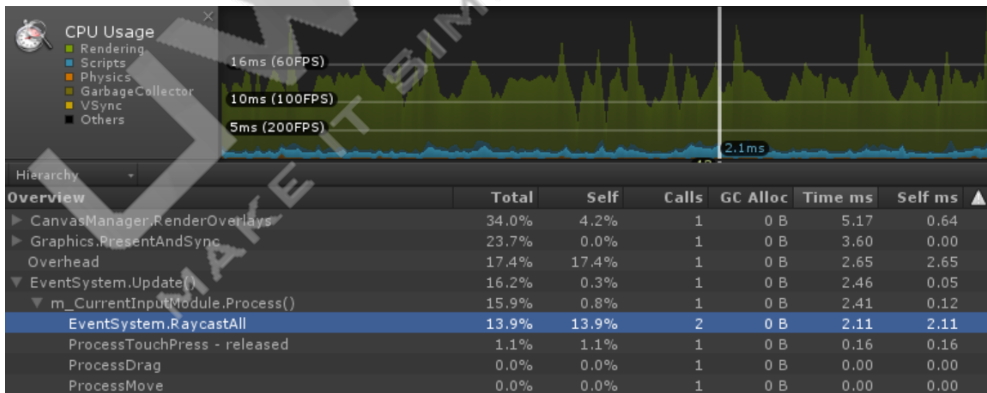
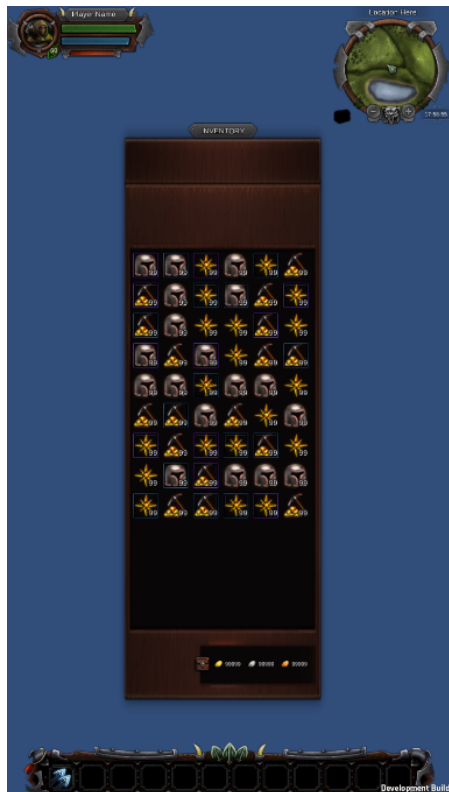
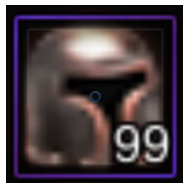
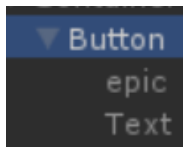


```
[NonSerialized] static readonly List<Graphic> s_SortedGraphics = new List<Graphic>();  
private static void Raycast(Canvas canvas, Camera eventCamera, Vector2 pointerPosition, List<Graphic> results)  
{  
    // Debug.Log("ttt" + pointerPosition + "::::" + camera);  
    // Necessary for the event system  
    var foundGraphics = GraphicRegistry.GetGraphicsForCanvas(canvas);  
    s_SortedGraphics.Clear();  
    for (int i = 0; i < foundGraphics.Count; ++i)  
    {  
        Graphic graphic = foundGraphics[i];  
  
        // -1 means it hasn't been processed by the canvas, which means it isn't actually drawn  
        if (graphic.depth == -1 || graphic.raycastTarget == false)  
            continue;  
  
        if (!RectTransformUtility.RectangleContainsScreenPoint(graphic.rectTransform, pointerPosition, eventCamera))  
            continue;  
  
        if (graphic.Raycast(pointerPosition, eventCamera))  
        {  
            s_SortedGraphics.Add(graphic);  
        }  
    }  
}
```

开销分析

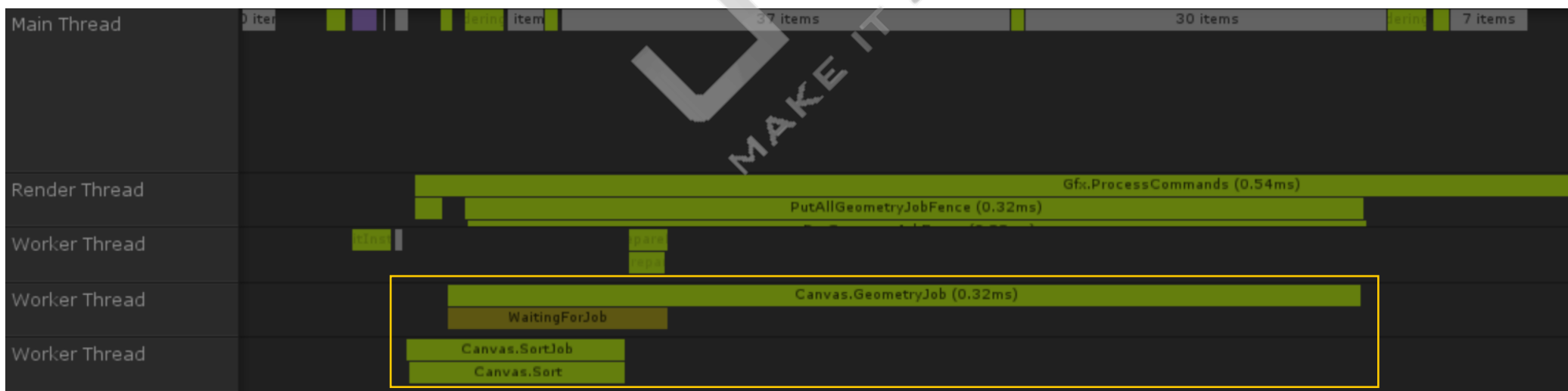
- 事件检测
 - 过滤不需要检测的Graphic
 - 一个 Item 只需要一个 Target 进行检测

```
Graphic[] graphics = Resources.FindObjectsOfTypeAll<Graphic>();
foreach (Graphic g in graphics)
{
    if (g.GetComponent<Button>() == null)
    {
        g.RaycastTarget = false;
    }
}
```



