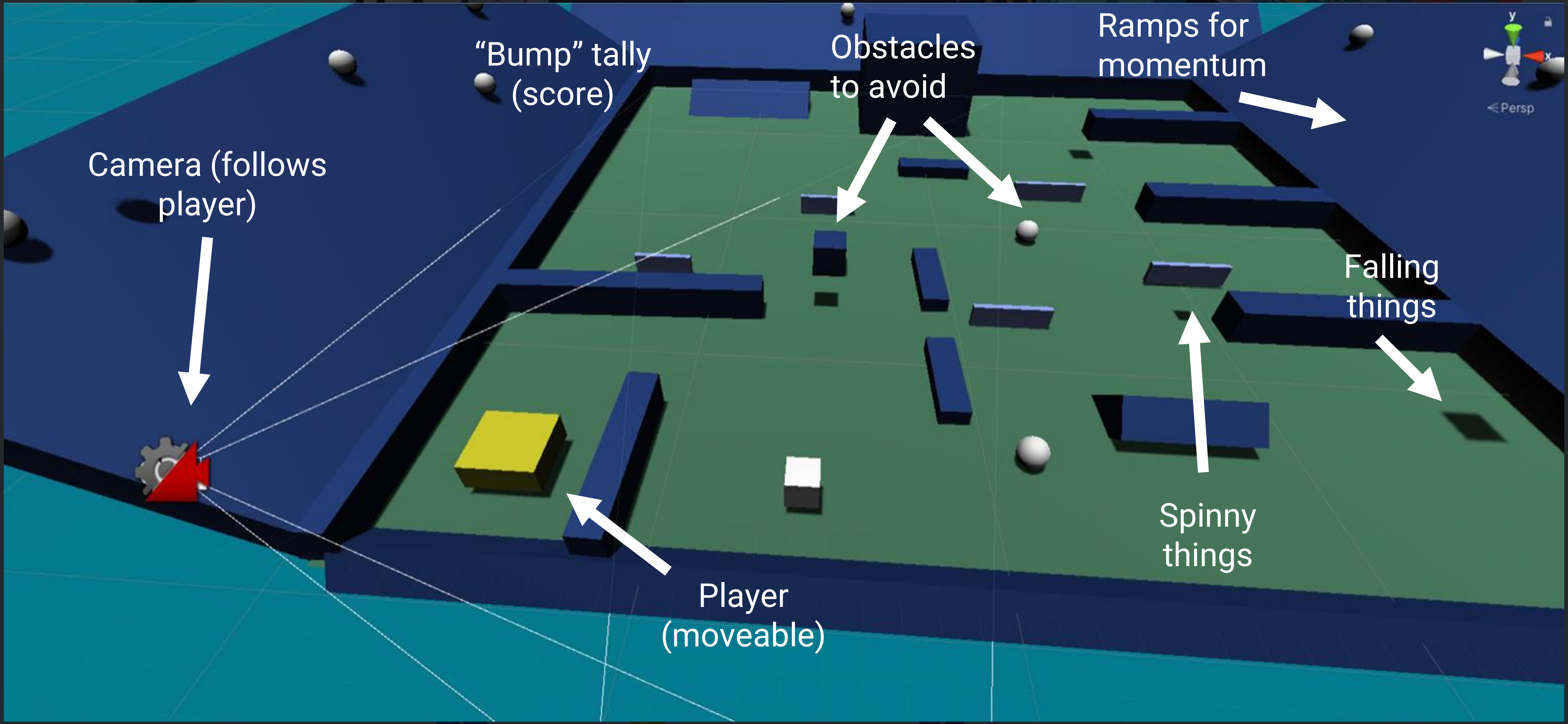
Obstacle Course

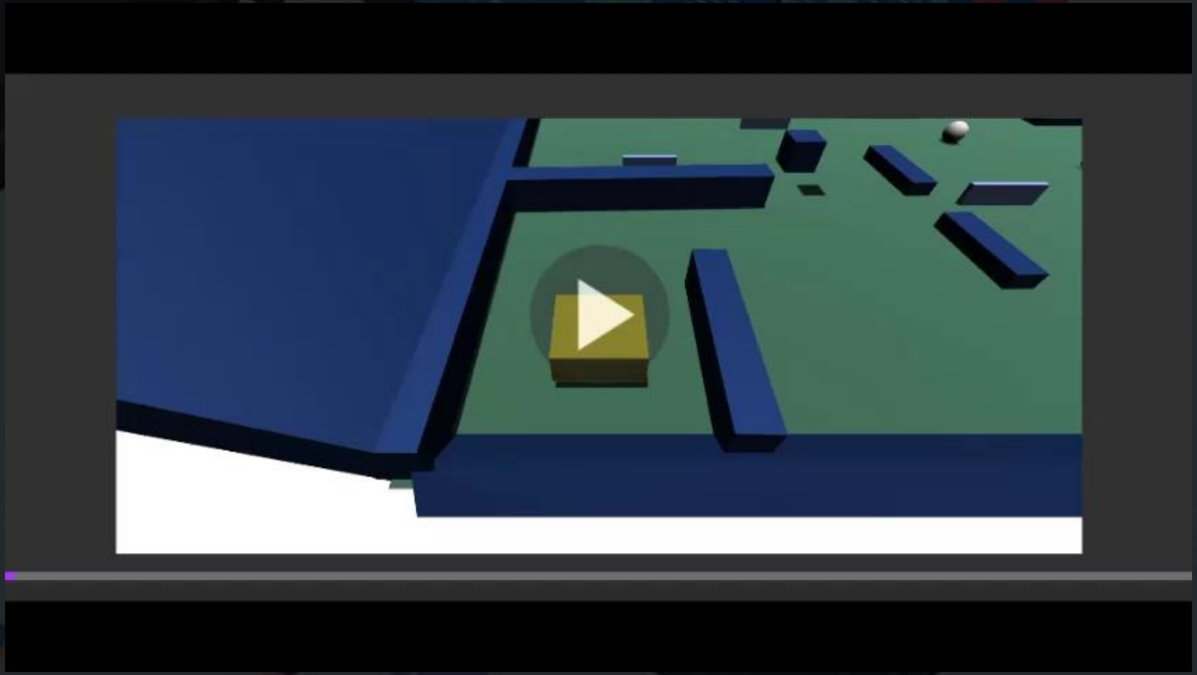
Game Design

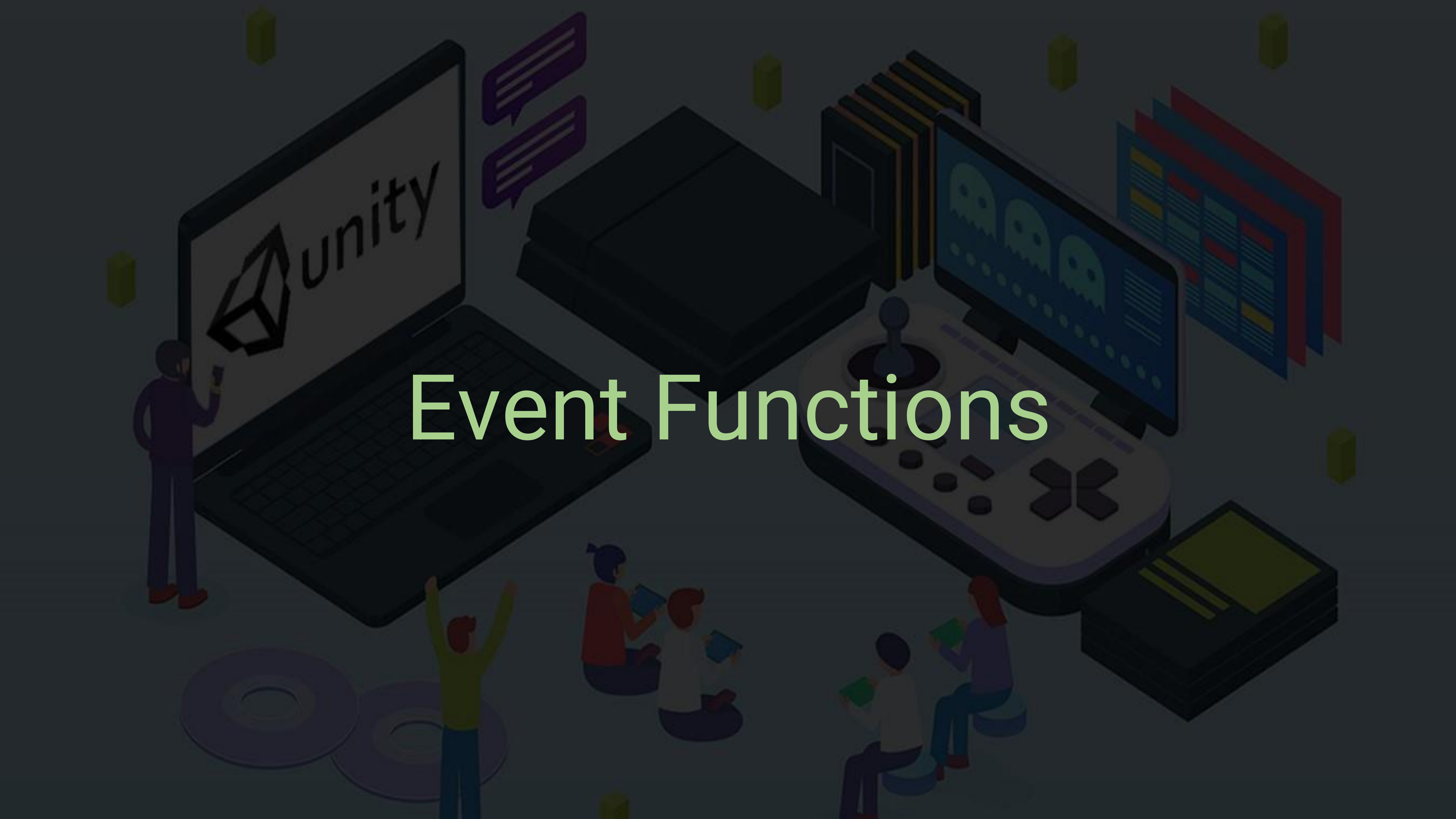
Core Gameplay Overview



Game Design

- Player Experience:
  - Nimble / agile
- Core Mechanic:
  - Move & dodge obstacles
- Game Loop:
  - Get from A to B

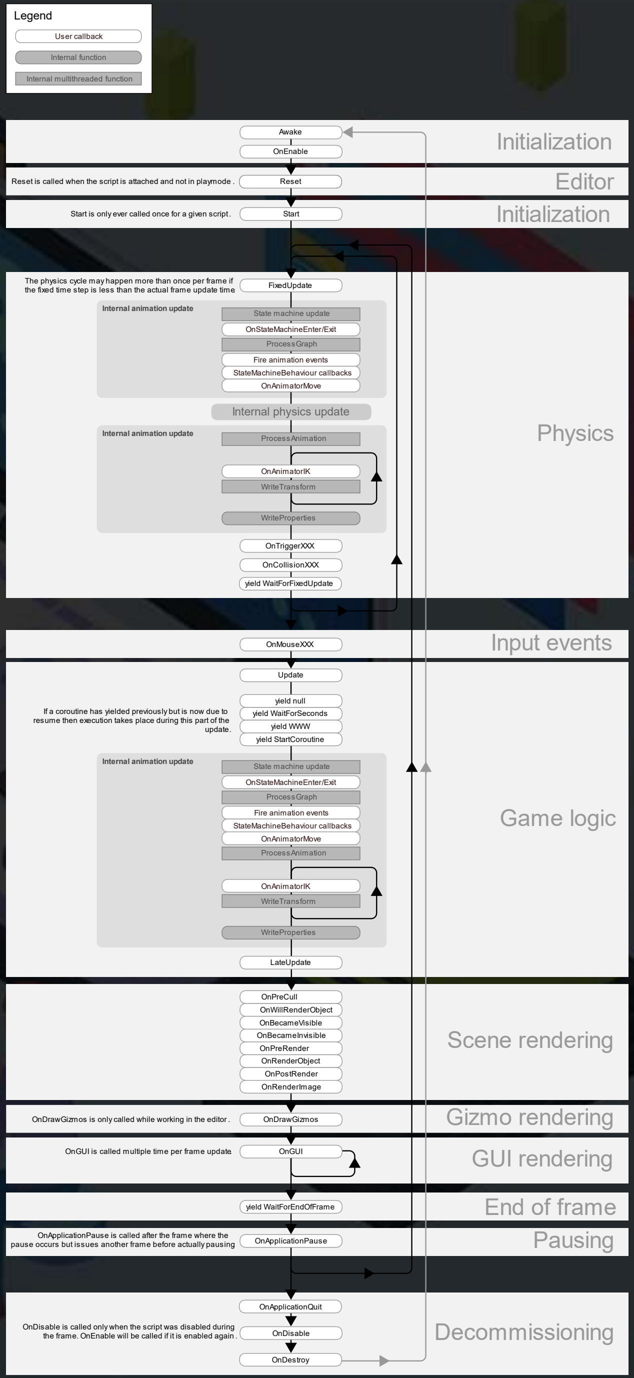




Event Functions

Unity Order of Execution

- Awake
  - Called when a scene starts.
- Start
  - Called before the first frame update
- FixedUpdate
  - Called more frequently then Update
  - Can be called multiple times per frame
  - All physics calculations are made after Fixed Update
- Update
  - Called per frame
  - Main workhorse of a frame
- LateUpdate
  - Called once per frame after Update has finished.



Reset is called when the script is attached and not in playmode .

Start is only ever called once for a given script .

The physics cycle may happen more than once per frame if the fixed time step is less than the actual frame update time

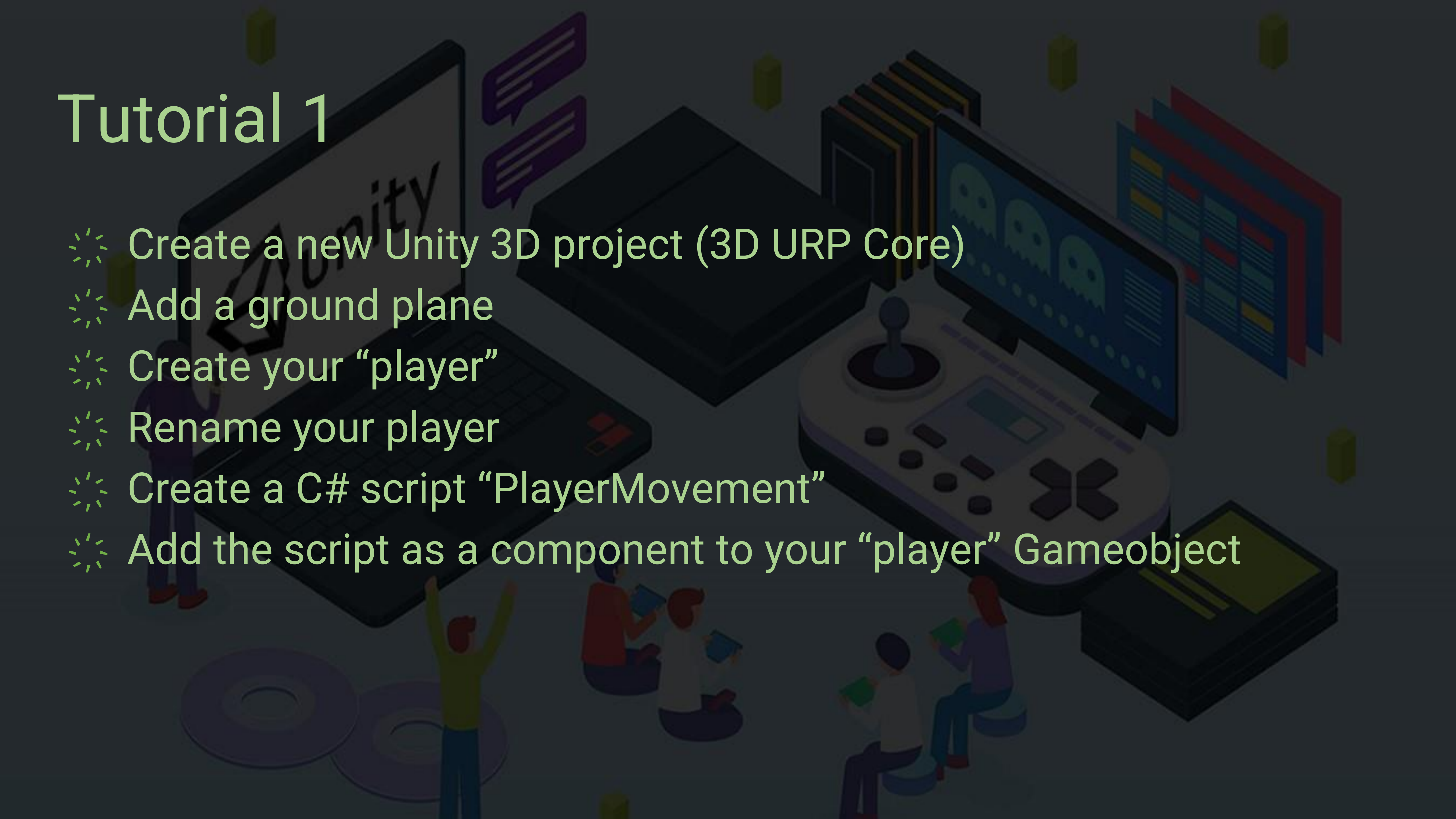
If a coroutine has yielded previously but is now due to resume then execution takes place during this part of the update .

OnDrawGizmos is only called while working in the editor .

OnGUI is called multiple time per frame update.

OnApplicationPause is called after the frame where the pause occurs but issues another frame before actually pausing

OnDisable is called only when the script was disabled during the frame. OnEnable will be called if it is enabled again .



