

3D Mobile Game Development Series

In this 10-session digital workshop series, participants will learn to create mobile gaming applications through a project-based approach. While utilizing Unity's 3D development tools, participants will develop a 3D scavenger hunt game in a collaborative learning environment consisting of Instructor-led Live Sessions, Instructor-guided Project Work and 1:1 Project Review Office Hours. By the end of this workshop, participants will have applied new skills for building user interfaces, animating figures, coding basic gameplay interactions, lighting, creating cutscenes, and publishing a build to create an Android-ready final project.

Learning Objectives

- Identify the features of Unity needed to create mobile games
- Identify the best methods to configure and maintain assets for high performance
- Identify best practices for writing C# in Unity
- Create optimized UIs for interactivity and playability
- Build animations in Unity
- Manage a project with multiple scenes
- Identify camera functionality, options, and configurability
- Implement appropriate lighting configurations
- Recognize and solve common optimization issues

Unit 1		Unit 2		Unit 3		Unit 4		Unit 5	
	Session 1 Introduction to 3D Mobile Game Development		Session 2 Building the Game Environment		Session 3 Coding the Game		Session 4 Creating Optimized User Interfaces		Session 5 3D Animation
	Activity 1 Project Setup and Asset Collection		Activity 2 + Office Hours Capstone Project Kickoff		Activity 3 Gameplay and Coding Challenge		Activity 4 + Office Hours Create User Interfaces		Activity 5 Animate the Game

Unit 6		Unit 7		Unit 8		Unit 9		Unit 10	
	Session 6 Managing Multiple Scenes		Session 7 Lighting 3D Scenes		Session 8 Cinematography and Cutscene Animation		Session 9 Optimizing and Publishing for Mobile Platforms		Session 10 Capstone Reviews
	Activity 6 + Office Hours Develop and Manage Scenes		Activity 7 Add Lighting to your Project		Activity 8 + Office Hours Cutscene Challenge		Activity 9 Complete Capstone Project		Activity 10 + Office Hours Capstone Project Review

Instructor-Led Live Session	Instructor-Assisted Project Work	Project work with Instructor Office Hours
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Table of Contents

[Session 1 - Introduction to 3D Mobile Game Development](#)

[Lesson 1: What Makes Mobile Games Different](#)

[Lesson 2: Get Started in Unity](#)

[Activity 1: Project Setup and Asset Collection](#)

[Self-Paced Activity](#)

[Session 2: Building the Game Environment](#)

[Lesson 1: Welcome to the Quiz Adventure](#)

[Lesson 2: Designing and Developing Game Objects](#)

[Activity 2: Capstone Project Kickoff](#)

[Office Hour Session](#)

[Session 3: Coding the Game](#)

[Lesson 1: Managing User Input](#)

[Lesson 2: Controlling NPC Behavior](#)

[Activity 3: Gameplay and Coding Challenge](#)

[Session 4: Creating User Interfaces](#)

[Lesson 1: World Space UI](#)

[Discussion](#)

[Lesson 2: Screen Space UI](#)

[Lesson 3: Create Transitions Between Levels](#)

[Activity 4: Create User Interfaces](#)

[Office Hour Session](#)

[Session 5: 3D Animation](#)

[Lesson 1: Organize Animation Objects](#)

[Lesson 2: Use the Animation Window](#)

[Activity 5: Animate the Game](#)

[Session 6: Managing Multiple Scenes](#)

[Lesson 1: Create Sub-Scenes](#)

[Lesson 2: Manage Sub-Scenes with Scriptable Objects](#)

[Activity 6: Develop and Manage Multiple Scenes](#)

[Office Hour Session](#)

[Session 7: Lighting 3D Scenes](#)

[Lesson 1: Lighting Types in Unity](#)

[Lesson 2: Baking Lightmaps](#)

[Activity 7: Add Lighting to your Project](#)

[Session 8: Cinematography and Cutscene Animation](#)

[Lesson 1: Configuring Cameras with Cinemachine](#)

[Lesson 2: Managing Animations with Timeline](#)

[Lesson 3: Creating a Keyframe Animation for Your Cutscene](#)

[Activity 8: Cutscene Challenge](#)

[Office Hour Session](#)

[Self-Paced Activity](#)

[Session 9: Optimizing and Publishing for Mobile Platforms](#)

[Lesson 1: Identifying Optimization Issues](#)

[Lesson 2: Publishing Your Project](#)

[Activity 9: Complete Capstone Project](#)

[Session 10: Capstone Reviews](#)

[Activity 10: Capstone Project Review](#)

[Office Hour Session](#)

Recommended Participant Prerequisites

- **Work confidently in the Unity Editor**
 - Suggested course: [John Lemon's Haunted Jaunt: 3D Beginner](#)
- **Write and apply basic C# scripts**
 - Suggested course: [Unity C# Survival Guide](#)

[Unity's Recommendations for Virtual Bootcamps](#)

Hardware Requirements

Laptop or Workstation with a mouse, that has the following requirements:

- OS: Windows 7 SP1+, 8, 10, 64-bit versions only; macOS 10.12+
- CPU: SSE2 instruction set support.
- GPU: Graphics card with DX10 (shader model 4.0) capabilities.
- An Android device and a USB cable to connect it to the computer.

Software Requirements

- Have **Unity Hub** and **Unity 2019.3.15f1** installed.
- Complete the Android environment setup [described here](#).

Session 1 - Introduction to 3D Mobile Game Development		120 minutes	Instructor Notes
Overview	In this session, you and the participants will: <ul style="list-style-type: none"> Get familiar with the entire workshop series Discuss the special requirements of games in a 3D mobile environment Get familiar with Unity 		Files needed to conduct this session: <ul style="list-style-type: none"> Design Brief Template 3DMobileGaming-Assets.zip 3DMobileGaming-Office Hours Signup
Outcome	When you're done, participants will have: <ul style="list-style-type: none"> Clear expectations about the course and what is to come. Familiarity with Unity basics 		
Objectives	By the end of this session, participants will be able to: <ul style="list-style-type: none"> Become familiar with the webinar format and the goals for this series Become [re]familiarized with the Unity editor Identify key features of Unity needed to create mobile games 		
Welcome Activity	Chat prompt: What's your favourite 3D mobile game?	~	Complete this activity while waiting for participants to join the session
Introduction	<p>Follow the slides for:</p> <ul style="list-style-type: none"> Introductions Outline of the series Goals for the series Today's agenda Today's objectives Ground rules <p>Webinar Format</p> <ul style="list-style-type: none"> Webinar tools <ul style="list-style-type: none"> Q&A vs Chat Live Session - Learn, Demo, and Do <ul style="list-style-type: none"> Learn - Instructor goes through slides and explains concepts Challenge - Follow the instructor's steps in your own project Activity Sessions - Work to accomplish challenges in your project during the allocated time slots. Instructor Office Hours - Sign up for time slots for 1:1 project review time Capstone Project 	15 min	<p>Introduce yourself, and have participants introduce each other in any way you like.</p> <p>Ground rules include instructions on how to ask questions and use the conference technology. Add your customized information to the existing slide deck.</p>

