JAN 29, 2019 - 4 MINUTE READ - COMMENTS - GAME HACKING

Cheating at Moonlighter - Part 3 - Enabling Debug HUD

In this part, I am going to use dnSpy to enable the Debug HUD. We will analyze how it's enabled and how it can be accessed.

Who am I?

I am Parsia, a security engineer at Electronic Arts.

I write about application security, reverse engineering, Go, cryptography, and (obviously) videogames.

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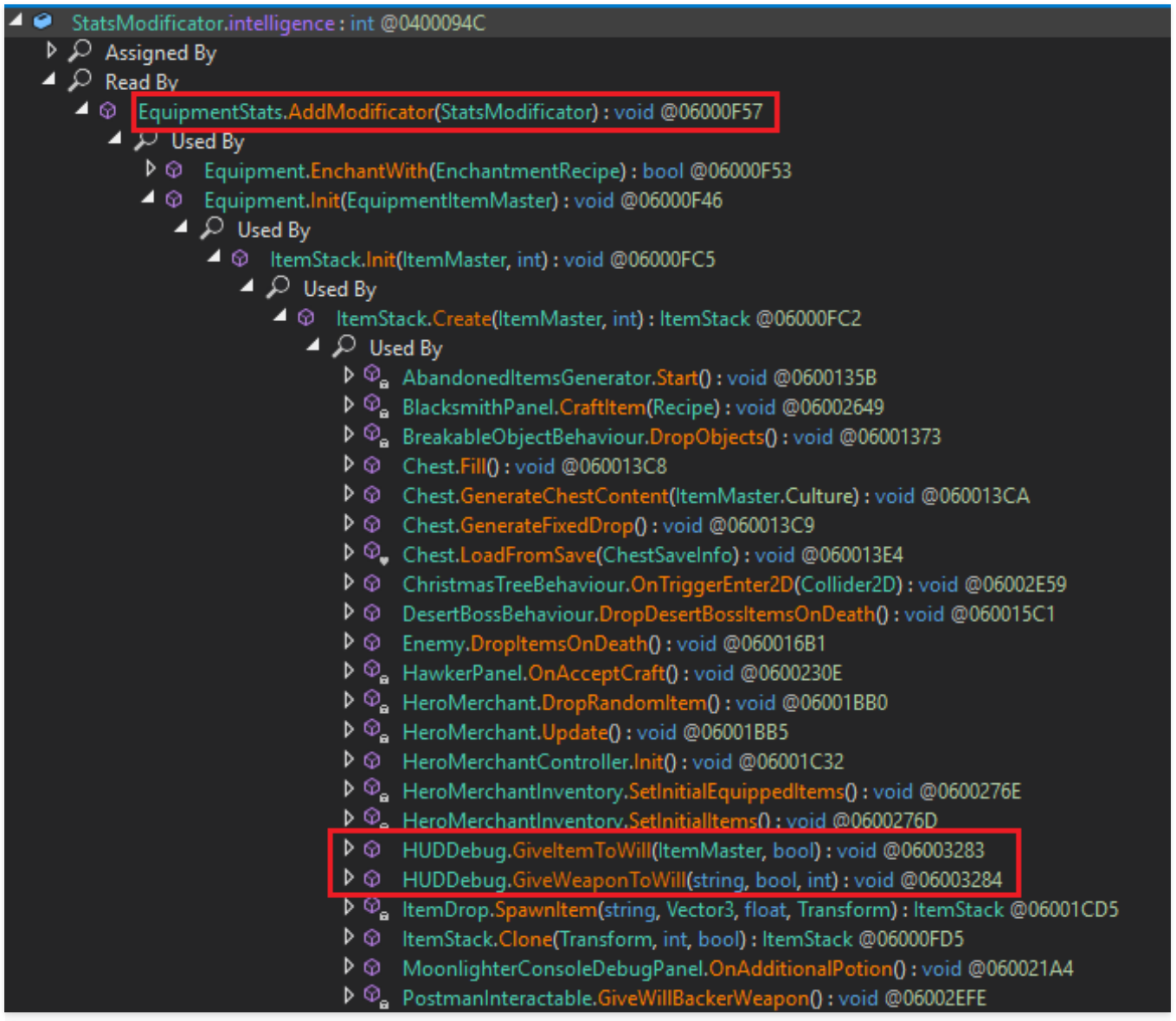
Collections

- Cheating at Moonlighter - Part 1 - Save File
- Cheating at Moonlighter - Part 2 - Changing Game Logic with dnSpy