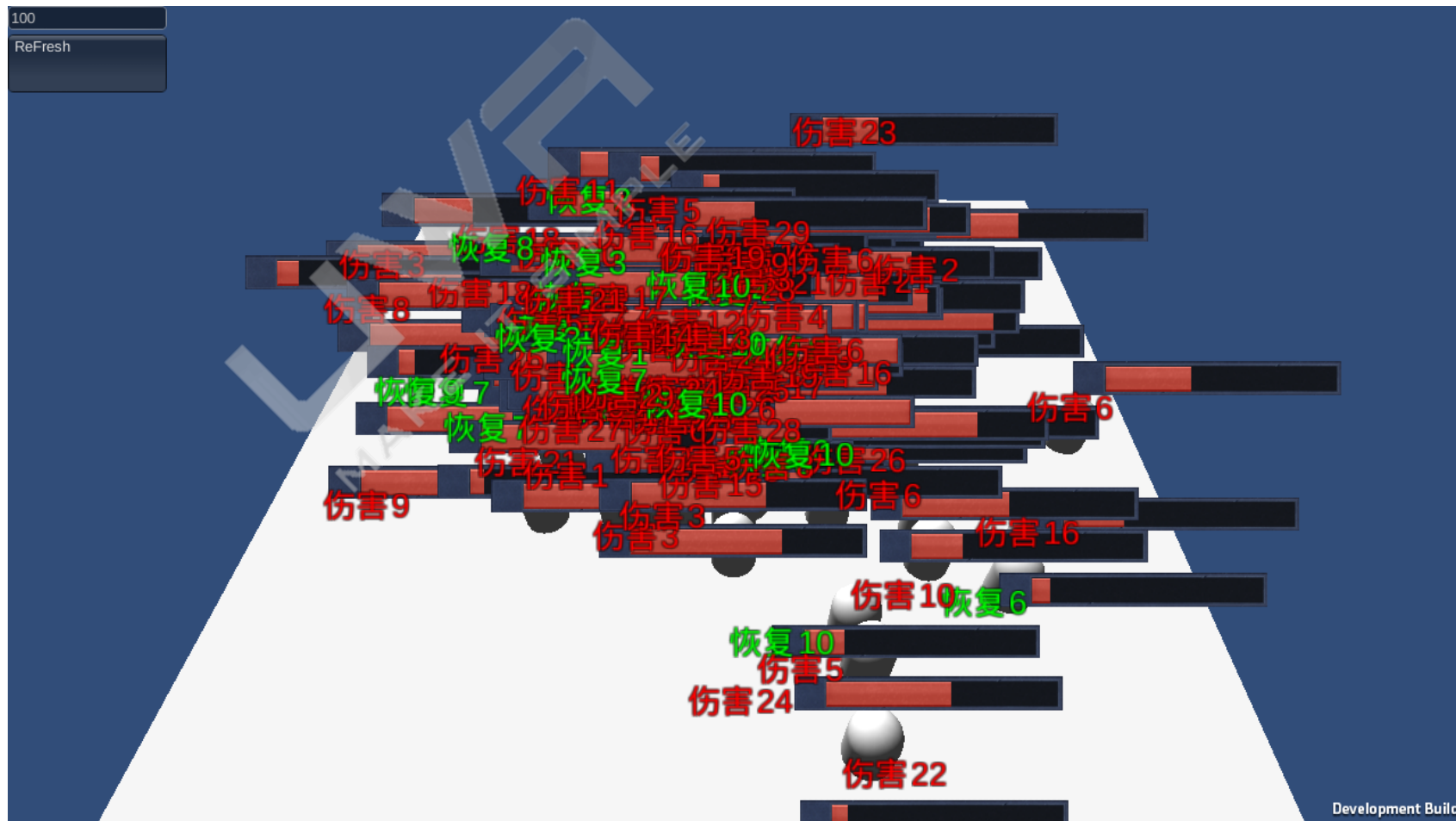
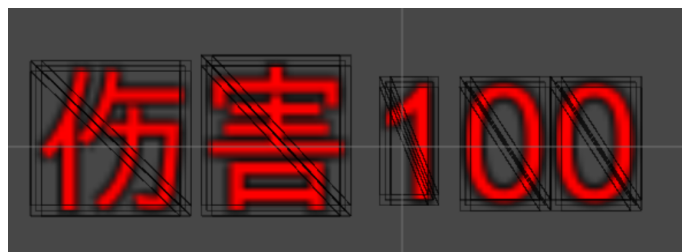
开销分析