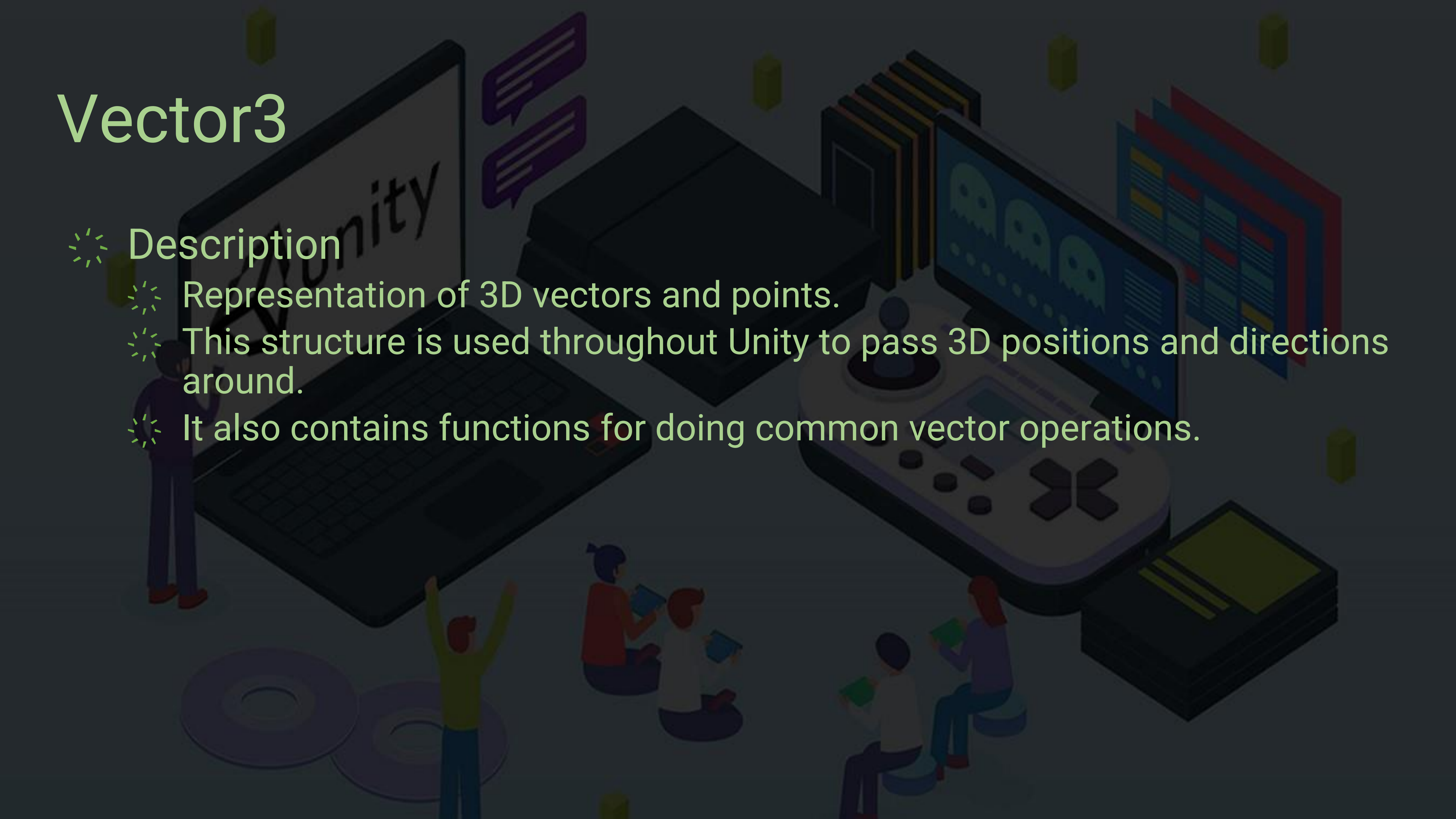
Tutorial 1

- Create a new Unity 3D project (3D URP Core)
- Add a ground plane
- Create your “player”
- Rename your player
- Create a C# script “PlayerMovement”
- Add the script as a component to your “player” Gameobject

Moving the Player

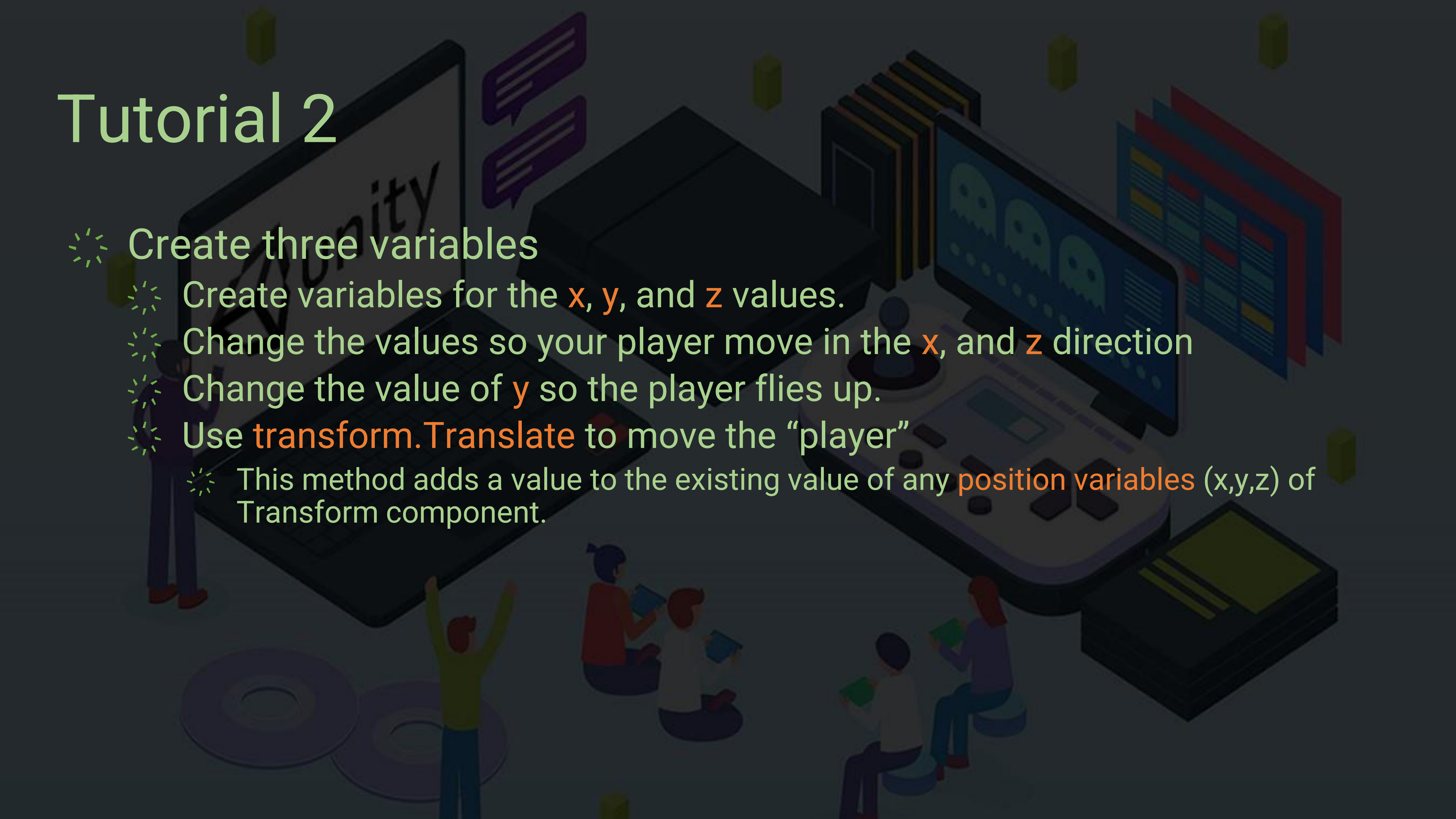
Transform.Translate

- Declaration
  - `public void Translate(Vector3 translation);`
  - `public void Translate(float x, float y, float z);`
- Description
  - Moves the transform in the direction and distance of translation.



Vector3

- Description
  - Representation of 3D vectors and points.
  - This structure is used throughout Unity to pass 3D positions and directions around.
  - It also contains functions for doing common vector operations.



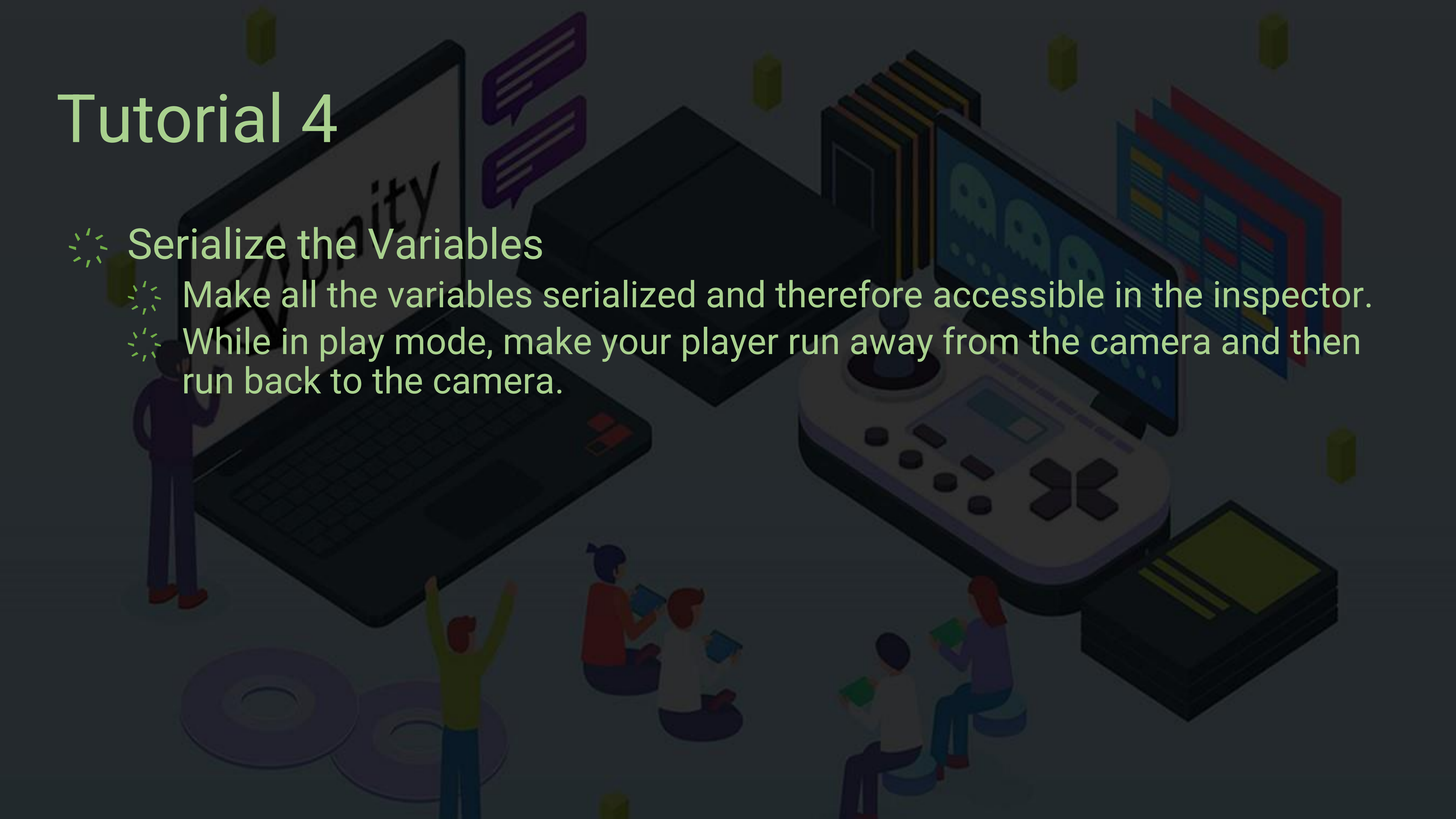
Tutorial 2

- Create three variables
  - Create variables for the x, y, and z values.
  - Change the values so your player move in the x, and z direction
  - Change the value of y so the player flies up.
  - Use transform.Translate to move the “player”
    - This method adds a value to the existing value of any position variables (x,y,z) of Transform component.

Tutorial 3

- Add some colors
  - Create Materials for your Gameobjects
  - Add the material to the MeshRenderer component

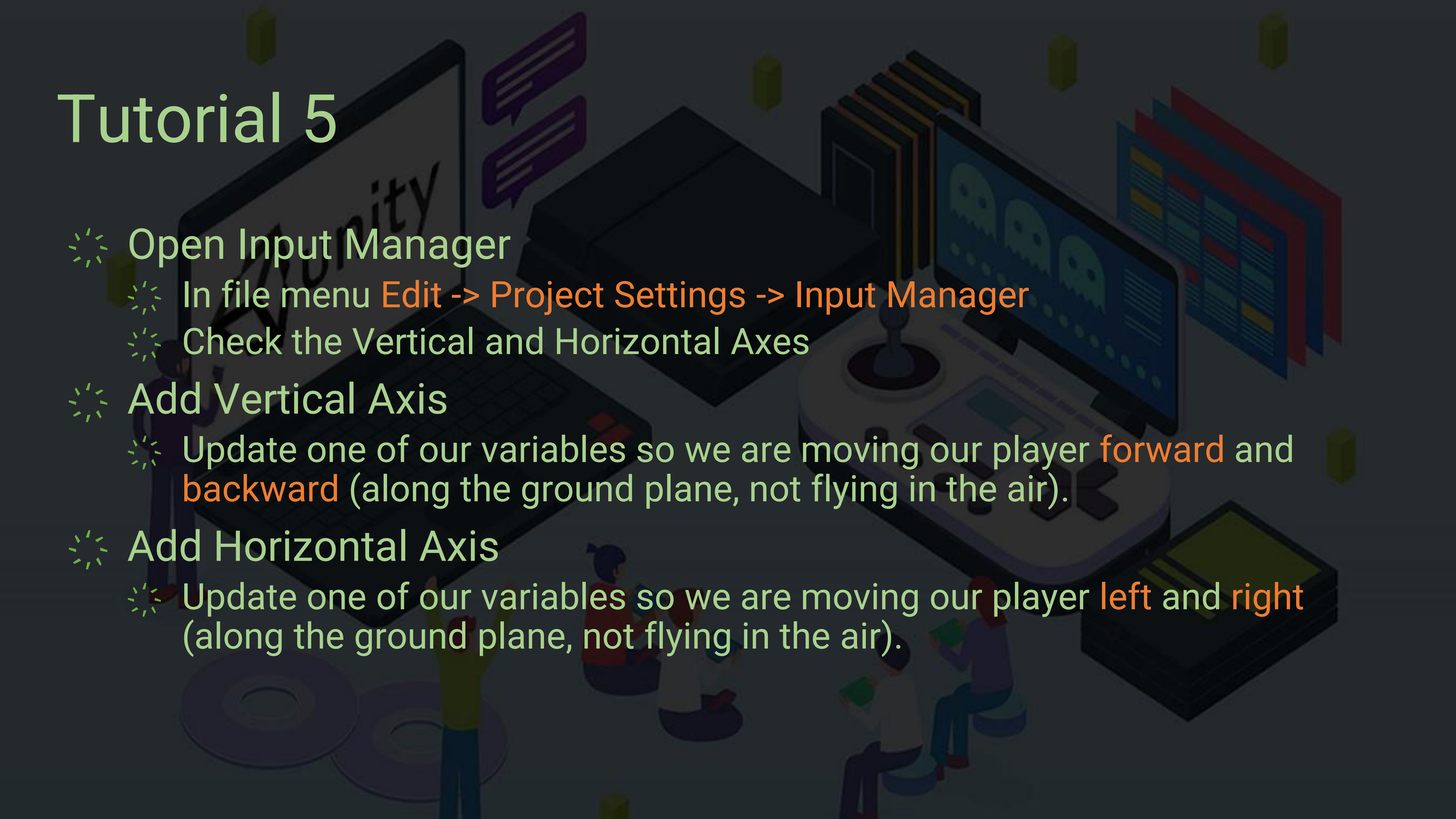
SerializeField



Tutorial 4

- Serialize the Variables
  - Make all the variables serialized and therefore accessible in the inspector.
  - While in play mode, make your player run away from the camera and then run back to the camera.

User Input



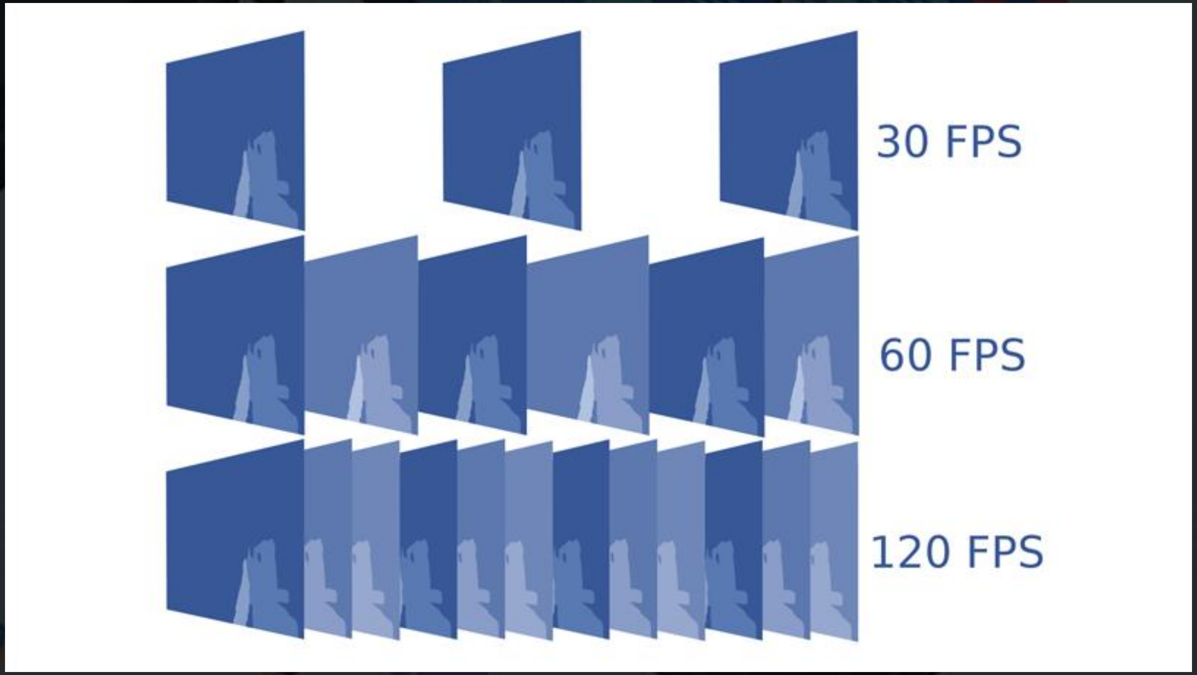
Tutorial 5

- Open Input Manager
  - In file menu Edit -> Project Settings -> Input Manager
  - Check the Vertical and Horizontal Axes
- Add Vertical Axis
  - Update one of our variables so we are moving our player forward and backward (along the ground plane, not flying in the air).
- Add Horizontal Axis
  - Update one of our variables so we are moving our player left and right (along the ground plane, not flying in the air).