Lesson 1: What Makes Mobile Games Different		40 min	
Discussion 1.1	<p>The current state of mobile gaming and technology</p> <ul style="list-style-type: none"> • Examples of successful mobile games • iOS vs Android <ul style="list-style-type: none"> ◦ Use Cases and Hardware examples • Poll/Chat: <ul style="list-style-type: none"> ◦ What type of mobile devices do you use? ◦ What platform do you prefer and why? <p>Core game design principles</p> <ul style="list-style-type: none"> • Game objectives - what are the objectives of the game, are they clear? • Reward/incentive - why will users play your game? • Usability - how intuitive/enjoyable/straightforward will it be for users? • Visual fidelity - trade-off for hardware constrained devices. Optimized assets and a simpler approach to fidelity are good practices to follow. • Success criteria - how will you assess the success of a game? • Scalability - can your game grow? • Unique selling point? What distinguishes your game from others? 	15 min	
Challenge 1.1	<p>Think of a simple novel mobile game that you might like to develop in the future. Fill in the game design brief document and consider the aspects of your game that would relate to the core principles introduced.</p> <p>Discussion: Select some participants to present their briefs.</p>	25 min	<p>Provide some thought provoking ideas throughout this challenge. Consider a wide range of games and their use cases from the simple and successful to the unique and weird to the complex and challenging. Give your own ideas and find ones that are relatable.</p> <p>Give positive feedback - this exercise is to encourage their ideas and isn't a test on how well they relate back to the principles. If time allows, ask for peer-feedback.</p>
Lesson 2: Get Started in Unity		60 min	
Demo 2.1	Get Started	20 min	Assess and reinforce the participants' existing

	<ul style="list-style-type: none"> • Use the Unity Hub to open and create a new 3D project. <ul style="list-style-type: none"> ◦ Explain Unity Hub templates. • Introduce/review as needed: <ul style="list-style-type: none"> ◦ Unity windows ◦ Creating primitives ◦ Navigating in the editor <ul style="list-style-type: none"> ■ Alt+mouse controls to navigate ■ F for Focus ◦ Manipulating objects <ul style="list-style-type: none"> ■ QWERTY keys/tools ■ XYZ ■ Transform in the Inspector ◦ Objects in Hierarchy and Project windows 		<p>Unity knowledge. If they are already familiar with Unity, they can use this time to practice or explore. Or, skip some steps and get them engaged quickly.</p> <p>If participants have various levels of Unity experience, try pairing up experienced and inexperienced participants in breakout rooms and allow those with experience to mentor others.</p> <p>Check to see if participants have 2019.3.15f1 or higher installed. If not, strongly recommend that they install it before the next session. A tutorial is provided (see “Self-Paced Activity” below).</p>
Challenge 2.1	Creating a Scene <ul style="list-style-type: none"> • Use the Unity Hub to open and create a new 3D project. • Add primitives such as cubes and spheres to your scene. • Organize your primitives in the Hierarchy and Project windows. 	10 min	
Demo 2.2	Demonstrate how objects and the ground can go through each other. Add simple colliders and apply gravity. Stack objects.	10 min	
Challenge 2.2	Working with Objects in Unity Build a model of a snowman or other character using primitives with colliders and gravity.	10 min	If participants enjoy getting creative with this exercise, ask them to share their creations.
Demo 2.3	Setting up a project for mobile development in Unity <ul style="list-style-type: none"> • Asset store for free/paid for content • Project settings 	10 min	
	Review and Transition	5 min	
Activity 1: Project Setup and Asset Collection		60 minutes	Instructor Notes
	Fill out Office Hours Availability for Session 2. Explore Unity <ul style="list-style-type: none"> • Create a new 3D project for mobile via the Unity Hub. 	60 min	This activity is to get learners familiar with the Asset Store and to start exploring working with assets in Scenes, navigating 3D space, and

- Explore the Asset Store and populate the project with free assets that could be used for the game you designed.
- Create a mock-up scene with content that visually represents your idea(s).
- Take a screenshot and share it with the group.

rapid prototyping in the Editor. How far they take this exercise will give you a good sense of their abilities.

Check in with participants periodically to see how they are doing.

Self-Paced Activity	60 minutes	Instructor Notes
<p>Install the Unity Version: Before the next session, be sure to install Unity version <u>2019.3.15f1</u> on the computer you will use in this course.</p> <p>Download Project: Before the next session, download the project file <u>3DMobileGaming-Assets.zip</u> and unzip it.</p>	60 min	It is important the participants install Unity and the project before the next session, so that valuable session time will not be wasted and participants will not get behind.

Session 2: Building the Game Environment		120 minutes	Instructor Notes
Overview	In this session, you and the participants will learn what they need to know about the prototype project in order to build their own town environment.		Files needed to conduct this session: <ul style="list-style-type: none"> 3DMobileGaming-Assets.zip RockExample.unitypackage 3DMobileGaming-Office Hours Signup
Outcome	When you're done, participants will have: <ul style="list-style-type: none"> A "starter" environment in which they will be able to build and customize a 3C mobile game. Familiarity with the constraints and possibilities of the environment. 		
Objectives	By the end of this session, participants will be able to: <ul style="list-style-type: none"> Use and customize the Quiz Adventure/Simple Town project effectively Add Points of Interest to customize the prototype game Plan character navigation by creating a NavMesh Import additional assets into the project Add visual realism by applying Materials to objects Organize and reuse their assets using Prefabs and Nested Prefabs 		
Welcome Activity	Chat prompt: What is your favourite environment in a 3D mobile game?	~	
Introduction	Follow the slides for: <ul style="list-style-type: none"> Welcome and Introduction Today's agenda Today's objectives Ground rules Assignment Check on Activity 1 	10 min	Ground rules include instructions on how to ask questions and use the conference technology. Add your customized information to the existing slide deck.
Lesson 1: Welcome to the Quiz Adventure		55 min	
Demo 1.1	Demonstrate the Quiz Adventure Project <ul style="list-style-type: none"> Important: Temporarily rename Assets\QuizAdventure\Scripts\InputManager.cs.DEMO to InputManager.cs. Demonstrate Assets\QuizAdventure\Scenes\Level1Final or Level2Final. Explain that this is a pre-built 3D environment with a game set up to get them started quickly. In this workshop, participants will build their own version of this game from scratch using the provided assets and customizing it along the way. Demonstrate how the existing game is played, specifically: 	5 min	In this particular game, Points of Interest are the objects the player tries to find and collect information about.

	<ul style="list-style-type: none"> ○ Basic gameplay: the player discovers information about certain places, which we call <i>Points of Interest</i> in this game. ○ The ways and places that characters move in the town: introduce concepts of Colliders, NavMesh, and Navigation Static. ○ The way a building will fade out if the player character goes behind it; introduce concepts of Layers and Raycasting. <p>Open the Starter Scene</p> <ul style="list-style-type: none"> ● Open the start scene in <i>Assets/GamingWorkshop/Scenes/Activity1Start</i>. ● Explain that this is the “empty” town with some pre-configured features where they will build their own environment and game. 		
Challenge 1.1	<p>Open the Starter Scene</p> <ul style="list-style-type: none"> ● Open the starter Scene: <i>Assets/GamingWorkshop/Scenes/Activity1Start</i>. ● Create an Empty Object named <i>Environment</i>. 		<p>The <i>Activity1Start</i> Scene contains a set-up Camera system, an Event System, the <i>Player</i>, and a Directional light.</p> <p>TIP: Use Empty Objects to group other GameObjects and keep your project organized.</p>
Demo 1.2	<p>Explain that the first things they will learn are some basics of working in this particular project that will jump-start their development.</p> <p>Creating the Walkable Ground</p> <ul style="list-style-type: none"> ● Demonstrate using empty GameObjects to keep the project organized. ● Explain how the Layer <i>EnvironmentWalkable</i> works. ● Add a Box Collider. ● Set the dirt tile to Static, and explain how that makes the tile walkable. ● Explain how to make duplicate tiles. 	5 min	<p>The <i>EnvironmentWalkable</i> layer is used to let the <i>OnClickDown</i> (triggered from the <i>InputManager</i>) know what surfaces the <i>Player</i> can click-to-move upon. E.g., you would not put the water meshes on this layer.</p> <p>The script <i>PlayerAvatarController</i> enables the player to click on the tile, and the <i>Player</i> character will walk to that point on Static tiles.</p>
Challenge 1.2	<p>Create the Ground for Your Town</p> <ul style="list-style-type: none"> ● Drag a dirt tile from the Project Window at <i>Assets/SimpleWorldVol1/SimpleMilitary/Optimized/Prefabs/Environment/SM_Env_Tile_Dirt_01</i> into <i>Environment</i>. ● Set the Layer to <i>EnvironmentWalkable</i>. ● Add a Box Collider. ● Set the dirt tile to Static. 	5 min	<p>TIP: You can hold V on the keyboard before you move the object to select a vertex on the mesh; then use that point to snap to another mesh to easily create a ground with no gaps..</p> <p>NOTE: Because there is a lot going on here, if participants are learning lots of new concepts</p>