- 多线程 Unity 5.2
 - WaitingForJob
 - PutAllGeometryJob



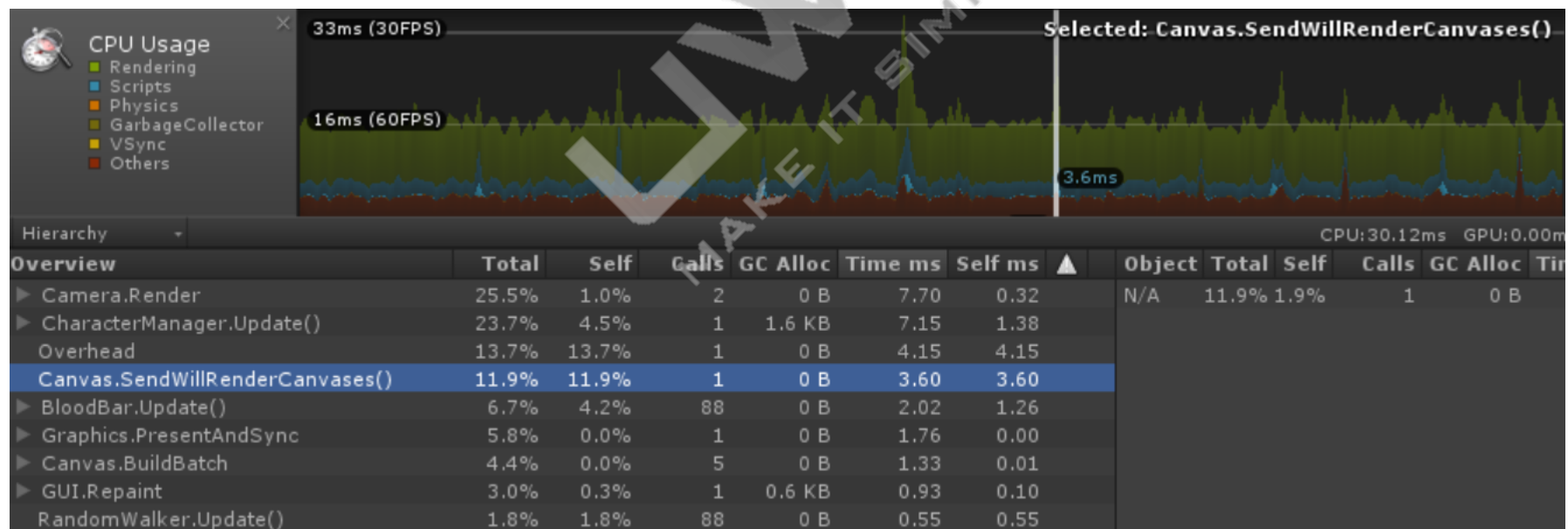
HUD血条优化

- HUD与血条设置
- 同屏100



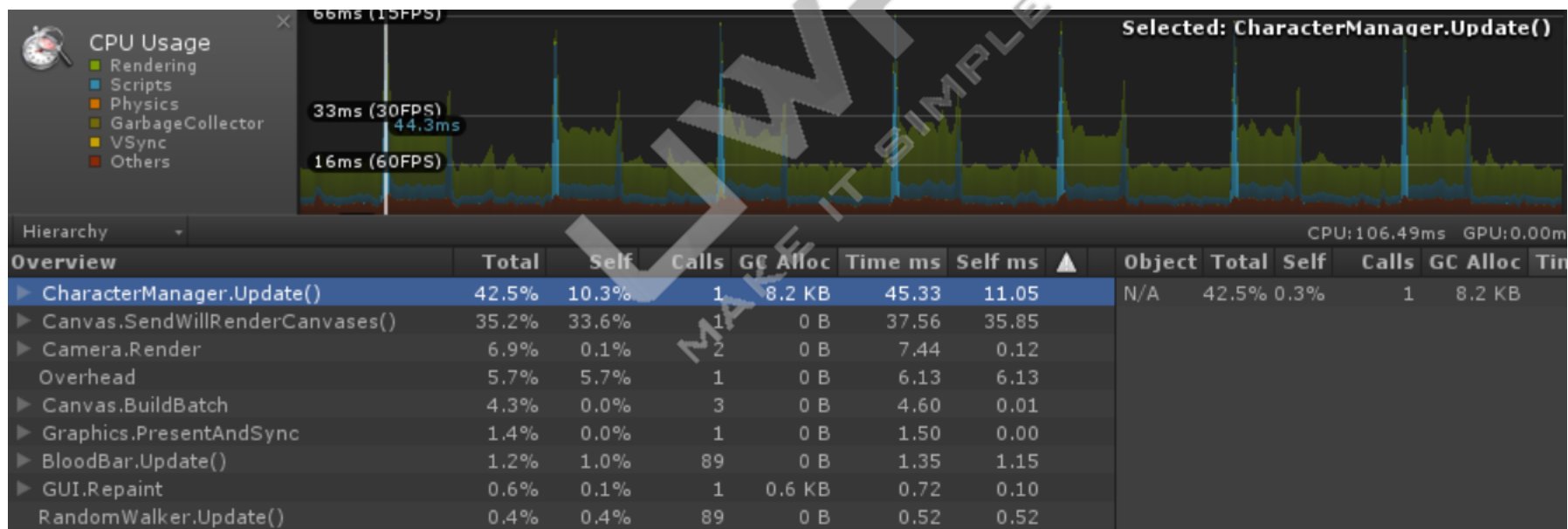
HUD血条优化

- 批量变动血条时出现的峰值
- 血条的消失/出现时间基本随机



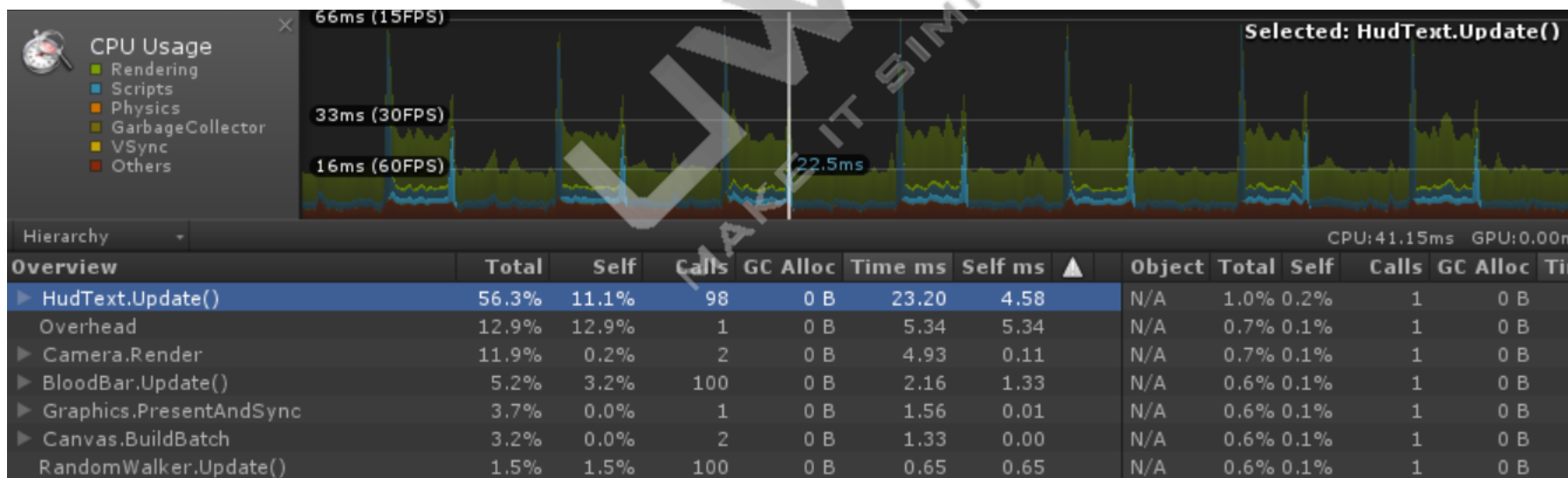
HUD血条优化

- 文字批量出现时的第一处峰值（批量出现时）



HUD血条优化

- 文字批量出现时的第二处峰值（批量消失时）



HUD血条优化

- 文字批量出现时的第一处峰值
 - CharacterManager.Update
- 去掉SetParent操作
- 去掉Outline效果

▼ CharacterManager.Update()	43.9%	8.4%	1	7.9 KB	39.03	7.52
▼ GameObject.Activate	31.9%	11.5%	103	216 B	28.33	10.25
Text.OnEnable()	13.9%	13.9%	188	0 B	12.40	12.40
RectTransform.SendReapplyDrivenF	3.2%	3.2%	188	0 B	2.92	2.92
▼ RandomWalker.OnEnable()	1.8%	0.1%	9	216 B	1.61	0.14
▼ GameObject.Activate	1.6%	0.8%	9	108 B	1.46	0.72
MaskableGraphic.OnEnable()	0.5%	0.5%	18	0 B	0.48	0.48
RectTransform.SendReapplyDi	0.2%	0.2%	18	0 B	0.18	0.18
BloodBar.OnEnable()	0.0%	0.0%	9	108 B	0.04	0.04
CanvasRenderer.OnTransform	0.0%	0.0%	27	0 B	0.03	0.03
CanvasRenderer.OnTransformChan	1.0%	1.0%	282	0 B	0.92	0.92
HudText.OnEnable()	0.2%	0.2%	94	0 B	0.21	0.21
▼ GameObject.Deactivate	2.0%	0.1%	9	0 B	1.84	0.14
▼ RandomWalker.OnDisable()	1.9%	0.2%	9	0 B	1.69	0.20
▼ GameObject.Deactivate	1.6%	0.7%	9	0 B	1.48	0.66
MaskableGraphic.OnDisable()	0.6%	0.6%	18	0 B	0.58	0.58
RectTransform.SendReapplyDi	0.2%	0.2%	18	0 B	0.22	0.22
Graphic.OnRectTransformDimensionsC	0.9%	0.9%	49	0 B	0.81	0.81
CanvasRenderer.OnTransformChange	0.4%	0.4%	309	0 B	0.42	0.42
UIBehaviour.OnRectTransformDimensi	0.1%	0.1%	49	0 B	0.10	0.10

▼ CharacterManager.Update()	42.5%	10.3%	1	8.2 KB	45.33	11.05
▼ GameObject.Activate	24.7%	8.2%	109	264 B	26.30	8.82
Text.OnEnable()	11.3%	11.3%	196	0 B	12.09	12.09
▼ RandomWalker.OnEnable()	2.3%	0.3%	11	264 B	2.47	0.42
GameObject.Activate	1.6%	0.7%	11	132 B	1.72	0.83
MaskableGraphic.OnEnable()	0.5%	0.5%	22	0 B	0.59	0.59
RectTransform.SendReapplyDi	0.1%	0.1%	22	0 B	0.20	0.20
BloodBar.OnEnable()	0.0%	0.0%	11	132 B	0.05	0.05
CanvasRenderer.OnTransform	0.0%	0.0%	33	0 B	0.02	0.02
Graphic.OnBeforeTransformParent	0.2%	0.2%	22	0 B	0.24	0.24