Framerate Independence

Framerate

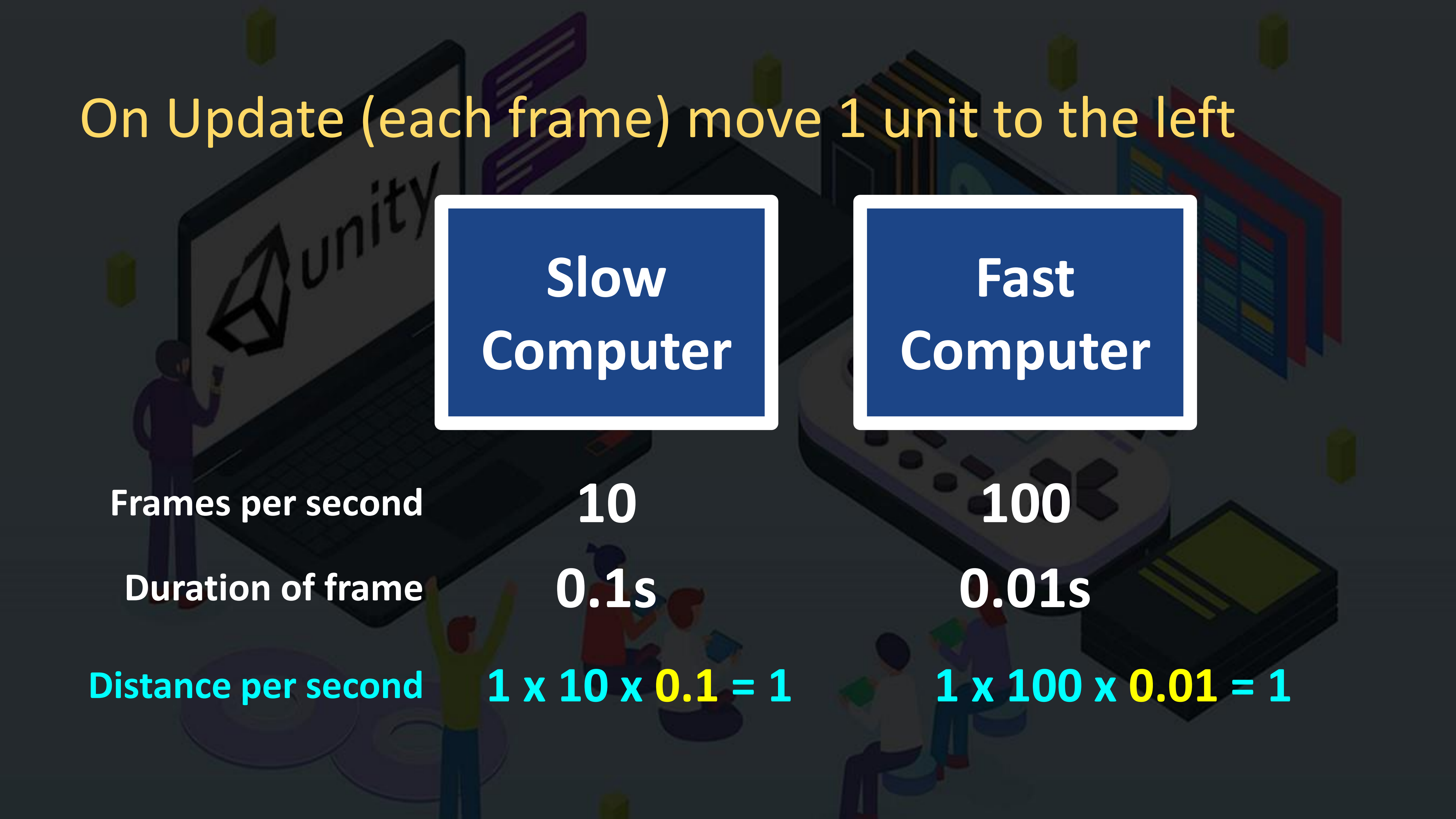
- Your frame rate, measured in frames per second (fps), describes how smoothly a given game runs on your PC.
- The more frames you can pack into one second, the smoother on-screen motion will appear.
- Lower frame rates—typically frame rates lower than 30fps or so—will appear choppy or slow.



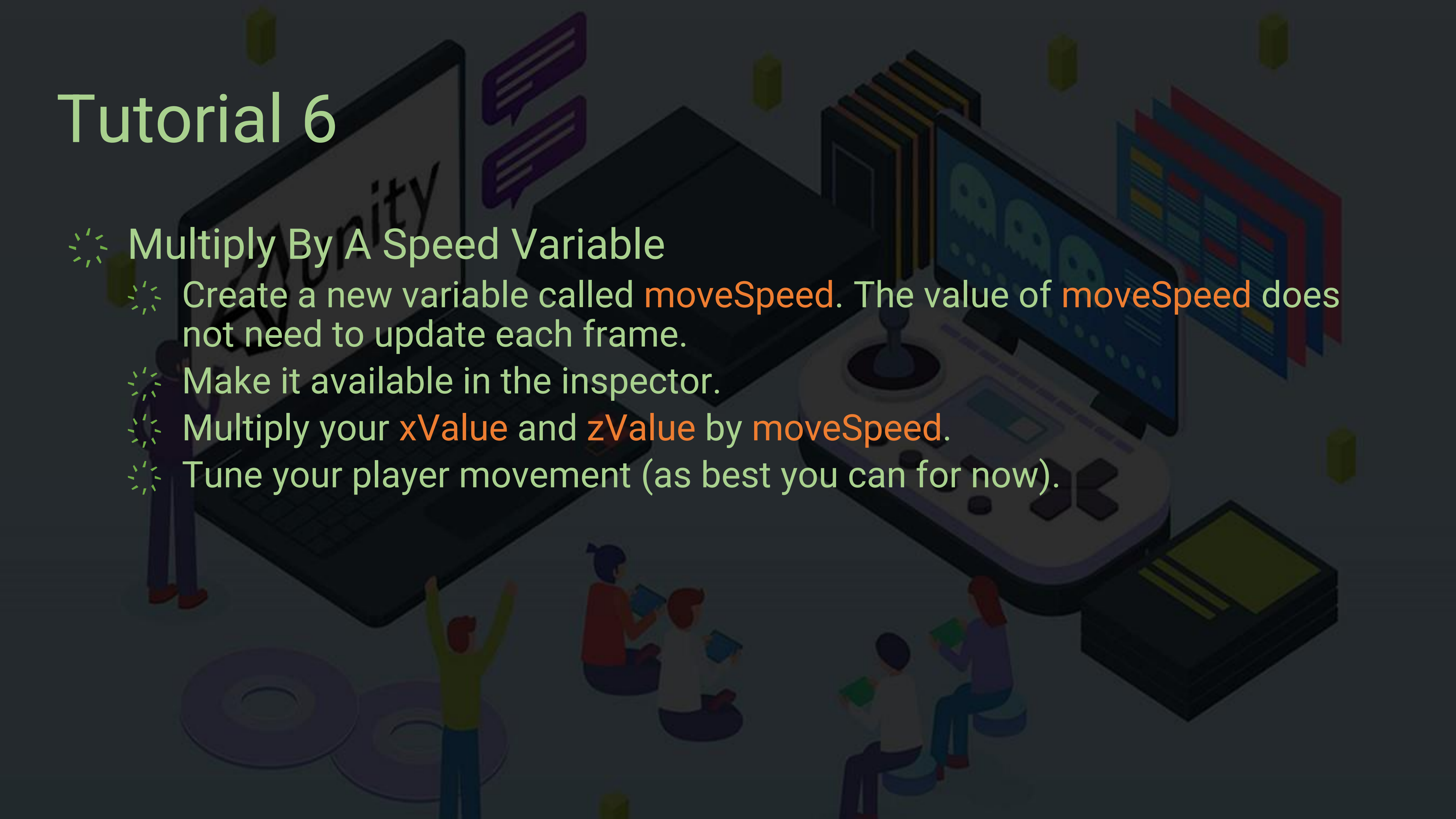
Using Time.deltaTime

- Using Time.deltaTime Unity can tell us how long each frame took to execute.
- When we multiply something by Time.deltaTime it makes our game “frame rate independent”.
  - i.e. The game behaves the same on fast and slow computers

On Update (each frame) move 1 unit to the left



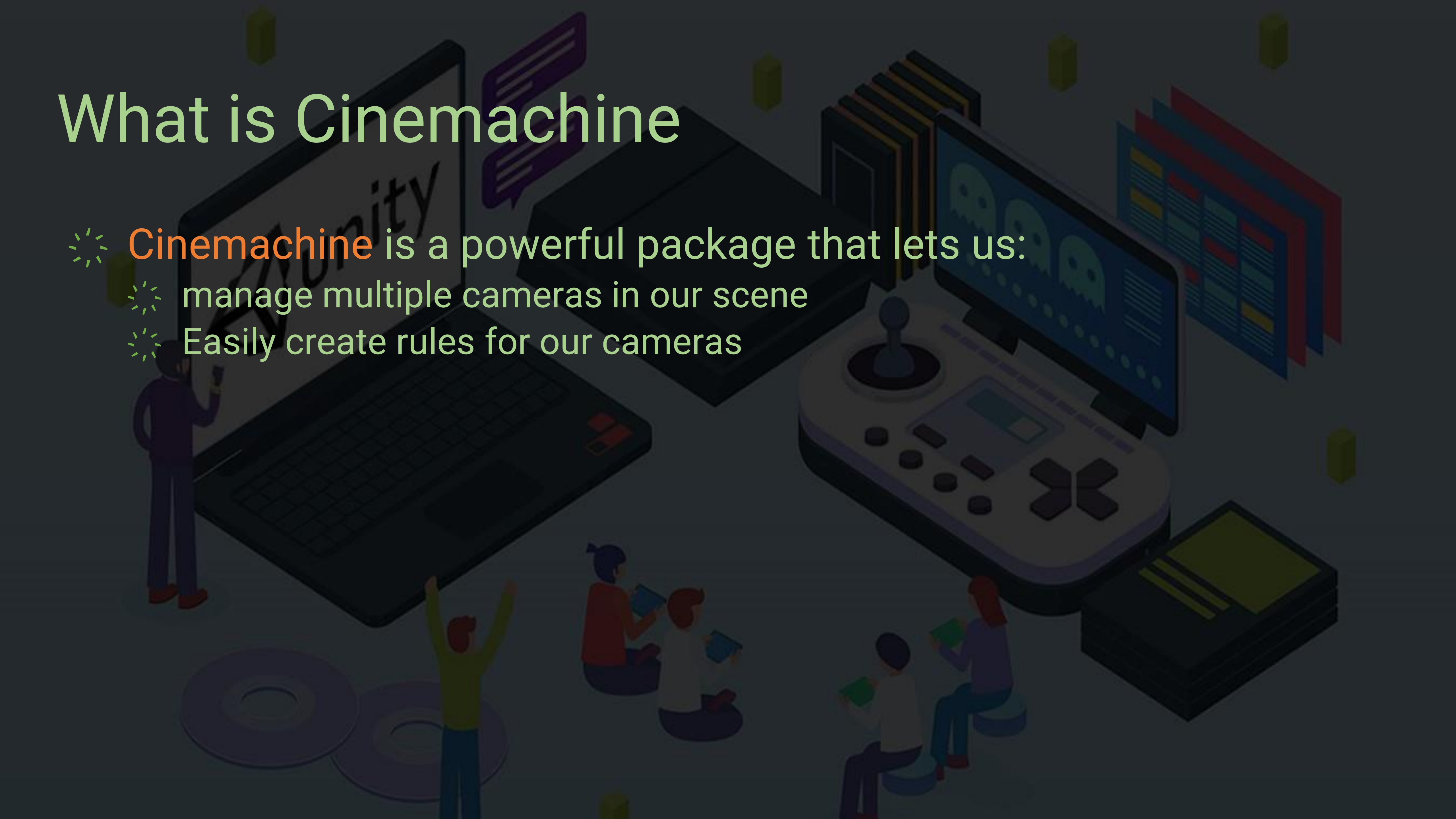
	Slow Computer	Fast Computer
Frames per second	10	100
Duration of frame	0.1s	0.01s
Distance per second	1 x 10 x 0.1 = 1	1 x 100 x 0.01 = 1



Tutorial 6

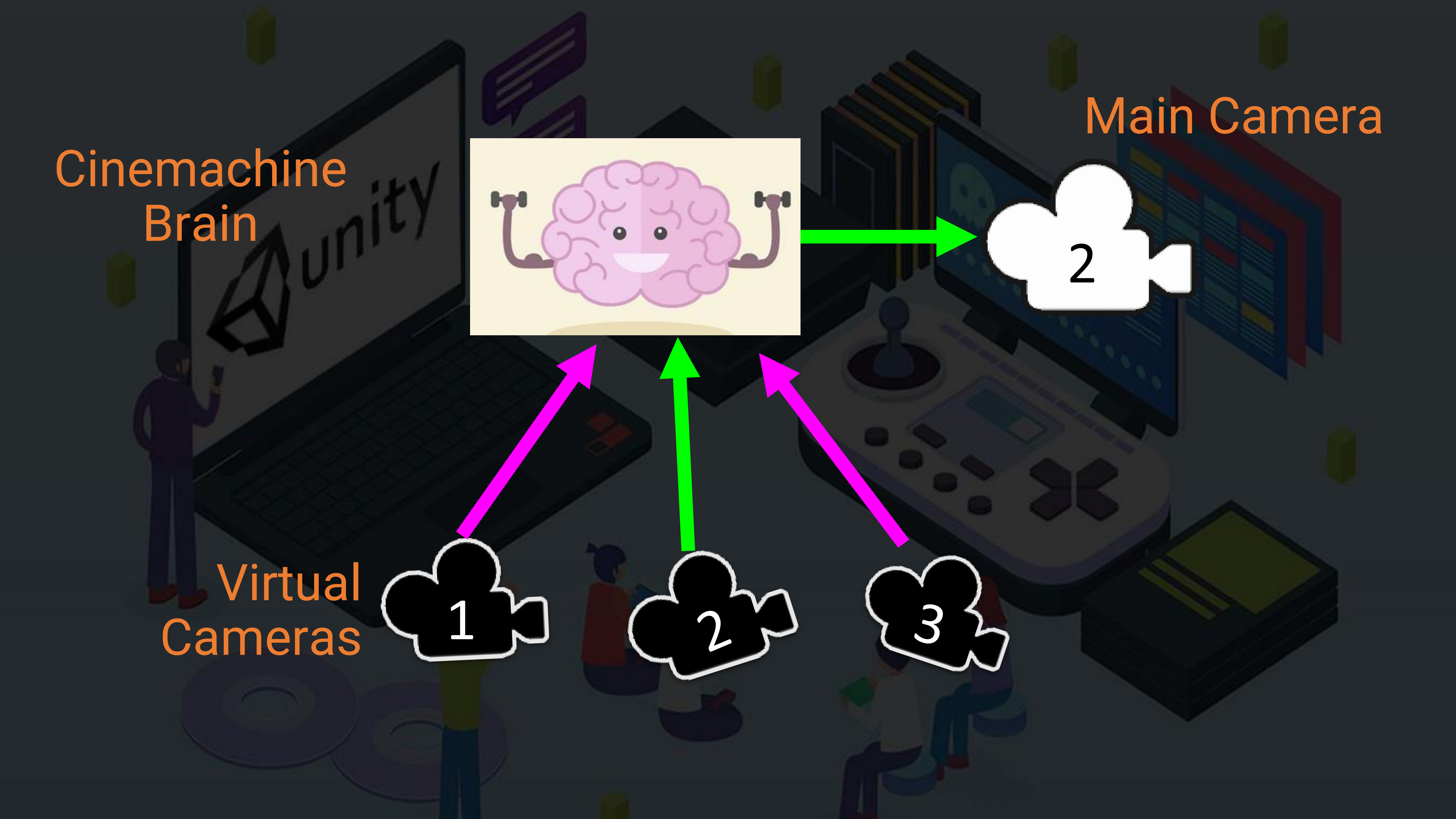
- Multiply By A Speed Variable
  - Create a new variable called moveSpeed. The value of moveSpeed does not need to update each frame.
  - Make it available in the inspector.
  - Multiply your xValue and zValue by moveSpeed.
  - Tune your player movement (as best you can for now).

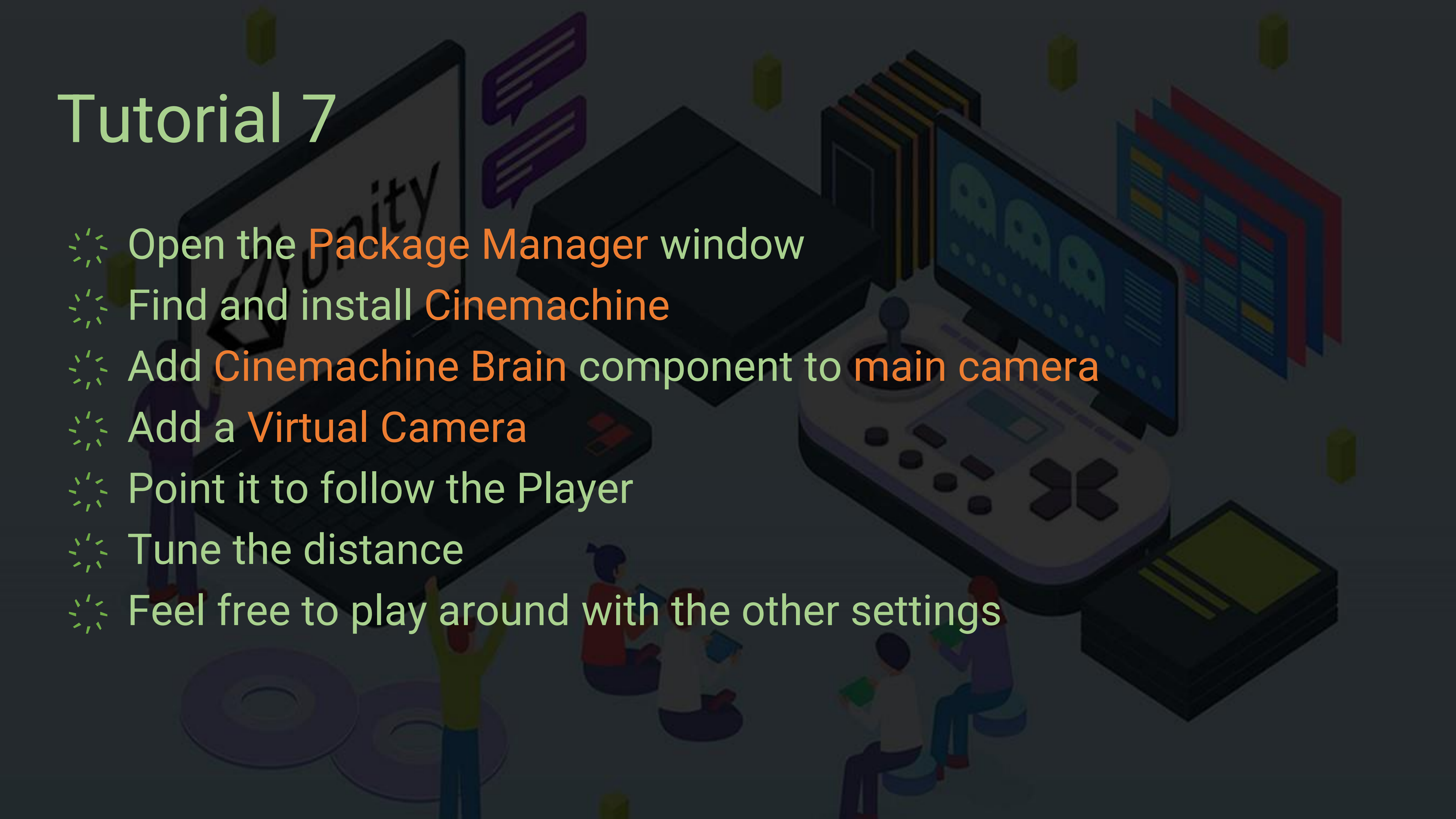
Cinemachine



What is Cinemachine

- Cinemachine is a powerful package that lets us:
  - manage multiple cameras in our scene
  - Easily create rules for our cameras