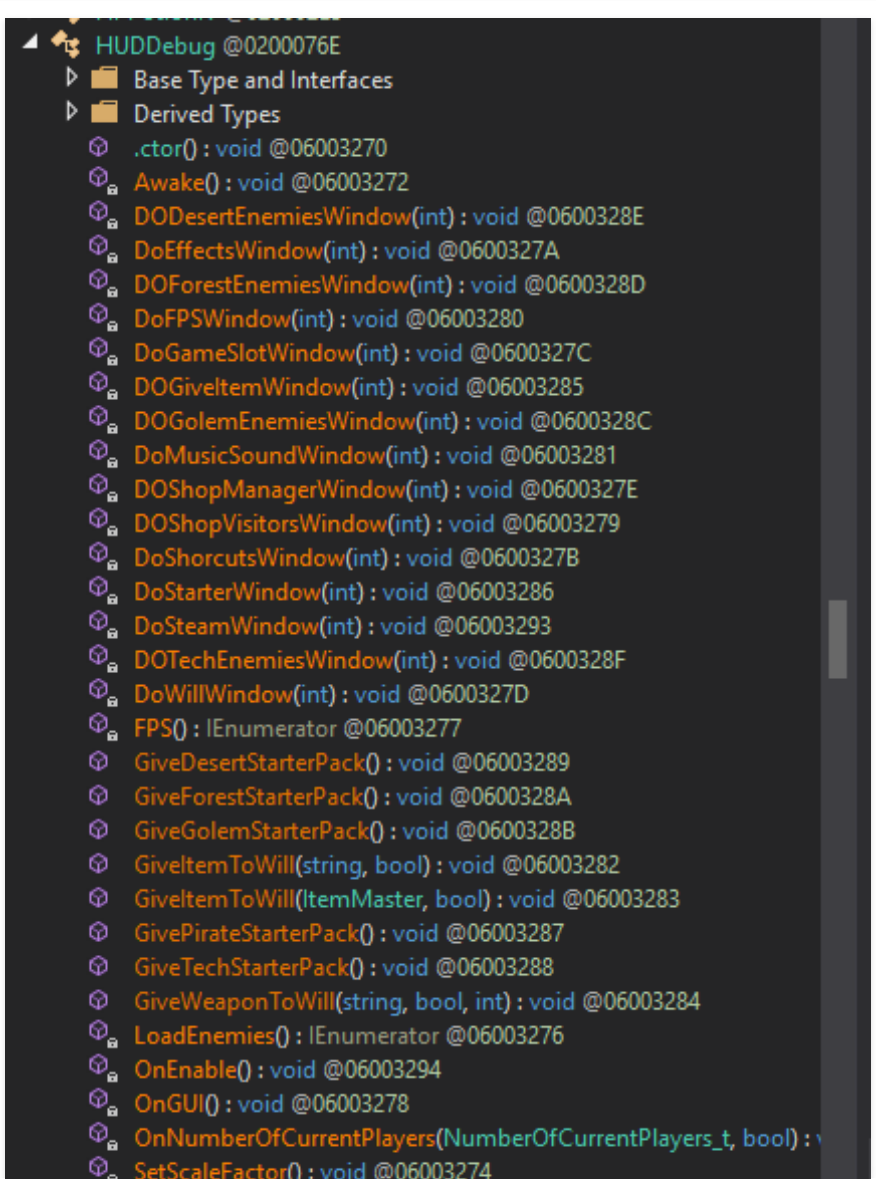
Looking at `StatsModificator.intelligence`, I went down this rabbit hole to see how items are created.

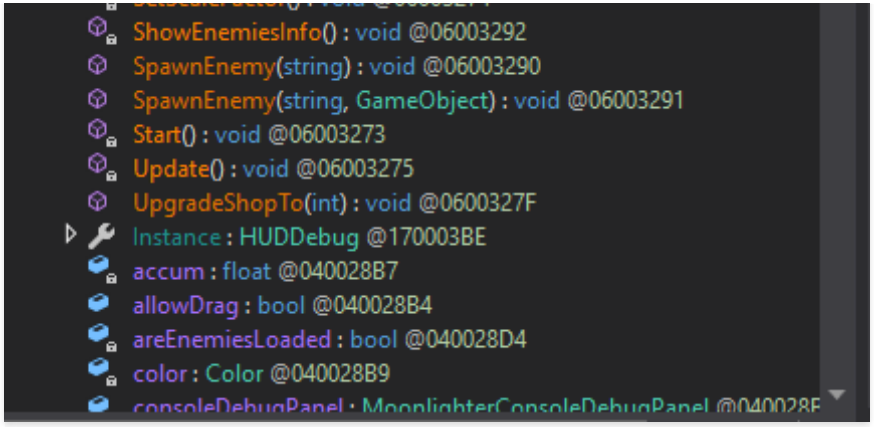
Thick Client Proxying
Go/Golang
Blockchain/Distributed Ledgers
Automation
Reverse Engineering
Crypto(graphy)
CTFs/Writeups
WinAppDbg
AWSome.pw - S3 bucket squatting - my very legit branded vulnerability



Item creation call analysis

And I saw these two methods in a class named `HUDDebug`. They have curious names `GiveItemToWill` and `GiveWeaponToWill`. If my guess is correct, there's a debug UI somewhere in the game that allows spawning items.