MaskableGraphic.OnTransformPa	0.0%	0.0%	22	0 B	0.04	0.04
CanvasRenderer.OnTransformCh	0.0%	0.0%	22	0 B	0.03	0.03
RectTransform.SendReapplyDrivenF	1.8%	1.8%	196	0 B	1.99	1.99
BaseVertexEffect.OnEnable()	0.4%	0.4%	98	0 B	0.48	0.48
CanvasRenderer.OnTransformChan	0.2%	0.2%	294	0 B	0.23	0.23
HudText.OnEnable()	0.1%	0.1%	98	0 B	0.20	0.20
▼ GameObject.Deactivate	2.8%	0.2%	11	0 B	3.02	0.24
▼ RandomWalker.OnDisable()	2.6%	0.5%	11	0 B	2.78	0.61
▼ GameObject.Deactivate	1.6%	0.8%	11	0 B	1.79	0.89
MaskableGraphic.OnDisable()	0.6%	0.6%	22	0 B	0.68	0.68
RectTransform.SendReapplyDi	0.2%	0.2%	22	0 B	0.21	0.21
Graphic.OnBeforeTransformParent	0.2%	0.2%	22	0 B	0.23	0.23
CanvasRenderer.OnTransformCh	0.0%	0.0%	22	0 B	0.08	0.08
MaskableGraphic.OnTransformPa	0.0%	0.0%	22	0 B	0.05	0.05
Graphic.OnBeforeTransformParentCha	2.1%	2.1%	196	0 B	2.30	2.30
Graphic.OnRectTransformDimensionsC	0.8%	0.8%	64	0 B	0.87	0.87
CanvasRenderer.OnTransformChange	0.5%	0.5%	512	0 B	0.60	0.60
MaskableGraphic.OnTransformParentC	0.4%	0.4%	196	0 B	0.44	0.44
UIBehaviour.OnBeforeTransformParen	0.2%	0.2%	196	0 B	0.30	0.30
UIBehaviour.OnTransformParentChang	0.2%	0.2%	196	0 B	0.27	0.27
UIBehaviour.OnRectTransformDimensi	0.1%	0.1%	64	0 B	0.13	0.13

HUD血条优化

- 文字批量出现时的第一处峰值
 - Canvas.SendWillRenderCanvases
- 去掉SetParent操作
- 去掉Outline效果

Canvas.SendWillRenderCanvases()	40.4%	0.0%	1	0 B	160.49	0.00
CanvasUpdateRegistry.PerformUpdate()	40.4%	0.5%	1	0 B	160.49	2.29
Graphic.Rebuild()	39.4%	0.1%	602	0 B	156.69	0.41
Text.UpdateGeometry()	32.9%	0.1%	194	0 B	130.63	0.44
Graphic.UpdateGeometry()	32.7%	0.6%	194	0 B	130.16	2.68
Outline.ModifyVertices()	23.4%	0.7%	194	0 B	93.15	2.92
Text.OnFillVBO()	7.5%	3.1%	194	0 B	30.05	12.66
ComponentListPool.Release()	0.2%	0.0%	194	0 B	1.04	0.09
CanvasRenderer.SetVertices()	0.2%	0.0%	194	0 B	0.90	0.17
ObjectPool`1.Release()	0.2%	0.0%	194	0 B	0.86	0.39

Canvas.SendWillRenderCanvases()	35.2%	33.6%	1	0 B	37.56	35.85
Font.CacheFontForText	1.6%	1.6%	392	0 B	1.71	1.71



Canvas.SendWillRenderCanvases()	33.2%	31.2%	1	0 B	29.52	27.76
Font.CacheFontForText	1.9%	1.9%	376	0 B	1.75	1.75

