

CMSC 498W

Lecture 7

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Generating Virtual Worlds – II
Animation, Physics, Scripting

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Scripting

Unity Scripting Tutorials

<http://unity3d.com/learn/tutorials/topics/scripting>

Scripting

Supported languages

- C# (like Java)
- JavaScript (not like Java)
- Boo (like Python)

Scripting

- Scripts are attached to objects
- Scripts can access components on their object and on other objects
 - For example, access Rigid Body component and change physics properties
 - See GetComponent
- Scripts are Event Driven
 - Called when an event is triggered, run, and then return control to Unity

Scripting Events

- **Awake**
 - Called when object is created
- **Start**
 - Called when object is enabled

Scripting Events

- Update
 - Called every frame
 - `Time.deltaTime` gives time since last update
- FixedUpdate
 - Called at fixed time intervals of length `Time.fixedDeltaTime`

Scripting Events

- **OnCollisionEnter / OnTriggerEnter**
 - Object enters a collision/trigger region
- **OnCollisionStay / OnTriggerStay**
 - Object is within a collision/trigger region
- **OnCollisionLeave / OnTriggerLeave**
 - Object leaves a collision/trigger region

Scripting Events

- OnMouseDown / OnMouseUp / OnMouseEtc...
 - Triggered when a mouse button is clicked, released, etc. over an object
 - Useful for GUIs
- Many others

Scripting Coroutines

From Unity Coroutines Tutorial

```
using UnityEngine;
using System.Collections;

public class CoroutinesExample : MonoBehaviour
{
    public float smoothing = 1f;
    public Transform target;

    void Start ()
    {
        StartCoroutine(MyCoroutine(target));
    }

    IEnumerator MyCoroutine (Transform target)
    {
        while(Vector3.Distance(transform.position, target.position) > 0.05f)
        {
            transform.position = Vector3.Lerp(transform.position, target.position, smoothing * Time.deltaTime);

            yield return null;
        }
    }
}
```

Physics

Unity Physics Tutorials

<http://unity3d.com/learn/tutorials/topics/physics>

Physics Rigidbody

- Component for Unity physics
- Contain physical properties
 - Mass, Drag, Use Gravity, etc...
- Can be combined with Joints
 - Spring, Fixed, Hinge
 - Can be set to break

Physics Colliders

- React to other objects that have a Collider if one has a RigidBody
 - Normally cannot intersect
 - If Collider is a Trigger, objects pass through it
- Simple shapes
 - Sphere, Capsule, Cube
 - Can combine to form more complex shapes
- Generally have simpler geometry than meshes
- Have Material properties
 - Friction, Bounciness, etc.

Physics Optimizations

- Physics can be expensive
- RigidBody can be set to Kinematic
 - Motion is controlled directly, not by physics
 - Collisions still checked
 - Saves physics computations
- Objects can be set to Static
 - Do not move
 - Saves collision checks between Static objects

Physics Forces

- Scripts can apply forces to object
 - Can apply accelerations (gradual) or impulses (instantaneous)
 - For VR, may want to minimize accelerations of player...
- Forces can be linear or rotational (torque)

Physics Raycasting

Physics engine can collide a ray against objects

- Check line of sight
- Check what is hit by bullet
- Etc.

Other Physics

- Non-rigid-body physics
 - Hair
 - Cloth
 - Fluids (water, smoke...)
- Unity support
 - Built-in
 - External assets

Animation

Unity Animation Tutorials

<http://unity3d.com/learn/tutorials/topics/animation>

Animation

- Animations are assets, just like Models, Sounds, or Textures
- Can be time-consuming to create
- Recommend using existing, if possible

Animation

- Unity has a built-in animation program, the Animation View
- Create key-frames and Unity will transition between them
- Contains tools to create animation loops

Animation

- Colliders can be adjusted to match object shape during animation
- Scripts can get the current point in an animation
 - Play a sound
- Scripts can also alter the animation
 - Respond to user input or game events

Animation

- Different animations can be automatically blended
 - Idle -> Walk -> Run -> Jump
 - Mix in heavy breathing
- Blend Trees can blend multiple animations
 - different proportions based on various parameters