Advanced Scripting Lab

For this lab you are going to create a lot from scratch. We provide a loose framework for the game but you create the enemies from scratch.

Before we begin, there are 3 concepts we want to make sure you understand. The lab will help to reinforce all three of these ideas.

GetComponent and GameObject.Find

You almost certainly have run into at least one of these by now so I will keep it short.

- GameObject
  - Find()
    - Note this method is static meaning it is accessed by calling *GameObject.Find* (Note the capital G in GameObject!)
    - This method is considered inefficient. For the work you do in this class, optimization is not a big deal so using this method is fine. If you do want to try optimizing, you could potentially call this method once in the *Start()* method and then store a reference to what you found in the script.
    - Ex: *GameObject.Find('Player'), where 'Player' is the name of a GameObject instance in the scene*
  - GetComponent()
    - Not static and must be called on a GameObject instance (Pretty much anything in Unity)
    - To access the GameObject that your script is attached to you can simply use the keyword '*gameObject'.*
    - Similarly for the Transform you can just use the keyword '*transform'.*
    - *GetComponent<Class or Component Name>()*. The syntax is a little odd coming from coding in Java but you can think of it as both Casting and passing in a parameter of which Component to look for
    - This method is also considered inefficient. The same can be said here as was said about *Find()*.
    - Ex: If you want to access/change the color of your sprite, you would use '*GetComponent<SpriteRenderer>().color = new Color.red;'*
  - SetActive()
    - Nice way to turn off *GameObjects* (or components) while the game is running by passing in *False*
    - Ex. if you want to turn off ur player when getting killed you would use something like, 'gameObject.SetActive(False)'

We encourage you to explore the linked Script References. There are a lot of similar methods that we will not be covering that you may find useful!

Singletons

A singleton, as you may or may not have learned from other classes, is an object that there is only one of. This is a really useful model for centralized systems in your game. Some good examples of scripts where this may be useful include: *SpawnManager*, *PlayerData, LevelLoader* (These are made up names to get the idea across). So how do we make a singleton? Easy!

```
public class Score : MonoBehaviour {
    public static Score st;
    private void Awake()
    {
        st = this;
    }
```

Let's break this down.

- First off this is not a true singleton in that you could technically make more of them by attaching this script to more objects, but this does not matter for our use case
- Public means all scripts anywhere can access this variable
- Static means all *Score* script objects share the same *st* variable
    - It also means you can access this shared *st* variable using '*Score.st*'
        - This is nice because there are no *GetComponent*'s or *GameObject.Find*'s required!
- We do this in *Awake()* because *Awake()* is guaranteed to happen before *Start()* which is a place where this singleton might get used
    - If another script tries to reference *Score.st* from within an *Awake()* call there is no guarantee that *Score.st* will be assigned yet!!! (It will only work sometimes)
- We use a short variable name (*st* short for singleton in this case) to make future uses in other scripts cleaner and easier to read

Now when another script wants to modify the score they can simply say

```
Score.st.addScore(9001);
```

Instead of

```
Score scoreObj = GameObject.Find("Score").GetComponent<Score>();
scoreObj.addScore(1337);
```

Time.deltaTime

- Time.deltaTime
    - This is the amount of time that elapsed since the last frame.
    - I often find it useful to have countdown timers for things like cooldowns or enemy spawns
        - Set the variable to the total time you want to wait
        - Then subtract *Time.deltaTime* in each call to *Update()*

        - once it reaches 0, restart the timer (if applicable)
        - then do whatever action you were waiting to do
- Time.fixedDeltaTime
    - This is the amount of time between physics updates
    - Unlike *Time.deltaTime*, this value is consistent throughout your game
    - Whenever you use a physics method such as *FixedUpdate()*, you should be using this value instead of *Time.deltaTime* to avoid unwanted behaviour

Misc Tips

- Don't feel too overwhelmed by some of the crazy syntax and differences in C#, you can get really far by just pretending its Java and ignoring the new stuff
- Don't forget the tips from the last scripting lab! It covered ways to get more out of the Unity Inspector for your script (among other things):
    - Structs
    - Arrays/Lists
- There are several ways that your code might start running, the main ways are
    - Through a *MonoBehavior Event*
        - These include events such as "*Start()*", "*Update()*", "*FixedUpdate()*", "*OnMouseDown()*"
    - Or through an external method call
        - GUI button press set to call a method, another script calling one of your public methods, etc
- This is an extremely useful chart of what order things run in
    - Scroll to the bottom of the page