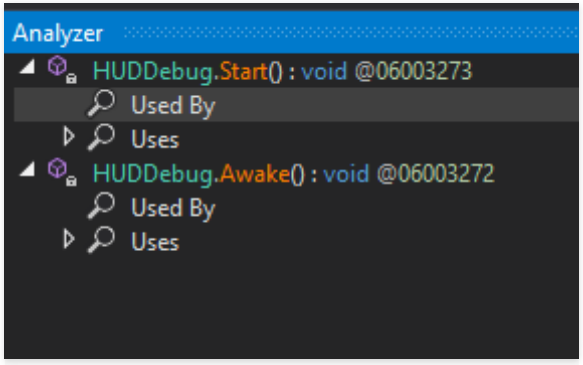




HUDDebug Class

It has a `Start()` method, we can analyze it to see what calls it.

Seems like nothing calls it, same with `Awake()`.



HUDDebug analysis

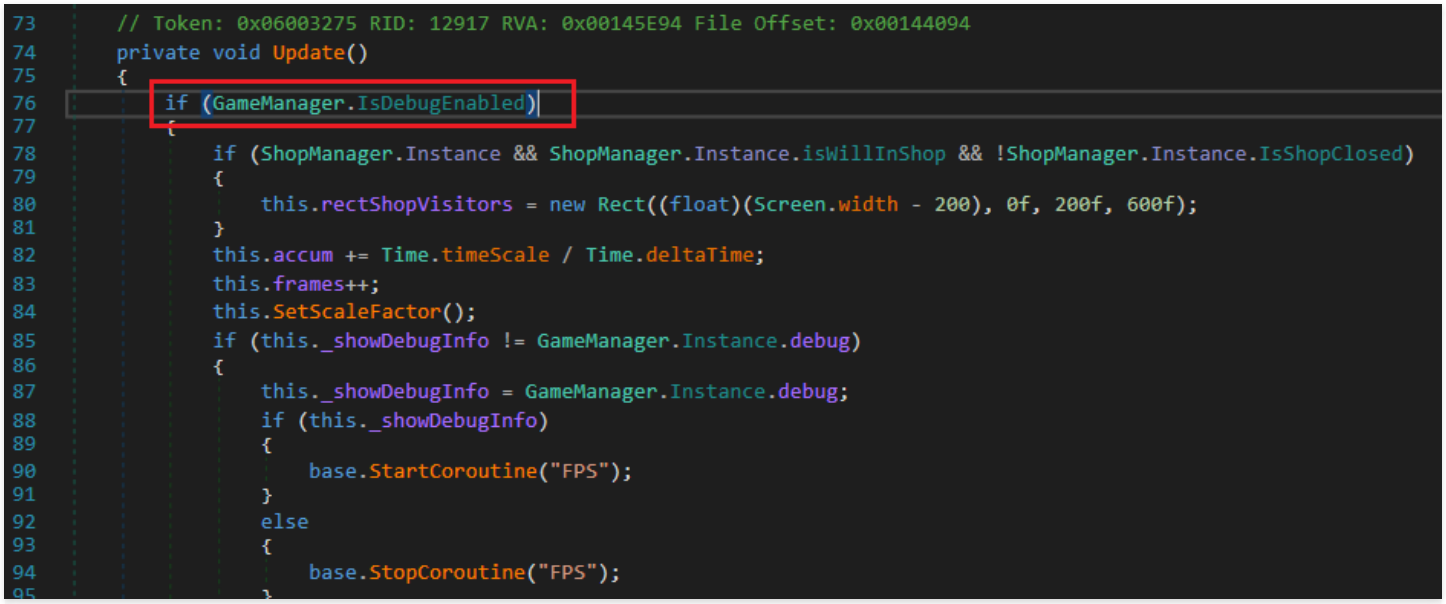
These are unity methods. According to this video https://unity3d.com/learn/tutorials/topics/scripting/awake-and-start:

1. `Awake()`: Called first even if the script is not enabled. Used for initialization.
2. `Start()`: Called only once after awake and before update if the script is enabled.
3. `Update()`: Called after the script is enabled and can be called multiple times.

These are called by the engine, so the `Analyze` tab will not have the chain.