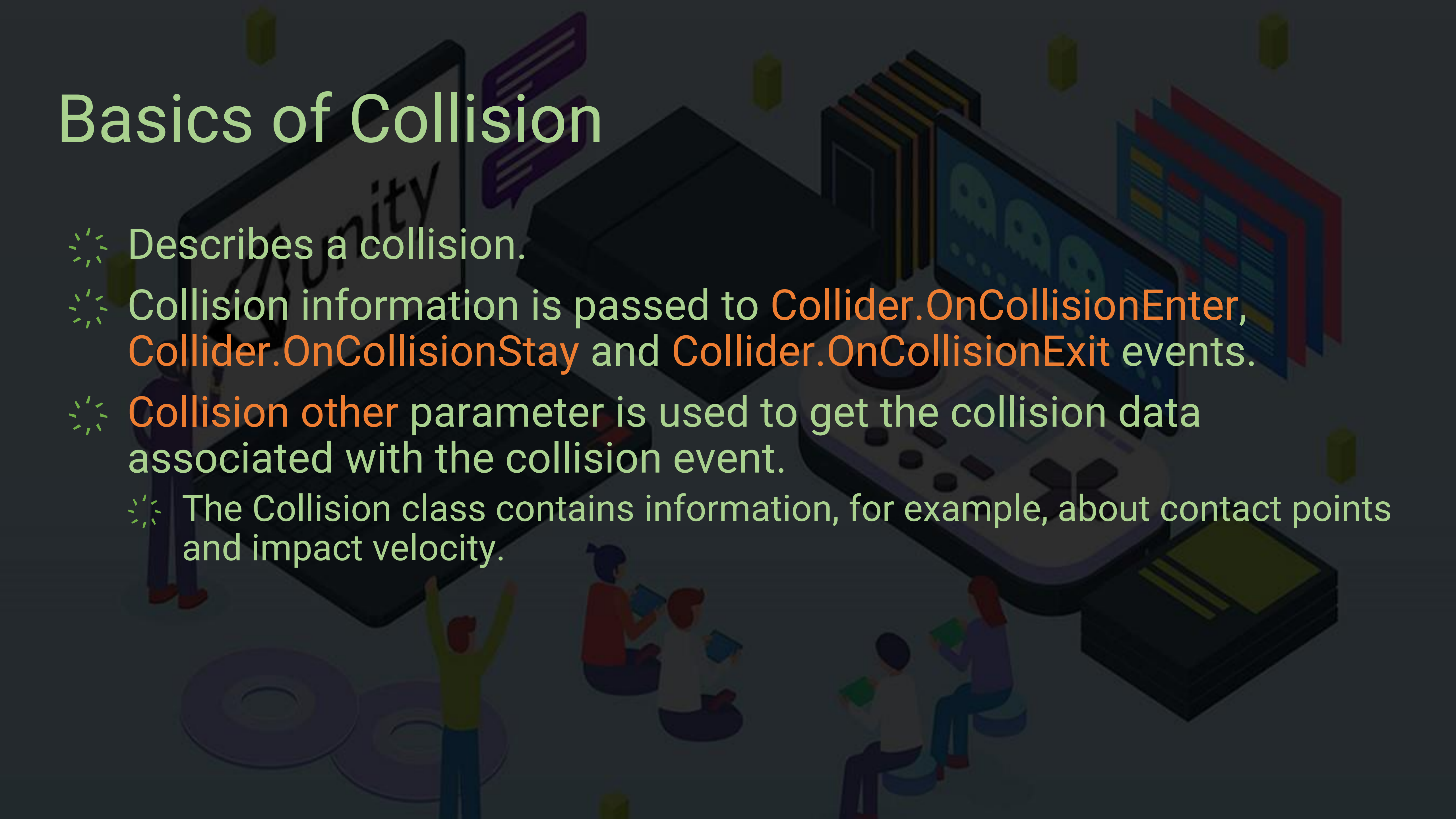

Cinemachine Brain
Main Camera
2
Virtual Cameras
1
2
3



Tutorial 7

- Open the Package Manager window
- Find and install Cinemachine
- Add Cinemachine Brain component to main camera
- Add a Virtual Camera
- Point it to follow the Player
- Tune the distance
- Feel free to play around with the other settings

Collisions

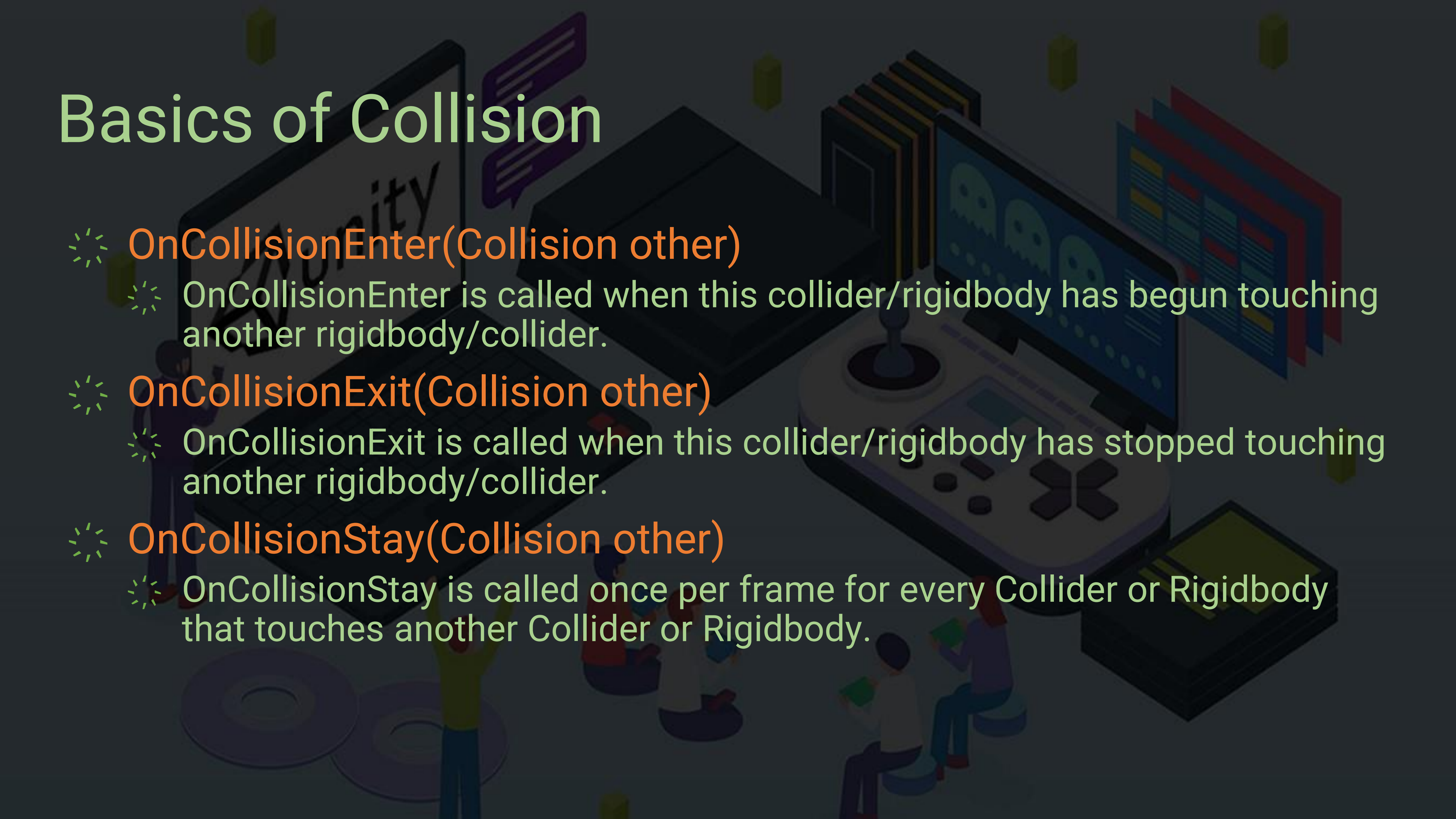


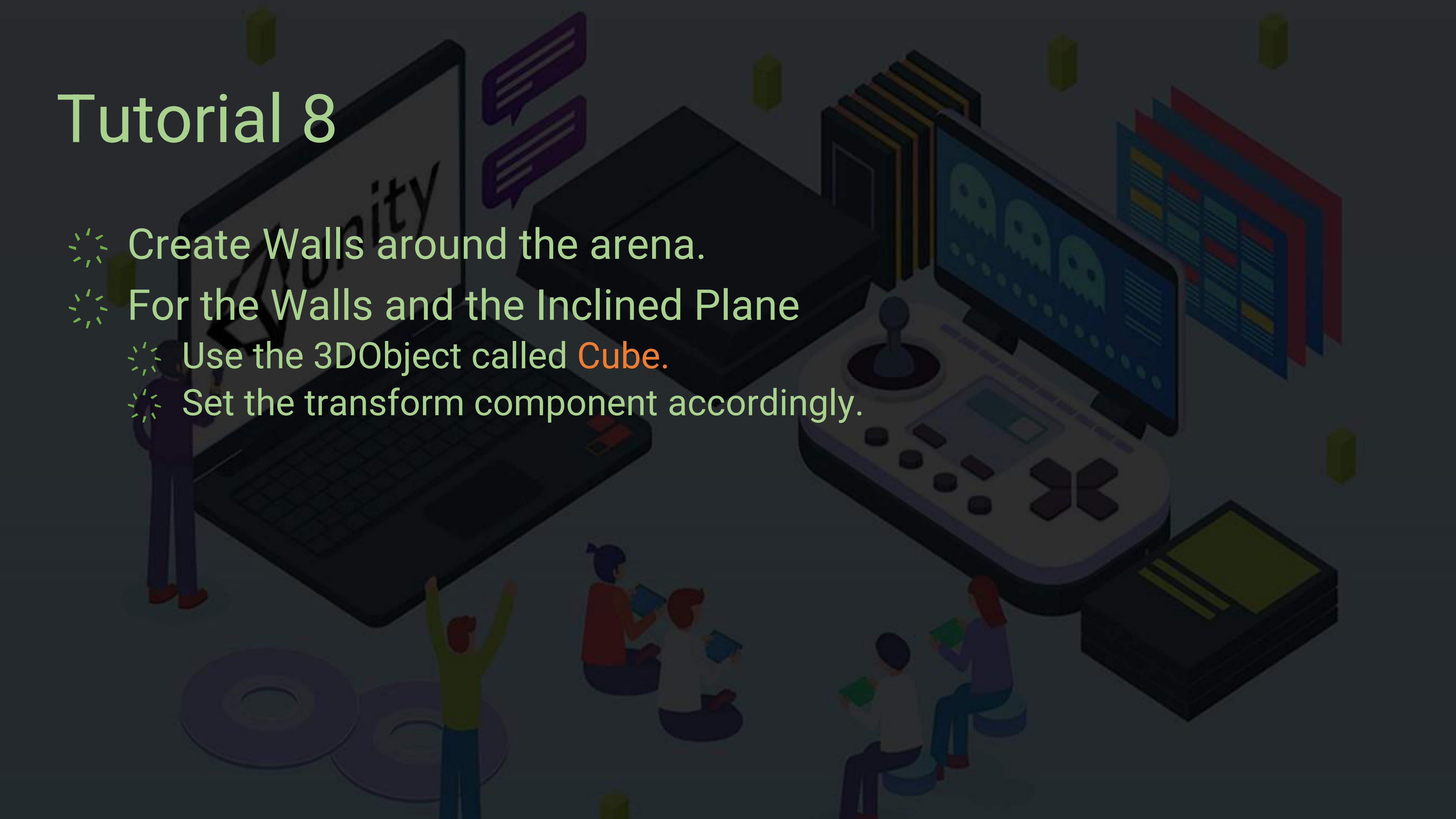
Basics of Collision

- Describes a collision.
- Collision information is passed to Collider.OnCollisionEnter, Collider.OnCollisionStay and Collider.OnCollisionExit events.
- Collision other parameter is used to get the collision data associated with the collision event.
  - The Collision class contains information, for example, about contact points and impact velocity.

Basics of Collision

- OnCollisionEnter(Collision other)
  - OnCollisionEnter is called when this collider/rigidbody has begun touching another rigidbody/collider.
- OnCollisionExit(Collision other)
  - OnCollisionExit is called when this collider/rigidbody has stopped touching another rigidbody/collider.
- OnCollisionStay(Collision other)
  - OnCollisionStay is called once per frame for every Collider or Rigidbody that touches another Collider or Rigidbody.

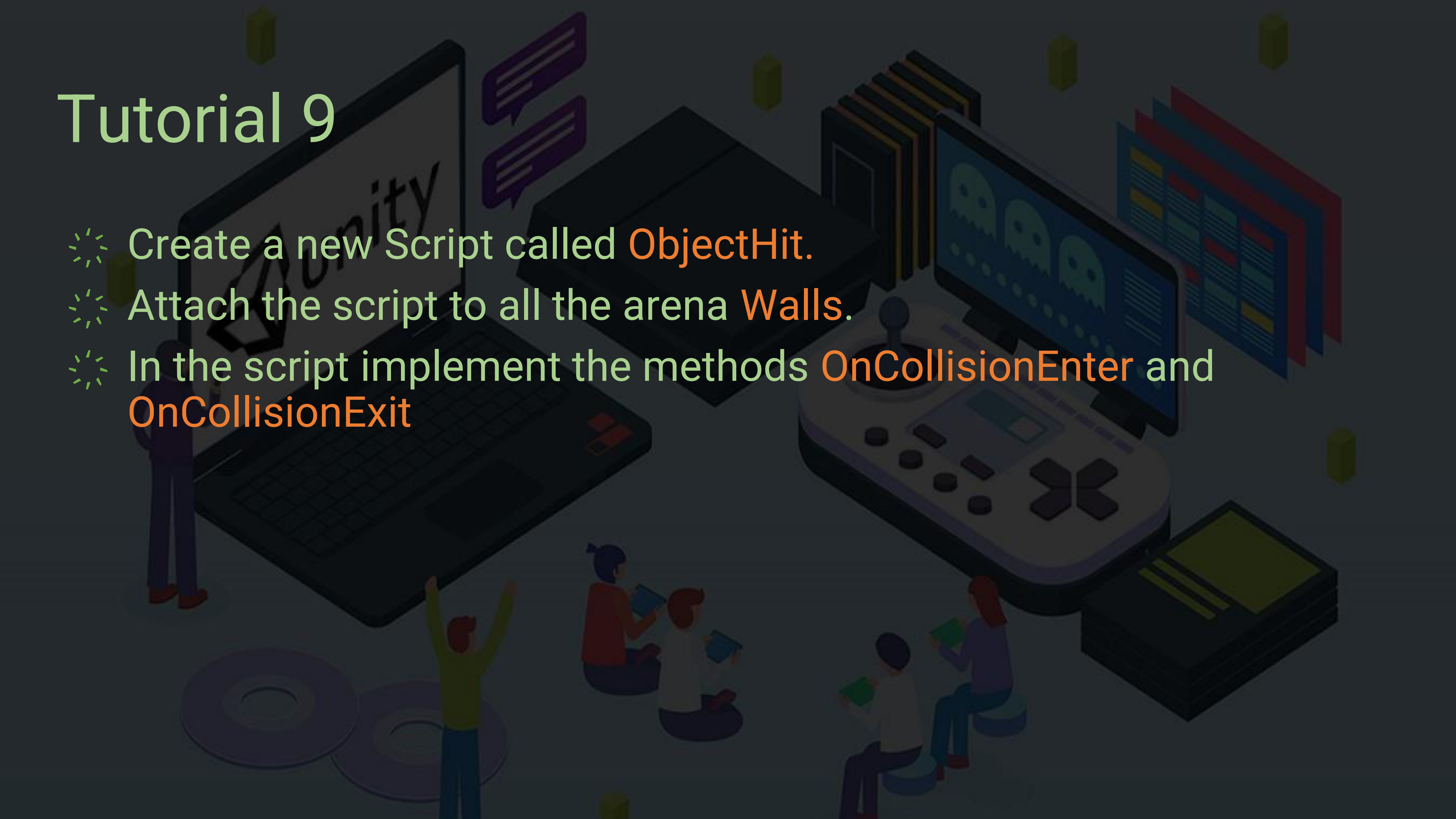




Tutorial 8

- Create Walls around the arena.
- For the Walls and the Inclined Plane
  - Use the 3DObject called Cube.
  - Set the transform component accordingly.

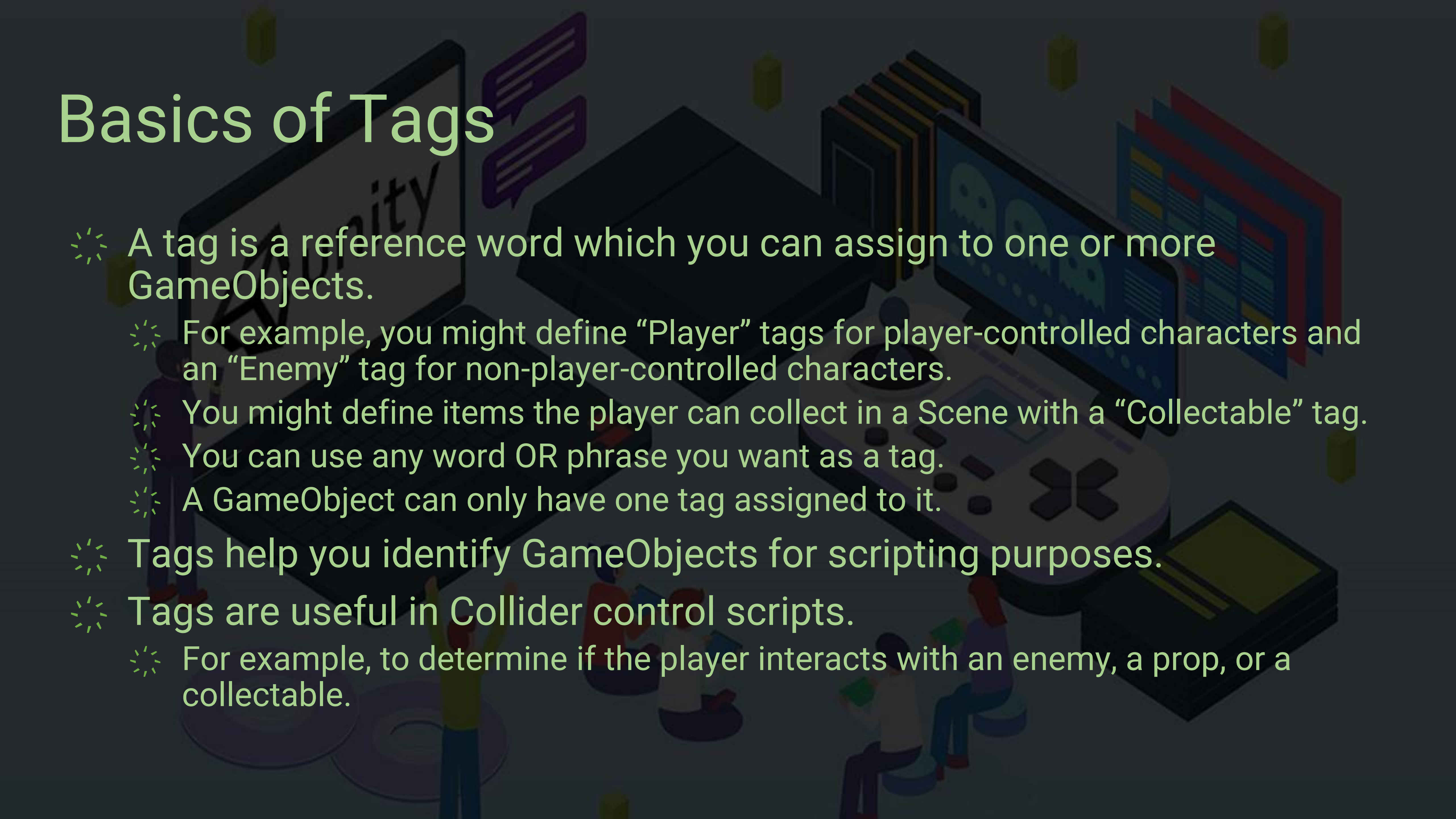
Using Collision Events



Tutorial 9

- Create a new Script called ObjectHit.
- Attach the script to all the arena Walls.
- In the script implement the methods OnCollisionEnter and OnCollisionExit

Tags

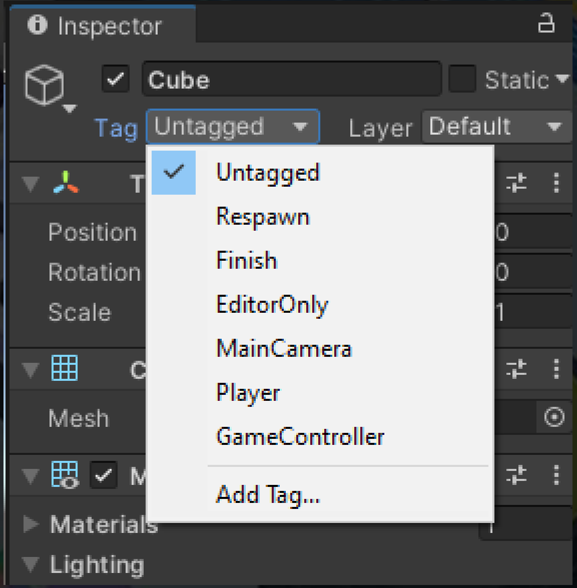


Basics of Tags

- A tag is a reference word which you can assign to one or more GameObjects.
  - For example, you might define “Player” tags for player-controlled characters and an “Enemy” tag for non-player-controlled characters.
  - You might define items the player can collect in a Scene with a “Collectable” tag.
  - You can use any word OR phrase you want as a tag.
  - A GameObject can only have one tag assigned to it.
- Tags help you identify GameObjects for scripting purposes.
- Tags are useful in Collider control scripts.
  - For example, to determine if the player interacts with an enemy, a prop, or a collectable.