Organization and Practices

1. When writing a lot of code, you want to try your best to keep it organized and clear
2. Decide on a naming convention to differentiate script variables from local function variables. Personally, I will preface any script variable with an *m_* and leave it out from local function variables. So instead of *score*, I would use *m_Score*.
3. Keep ALL variables and functions private. There are very few reasons to make variables public. If you go through the delegates and events lab, there will be exceptions there. Certain functions need to be public as well (*AddScore()*).
4. If you need to edit a variable in the editor, give it the [SerializeField] heading AND a [Tooltip("explain what this variable is here")]
5. Try your best to group different functions together and then use:
    a. #region Region Name
    b. #endregion
        i. to group these functions together
6. Use short accessors and mutators
7. Generally, use the [DisallowMultipleComponent] (with brackets) because you would rather be safe than sorry; this header will ensure that you do not place the same script twice on the same object

8. Use the [RequireComponent(typeof(ENTER_TYPE_HERE))] header as well whenever you use the function GetComponent<>()
9. You will find examples of each of these points in the scripts of this lab

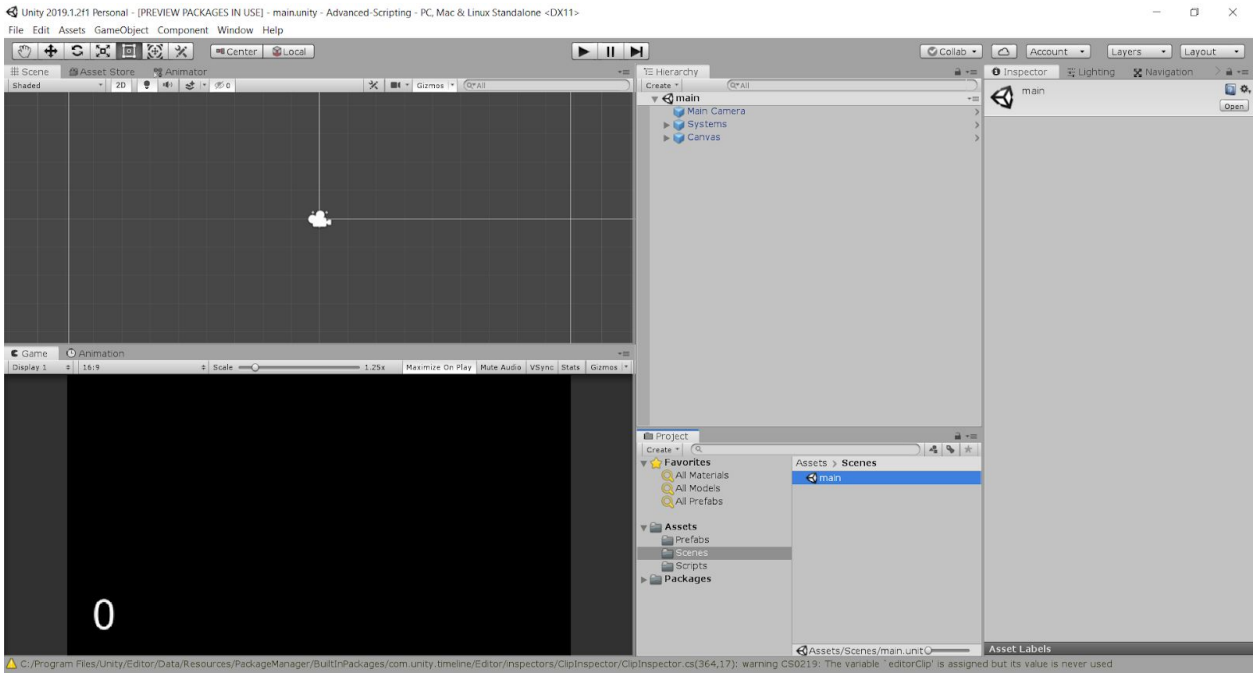
Do not worry if you don't know what some of these things mean. As you go spend more time in Unity, this section will make a lot more sense. For now, use **REGIONS** as your main organizational tool.

Useful Scripting Reference links

- Mathf
- Instantiate() (used for prefabs mainly)
- Vector2, Vector3, .normalize(), and .normalized
- BoxCollider2D
- Rigidbody2D (Used for physics-based movement)
- Transform
- SpriteRenderer

The actual lab assignment!

BEFORE YOU START: Make sure your screen looks like this picture. If it doesn't, go to File > Open Scene > Scenes > Main.unity



Sorry for the essay above, there is a lot to cover.

For this lab we have a few systems in place. (Open the Systems prefab to examine them)

1. **MouseInput**: tracks the mouse input and acts as an attack where the mouse left clicks.
2. **Score:** updates the score and changes a very simple UI.

YOUR TASK:

Your task will be to create the enemies from scratch.