Enabling Debug Mode

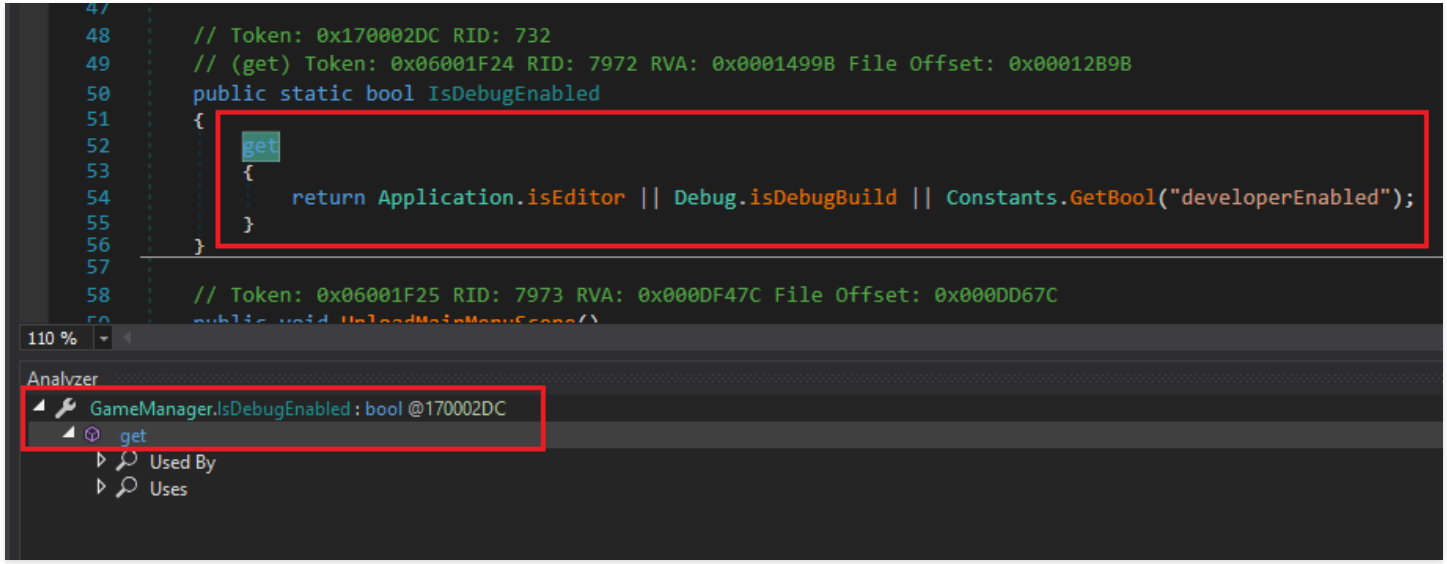
Inside `Update()` we can see:



```
73      // Token: 0x06003275 RID: 12917 RVA: 0x00145E94 File Offset: 0x00144094
74      private void Update()
75      {
76          if (GameManager.IsDebugEnabled)
77          {
78              if (ShopManager.Instance && ShopManager.Instance.isWillInShop && !ShopManager.Instance.IsShopClosed)
79              {
80                  this.rectShopVisitors = new Rect((float)(Screen.width - 200), 0f, 200f, 600f);
81              }
82              this.accum += Time.timeScale / Time.deltaTime;
83              this.frames++;
84              this.SetScaleFactor();
85              if (this._showDebugInfo != GameManager.Instance.debug)
86              {
87                  this._showDebugInfo = GameManager.Instance.debug;
88                  if (this._showDebugInfo)
89                  {
90                      base.StartCoroutine("FPS");
91                  }
92                  else
93                  {
94                      base.StopCoroutine("FPS");
95                  }
```