Tutorial 10

- Create new tags
  - The Inspector displays the Tag and Layer dropdown menus below the name of a GameObject.
  - Click Add Tag... to add list of new tags



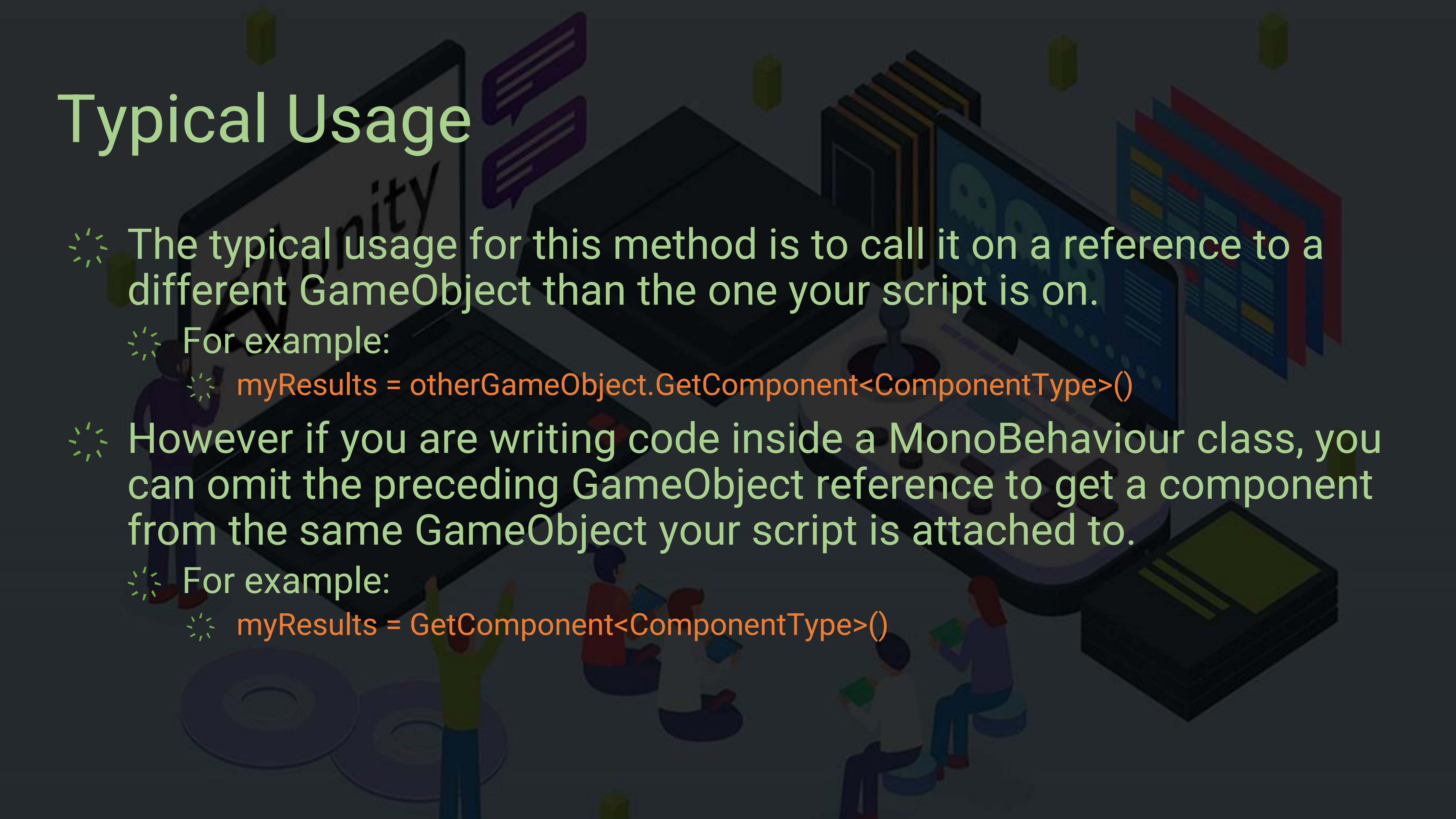
- Create Tags for Walls, Boxy, Obstacle, Ball, Box

Caching a reference to a Component

GetComponent

- Declaration
  - public T GetComponent();
- Returns
  - T A reference to a component of the type T if one is found, otherwise null.
- Description
  - Gets a reference to a component of type T on the specified GameObject.

Typical Usage



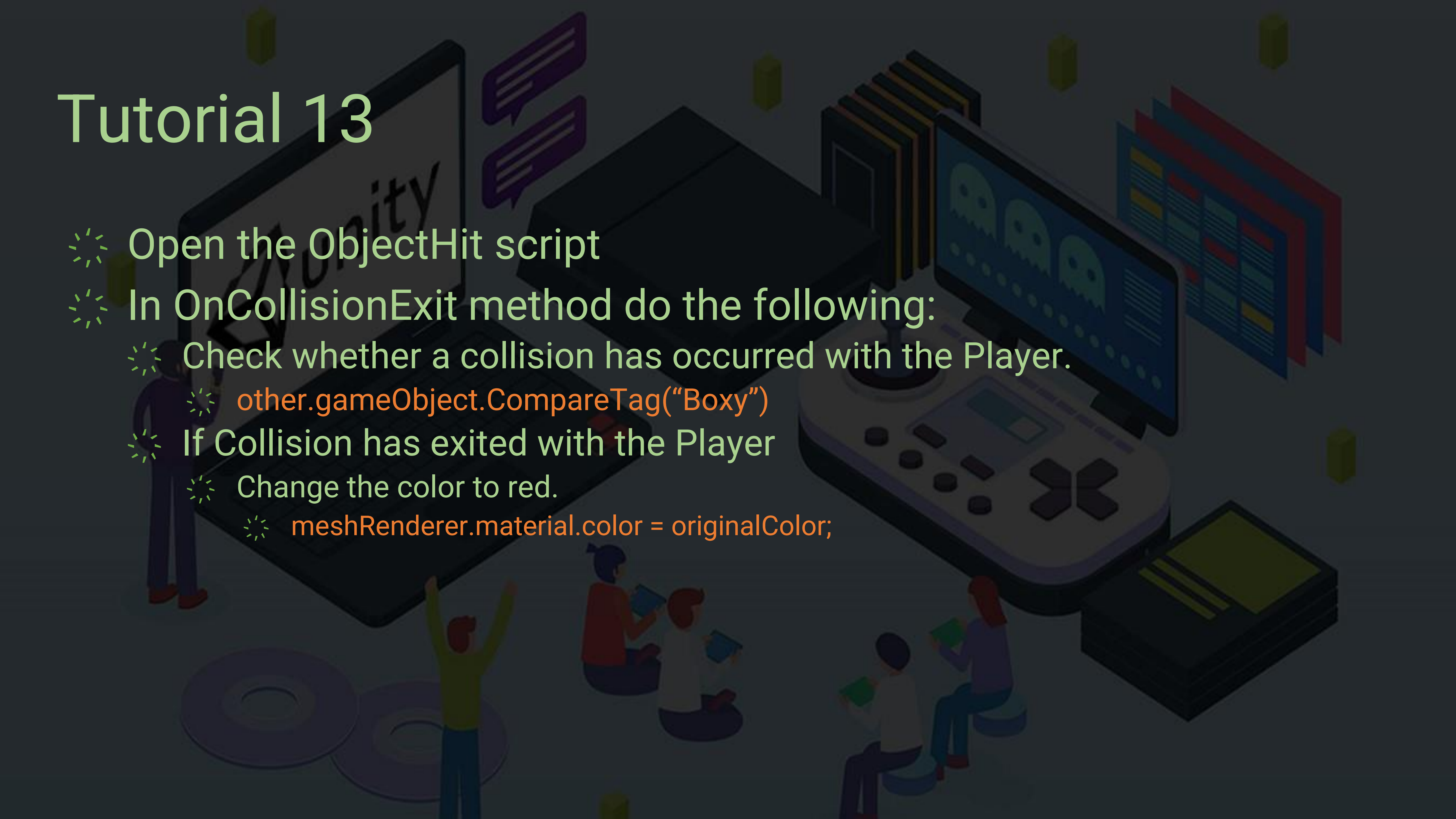
- The typical usage for this method is to call it on a reference to a different GameObject than the one your script is on.
  - For example:
    - `myResults = otherGameObject.GetComponent<ComponentType>()`
- However if you are writing code inside a MonoBehaviour class, you can omit the preceding GameObject reference to get a component from the same GameObject your script is attached to.
  - For example:
    - `myResults = GetComponent<ComponentType>()`

Tutorial 11

- Open the ObjectHit script
- Define variables
  - MeshRenderer meshRenderer;
  - Color originalColor;
- In Start method
  - Get a reference to the MeshRenderer component using the following statement.
    - meshRenderer = GetComponent<MeshRenderer>();
  - Save the current color of the GameObject
    - originalColor = meshRenderer.material.color;

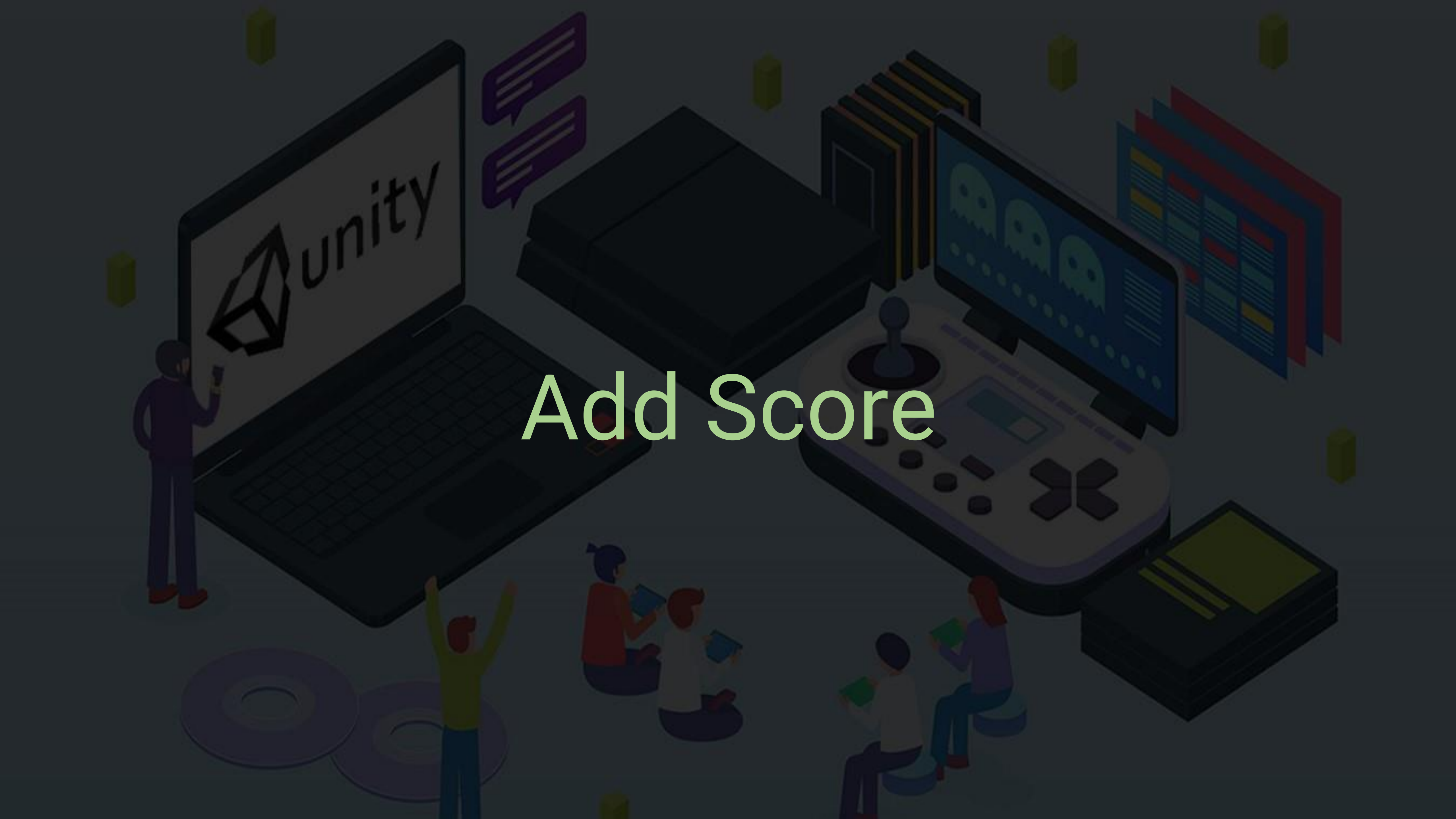
Tutorial 12

- Open the ObjectHit script
- In OnCollisionEnter method do the following:
  - Check whether a collision has occurred with the Player.
    - other.gameObject.CompareTag(“Boxy”)
  - If Collision has occurred with the Player
    - Change the color to red.
      - meshRenderer.material.color = Color.red;

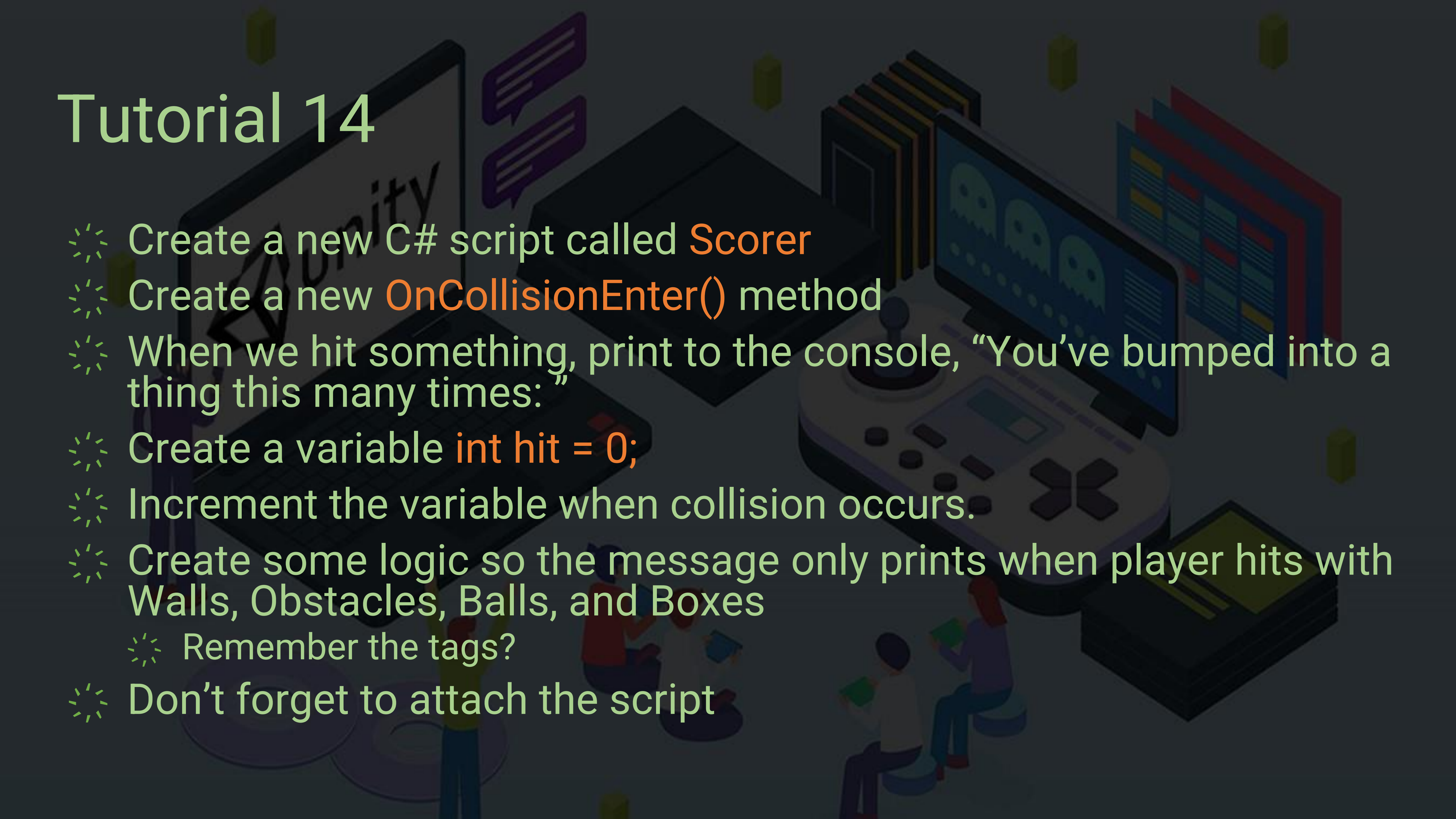


Tutorial 13

- Open the ObjectHit script
- In OnCollisionExit method do the following:
  - Check whether a collision has occurred with the Player.
    - other.gameObject.CompareTag(“Boxy”)
  - If Collision has exited with the Player
    - Change the color to red.
      - meshRenderer.material.color = originalColor;