	<ul style="list-style-type: none"> Now duplicate this dirt tile several times and create a larger play area. 		at once, review or quiz them on the purposes of the empty GameObject, Layer, Collider, and Static setting.
Demo 1.3	Adding Buildings <ul style="list-style-type: none"> Drag the <i>Donut Shop</i> from <i>Assets/SimpleWorldVol1/SimpleBuildings/Prefabs/donut_shop</i> into your <i>Environment</i> object, and place it to face the camera. Mark it Static. Explain the purpose of the <i>EnvironmentIgnoreRaycast</i> Layer. Add Box Colliders to the building and sign. 	5 min	TIP: The <i>EnvironmentIgnoreRaycast</i> Layer is used in the <i>FadeCameraObstructions</i> script, which casts a ray from the Main Camera to the Player. Any objects with Colliders obstructing the view of the Player on this layer will be faded out.
Challenge 1.3	Add a Building to the Town <ul style="list-style-type: none"> Drag a building from <i>Assets/SimpleWorldVol1/SimpleBuildings/Prefabs</i> into your <i>Environment</i> object. (We'll cover Prefabs soon.) Rotate and position the building to face the camera. Mark the <i>Donut Shop</i> as Static. Set it to the <i>EnvironmentIgnoreRaycast</i> Layer. Add a Box Collider to the building and resize it; add a separate collider for the sign. 	5 min	TIP: The <i>EnvironmentIgnoreRaycast</i> Layer is used by a script that causes the building to fade if they block the view of the Player. TIP: Add a Collider to the sign so that the raycasting will "see" it.
Demo 1.4	Creating a Point of Interest <ul style="list-style-type: none"> Create the <i>POIs</i> empty object. Explain why the POI is a different object from the building itself. Drag the <i>POIObject Prefab</i> to the <i>POIs</i> object in the Hierarchy. Name this <i>POIObject</i> "<i>DonutStore_POI</i>" and move it in front of the door to the <i>Donut Store</i> object in the scene. In the <i>Point of Interest</i> script, fill in the variables with your own flavour text. (See example in Detailed Instructions.) You can leave the POI Canvas and Time To Pause alone. 	5 min	In this particular game, Points of Interest are the objects the player tries to find and collect information about.
Challenge 1.4	Create a Point of Interest for this Game <ul style="list-style-type: none"> Create the <i>POIs</i> empty object and position it at 0, 0, 0. Place all POIs here in the future. Drag the <i>POIObject</i> from <i>Assets/QuizAdventure/Prefabs/POIObject</i> to the <i>POIs</i> object in the Hierarchy. Name your POI and position it where you want to trigger it. Add flavor text by filling in the variables in the Inspector. [Sample values appear on slide.] Leave POI Canvas and Time To Pause alone. 	5 min	TIP: Place POIs at the front door of a building or other location where you want the Player to trigger the user interface. TIP: The large rectangle above the POI's shimmering star is its user interface. We will cover UIs in Session 4.

Demo 1.5	Creating the NavMesh <ul style="list-style-type: none"> Explain what a NavMesh is and why it is “baked” into the Scene. In Navigation window, change settings for dirt tiles and buildings: <ul style="list-style-type: none"> Explain how unchecking Generate OffMeshLinks will save time when baking the NavMesh. Demonstrate making the ground <i>Walkable</i> and the buildings <i>Not Walkable</i>. Bake. 	5 min	If you play the level you will notice you cannot click to move. This is because we have not yet made the <i>InputManager</i> . We will be doing that in a later lesson. Meanwhile, you can select the Player in the Hierarchy and manually move it in the scene. Notice when you collide with the POI, a UI will pop up. If you move the player behind the building it will fade out and fade back in after you move out from behind it.
Challenge 1.5	Designate Walkable Areas with a NavMesh <ul style="list-style-type: none"> In Window>AI>Navigation, Object tab, select dirt tiles and: <ul style="list-style-type: none"> Uncheck Generate OffMeshLinks Set Navigation Area to <i>Walkable</i>. Select your building(s) and: <ul style="list-style-type: none"> Uncheck Generate OffMeshLinks Set Navigation Area to <u>Not</u> <i>Walkable</i>. Select the Bake tab in the Navigation Window, leave the settings at default and click Bake. <p>When Baking is complete, go to <i>File>Save As...</i> and save your Scene in the folder <i>Assets\GamingWorkshop\Scenes</i> with a new name such as <i>CAPSTONE</i>. Build your Capstone Project in this Scene.</p> <p>Select the Player and move it in the Scene.</p> <ul style="list-style-type: none"> Bump into buildings. Move it to your POI. Move it behind a building. <p>In the next session, you will move the player with game controls.</p>	10 min	
Lesson 2: Designing and Developing Game Objects		50 min	
Demo 2.1	Introduce the lesson by explaining that now that they know how Quiz Adventure is built, they'll introduce additional game objects and effects to add interest to the Scene. Using	5 min	Encourage participants to start thinking about how they will build their own town for their Capstone Project.

	<p>Prefabs, they will be able to manage many objects and keep a consistent look as they experiment with their project.</p> <p>Importing Assets</p> <ul style="list-style-type: none"> • Open a new empty Scene. • Import <i>RockExample.unitypackage</i>. 		
Challenge 2.1	<p>Import Rocks</p> <ul style="list-style-type: none"> • Open a new Scene. • Go to <i>Assets>Import Package>CustomPackage</i>. • Navigate to the location you downloaded the provided <i>RockExample.unitypackage</i> file and press Open. • In the pop-up, make sure all the fields have a checkmark. • Click Import. 	5 min	
Demo 2.2	<p>Graphics Overview: How Rendering Works</p> <ul style="list-style-type: none"> • Provide a high-level overview of Scriptable Render Pipelines in general. Explain that this project uses the Universal Render Pipeline. • Explain the definitions of Materials, Shaders, and Textures on the slide. <p>Creating a URP Material</p> <ul style="list-style-type: none"> • Explain that this project uses the Universal Render Pipeline and a Shader called <i>Simple Lit</i>, which is not photorealistic but more efficient for mobile games. • Demonstrate creating the Material and changing the Shader. 	10 min	
Challenge 2.2	<p>Create a Rock Material</p> <ul style="list-style-type: none"> • In the <i>Rocks</i> folder, create a folder called <i>Materials</i>. • In the <i>Materials</i> folder, create a new Material and call it <i>Rock_MAT</i>. • With the <i>Rock_MAT</i> selected, change the Shader in the Inspector from <i>Universal Render Pipeline/Lit</i> to <i>Universal Render Pipeline/Simple Lit</i> • Change the Color Field next to the Base Map to a shade of gray that you like. 	5 min	
Demo 2.3	<p>Introduction to Prefabs</p> <ul style="list-style-type: none"> • Explain Prefabs at a high level. • Demonstrate creating a Prefab of the rock formation, and explain the steps. 	5 min	
Challenge 2.3	<p>Create a Rock Prefab</p> <ul style="list-style-type: none"> • Create an Empty Object and name it <i>RockFormation</i>. Move it to 0,0,0. 	5 min	Participants now have a rock formation prefab that they can place throughout their Scene.