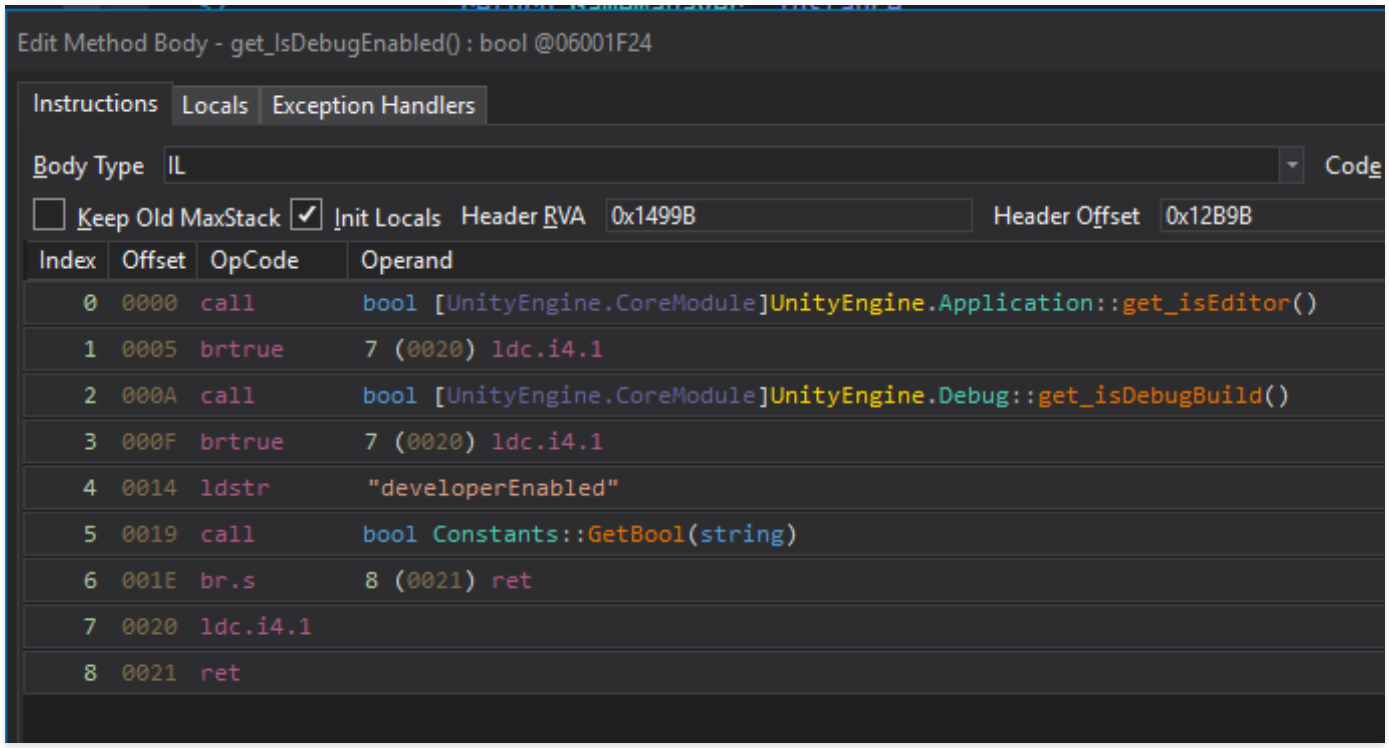
HUDDebug.Update()

Pay attention to line 76. There's an `if` condition that enables everything. We can analyze `IsDebugEnabled`:



IsDebugEnabled analysis

Woot. It seems like we found it. Now we need to modify this to only return `true`.

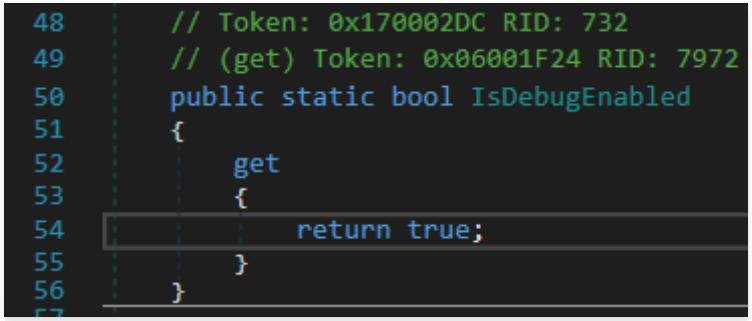


IL instructions for get_IsDebugEnabled

To return true, we need to return 1. We can delete lines 0 to 6 and only keep lines 7 and 8:

```
7: ldc.i4.1     // push 1 to the stack
8: ret          // return
```

Highlight lines 0 to 6 and press delete (or use the context menu) to remove them. Press `Ok` to get the modified C# code.

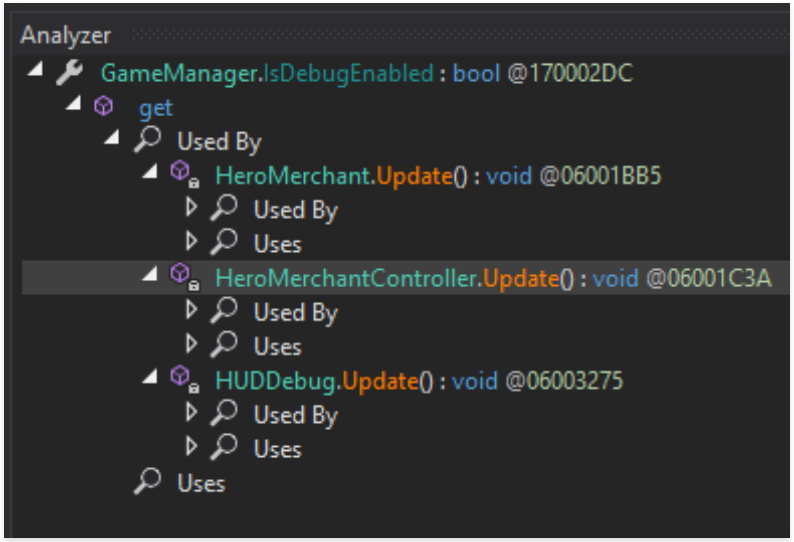


Modified get_IsDebugEnabled

This enables debug mode for every run. But what else is out there?