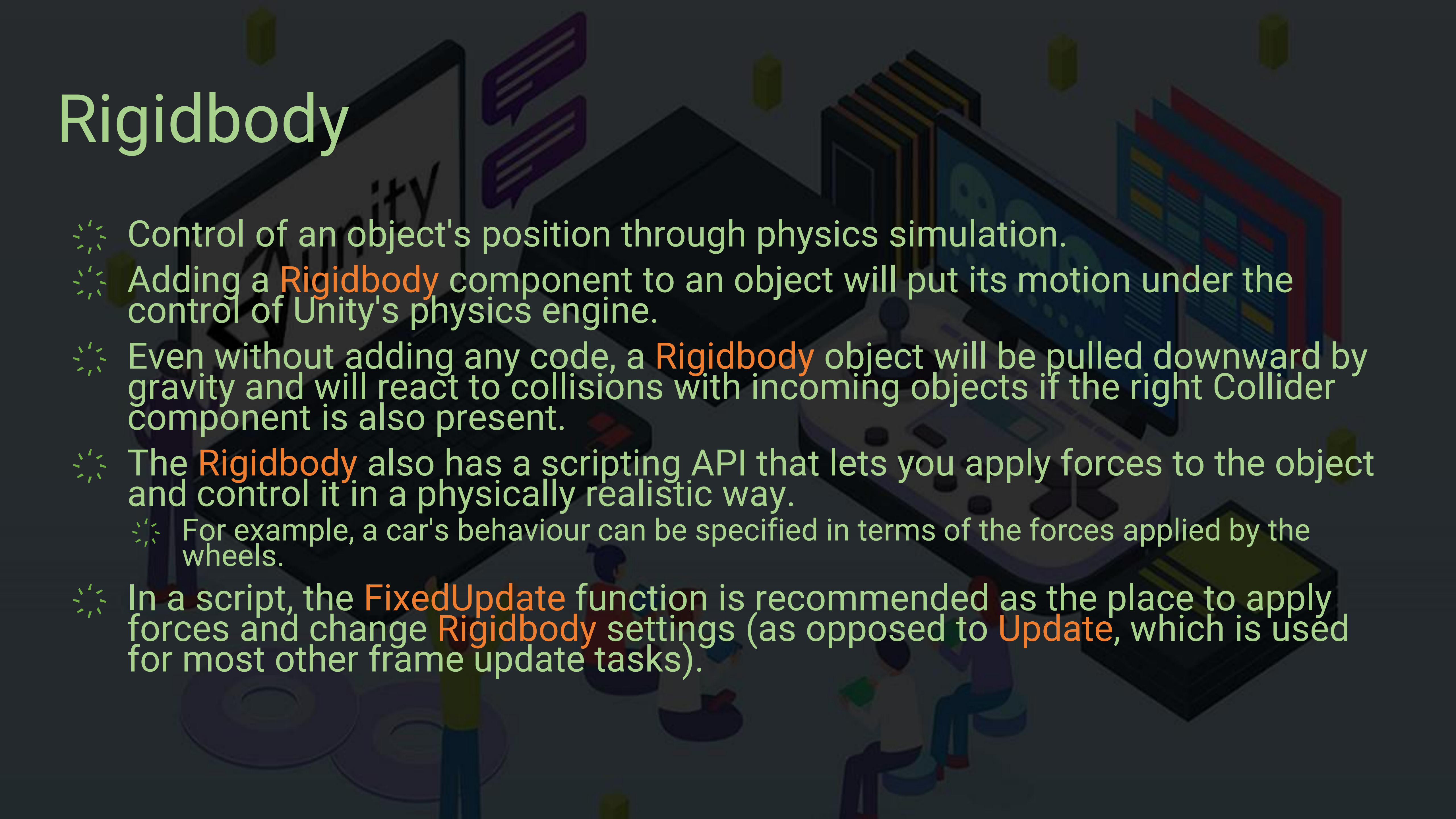
Add Score



Tutorial 14

- Create a new C# script called Scorer
- Create a new OnCollisionEnter() method
- When we hit something, print to the console, “You’ve bumped into a thing this many times: ”
- Create a variable int hit = 0;
- Increment the variable when collision occurs.
- Create some logic so the message only prints when player hits with Walls, Obstacles, Balls, and Boxes
  - Remember the tags?
- Don’t forget to attach the script

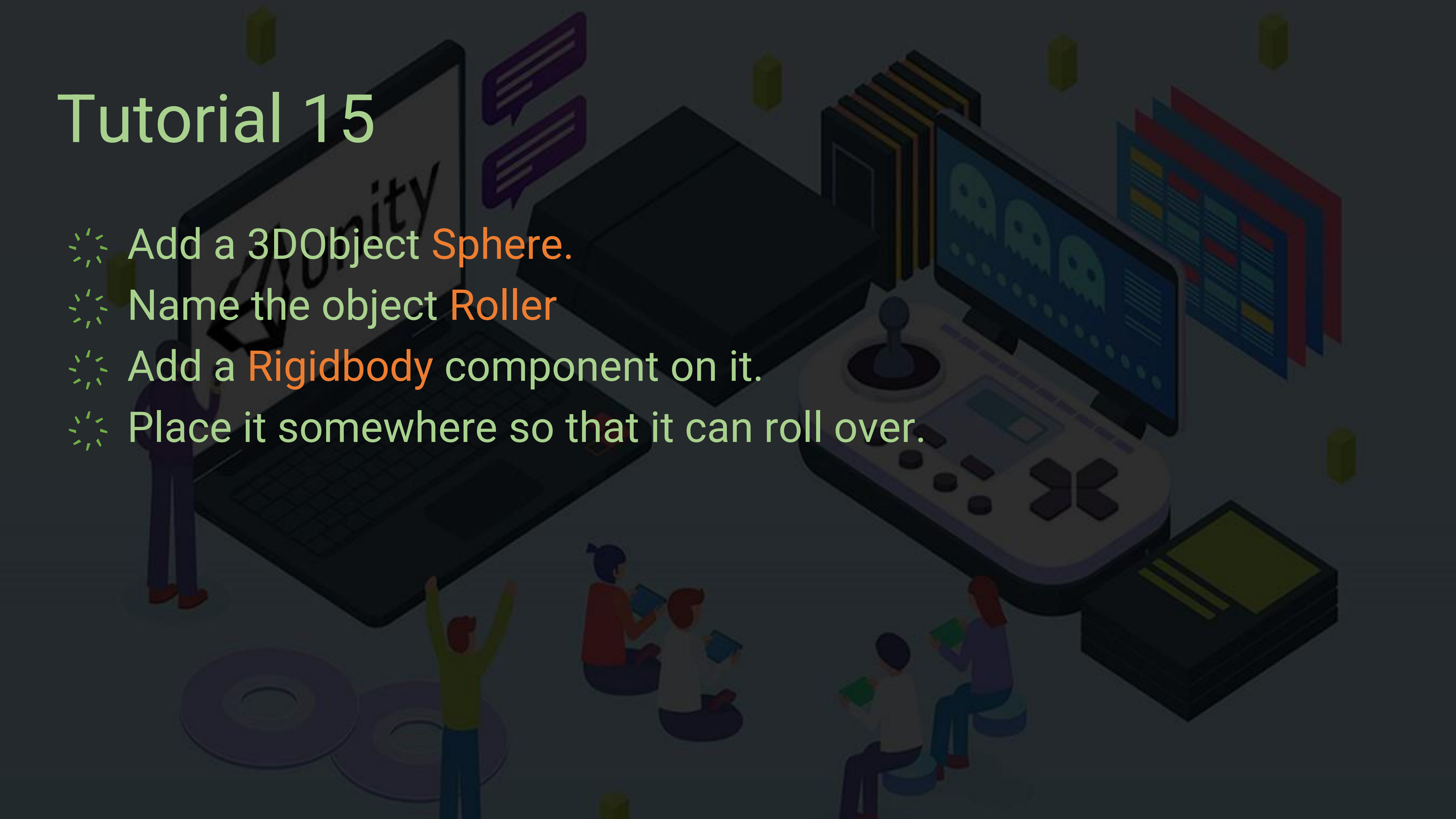
Rigidbody



Rigidbody

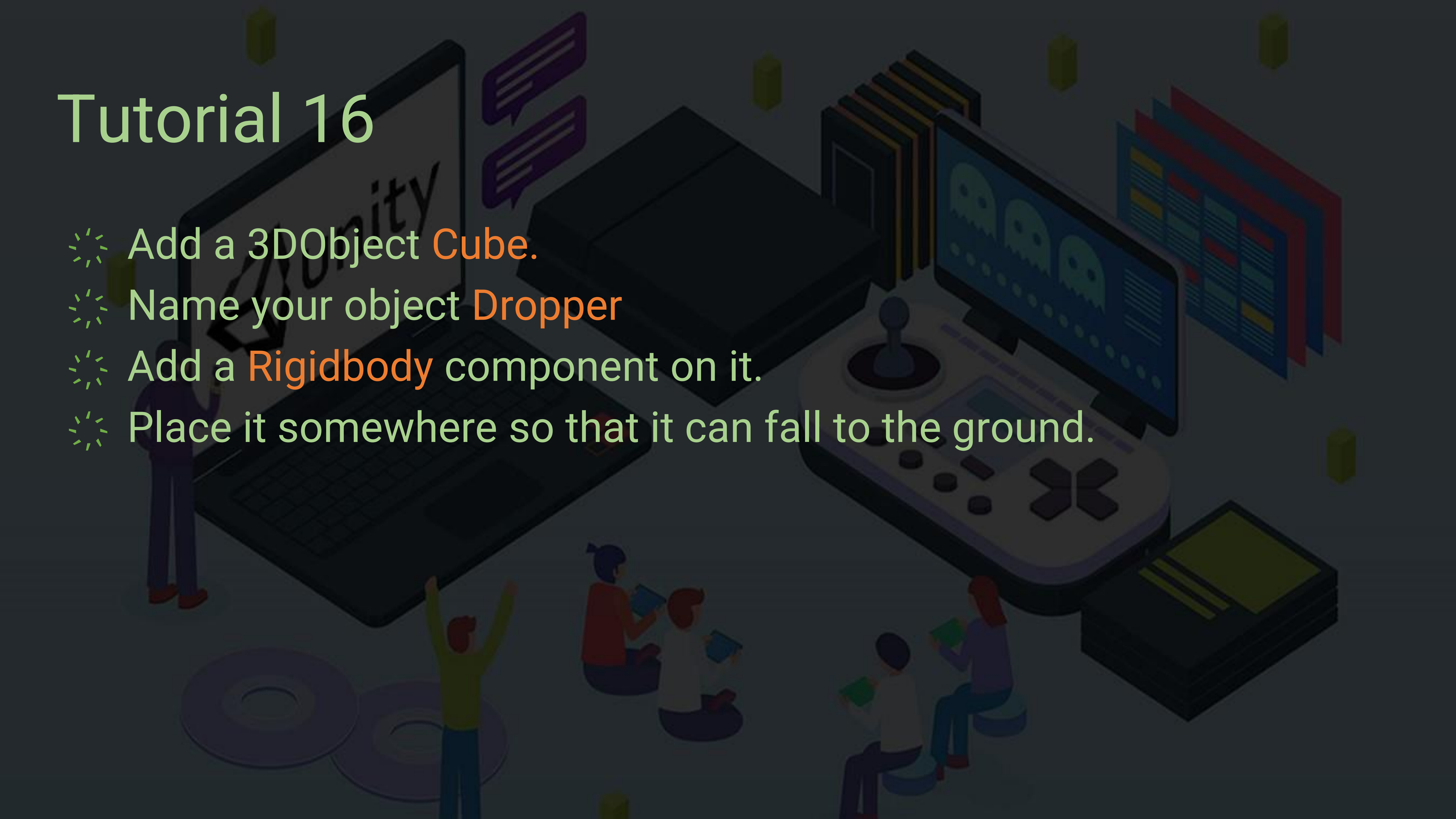
- Control of an object's position through physics simulation.
- Adding a Rigidbody component to an object will put its motion under the control of Unity's physics engine.
- Even without adding any code, a Rigidbody object will be pulled downward by gravity and will react to collisions with incoming objects if the right Collider component is also present.
- The Rigidbody also has a scripting API that lets you apply forces to the object and control it in a physically realistic way.
  - For example, a car's behaviour can be specified in terms of the forces applied by the wheels.
- In a script, the FixedUpdate function is recommended as the place to apply forces and change Rigidbody settings (as opposed to Update, which is used for most other frame update tasks).

Create Obstacles



Tutorial 15

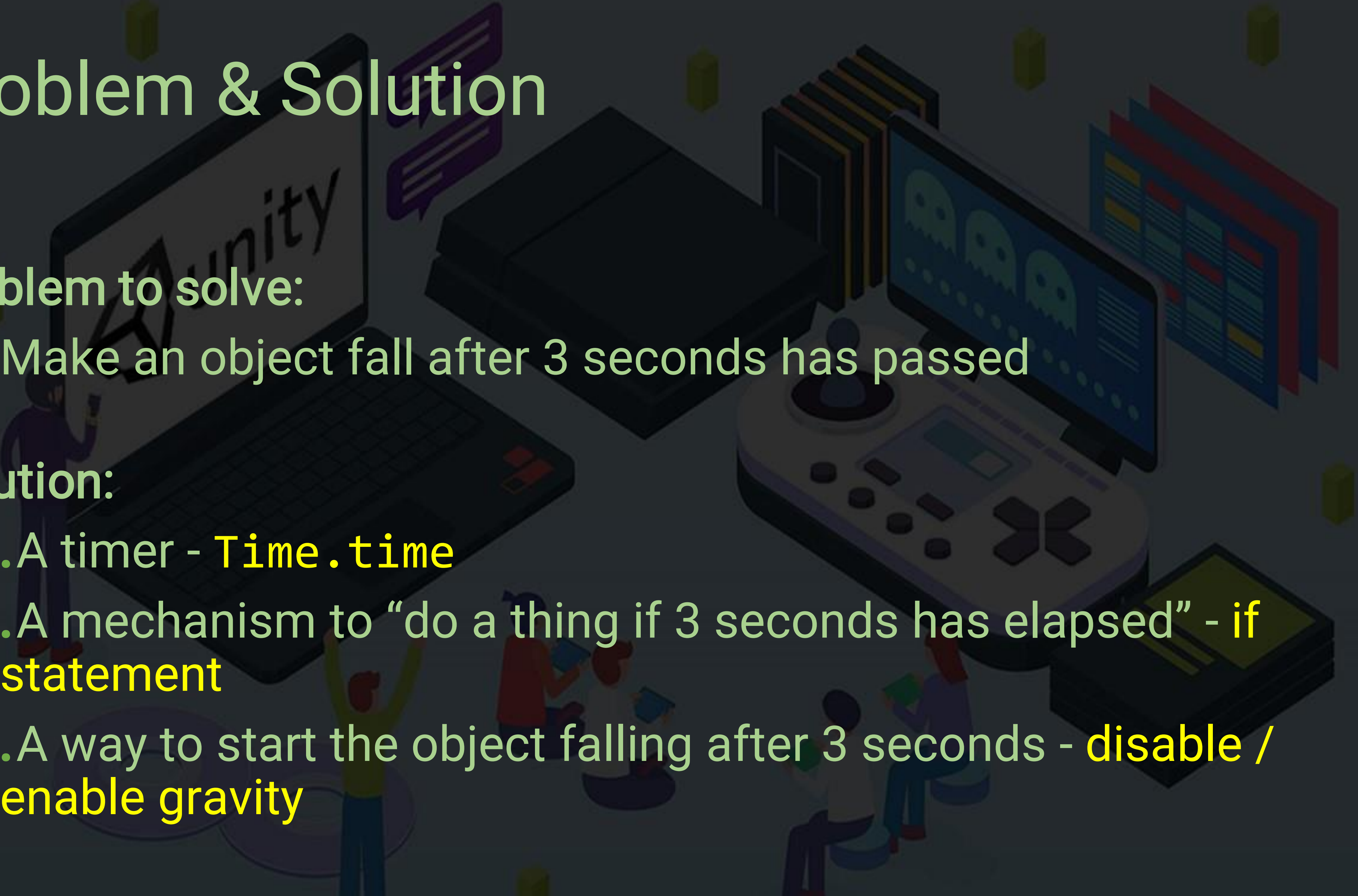
- Add a 3DObject Sphere.
- Name the object Roller
- Add a Rigidbody component on it.
- Place it somewhere so that it can roll over.



Tutorial 16

- Add a 3DObject Cube.
- Name your object Dropper
- Add a Rigidbody component on it.
- Place it somewhere so that it can fall to the ground.

Using Time.time



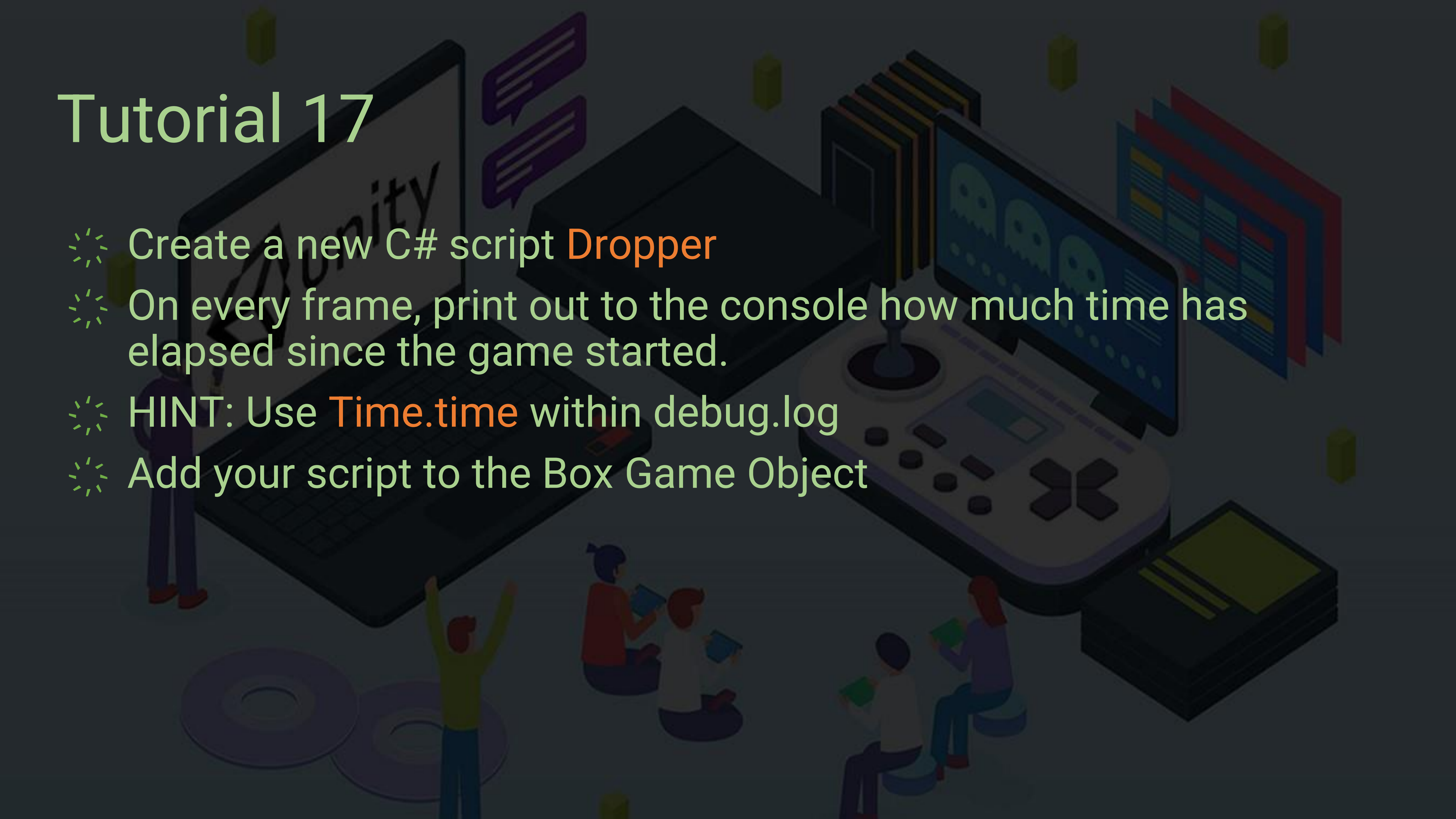
Problem & Solution

Problem to solve:

- Make an object fall after 3 seconds has passed

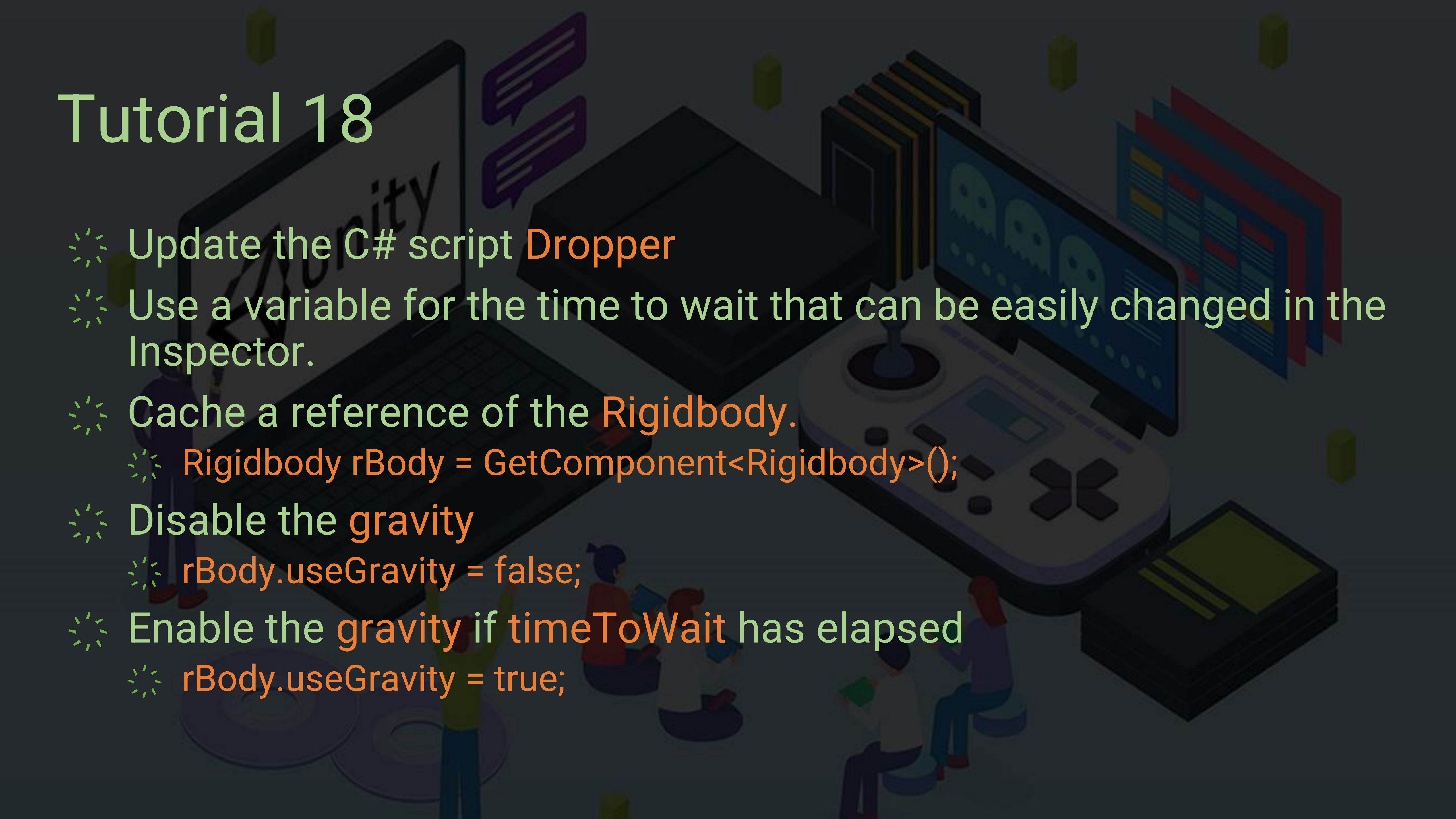
Solution:

1. A timer - `Time.time`
2. A mechanism to “do a thing if 3 seconds has elapsed” - if statement
3. A way to start the object falling after 3 seconds - disable / enable gravity



Tutorial 17

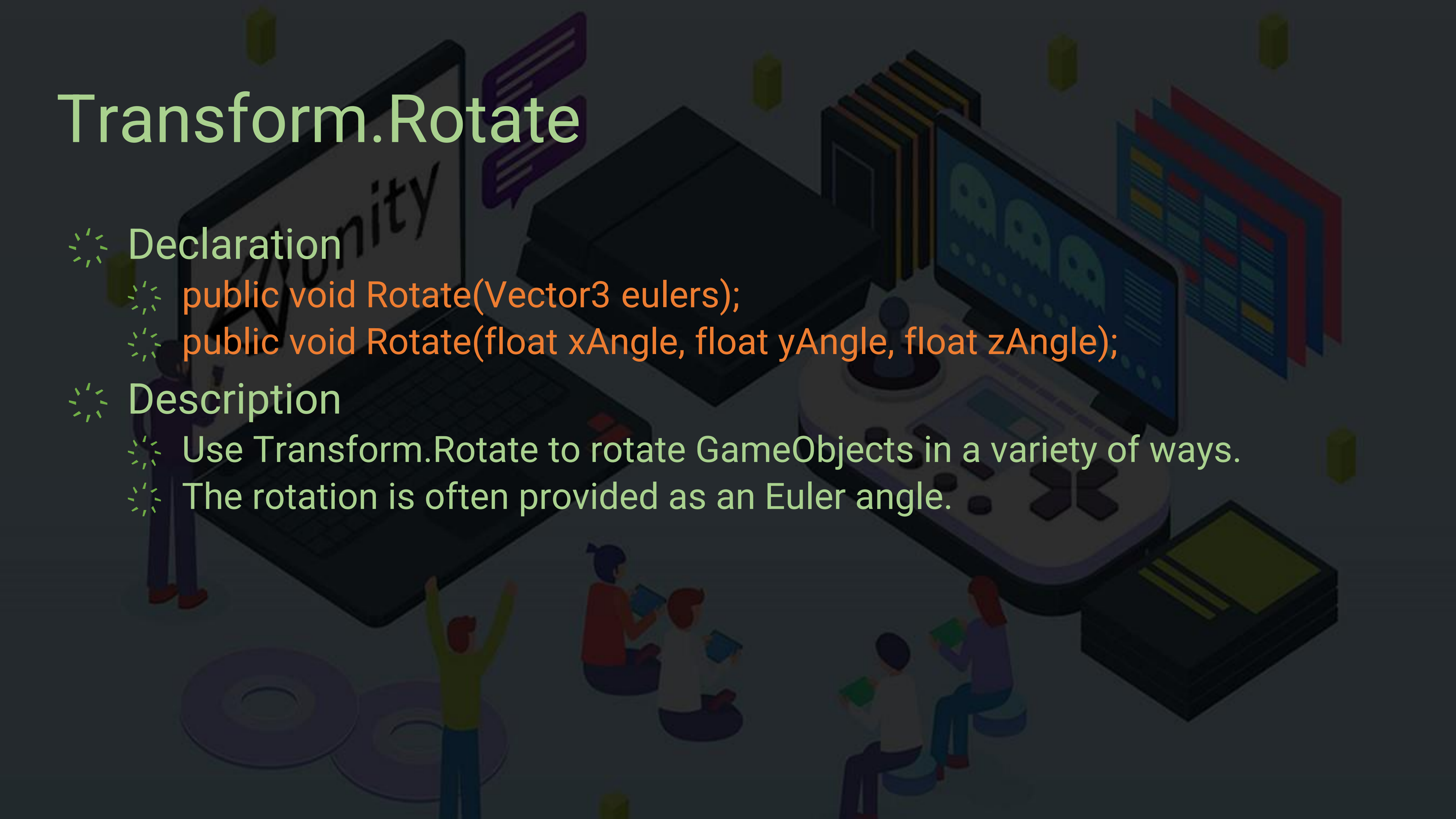
- Create a new C# script Dropper
- On every frame, print out to the console how much time has elapsed since the game started.
- HINT: Use Time.time within debug.log
- Add your script to the Box Game Object



Tutorial 18

- Update the C# script Dropper
- Use a variable for the time to wait that can be easily changed in the Inspector.
- Cache a reference of the Rigidbody.
  - Rigidbody rBody = GetComponent<Rigidbody>();
- Disable the gravity
  - rBody.useGravity = false;
- Enable the gravity if timeToWait has elapsed
  - rBody.useGravity = true;

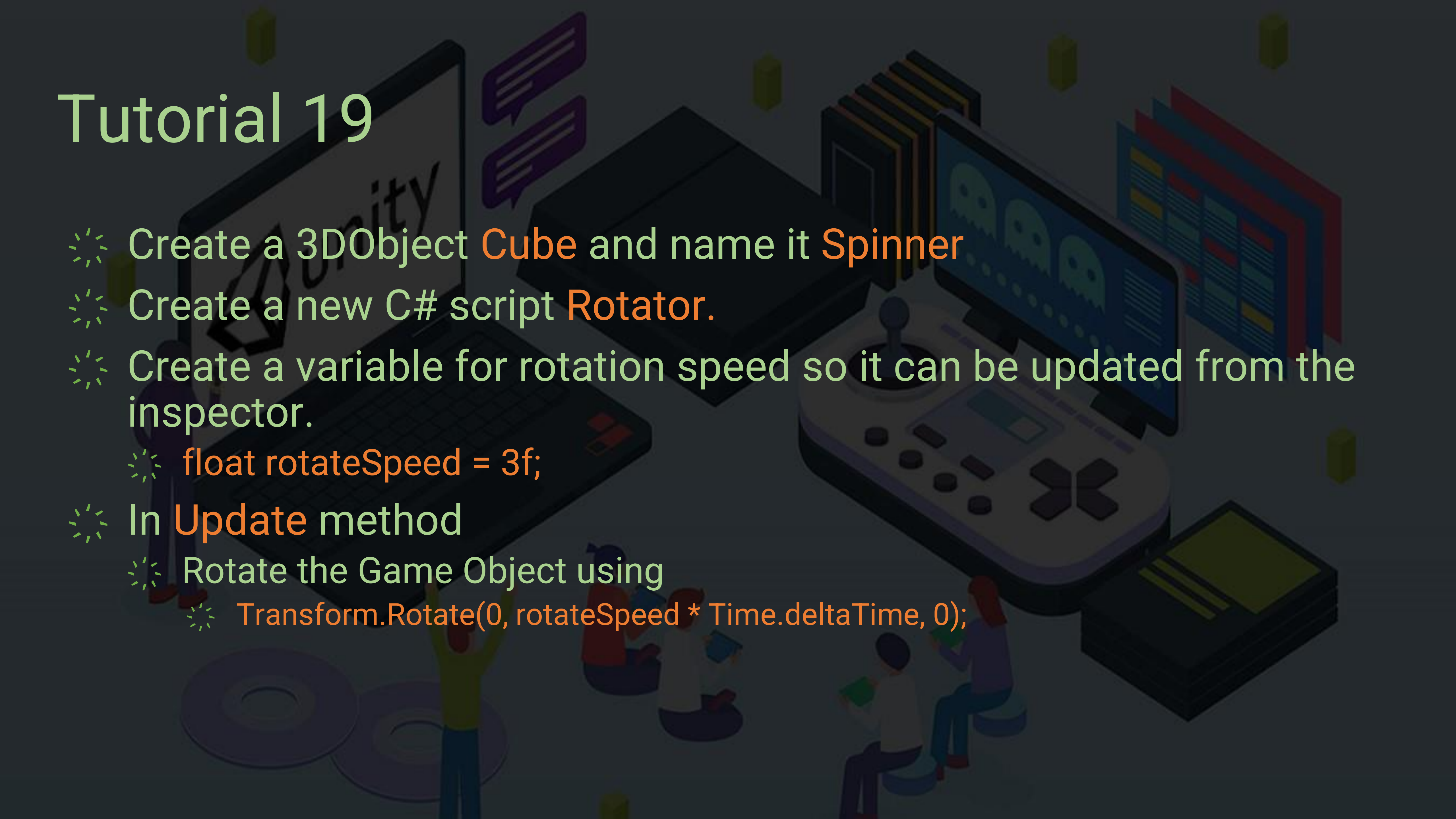
Rotate an Object



Transform.Rotate

- Declaration
  - `public void Rotate(Vector3 eulers);`
  - `public void Rotate(float xAngle, float yAngle, float zAngle);`
- Description
  - Use Transform.Rotate to rotate GameObjects in a variety of ways.
  - The rotation is often provided as an Euler angle.

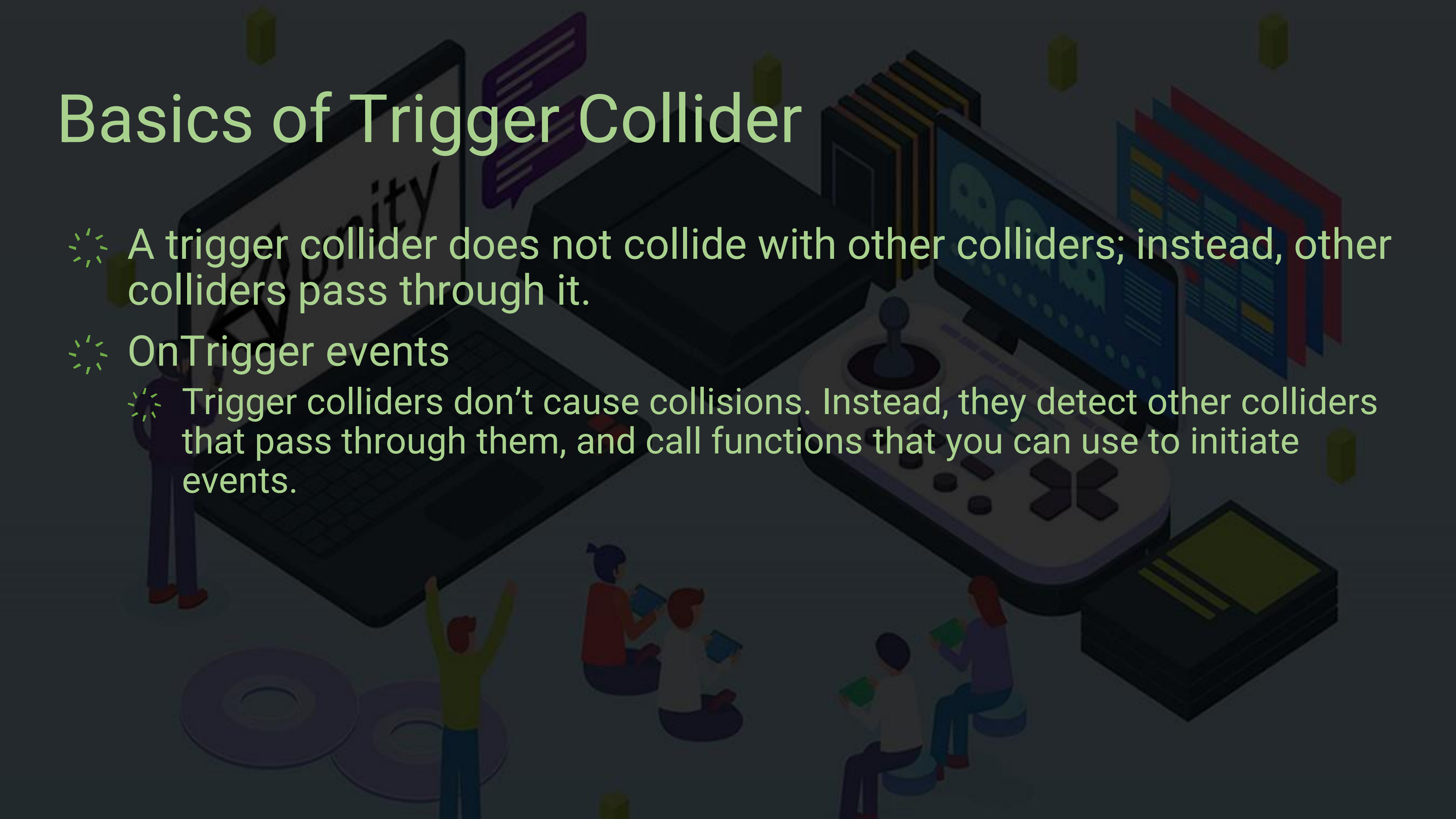
Tutorial 19



- Create a 3DObject Cube and name it Spinner
- Create a new C# script Rotator.
- Create a variable for rotation speed so it can be updated from the inspector.
  - float rotateSpeed = 3f;
- In Update method
  - Rotate the Game Object using
    - Transform.Rotate(0, rotateSpeed * Time.deltaTime, 0);

Trigger Collider

Basics of Trigger Collider



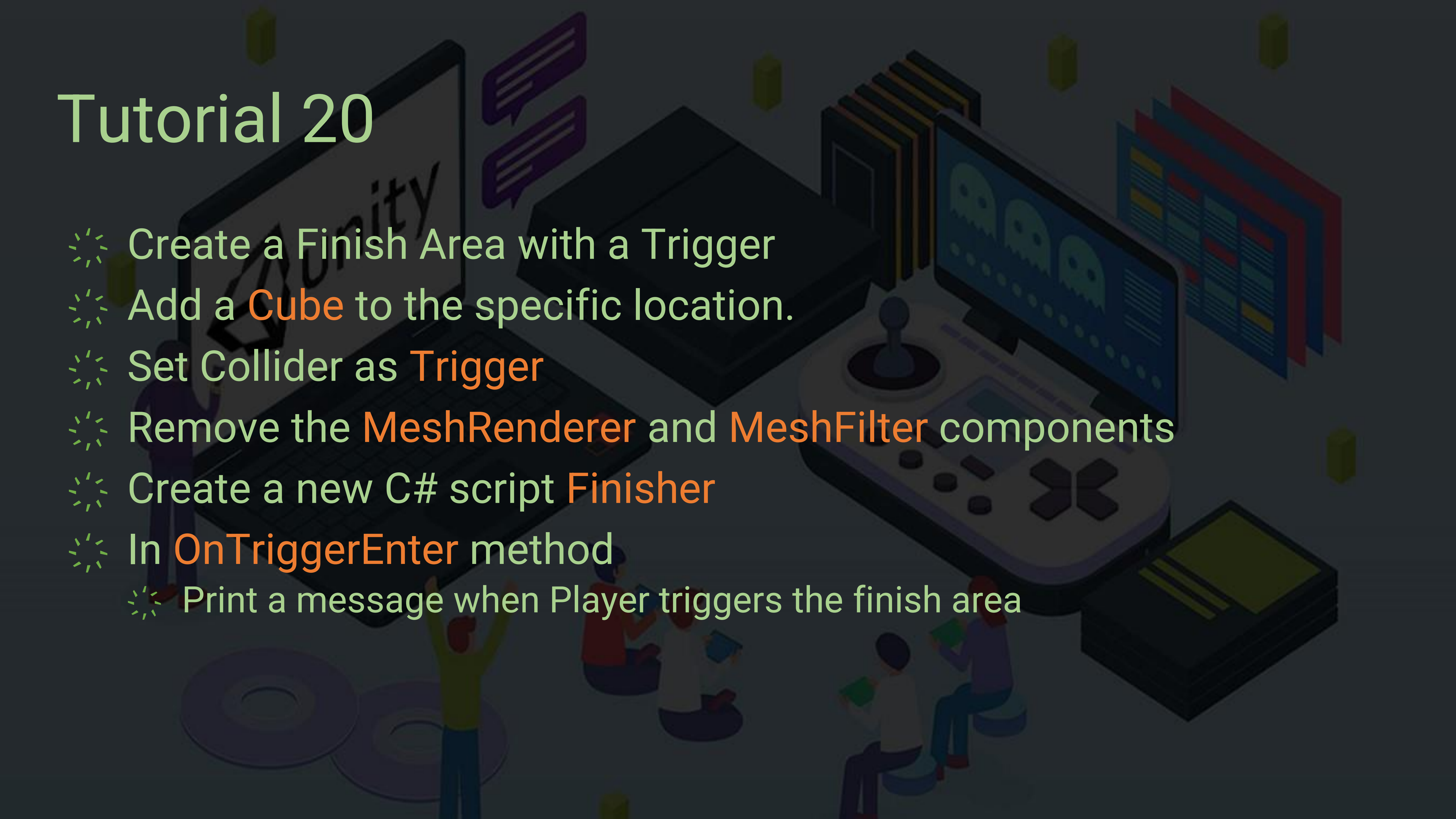
- A trigger collider does not collide with other colliders; instead, other colliders pass through it.
- OnTrigger events
  - Trigger colliders don’t cause collisions. Instead, they detect other colliders that pass through them, and call functions that you can use to initiate events.