You can think of this game as essentially fruit ninja. You click on the screen to clear enemies in a certain area but you don't want to hit the bombs.

Checkoff (Feel free to surpass these)

- A functioning minigame similar to Fruit ninja (in the loosest sense)
- 2 enemy types
    - One that you want to hit, one that you don't
- Score integration (use *Score.st.addScore()*)
- A functioning spawn system
- Mouse attacks should kill enemies
- And ensuring everything is organized (the enemy script in particular)!
    - Use regions
    - Variables and functions should be kept private
    - Variables that can be edited in the editor should have a tooltip

You have a lot of creative freedom here. You can take that and run with it or you can follow the more chunked up, bare minimum steps below.

First off we need an enemy to interact with

- In the Hierarchy window, right click and select *2D GameObject* > *Sprite*
- Add a Sprite to the *SpriteRenderer* component, any of the defaults will suffice
    - Click the circle next to *Sprite* in the inspector
- Adjust the scale of the transform to your liking
- *Add Component* > *Box Collider 2D (or Circle Collider 2D)*
- If you want your enemy to have physics based movement/gravity then add a *Rigidbody2D* Component as well. **HOWEVER**, the rest of these tips will assume you didn't do this
- Make it a prefab so you can spawn copies of it later
    - Just drag it into your assets folder

Now we need the enemy to move (Or not, that's up to you. But it should at the very least spawn in a random location and maybe despawn after some time has passed)

- Right click the *Assets* tab *Create* > *C# Script* (name the script something like 'Enemy')
- Open the script

- In the *Start* function find some satisfiable way to move the enemy to a good spawn location. I recommend using something like
    - `transform.position = new Vector2( Random.Range(-horizontalBound, horizontalBound), Random.Range(-verticalBound, verticalBound));`
    - For the purpose of this lab you can just hard code values for *horizontalBound* and *verticalBound*
        - In a real game you would want to figure out how to do this dynamically (just google it) but it is not worth doing for this lab
        - There are two version of Random.Range, one for floats and one for integers. Make sure you use the one for floats
- In the *Update* function find some satisfiable way to move the enemy around or you can just leave them stationary
    - *`transform.position = startingPosition + new Vector2(radius * Mathf.Sin( elapsedTime), radius * Mathf.Sin(elapsedTime));`*
    - Sin and Cos always give fun patterns when you get them out of sync (you can do this by multiplying in a random constant from *Random.value* or *Random.Range*
    - You can keep track of *elapsedTime* with:
        - *`elapsedTime = elapsedTime + Time.deltaTime;`*
    - You will need to create 3 new variables if you choose to follow the above:
        - '`startingPosition`' should be a Vector2 that is set to your transform.position in Start AFTER you reset transform.position to a random spot
        - '`elapsedTime`' should be a float that is set to 0 in the beginning
        - '`radius`' should be a float set in the inspector (make it private, serialize it, and give it a tooltip)
- Make sure to attach the script you made to your enemy!!!

Repeat the above steps for the second enemy type (Or just copy and paste and change the *SpriteRenderer* color and make a new prefab for it)

Now that we have an enemy to hit, go into the *MouseInput* script and add some code to deal with when the player clicks on an enemy

- The easiest thing to do would be to check whether it is a good or a bad enemy
    - For this we recommend using the *Tag* field at the top of the inspector. You can access the *Tag* in script with *gameObject.tag*
        - A *Tag* is just a way of grouping *GameObjects* essentially for purposes exactly like this
        - *Layers* also group *GameObjects* but are also used when rendering or calculating collisions

- If it is a good enemy, call *Score.Singleton.AddScore(10);*
- If it is a bad enemy, call *Score.Singleton.AddScore(-10000);*
    - Or you could find some more elegant way to end the game, but this will suffice for the lab
- Then delete the enemy

Now we have to spawn the enemies! Open up the SpawnManager script and fill in the appropriate functions. Finally, stick this SpawnManager script on an object in the scene that will NOT be destroyed (like an empty game object that just exists to spawn stuff).

You did it! Congratulations! As a challenge, try and go back and improve things as much as you can :D

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I keep my scripts organized using the following Region Headers. The bolded headers are ones that you will see in this lab (and you will probably want to use these). If you have any questions about any of them, feel free to ask.

Delegates and Events
Editor Variables
Non-Editor Variables
Cached Components
Cached Instance References
Singletons
First Time Initialization and Set Up
OnEnable, Set Ups, and Resetters
Main Updates
Game Loop Updates
OnDisable and Other Enders
Accessors and Mutators
Getters
Checkers and Verifiers
Collision Methods
Unity Misc
Script Specific Headers