HUD血条优化

- 文字批量出现时的第一处峰值
 - Camera.Render
- 去掉SetParent操作
- 去掉Outline效果

▼ Camera.Render	6.9%	0.1%	2	0 B	8.13	0.12
▼ Drawing	6.4%	0.0%	2	0 B	7.58	0.03
▶ Render.OpaqueGeometry	3.6%	0.0%	2	0 B	4.21	0.08
▼ Render.TransparentGeometry	2.7%	0.0%	2	0 B	3.26	0.02
▼ RenderForwardAlpha.Render	2.7%	0.0%	2	0 B	3.22	0.05
Mesh.CreateVBO	2.0%	2.0%	2	0 B	2.39	2.39
Mesh.DrawVBO	0.6%	0.6%	2	0 B	0.73	0.73
Shader.SetPass	0.0%	0.0%	2	0 B	0.04	0.04
RenderForwardAlpha.Prepare	0.0%	0.0%	2	0 B	0.01	0.01
RenderForwardAlpha.Sort	0.0%	0.0%	2	0 B	0.00	0.00
Render.Prepare	0.0%	0.0%	2	0 B	0.06	0.06
Camera.ImageEffects	0.0%	0.0%	2	0 B	0.00	0.00
▶ Culling	0.3%	0.1%	2	0 B	0.38	0.19
Camera.ImageEffects	0.0%	0.0%	2	0 B	0.03	0.03
RenderTexture.SetActive	0.0%	0.0%	2	0 B	0.00	0.00

Camera.Render	7.4%	0.1%	2	0 B	6.65	0.11
▼ Drawing	6.8%	0.0%	2	0 B	6.11	0.03
▶ Render.OpaqueGeometry	4.7%	0.0%	2	0 B	4.22	0.02
▼ Render.TransparentGeometry	1.9%	0.0%	2	0 B	1.75	0.01
▼ RenderForwardAlpha.Render	1.9%	0.0%	2	0 B	1.72	0.06
Mesh.CreateVBO	1.3%	1.3%	2	0 B	1.15	1.15
Mesh.DrawVBO	0.5%	0.5%	2	0 B	0.45	0.45
Shader.SetPass	0.0%	0.0%	2	0 B	0.04	0.04
▶ RenderForwardAlpha.Prepare	0.0%	0.0%	2	0 B	0.01	0.01
RenderForwardAlpha.Sort	0.0%	0.0%	2	0 B	0.00	0.00
Render.Prepare	0.1%	0.1%	2	0 B	0.10	0.10
Camera.ImageEffects	0.0%	0.0%	2	0 B	0.00	0.00
▶ Culling	0.4%	0.2%	2	0 B	0.41	0.23
RenderTexture.SetActive	0.0%	0.0%	2	0 B	0.00	0.00
Camera.ImageEffects	0.0%	0.0%	2	0 B	0.00	0.00

HUD血条优化

- 文字批量出现时的第一处峰值
 - Canvas.BuildBatch
- 去掉SetParent操作
- 去掉Outline效果

▼ Canvas.BuildBatch	4.2%	0.0%	3	0 B	4.97	0.00
▼ Canvas.GenerateBatchedMesh	4.2%	0.7%	3	0 B	4.96	0.82
▼ Canvas.FillBatchMesh	2.6%	0.4%	3	0 B	3.03	0.55
Canvas.FillVerts	2.0%	2.0%	3	0 B	2.33	2.33
Canvas.DoIndicies	0.1%	0.1%	3	0 B	0.13	0.13
Canvas.FillQuads	0.0%	0.0%	3	0 B	0.01	0.01
Canvas.BatchSort	0.9%	0.9%	3	0 B	1.09	1.09
Mesh.AwakeFromLoad	0.0%	0.0%	3	0 B	0.01	0.01

▼ Canvas.BuildBatch	2.8%	0.0%	2	0 B	2.53	0.00
▼ Canvas.GenerateBatchedMesh	2.8%	0.2%	2	0 B	2.53	0.24
▼ Canvas.FillBatchMesh	1.5%	0.3%	2	0 B	1.34	0.27
Canvas.FillVerts	1.0%	1.0%	2	0 B	0.95	0.95
Canvas.DoIndicies	0.1%	0.1%	2	0 B	0.11	0.11
Canvas.FillQuads	0.0%	0.0%	2	0 B	0.00	0.00
Canvas.BatchSort	1.0%	1.0%	2	0 B	0.94	0.94
Mesh.AwakeFromLoad	0.0%	0.0%	2	0 B	0.00	0.00

HUD血条优化

- 文字批量出现时的第二处峰值
 - 去掉SetParent操作
 - 去掉Outline效果

▼ HudText.Update()	55.5%	11.1%	100	0 B	23.69	4.74
▼ GameObject.Deactivate	35.3%	14.2%	100	0 B	15.04	6.06
Text.OnDisable()	14.7%	14.7%	200	0 B	6.29	6.29
RectTransform.SendReapplyDrivenF	4.8%	4.8%	200	0 B	2.05	2.05
HudText.OnDisable()	0.8%	0.8%	100	0 B	0.35	0.35
BaseVertexEffect.OnDisable()	0.6%	0.6%	100	0 B	0.28	0.28
Graphic.OnBeforeTransformParentCha	4.9%	4.9%	200	0 B	2.08	2.08
CanvasRenderer.OnTransformChange	1.8%	1.8%	200	0 B	0.77	0.77
MaskableGraphic.OnTransformParentC	1.0%	1.0%	200	0 B	0.45	0.45
UIBehaviour.OnBeforeTransformParen	0.7%	0.7%	200	0 B	0.30	0.30
UIBehaviour.OnTransformParentChang	0.6%	0.6%	200	0 B	0.27	0.27



▼ HudText.Update()	47.7%	3.7%	94	0 B	16.08	1.26
▼ GameObject.Deactivate	43.9%	18.0%	94	0 B	14.81	6.07
Text.OnDisable()	18.9%	18.9%	188	0 B	6.38	6.38
RectTransform.SendReapplyDrivenF	5.9%	5.9%	188	0 B	2.01	2.01
HudText.OnDisable()	1.0%	1.0%	94	0 B	0.35	0.35

HUD血条优化

- 文字激活和禁用的开销
 - OnEnable/OnDisable

```
public static void TrackText(Text t)
{
    if (t.font == null)
        return;

    List<Text> exists;
    m_Tracked.TryGetValue(t.font, out exists);
    if (exists == null)
    {
        exists = new List<Text>();
        m_Tracked.Add(t.font, exists);

        t.font.textureRebuildCallback += RebuildForFont(t.font);
    }

    for (int i = 0; i < exists.Count; i++)
    {
        if (exists[i] == t)
            return;
    }

    exists.Add(t);
}
```