Debug Shortcuts

Let's go back to the analysis results for `GameManager.IsDebugEnabled`



IsDebugEnabled analysis

We have already looked at `HUDDebug.Update`, now we look at the other two.

`HeroMerchant.Update()` has some shortcuts.

```
// Token: 0x06001BB5 RID: 7093 RVA: 0x000C42D8 File Offset: 0x000C24D8
private void Update()
{
    if (GameManager.IsDebugEnabled)
    {
        if (Input.GetKeyDown(99) && Input.GetKey(304))
        {
            this.RepositionInShopOrDungeon();
        }
        if (Input.GetKeyDown(104) && Input.GetKey(304))
        {
            ItemStack itemStack = this.heroMerchantInventory.GetEquippedItemByType(HeroMerchantInventory.EquipmentSlot.Potion);
            if (itemStack && itemStack.FreeStack > 0)
            {
                itemStack.Quantity++;
                this.heroMerchantInventory.SetEquippedItemByType(itemStack, HeroMerchantInventory.EquipmentSlot.Potion);
            }
            else if (!itemStack)
            {
                ItemMaster itemByName = ItemDatabase.GetItemByName("HP Potion IV");
                itemStack = ItemStack.Create(itemByName, 1);
                this.heroMerchantInventory.SetEquippedItemByType(itemStack, HeroMerchantInventory.EquipmentSlot.Potion);
            }
            else
            {
                ItemMaster itemByName2 = ItemDatabase.GetItemByName("HP Potion IV");
                itemStack = ItemStack.Create(itemByName2, 1);
                if (this.heroMerchantInventory.TryAddItem(itemStack, 0) && itemStack.Quantity == 0)
                {
                    Object.Destroy(itemStack.gameObject);
                }
            }
        }
        if (Input.GetKeyDown(113) && Input.GetKey(304))
        {
            DungeonManager instance = DungeonManager.Instance;
            if (instance != null)
            {
```

HeroMerchant.Update()

KeyCodes

Input.GetKeyDown detects when a key is pressed and released. The parameter to the method is an enum of type KeyCode or a string. It took me a while to find out the associated numbers.

I found it in the decompiled code at:

- https://github.com/jamesjlinden/unity-decompiled/blob/master/UnityEngine/UnityEngine/KeyCode.cs

Here's a local copy, in case the repository is taken down.

It's based on ASCII-Hex decimal values with extra keys (e.g. gamepad) in the end.

Now we can decipher some debug shortcuts:

```
if (Input.GetKeyDown(104) && Input.GetKey(304))
{
    ItemStack itemStack = this.heroMerchantInventory.GetEquippedItemByType(HeroMerchantInventory.EquipmentSlot.Potion);
    if (itemStack && itemStack.FreeStack > 0)
    {
        itemStack.Quantity++;
        this.heroMerchantInventory.SetEquippedItemByType(itemStack, HeroMerchantInventory.EquipmentSlot.Potion);
    }
    else if (!itemStack)
    {
        ItemMaster itemByName = ItemDatabase.GetItemByName("HP Potion IV");
        itemStack = ItemStack.Create(itemByName, 1);
        this.heroMerchantInventory.SetEquippedItemByType(itemStack, HeroMerchantInventory.EquipmentSlot.Potion);
    }
    else
    {
        ItemMaster itemByName2 = ItemDatabase.GetItemByName("HP Potion IV");
        itemStack = ItemStack.Create(itemByName2, 1);
        if (this.heroMerchantInventory.TryAddItem(itemStack, 0) && itemStack.Quantity == 0)
        {
            Object.Destroy(itemStack.gameObject);
        }
    }
```

Potion Shortcut

- `104`: `H`
- `304`: `LeftShift`

Note we can also change the item granted with anything we want.

```
if (Input.GetKeyDown(98) && Input.GetKey(304))
{
    this.TeleportToFloorEnd();
}
```

We can teleport to the last room of any dungeon floor:

- `98`: `B`
- `304`: `LeftShift`

And so on.