	<ul style="list-style-type: none"> • Drag several rocks from the <i>Rocks</i> folder into the <i>RockFormation</i> object. • Select all of the rocks in the Hierarchy, then open the Materials section under Mesh Renderer in the Inspector. • Set the Element 0 to your <i>Rock_MAT</i>. • Create a folder in your <i>Rocks</i> folder called <i>Prefabs</i>. • Drag the <i>RockFormation</i> object from the Hierarchy to the <i>Rocks/Prefabs</i> folder in the Project Window. 		Explain that changes to the Prefab will affect all objects made from it. Encourage them to start thinking about ways they could use Prefabs in their Capstone Project.
Demo 2.4	Creating a Nested Prefab <ul style="list-style-type: none"> • Explain what Nested Prefabs are and how they are used. • In a new Scene, create Nested Prefabs using provided Prefabs from the project assets. (See Detailed Instructions for an example.) 	5 min	If participants are confident, demonstrate a different Nested Prefab than the one documented so that they will be working on something new. Or, let them choose which assets to use.
Challenge 2.4-5	Create a Building Prototype with Nested Prefabs <ul style="list-style-type: none"> • In a new Scene, create an Empty Object at 0,0,0 and name it <i>Building</i>. • From <i>SimpleWorldVol1/SimpleBuildings/Prefabs</i>, drag a building into <i>Building</i>. • Explore <i>SimpleBuildings/Prefabs</i> and <i>SimpleProps/Prefabs</i> to decorate your building with such items as a table and chairs, a sign, or a mailbox. Add all objects to <i>Building</i>. • To create a Prefab of Nested Prefabs, drag the <i>Building</i> object from the Hierarchy to the <i>Rocks/Prefabs</i> folder in the Project Window. Save Time with Prefabs <ul style="list-style-type: none"> • Drag the Prefab you just made into your Scene to create a copy. Position the second building in your Scene. • Navigate to any of the Prefabs used in your Nested Prefab and double-click to enter Prefab Mode. Make a change the Prefab, such as Rotation, Scale, or Material, and observe the changes in your Scene. • To close and save, click the arrow (>) at the top-left of the Hierarchy. 	10 min	Remind participants that once they have made the new Nested Prefab, they will be able to use it multiple times in any Scene and save a lot of development time. Now they are ready to build their own town!
	Review and Transition	5 min	
Activity 2: Capstone Project Kickoff		60 minutes	Instructor Notes
Activity Session	Build your Own Town <ul style="list-style-type: none"> • You can use any of the Prefabs in the <i>SimpleWorldVol 1</i> folder to populate your world. 	60 min	

	<ul style="list-style-type: none"> • Try making streets with the provided road prefabs. • Remember to mark those prefabs you will be walking on as Static, add it to the <i>EnvironmentWalkable</i> layer and add a Box Collider. • Add some more buildings but make sure you have plenty of room between them if you want the player and NPCs to be able to navigate between them! <p>Plan Your Capstone Project</p> <ul style="list-style-type: none"> • Start planning a Capstone Project that you can complete during this course. • You will be using the Simple Town assets in the Quizmaster Adventure game provided. You may add other assets as desired. • You can use the idea you started developing in Activity 1, or start a new idea. 		
Office Hour Session		15 min	
	<p>Review and answer questions about today's session. Make sure they feel confident building the environment for the game on their own.</p> <p>Discuss ideas for their Capstone Project. Help ensure that their idea is practical for development during the time span of the course.</p>		Share the workload of Office Hours and Activity questions with TAs.

Session 3: Coding the Game		120 minutes	Instructor Notes
Overview	In this session, you and the participants will: <ul style="list-style-type: none"> Create the input manager script that will allow user interaction. Explore ways to add and change behaviors (AI) of NPCs. 		Files: <ul style="list-style-type: none"> Refer to <i>InputManager_Reference.doc</i> in the course materials, or <i>Assets\QuizAdventure\Scripts\InputManager.cs.DEMO</i> in the project, for the completed script.
Outcome	When you're done, participants will have: <ul style="list-style-type: none"> A Capstone Project prototype with animated AI.. 		
Objectives	By the end of this session, participants will be able to: <ul style="list-style-type: none"> Determine proper use of various Unity methods. Identify common methods and terms used in C#. Enable user interaction in a game through coding. Add and change the states and behaviors of NPCs using coding and the Animator. 		
Welcome Activity	Chat prompt: What experience do you have with coding?	~	Complete this activity while waiting for participants to join the session
Introduction	Follow the slides for: <ul style="list-style-type: none"> Welcome and Introduction Today's agenda Today's objectives Ground rules 	5 min	Ground rules include instructions on how to ask questions and use the conference technology. Add your customized information to the existing slide deck.
Lesson 1: Managing User Input		65 min	
Demo 1.1	Getting Started <ul style="list-style-type: none"> Have participants work in their Capstone Scene. Guide them to make a backup before starting. Create the "InputManager" Script <ul style="list-style-type: none"> In the <i>Assets/QuizAdventure/Scripts</i> folder, create a new C# script and name it <i>InputManager</i>. You will also see a file called <i>InputManager.cs.DEMO</i> in that folder. That is a premade copy of the script in case you need it. Double click your new <i>InputManager</i> script to open it in your IDE. 	5 min	Explain that rather than copy and paste pre-written code, you are walking through the process so that they can manipulate this code later in their Capstone Project. Note: Actual code snippets are provided on the slides and in the Detailed Instructor Notes.
Challenge 1.1	Open a new script in your development environment:	5 min	

	<ul style="list-style-type: none"> • In the <i>Assets/QuizAdventure/Scripts</i> folder, create a new C# script and name it <i>InputManager</i>. • Double click your new <i>InputManager</i> script to open it in your IDE. 		
Demo 1.2 (3 slides)	<p>Discuss and define Events and Handlers.</p> <p>At the top of the script add:</p> <pre>using System;</pre> <p>Add an Event and Handler for when user clicks the mouse or taps the screen.</p> <p>Add an Event and Handler for when user clicks the Home icon or presses ESC:</p> <pre>public delegate void EscHandler(object source, EventArgs args); public event EscHandler EscEvent;</pre> <p>Create a bool variable that will track if the player can move.</p> <ul style="list-style-type: none"> • Use the <i>HideInInspector</i> so it cannot be changed in the Editor by accident; we can still use a public variable in our scripts. <p>Create an Awake method that will set our <code>bCanPlayerMove = true</code> so the user can start the game being able to click to move:</p> <p>Explain when and how this code runs.</p>	15 min	<p>As you go, point out which names are built-in and which you are defining in the code. E.g., <code>Input.GetKeyDown</code> is built-in and <code>OnEscPressed</code> is a routine you are creating.</p> <p>Encourage participants to add comments to document their code.</p>
Challenge 1.2	Instruct participants to add the code above to their own projects.		
Demo 1.3	<p>Test for Mouse and Keyboard Input</p> <p>In the Update method, create two conditionals. The first one will test if the mouse button is clicked or a screen touch has been counted.</p> <p>The second will test if the ESC key was pressed. (You will use ESC when testing the game in the Unity Editor.)</p> <p>Explain when and how this code runs.</p>	15 min	
Challenge 1.3	Instruct participants to add the code above to their own projects.		