CharacterManager.Update()	43.9%	8.4%	1	7.9 KB	39.03	7.52
GameObject.Activate	31.9%	11.5%	103	216 B	28.33	10.25
Text.OnEnable()	13.9%	13.9%	188	0 B	12.40	12.40
RectTransform.SendReapplyDrivenF	3.2%	3.2%	188	0 B	2.92	2.92
RandomWalker.OnEnable()	1.8%	0.1%	9	216 B	1.61	0.14
CanvasRenderer.OnTransformChan	1.0%	1.0%	282	0 B	0.92	0.92
HudText.OnEnable()	0.2%	0.2%	94	0 B	0.21	0.21
GameObject.Deactivate	2.0%	0.1%	9	0 B	1.84	0.14
Graphic.OnRectTransformDimensionsC	0.9%	0.9%	49	0 B	0.81	0.81
CanvasRenderer.OnTransformChange	0.4%	0.4%	309	0 B	0.42	0.42
UIBehaviour.OnRectTransformDimensi	0.1%	0.1%	49	0 B	0.10	0.10

HudText.Update()	47.7%	3.7%	94	0 B	16.08	1.26
GameObject.Deactivate	43.9%	18.0%	94	0 B	14.81	6.07
Text.OnDisable()	18.9%	18.9%	188	0 B	6.38	6.38
RectTransform.SendReapplyDrivenF	5.9%	5.9%	188	0 B	2.01	2.01
HudText.OnDisable()	1.0%	1.0%	94	0 B	0.35	0.35

CharacterManager.Update()	55.2%	0.1%	1	8.6 KB	219.10	0.68
RandomWalker.Damage()	51.2%	0.1%	100	8.1 KB	203.31	0.48
HudManager.AddHud()	50.4%	0.3%	97	6.9 KB	200.26	1.24
SimpleObjPool.Spwan()	46.3%	0.1%	97	0 B	184.14	0.67
GameObject.SetActive()	42.2%	0.0%	97	0 B	167.67	0.11
GameObject.Activate	42.2%	1.8%	97	0 B	167.56	7.27
Text.OnEnable()	37.8%	0.1%	194	0 B	150.25	0.69
FontUpdateTracker.TrackText()	31.5%	5.0%	194	0 B	125.03	99.50
Object.op_Equality()	6.1%	3.8%	56163	0 B	24.56	15.38
Dictionary`2.TryGetValue()	0.1%	0.0%	194	0 B	0.69	0.34
List`1.Add()	0.0%	0.0%	194	0 B	0.09	0.08
List`1.get_Item()	0.0%	0.0%	55969	0 B	0.07	0.07
List`1.get_Count()	0.0%	0.0%	56163	0 B	0.07	0.07

HUD血条优化

- 文字激活和禁用的开销
 - OnEnable/OnDisable
- 去掉Text.OnEnable/Disable操作
 - 通过.text = ""代替

▼ CharacterManager.Update()	43.9%	8.4%	1	7.9 KB	39.03	7.52
▼ GameObject.Activate	31.9%	11.5%	103	216 B	28.33	10.25
Text.OnEnable()	13.9%	13.9%	188	0 B	12.40	12.40
RectTransform.SendReapplyDrivenF	3.2%	3.2%	188	0 B	2.92	2.92
▶ RandomWalker.OnEnable()	1.8%	0.1%	9	216 B	1.61	0.14
CanvasRenderer.OnTransformChan	1.0%	1.0%	282	0 B	0.92	0.92
HudText.OnEnable()	0.2%	0.2%	94	0 B	0.21	0.21
▶ GameObject.Deactivate	2.0%	0.1%	9	0 B	1.84	0.14
Graphic.OnRectTransformDimensionsC	0.9%	0.9%	49	0 B	0.81	0.81
CanvasRenderer.OnTransformChange	0.4%	0.4%	309	0 B	0.42	0.42
UIBehaviour.OnRectTransformDimensi	0.1%	0.1%	49	0 B	0.10	0.10



▼ CharacterManager.Update()	21.7%	12.9%	1	8.1 KB	12.60	7.49
▼ GameObject.Activate	2.5%	0.2%	7	168 B	1.45	0.13
▶ RandomWalker.OnEnable()	2.2%	0.1%	7	168 B	1.31	0.09
GameObject.Deactivate	2.2%	0.2%	7	0 B	1.31	0.12
▶ RandomWalker.OnDisable()	2.0%	0.2%	7	0 B	1.19	0.13
CanvasRenderer.OnTransformChange	1.8%	1.8%	303	0 B	1.08	1.08
Graphic.OnRectTransformDimensionsC	1.6%	1.6%	49	0 B	0.94	0.94
HudText.OnEnable()	0.3%	0.3%	99	0 B	0.23	0.23
UIBehaviour.OnRectTransformDimensi	0.1%	0.1%	49	0 B	0.09	0.09

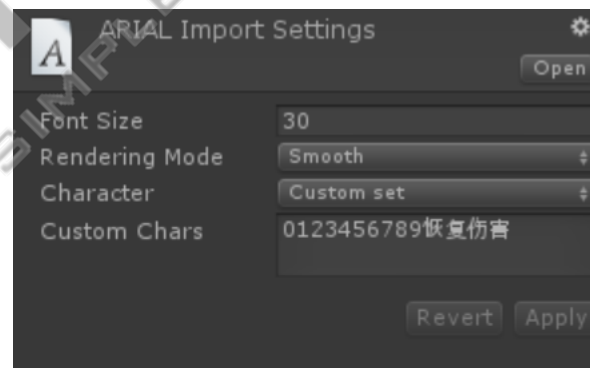
▼ HudText.Update()	47.7%	3.7%	94	0 B	16.08	1.26
▼ GameObject.Deactivate	43.9%	18.0%	94	0 B	14.81	6.07
Text.OnDisable()	18.9%	18.9%	188	0 B	6.38	6.38
RectTransform.SendReapplyDrivenF	5.9%	5.9%	188	0 B	2.01	2.01
HudText.OnDisable()	1.0%	1.0%	94	0 B	0.35	0.35



▼ HudText.Update()	6.6%	4.0%	99	0 B	2.31	1.41
HudText.OnDisable()	2.5%	2.5%	99	0 B	0.89	0.89

HUD血条优化

- Canvas.SendWillRenderCanvases
 - Font.CacheFontForText
 - Text.OnFillVBO
- 采用静态字体