Trigger Events

- Collider.OnTriggerEnter
  - Unity calls this function on a trigger collider when it first makes contact with another collider.
- Collider.OnTriggerStay
  - Unity calls this function on a trigger collider once per frame if it detects another Collider inside the trigger collider.
- Collider.OnTriggerExit
  - Unity calls this function on a trigger collider when it ceases contact with another collider.

Tutorial 20

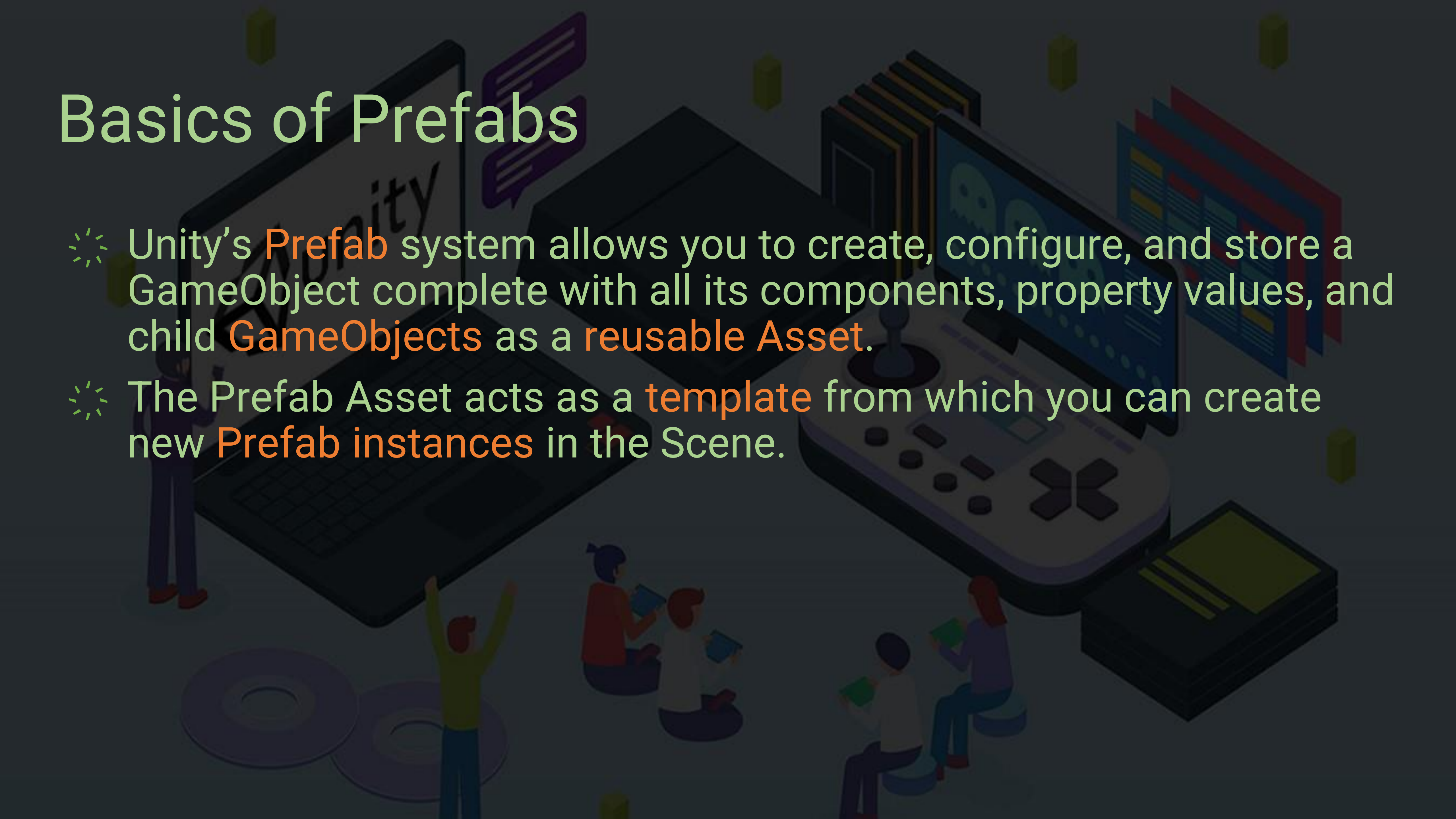
- Create a Finish Area with a Trigger
- Add a Cube to the specific location.
- Set Collider as Trigger
- Remove the MeshRenderer and MeshFilter components
- Create a new C# script Finisher
- In OnTriggerEnter method
  - Print a message when Player triggers the finish area



Prefabs

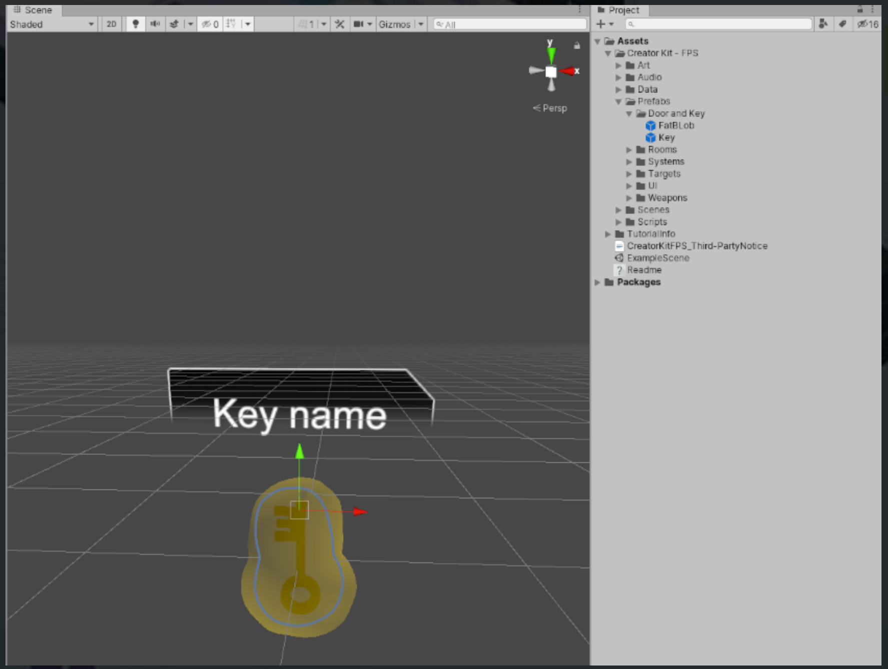
Basics of Prefabs

- Unity's Prefab system allows you to create, configure, and store a GameObject complete with all its components, property values, and child GameObjects as a reusable Asset.
- The Prefab Asset acts as a template from which you can create new Prefab instances in the Scene.



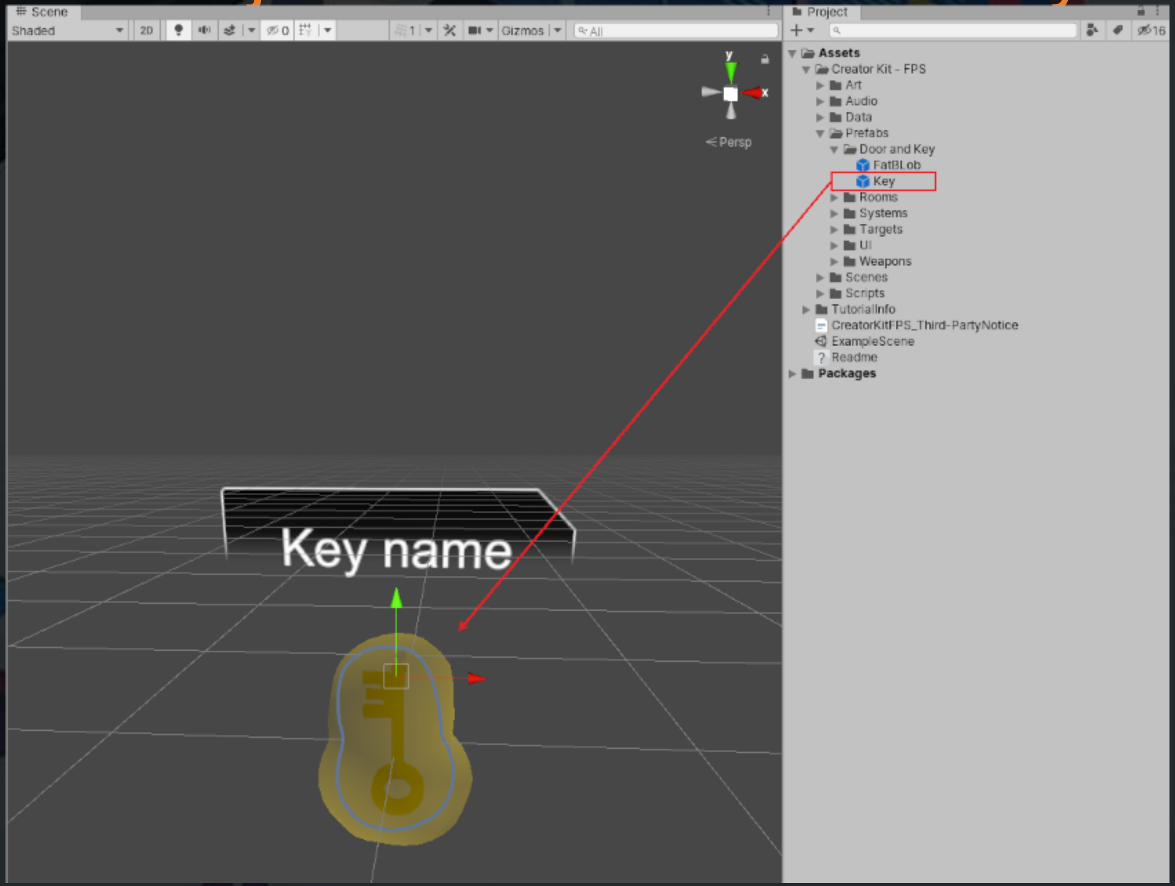
Create Prefab

- To create a Prefab Asset, drag a GameObject from the Hierarchy window into the Project window.
- Prefabs Assets in the Project window are shown with a thumbnail view of the GameObject, or the blue cube Prefab icon.



Create Prefab Instance

- You can create instances of the Prefab Asset in the Editor by dragging the Prefab Asset from the Project view to the Hierarchy or Scene view.

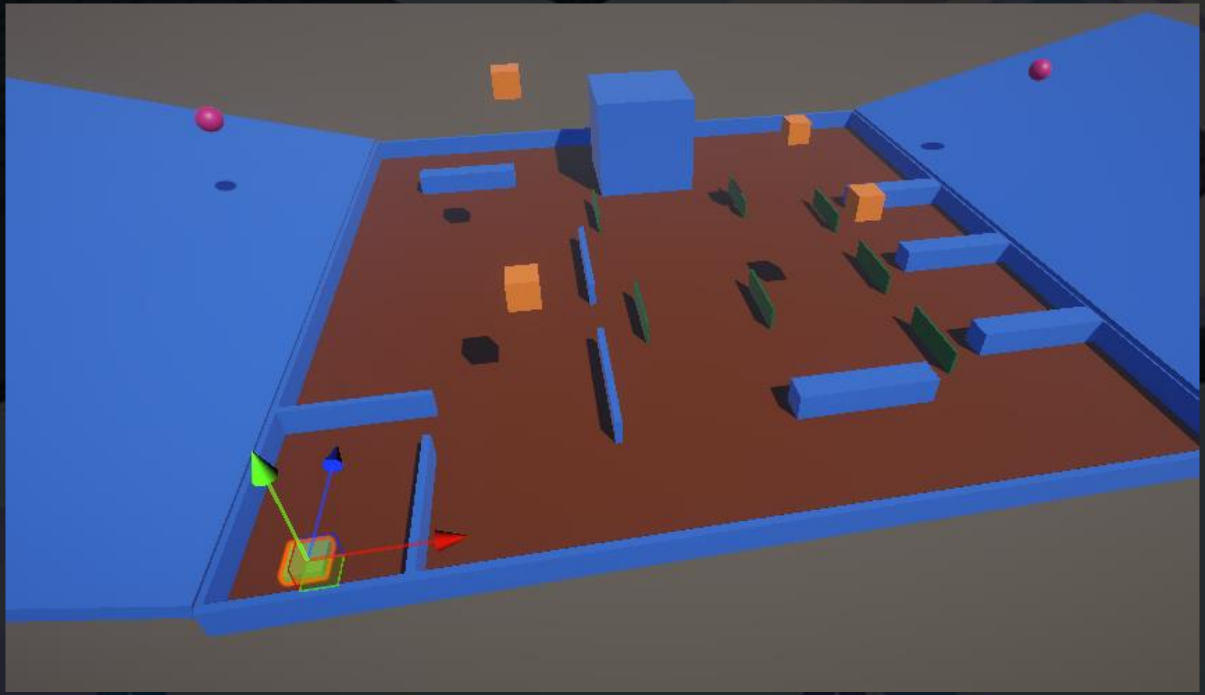


Tutorial 21

- Create Prefabs for the following GameObjects
  - Boxy (Player)
  - Wall
  - Dropper
  - Roller
  - Spinner

Final Tutorial

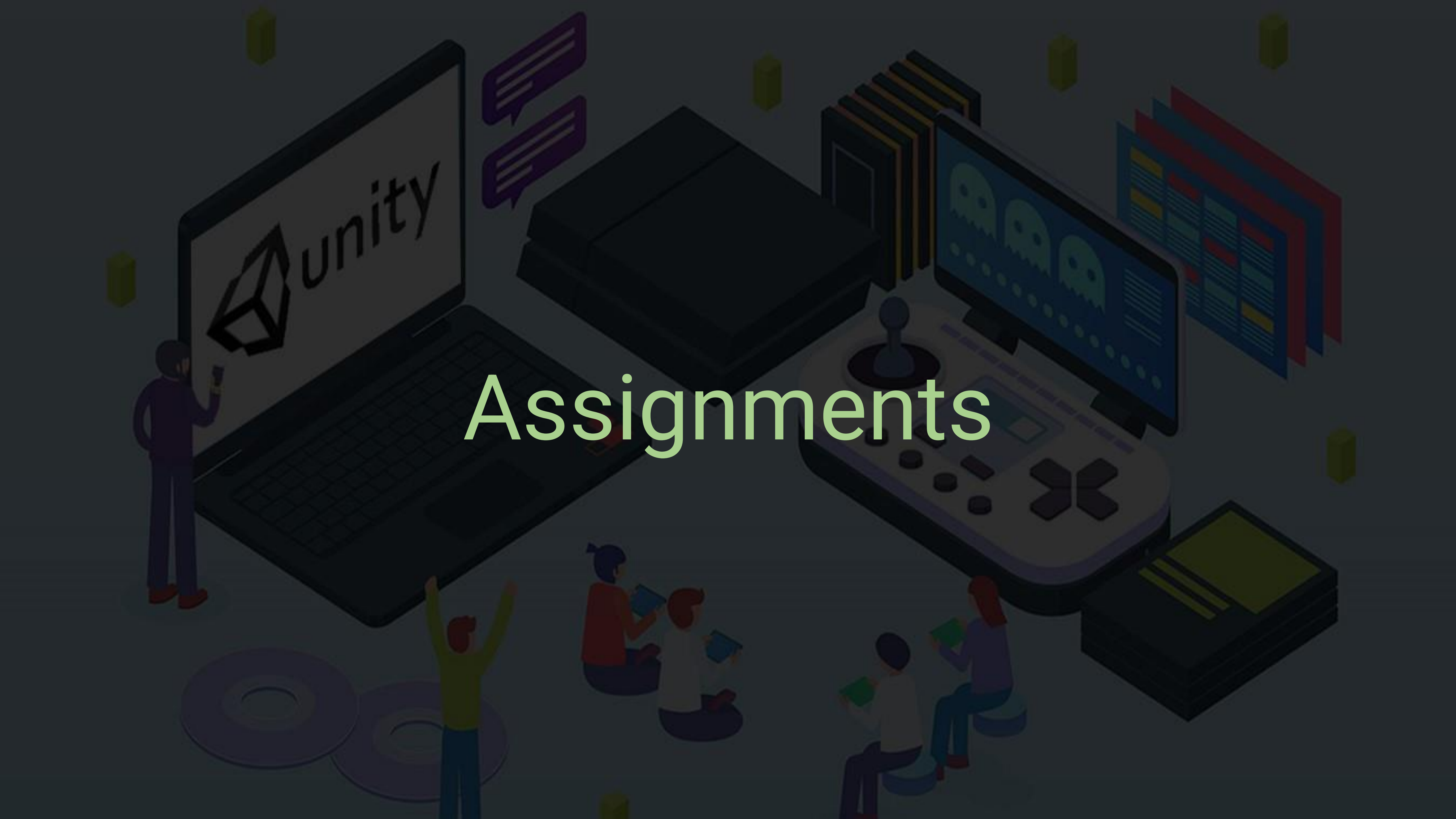
- Create a fun Arena that makes the player go from A to B.
- Use your droppers, rollers and spinners to create interesting moments for the player.



Destroy Objects

Object.Destroy

- Declaration
  - `public static void Destroy(Object obj, float t = 0.0F);`
- Description
  - Removes a GameObject, component or asset.
  - The object obj is destroyed immediately after the current Update loop, or t seconds from now if a time is specified.
  - If obj is a Component, this method removes the component from the GameObject and destroys it.
  - If obj is a GameObject, it destroys the GameObject, all its components and all transform children of the GameObject.
- Note: When destroying MonoBehaviour scripts, Unity calls OnDisable and OnDestroy before the script is removed.



Assignments

Lab Assignment

- Complete this tutorial
- Create a Finish Area
  - User Trigger Collider
- Take All the Balls to the Finish Area.
- Score is given when ball is in the finish area.

Assignment

- Complete this Tutorial
- Add Pickups at the arena that boosts the player when picked up.
  - HINT:
    - Use Trigger Collider
    - Destroy the pickups using Destroy() method.
- Add a Hit Text as a child GameObject of Boxy (Player) that floats above the player and displays the current hits
  - Use 3dObject -> Text - TextMeshPro