Demo 1.4	Test for GUI Input Create a method to detect whether ESC GUI button has been pressed. Explain when and how this code runs.	5 min	
Challenge 1.4	Instruct participants to add the code above to their own projects.		
Demo 1.5	Create Event Handlers Create the body of the <code>OnEscPressed</code> Event that will be called when the player presses the Esc key or ESC in the UI. Create the body of the <code>OnClickDown</code> Event that will be called when the user clicks the mouse or taps the screen. Explain when and how this code runs.	10 min	
Challenge 1.5	Instruct participants to add the code above to their own projects. The code for managing input is complete. Answer any questions.		
Demo 1.6	Place the Script in the Project <ul style="list-style-type: none"> • Open your Capstone project scene. • Create an Empty Object, name it <i>InputManagerObj</i> and place it at 0,0,0. • Add your new <i>InputManager</i> script to it. 	10 min	
Challenge 1.6	Instruct participants to place the script in the project. Now they can test the level. When they click on the ground, the player will walk to that location! Talk through what happens in the code whenever they click the ground.		
Lesson 2: Controlling NPC Behavior		45 min	
Lecture/ Demo	Demonstrate the following existing code that controls the NPC: <ul style="list-style-type: none"> • Open the <i>NPCAvatarController</i> script at <i>Assets/QuizAdventure/Scripts/NPCAvatarController</i> in your IDE. • The state machine is located in the Update method. It will look at the current desired state and then call a method that tells the NPC what to do. • Show the <i>OnTriggerEnter</i> method. Explain that when the NPC bumps into the player, the script does the following: 	10 min	

	<ul style="list-style-type: none"> ○ Sets the <i>objectMotor</i> to Stop to prevent the NPC from moving. ○ Calls the Animator to trigger the Wave animation. ○ Sets the state to Wave. ○ Enables the NPC Canvas so the player can read the NPC text box. ● On the next tick of the program, the Wave state will call the Wave method which rotates the NPC to look at the Player, and rotates the NPC's world space UI to point at the Main Camera. 		
Demo 2.1	<p>Program the NPC to Sit when Idle</p> <ul style="list-style-type: none"> ● When the NPC is deciding on what to do it first calls the <i>WhatDoIDo</i> method which calls the <i>PauseCharacter</i> method. Right now that defaults to calling the <i>Idle</i> state. ● In the <i>PauseCharacter</i> method after <i>bIsDeciding = false</i> and before <i>currentAIState = AIState.IDLE</i>; add the following: <pre>float percent = Random.Range(0f, 1f); if (percent >= 0.1) { currentAIState = AIState.SIT; } else { and add the final bracket after currentAIState = AIState.IDLE;</pre> <ul style="list-style-type: none"> ● This creates a random number between 0 and 1 that we will use as a percent. If the random number is above 0.1 the state will be set to Sit (90% chance) otherwise it is set to Idle (10% chance) ● This is for testing so we will be assured of seeing the sit functionality. 	10 min	
Challenge 2.1	Instruct participants to add the code above to their own projects.		
Demo 2.2	<p>Trigger the Animations</p> <ul style="list-style-type: none"> ● In the <i>Sit</i> method add code to trigger the sit animation in the Animator and then set our state back to deciding to choose another action. ● In the <i>Idle</i> method add the code to trigger the stand animation. 	5 min	Walk through these code changes in steps. Explain what each code snippet is doing. See the Detailed Instructor Notes for details.

Challenge 2.2	Instruct participants to add the code above to their own projects.		
Demo 2.3	Adding Sit and Stand to the Animator <ul style="list-style-type: none"> Introduce the Animator Controller and Animator Window. Explain the concepts of a state machine, states, and transitions in an Animator Controller. 	10 min	Explain that now that the triggers are in place, you will create the animations to be triggered.
Challenge 2.3 (3 slides)	Add the Sit and Stand Animations <ul style="list-style-type: none"> In the Project Window, select the <i>SimpleCitizens Animator Controller</i> in <i>Assets/SimpleWorldVol1/SimpleCitizens/Models/SimpleCitizens</i>. Open the Animator Window by going to <i>Window>Animation>Animator</i>. In the Animator Window switch to the Parameters tab and you will see some premade parameters. Press the + button and add two Triggers. Call one <i>Sit</i> and the other <i>Stand</i>. Make Transition to Sit <ul style="list-style-type: none"> In the Animator field you will see a premade set of animations and transitions. We will be using one of the non-connected animations on the left side. Connect <i>Any State</i> to <i>Idle_SittingOnGround</i>: <ul style="list-style-type: none"> Move the <i>Idle_SittingOnGround</i> node to the right of the <i>Any State</i> node. Right click the <i>Any State</i> node, select <i>Make Transition</i> and drag that line onto the <i>Idle_SittingOnGround</i> node. Select this new transition and in the Inspector press the + under the <i>Conditions</i> section and select the <i>Sit</i> Trigger. Make Transition to Stand <ul style="list-style-type: none"> Connect the <i>Idle_SittingOnGround</i> node to the <i>Idle</i> node using the same method as above. Select this new transition and in the Inspector press the + under the <i>Conditions</i> section and select the <i>Stand</i> Trigger. <p>Now you can test your level and watch the NPC sit, stand up, run or wave. They will spend most of their time sitting though!</p>	10 min	<p>Point out the relationships between the nodes and state machines in the Animator Window and the triggers they just set up in the code.</p> <p>These character animations were pre-set to get them started. We will cover animation in-depth in Session 5.</p> <p>By connecting the <i>AnyState</i> to <i>Idle_SittingOnGround</i> we ensure that the NPC can start the Sitting animations from any currently running state. For example, it can transition from Idle, Run or Wave to Sit.</p> <p>After the NPC stands, it will play its <i>Idle</i> animation. The Idle state is tracked in our <i>NPCAvatarController</i> script. The NPC can only select a new location to walk if it is currently in the <i>Idle</i> animation.</p>
	Review and Transition	5 min	

Activity 3: Gameplay and Coding Challenge	60 minutes	Instructor Notes
	<p>Fill out Office Hours Availability for Session 4.</p> <p>Add More Animations</p> <ul style="list-style-type: none"> • Now that we know how to add states and adjust our Animator, try to add one or more states using the remaining five unused animations. • Adjust the random percent chance so the NPC doesn't spend most of its time sitting. <p>Design Your Capstone Project</p> <ul style="list-style-type: none"> • Now that you are familiar with this game, how will you customize and innovate to create your Capstone Project? • Use the Design Brief Template or make other notes to organize your plans. • Share your plans with the instructor during Office Hours at the end of the next session. 	<p>60 min</p> <p>Depending on the experience of your participants, you can either challenge them to create their own unique version of the Quiz Adventure, or something completely different such as a maze, an obstacle course, or a treasure hunt.</p>