Controller Shortcuts

`HeroMerchantController.Update()` defines controller shortcuts.

```
if (GameManager.IsDebugEnabled)
{
    if (Input.GetKeyDown(121))
    {
        this.MoveAutomaticallyToPoint(base.transform.position + Vector3.right * 100f, 2f, true, false);
    }
    if (Input.GetKey(306) && (Input.GetKeyDown(273) || Input.GetKeyDown(274)))
    {
        this.DisableVerticalMoveInput();
    }
    if (Input.GetKey(306) && (Input.GetKeyDown(276) || Input.GetKeyDown(275)))
    {
        this.DisableHorizontalMoveInput();
    }
    if (Input.GetKeyDown(48))
    {
        this.EnableMoveInput();
    }
}
```

Controller shortcuts

Save/Reset Shortcuts

There are a couple of more shortcuts inside `HUDDebug.Update()`:

```
if (Input.GetKeyDown(115) && Input.GetKeyDown(304))
{
    Debug.Log("Saving game with shrotcut");
    GameManager.Instance.SaveAll();
}
if (Input.GetKeyDown(114) && Input.GetKeyDown(304))
{
    Debug.Log("Resetting save game with shrotcut");
    GameManager.Instance.HardResetSave();
    GameManager.Instance.SerializeGameSlot();
}
```

Save/reset shortcuts

- Save: `LeftShift` + `S`
- Reset: `LeftShift` + `R`

Enabling Debug HUD

We still need to enable the HUD. It must have a shortcut key. Searching the internet tells us it's `Tab`.

See this page about a CheatEngine trainer:

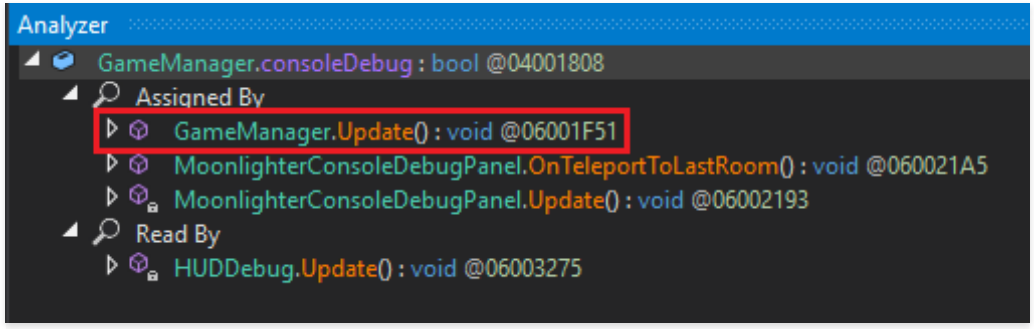
- http://fearlessrevolution.com/viewtopic.php?p=47682#p47682

How can we find it ourselves? Back inside `HUDDebug.Update()` we can see a block that enables and disables `consoleDebugPanel`:

```
if (this._showConsoleDebugInfo != GameManager.Instance.consoleDebug && this.consoleDebugPanel)
{
    this._showConsoleDebugInfo = GameManager.Instance.consoleDebug;
    if (this._showConsoleDebugInfo)
    {
        this.consoleDebugPanel.Enable();
    }
    else
    {
        this.consoleDebugPanel.Disable();
    }
}
```