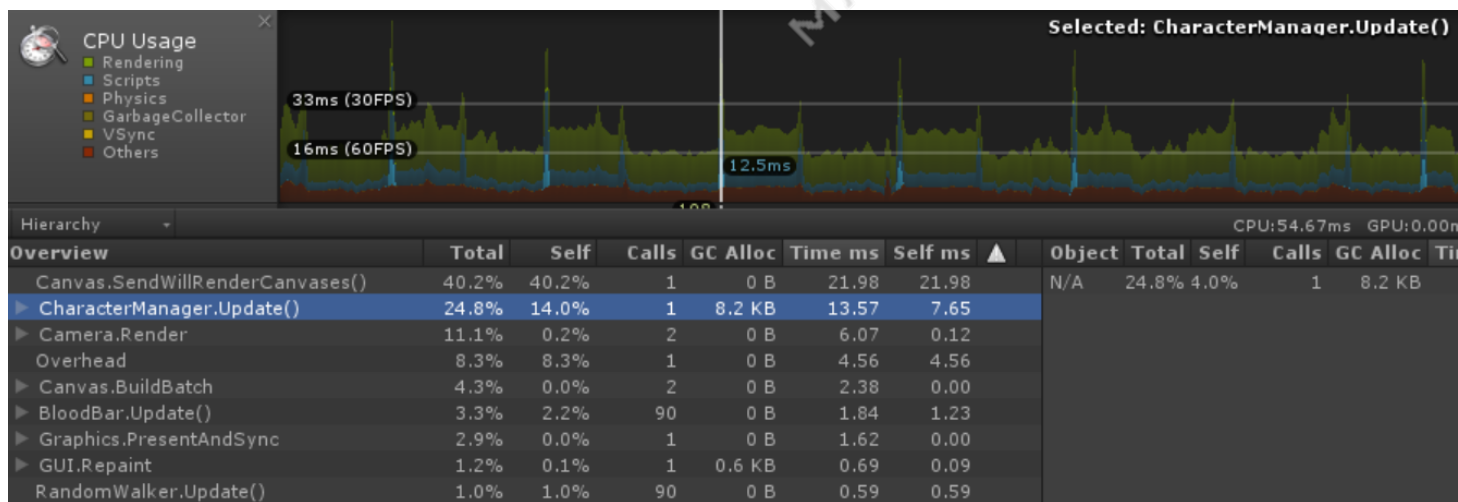
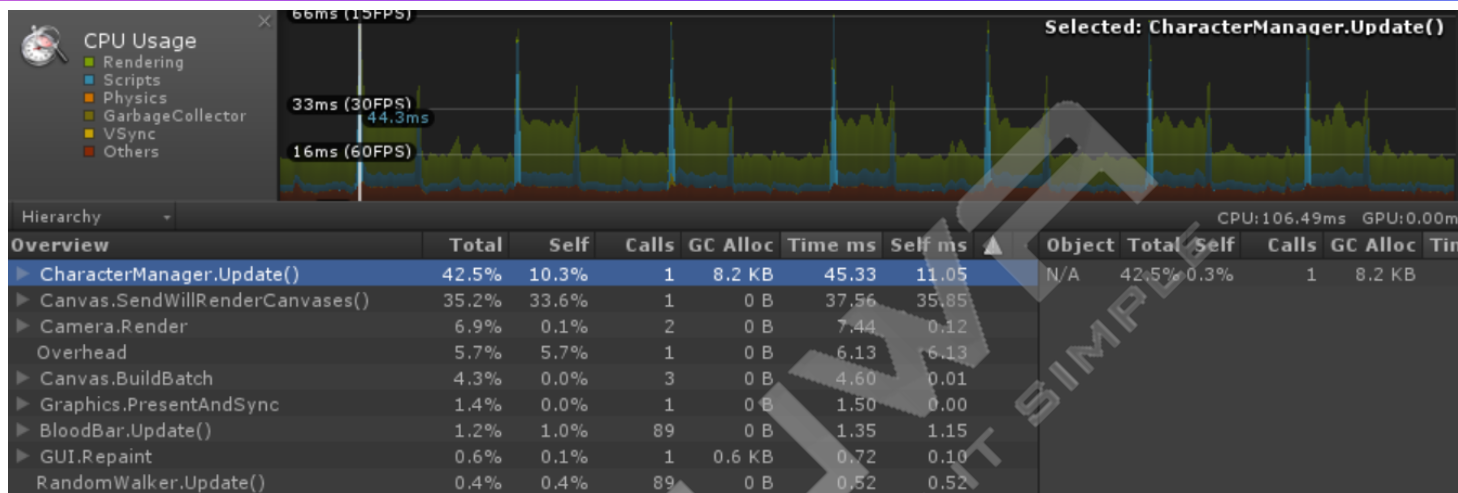


▼ Canvas.SendWillRenderCanvases()	33.2%	31.2%	1	0 B	29.52	27.76
Font.CacheFontForText	1.9%	1.9%	376	0 B	1.75	1.75