Session 4: Creating User Interfaces		120 minutes	Instructor Notes
Overview	In this session, you and the participants will: <ul style="list-style-type: none"> • Create a World Space UI • Create a Screen Space UI • Add a “portal” for moving from level to level 		Files needed to conduct this session:
Outcome	When you’re done, participants will have: <ul style="list-style-type: none"> • A working prototype containing several user interfaces they can use in their Capstone. 		Make sure you set up your Office Hours schedule slide before this session.
Objectives	By the end of this session, participants will be able to: <ul style="list-style-type: none"> • Build a World Space user interface connected to features in their game. • Create a Canvas. • Place text with TextMesh Pro. • Build a Screen Space UI that works with a dedicated camera. • Move the user between levels of their game. • Learn best practices for grouping UI objects. • Animate the User Interface. 		
Welcome Activity	Chat prompt: What is your favourite character in a mobile game?	~	Complete this activity while waiting for participants to join the session
Introduction	Follow the slides for: <ul style="list-style-type: none"> • Welcome and Introduction • Today’s agenda • Today’s objectives • Ground rules • Assignment Check for Activity 3 	10 min	Ground rules include instructions on how to ask questions and use the conference technology. Add your customized information to the existing slide deck.
Lesson 1: World Space UI		45 min	
Discussion	Introduction to User Interfaces <ul style="list-style-type: none"> • Examine a few User Interfaces from popular games. Discuss what makes them effective or ineffective. • Explain the difference between World Space and Screen Space. 	5 min	This lesson requires a scene that already has a NavMesh.
Demo 1.1	Adding a World Space UI	5 min	This lesson requires a scene that already has a

	<ul style="list-style-type: none"> Instruct participants to work in their Capstone Scene, or <i>GamingWorkshop/Scenes/Activity3Final</i>. Be sure they all have <i>InputManager.cs</i>. Explain that they are going to add a World Space UI to a Prefab of an NPC. 		NavMesh.
Challenge 1.1	Add a UI to an NPC Prefab <ul style="list-style-type: none"> Navigate to the <i>QuizAdventure/Prefabs</i> folder and drag a copy of the <i>NPC_WanderAI_Start</i> Prefab into your Scene. Choose a different character by disabling the <i>SC_Biker</i> child and enabling one of the others. Choose a different skin tone using materials in <i>SimpleWorldVol1/SimpleCitizens/Materials</i>. 	5 min	
Demo 1.2	<p>Explain that each NPC has a World Space UI for communicating with the Player through text. The UI will appear when the Player and an NPC collide.</p> <p>Adding a Canvas</p> <ul style="list-style-type: none"> Explain how a Canvas supports the World Space UI in this game. Demonstrate adding and configuring the Canvas. 	5 min	
Challenge 1.2	Add a Canvas for the UI <ul style="list-style-type: none"> Add a Canvas to the new NPC by selecting it and using <i>GameObject > UI > Canvas</i>. In the Canvas, set the Render Mode to World Space, the Event Camera to the Main Camera, and the Order In Layer to 1. Set the Width to 1980, the Height to 1024, Rotation X to 30 and the X,Y and Z scale to 0.012. Move the Canvas to be above and slightly in front of your NPC. 	10 min	These settings will set the aspect ratio for the text display box, scale it down to fit on the screen, and rotate it to face the camera.
Demo 1.3	<p>Filling the Canvas</p> <ul style="list-style-type: none"> Demonstrate adding the Image and TextMesh Pro object to the Canvas and configuring them. 	5 min	If this is the first time adding a Text Mesh Pro object in your project, you will get a pop-up asking you to import TMP Essentials . You do not need to import the examples or extras.
Challenge 1.3 (3 slides)	Add Graphics to the Canvas <ul style="list-style-type: none"> Add an Image to the Canvas (under <i>GameObject/UI</i>). Set the Source Image to <i>back (MobileUI/back)</i>. 	10 min	In the <i>NPC Avatar Controller</i> script, don't worry about the <i>NPC Text Box</i> that is only used if you want to go back to using the old Text UI component instead of Text Mesh Pro .

- Adjust the color, lowering the **Alpha** to about 170 so that the image is see-through.
- Add a **TextMesh Pro** object to the Canvas (under *GameObject/UI*).
- Configure the **TextMesh Pro** object as follows:
 - **Width** to 1300, **Height** to 800.
 - **Anchors** are all 0.5 to center it horizontally and vertically.
 - **Wrapping** to Enabled, **Overflow** to Truncate.
 - **Auto Size** checked, **Auto Size Options**: Min 0, Max 200.
 - **Vertex Color** black.

Connect the UI with the Controller Script

- On the *NPC_WanderAI_Start*, *NPC Avatar Controller* script, add the **TextMeshPro Text** to the *Text Mesh Pro Text* field and the **Canvas** to *NPC Canvas*.
- Set the **Layer** on the NPC **Canvas** to *NPC Canvas* and select *Change Children* in the pop up. This ensures that the UI appears through its own camera, on top of what appears through the Main Camera.
- Change the **Character Line** to whatever you want. This is what will be displayed in game.

Save Your Prefab

- Rename your NPC Prefab in the **Hierarchy** from *NPC_WanderAI_Start* to *NPC_With_UI*.
- Drag the prefab from the Hierarchy to the *QuizAdventure/Prefabs* folder in the **Project** window.

Because the Character Line is a short field, it can be easier to edit this text using a text editor, then pasting it in.

The *NPC Canvas* Layer is displayed in a special camera, *NPC UI Camera*, so that the UI overlays the Main Camera view and no other objects in the Scene get in the way.

Lesson 2: Screen Space UI

40 min

Demo 2.1

Explain that whereas our World Space UI was attached to objects in our world (NPCs), the Screen Space UI is attached to a camera, which controls the screen view.

Explain how the NPC UI Camera is used to display the *NPC Layer*.

5 min

Challenge 2.1

Control the Screen Space UI View

- In the **Main Camera**, set the **Render Type** to Base, and turn off the *NPC Canvas Layer* in the **Camera** script's **Culling Mask** drop-down to prevent the UI from displaying through the **Main Camera**.
- In the *NPC UI Camera*, set the **Render Type** to *Overlay*, and set the **Culling Mask** to only display *NPC Canvas*.

5 min

Demo 2.2	Creating the Screen Space Canvas <ul style="list-style-type: none"> Demonstrate creating the Canvas. Explain the settings. 	5 min	
Challenge 2.2	Control the Screen Space UI View <ul style="list-style-type: none"> Back in Main Camera create a Canvas object and make sure it's a child of the Main Camera. Set the Canvas to Screen Space - Overlay. Make sure it has a Canvas Scaler and Graphic Raycaster Components. Set the UI Scale Mode in the Canvas Scaler to <i>Scale With ScreenSize</i>. 	5 min	
Demo 2.3	Add the Fade Panel <ul style="list-style-type: none"> Demonstrate how the Fade Panel contains pre-made controls for the game. 	5 min	
Challenge 2.3	Add the Fade Panel <ul style="list-style-type: none"> Add the <i>Fade Panel Prefab</i> from the <i>QuizAdventure/Prefabs</i> folder to the Canvas on the Main Camera. Open the Fade Panel and select the HomeButton. In the OnClick add the <i>Input Manager</i> and set the function to <i>EscapeGUIPressed</i>. 	5 min	
Demo 2.4	Make a UI Panel Prefab <ul style="list-style-type: none"> Explain how the Main Camera, NPC UI Camera, and the Screen Space Canvas can now work as a Prefab. 	5 min	
Challenge 2.4	Make a UI Panel Prefab <ul style="list-style-type: none"> If you have not already done so, create a new Folder in your <i>Gaming Workshop</i> folder called <i>Prefabs</i>. Drag the set up Main Camera with UI to the <i>Prefabs</i> folder so you can re-use it in any other scene you want. 	5 min	
Lesson 3: Create Transitions Between Levels		20 min	
Demo 3.1	Explain Quizmaster Steve and demonstrate how to add him to the game.	10 min	QuizMaster Steve is the “host” of the Quiz Adventure. The Player will go to QuizMaster Steve to get a new question to answer or to advance to the next level (Scene).
Challenge	Add Quizmaster Steve		