Enabling and disable consoleDebugPanel

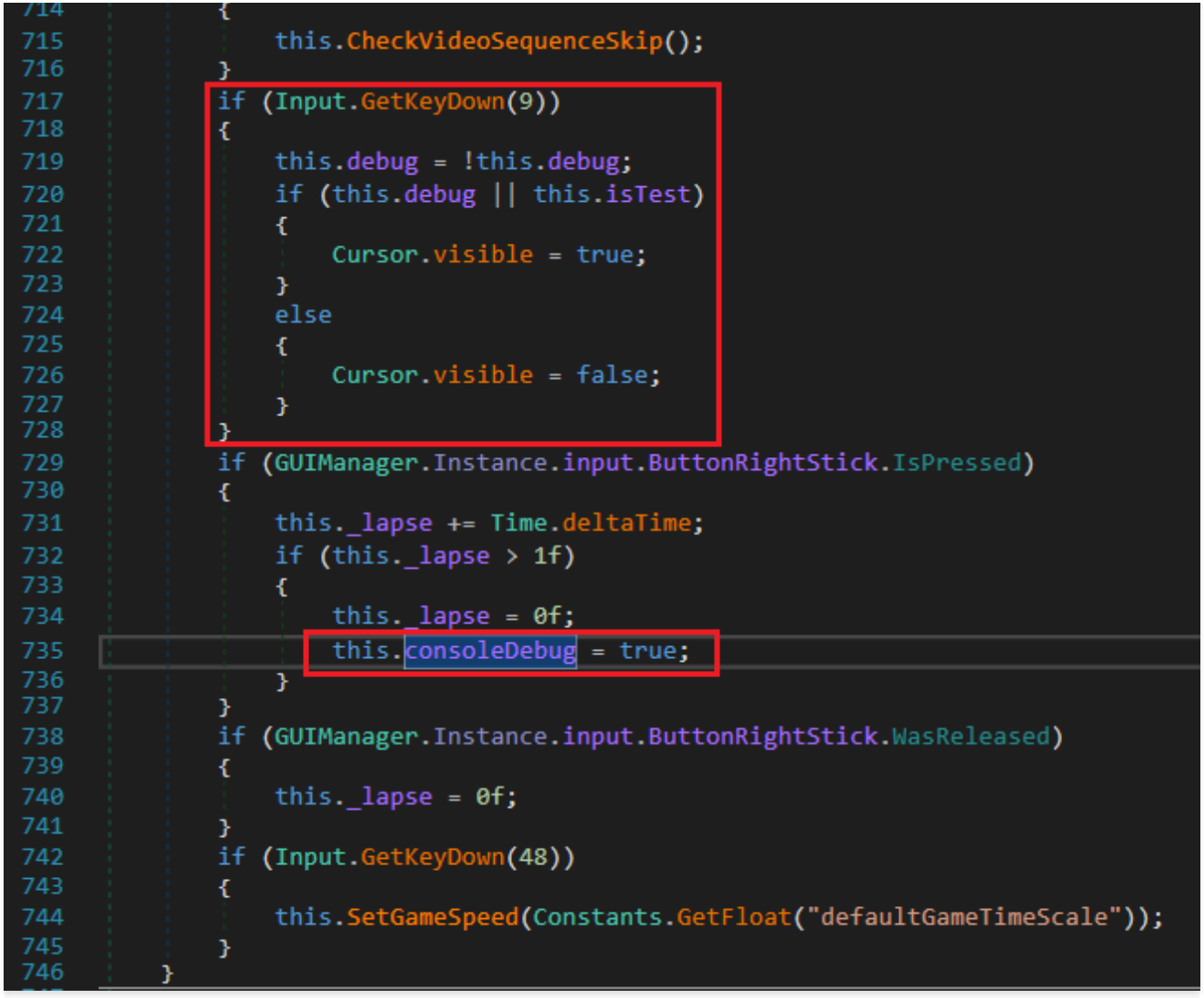
Inside the `if` we can see that `GameManager.Instance.consoleDebug` is referenced. Let's analyze that.



consoleDebug analysis

Double-click on `GameManager.Update()`:

```
710     public void Update()
711     {
712         Shader.SetGlobalFloat("_UnscaledTime", Time.unscaledTime);
713         if (this._startSequenceMovie)
```



```
714             {
715                 this.CheckVideoSequenceSkip();
716             }
717             if (Input.GetKeyDown(9))
718             {
719                 this.debug = !this.debug;
720                 if (this.debug || this.isTest)
721                 {
722                     Cursor.visible = true;
723                 }
724                 else
725                 {
726                     Cursor.visible = false;
727                 }
728             }
729             if (GUIManager.Instance.input.ButtonRightStick.IsPressed)
730             {
731                 this._lapse += Time.deltaTime;
732                 if (this._lapse > 1f)
733                 {
734                     this._lapse = 0f;
735                     this.consoleDebug = true;
736                 }
737             }
738             if (GUIManager.Instance.input.ButtonRightStick.WasReleased)
739             {
740                 this._lapse = 0f;
741             }
742             if (Input.GetKeyDown(48))
743             {
744                 this.SetGameSpeed(Constants.GetFloat("defaultGameTimeScale"));
745             }
746         }
```

GameManager.Update()

We can see it's triggered by holding the `ButtonRightStick` for a second (I think). A bit further up we can see the equivalent keyboard shortcut.

```
if (Input.GetKeyDown(9))
```

It's the `Tab` key which confirms what we found online. We can press `Tab` in the game to enable debug HUD.

Debug HUD

And it's quite extensive.

Lessons Learned

We learned:

- How to use dnSpy's Analyze feature to track variables/methods/etc.
- How to enable debug mode.
- Shortcut keys for various things such as potions.
- Shortcut key to enable the debug HUD.

My next plan was to use Cheat Engine to make cheats and enable debug HUD. But it's already done. In the next part, I will write my thoughts about some questions that I was asked about such cheating. Maybe after that, I will return and do the Cheat Engine part but I will need to re-learn the tool again.

Posted by Parsia • Jan 29, 2019 • Tags: Moonlighter dnSpy

Cheating at Moonlighter - Part 2 - Changing Game Logic with dnSpy

Cheating at Moonlighter - Part 4 - Defense