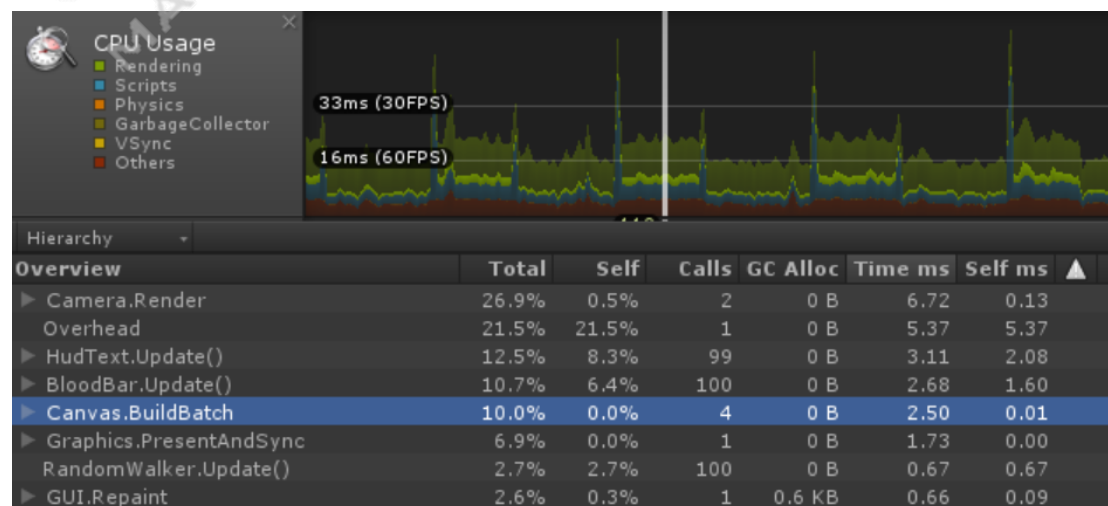
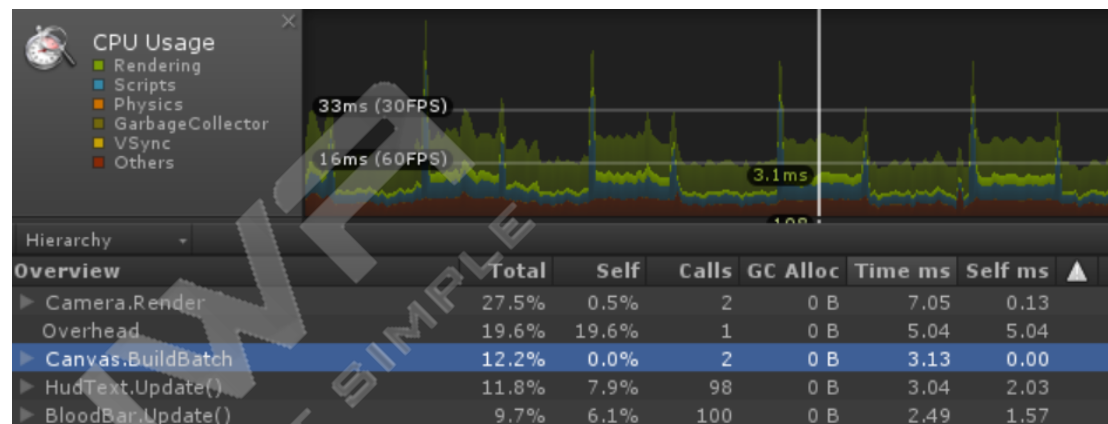
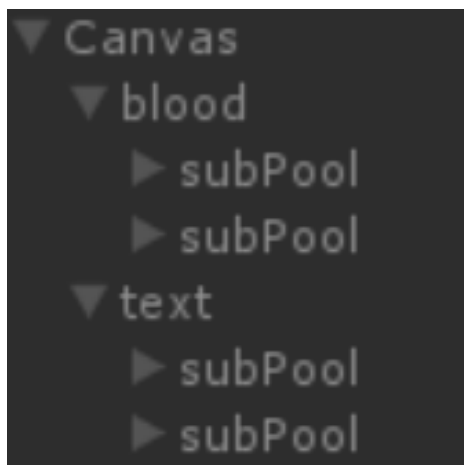
Canvas.SendWillRenderCanvases()	40.2%	40.2%	1	0 B	21.98	21.98
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HUD血条优化



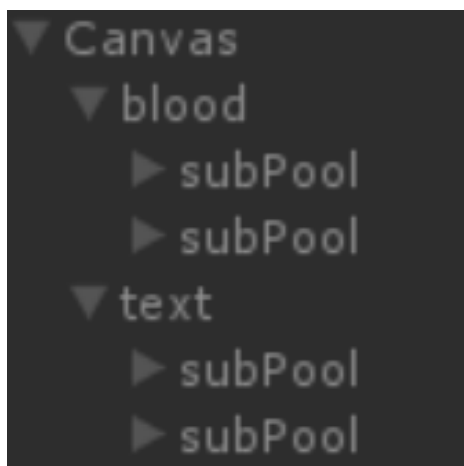
HUD血条优化

- 更新时的持续开销
 - Canvas.BuildBatch
- 拆分Canvas



HUD血条优化

- 更新时的持续开销
 - Canvas.BuildBatch
- 拆分Canvas



▼ Camera.Render	7.4%	0.1%	2	0 B	6.65	0.11
▼ Drawing	6.8%	0.0%	2	0 B	6.11	0.03
▶ Render.OpaqueGeometry	4.7%	0.0%	2	0 B	4.22	0.02
▼ Render.TransparentGeometry	1.9%	0.0%	2	0 B	1.75	0.01
▼ RenderForwardAlpha.Render	1.9%	0.0%	2	0 B	1.72	0.06
Mesh.CreateVBO	1.3%	1.3%	2	0 B	1.15	1.15
Mesh.DrawVBO	0.5%	0.5%	2	0 B	0.45	0.45
Shader.SetPass	0.0%	0.0%	2	0 B	0.04	0.04
▶ RenderForwardAlpha.Prepare	0.0%	0.0%	2	0 B	0.01	0.01
RenderForwardAlpha.Sort	0.0%	0.0%	2	0 B	0.00	0.00
Render.Prepare	0.1%	0.1%	2	0 B	0.10	0.10
Camera.ImageEffects	0.0%	0.0%	2	0 B	0.00	0.00
▶ Culling	0.4%	0.2%	2	0 B	0.41	0.23
RenderTexture.SetActive	0.0%	0.0%	2	0 B	0.00	0.00
Camera.ImageEffects	0.0%	0.0%	2	0 B	0.00	0.00

▼ Camera.Render	25.7%	0.5%	2	0 B	5.71	0.12
▼ Drawing	23.3%	0.1%	2	0 B	5.18	0.04
▶ Render.OpaqueGeometry	18.2%	0.1%	2	0 B	4.04	0.02
▼ Render.TransparentGeometry	4.6%	0.0%	2	0 B	1.02	0.01
▼ RenderForwardAlpha.Render	4.4%	0.3%	2	0 B	0.98	0.07
Mesh.CreateVBO	2.5%	2.5%	4	0 B	0.56	0.56
Mesh.DrawVBO	1.3%	1.3%	4	0 B	0.30	0.30
Shader.SetPass	0.1%	0.1%	2	0 B	0.03	0.03
▶ RenderForwardAlpha.Prepare	0.1%	0.0%	2	0 B	0.02	0.01
RenderForwardAlpha.Sort	0.0%	0.0%	2	0 B	0.00	0.00
Render.Prepare	0.3%	0.3%	2	0 B	0.07	0.07
Camera.ImageEffects	0.0%	0.0%	2	0 B	0.00	0.00
▶ Culling	1.7%	0.9%	2	0 B	0.39	0.22
RenderTexture.SetActive	0.0%	0.0%	2	0 B	0.00	0.00
Camera.ImageEffects	0.0%	0.0%	2	0 B	0.00	0.00

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