3.1	<ul style="list-style-type: none"> Drag the <i>QuizmasterSteve</i> and <i>ExitPortal</i> from <i>QuizAdventure/Prefabs</i> into your Hierarchy. Place them wherever you would like in your Scene. The Quizmaster will not wander around. 		
Demo 3.2	Explain how to specify the next Scene in the Build Settings .	10 min	
Challenge 3.2	Add the Level Transition <ul style="list-style-type: none"> To set up the <i>ExitPortal</i>, you just need to add the <i>FadePanel</i> from the Main Camera to the <i>FadePanelAnimator</i> variable in the <i>Portal Exit</i> script. To advance to a new game level/Scene, set the <i>Next Scene Number</i> to the Build Index of the next scene you want to open. You can find this in the list of Scenes in your Build Settings. This will default to 0, which will just open this current scene again. You can also set the <i>Seconds Of Fade</i> variable. This defaults to 1 second. 		
	Review and Transition	5 min	
Activity 4: Create User Interfaces		60 minutes	Instructor Notes
Activity Session	<p>Now you are ready to build a user interface for your Capstone Project. Apply the concepts you learned working in the Quiz Adventure game and apply them to your own game.</p> <ul style="list-style-type: none"> Create your own World Space user interface for NPCs in your game. Set up the Main Camera system in your Capstone Project or replace it with your new Prefab. Add a Quizmaster or other “portal” to move from level to level in your game. 	60 min	Check in with participants periodically to see how they are doing.
Office Hour Session		15 min	
	<p>At this point, participants should have an original idea for a 3D mobile game, even a very simple one, that they can create using the provided assets and techniques. They should be ready to share a draft Design Brief for their idea.</p> <p>During office hours, discuss their Capstone Project plan and set specific goals. Set realistic expectations for how much they can finish during the course.</p>		Share the workload of Office hours and Activity questions with TAs.

Session 5: 3D Animation		120 minutes	Instructor Notes
Overview	In this session, you and the participants will: <ul style="list-style-type: none"> Create a complex keyframe animation in the Animation Window. Use the animation system to trigger lighting and particle effects. 		Files needed to conduct this session:
Outcome	When you're done, participants will have: <ul style="list-style-type: none"> A prototype of a complex animated figure, demonstrating animation techniques they can use in their Capstone Project. 		
Objectives	By the end of this session, participants will be able to: <ul style="list-style-type: none"> Organize animated figures and their child objects efficiently. Create a keyframe animation using the Unity Animation editor. Create an animated lighting effect. Create an animated particle effect. 		
Welcome Activity	Chat prompt: What genre of game would you like to develop?	~	Complete this activity while waiting for participants to join the session
Introduction	Follow the slides for: <ul style="list-style-type: none"> Welcome and Introduction Today's agenda Today's objectives Ground rules 	5 min	Ground rules include instructions on how to ask questions and use the conference technology. Add your customized information to the existing slide deck.
Lesson 1: Organize Animation Objects		25 min	
Demo 1.1	Organize Objects for the Animation <ul style="list-style-type: none"> Demonstrate how to arrange the child objects for this animation in the Hierarchy. Explain how this method of organizing can save time and effort. 	10 min	
Challenge 1.1	Organize Objects for the Animation <ul style="list-style-type: none"> Open a new scene and save it as <i>Activity5Animation</i>. Create a Plane at 0,0,0 with a Scale of 20, 1, 20. Create an EmptyObject named <i>BouncingCube</i> at 0, 0,5, 0. Add a Cube as a child of <i>BouncingCube</i>. Name it <i>Graphics</i> and position it at 0,0,0. Add a Spotlight as a child of <i>BouncingCube</i>. 	15 min	TIP: We are disabling the particle system GameObject so that particles won't emit immediately when the Scene starts, but instead when they are animated.

	<ul style="list-style-type: none"> ○ Rotate the Spotlight 90 degrees on X. ○ Move the Y position to 5. ○ Set the Intensity to 12. ● In the Project Window, drag the <i>DustPuff</i> particleSystem from <i>Assets>GamingWorkshop>Particles</i> to the <i>BouncingCube</i> object. <ul style="list-style-type: none"> ○ Set the position to 0, 0.5, 0. ○ Disable the GameObject. 		
Lesson 2: Use the Animation Window		85 min	
Demo 2.1	Opening the Animation Window <ul style="list-style-type: none"> ● Introduce the Animation Window. ● Explain the properties that define the animation. 	5 min	
Challenge 2.1	Open the Animation Window <ul style="list-style-type: none"> ● In the Project Window create a new folder and name it <i>Animations</i>. ● If the Animation Window is not open, go to <i>Window>Animation>Animation</i> and open it. ● Select the <i>BouncingCube</i> and in the Animation Window, and select Create to create a new Animation Clip. ● Name this clip <i>BouncingCube</i> and save it into the <i>Animations</i> folder we created earlier. 	5 min	
Demo 2.2	Adding Animation Properties <ul style="list-style-type: none"> ● Explain the properties that define the animation. 	5 min	
Challenge 2.2	Add Animation Properties <ul style="list-style-type: none"> ● In the Animation Window use the AddProperty button to add the following properties of these objects to animate: <ul style="list-style-type: none"> ○ <i>Transform>Position</i>: to move the entire <i>BouncingCube</i> and its children. ○ <i>Graphics>Transform>Scale</i>: to change the scale of <i>Graphics</i> for the squash and stretch effects. ○ <i>SpotLight>Light>Intensity</i>: to flash the spotlight. ○ <i>DustPuff>IsActive</i>: to turn the particle system on and off. 	10 min	
Demo 2.3	Add Keyframes <ul style="list-style-type: none"> ● Demonstrate how keyframes will be added. 	10 min	

	<ul style="list-style-type: none"> Explain how keyframes are typically created when pre-determined coordinates are not available. 		
Challenge 2.3 (5 slides)	Add Keyframes <ul style="list-style-type: none"> Zoom the Animation Window out until you can see 0-130. We will be starting with a 2.1 second (at 60 frames) animation. Keyframe the BouncingCube Position. These coordinates create the bouncing arc motion of the cube. Keyframe the Graphics Scale. These values create a squash effect when the cube hits the ground and a stretch when the cube begins to jump. Keyframe the Graphics Position. These values are used to slightly raise or lower the cube while it is stretching and squashing so it does not appear to either float off the ground or penetrate into the ground. Keyframe the Light.Intensity. These values cause the light to flash when the cube hits the ground. Keyframe the DustPuff: Game Object.Is Active. These coordinates cause the dust puff effect when the cube bounces on the ground. 	30 min	The lists of coordinates are on the slides and in the Detailed Instructor Notes.
Demo 2.4	View the Result <ul style="list-style-type: none"> Demonstrate how to view the animation in the Animation Window and in Game view. 	5 min	
Challenge 2.4	View the Animation <ul style="list-style-type: none"> Press play in the Animation Window to see the movement, squash and lighting changes, but not the particles being emitted. To see the full animation you will need to play the scene by pressing the Play button at the top of the editor or press CTRL+P. 	15 min	
	Review and Transition	5 min	
Activity 5: Animate the Game		60 minutes	Instructor Notes
	Fill out Office Hours Availability for Session 6. Animation Challenge: <ul style="list-style-type: none"> Make a vehicle that drives around your town. <ul style="list-style-type: none"> You can find vehicle prefabs with separate wheels in the <i>Assets/SimpleWorldVol1/SimpleCars/Prefabs/PosZFacing</i> folder 	60 min	

- There is a **CarExhaust** particle system prefab in *Assets/QuizAdventure/Prefabs*
- If you are animating something that will intersect the **NavMesh**, make sure to add a **Nav Mesh Obstacle** component to the parent object and set it to **Carve**.
- Add other animations to enhance the game/project you have designed.
- Show your animation to the class in the next session.

Session 6: Managing Multiple Scenes		120 minutes	Instructor Notes
Overview	In this session, you and the participants will: <ul style="list-style-type: none"> Create a system to load and unload Scenes at runtime Use Scriptable Objects to hold Scene information. 		Files needed to conduct this session:
Outcome	When you're done, participants will have: <ul style="list-style-type: none"> A prototype demonstrating Scenes that load and unload. 		
Objectives	By the end of this session, participants will be able to: <ul style="list-style-type: none"> Reduce the computational load of their mobile games by managing multiple sub-Scenes. Use Scriptable Objects to facilitate the loading and unloading of sub-Scenes. 		
Welcome Activity	Chat prompt: What's a 3D game you've played recently? (or that you can remember?)	~	
Introduction	Follow the slides for: <ul style="list-style-type: none"> Welcome and Introduction Today's agenda Today's objectives Ground rules Assignment Check for Activity 5 	10 min	Ground rules include instructions on how to ask questions and use the conference technology. Add your customized information to the existing slide deck.
Lesson 1: Create Sub-Scenes		55 min	
Demo 1.1	Explain the Scripts for this Activity <ul style="list-style-type: none"> Walk through and explain the <i>LevelContainerScriptableObject</i> script. Walk through and explain the <i>LevelTracker</i> script. Setting up the Scene <ul style="list-style-type: none"> Demonstrate how you will set up the Base Scene for this prototype. 	15 min	These scripts are commented to assist you in the explanation. There are tooltips that will help the students understand what the variables need in the Inspector.
Challenge 1.1	Set Up the Scene <ul style="list-style-type: none"> Create a new scene and name it <i>BaseScene</i>. Create a cube, name it Player and place it at 0,0.8,0. Add the <i>TestController</i> script in <i>Assets>QuizAdventure>MultiLoadExample>Scripts</i> to the Player object. This 	10 min	

	<p>script enables simple user controls with the keyboard and mouse so you can test your system.</p> <ul style="list-style-type: none"> • In the <i>TestController</i> script set MoveSpeed to 10 and MouseSpeed to 500. • In the Hierarchy drag the Main Camera onto the Player, set the position to 0,7.75,-7.75 and rotation to 30,0,0. 		
Demo 1.2	<p>Setting up the Scene Loading Script</p> <ul style="list-style-type: none"> • Demonstrate adding the <i>SceneLoadingManager</i> to the Scene and setting the input variables. 	5 min	
Challenge 1.2	<p>Set up our SceneLoadingManager</p> <ul style="list-style-type: none"> • Create an Empty Object, name it <i>SceneLoadingManager</i> and place it at 0,0,0. • Add the <i>LevelTracker</i> script to the <i>SceneLoadingManager</i>. • In the <i>LevelTracker</i> script, set: <ul style="list-style-type: none"> ○ Player to the <i>Player</i> object in the Hierarchy. ○ Base Level Name to <i>BaseScene</i> (what you named this primary scene) ○ Both Number of Columns and Number of Rows to 3. ○ Tick Time to 0.1 (this is a good average to avoid loading delays and not run so often that it affects performance). ○ Mega Grid Size to 1 (so we can easily see the loading and unloading when we test the scene). 	10 min	
Demo 1.3	<p>Create Sample Sub-Scenes</p> <ul style="list-style-type: none"> • Demonstrate how to create the simple sub-Scenes for this prototype. 	5 min	
Challenge 1.3	<p>Create Sample Sub-Scenes</p> <ul style="list-style-type: none"> • In the Project Window create a new folder under <i>Assets</i> and name it <i>SubScenes</i>. • Create a new scene in this folder and name it <i>SubLevel0_0</i>. • Drag that scene into the Hierarchy Window. • Delete the Main Camera and Directional Light in <i>SubLevel0_0</i>. • Create a new Cube and place it at 0,0,0 with a Scale of 10, 0.5,10. • In the Project Window duplicate this scene 8 times. Move the cubes to create a grid. They will have names and positions like the following: <ul style="list-style-type: none"> ○ <i>SubLevel0_1</i>, cube at 0,0,10 ○ <i>SubLevel0_2</i>, cube at 0,0,20 ○ <i>SubLevel1_0</i>, cube at 10,0,0 ○ <i>SubLevel1_1</i>, cube at 10,0,10 ○ <i>SubLevel1_2</i>, cube at 10,0,20 	10 min	

	<ul style="list-style-type: none"> ○ <i>SubLevel2_0</i>, cube at 20,0,0 ○ <i>SubLevel2_1</i>, cube at 20,0,10 ○ <i>SubLevel2_2</i>, cube at 20,0,20 		
Lesson 2: Manage Sub-Scenes with Scriptable Objects		50 min	
Demo 2.1	Making Scriptable Objects <ul style="list-style-type: none"> ● Explain Scriptable Objects, and how they are used to manage multiple Scenes. 	5 min	
Challenge 2.1	Make Scriptable Objects <ul style="list-style-type: none"> ● In the Project Window create a new folder in the <i>Assets/SubScenes</i> folder called <i>ScriptableObjects</i>. ● Right click in this folder and choose <i>Create>Level Container Scriptable Object</i>. ● Name this <i>Level0_0</i>. ● We will now input some information in <i>Level0_0</i> that will match the set up of <i>SubLevel0_0</i>. ● Select <i>Level0_0</i> in the Project Window and enter the following: <ul style="list-style-type: none"> ○ My Scene Name = <i>SubLevel0_0</i> (This tells us what scene we will be loading.) ○ My Scene Grid Location = 0,0 (This is the location in the world grid we created.) ○ My Scene World Location = 0,0,0 (This is the world space location for that cube.) ○ My Scene Size is 10 (This matches the scale of the cube.) <p>Repeat for the 8 other Scenes.</p>	15 min	
Demo 2.2	Finish the SceneLoadingManager <ul style="list-style-type: none"> ● Demonstrate how to set up the multiple Scenes to load and unload. 	5 min	
Challenge 2.2	Finish the SceneLoadingManager <ul style="list-style-type: none"> ● In the Hierarchy, right-click on each sub-Scene and select Remove Scene (you can shift select multiple scenes and remove them all at the same time) ● Now you should only have <i>BaseScene</i> open. ● Select the <i>SceneLoadingManager</i> in the Hierarchy and press the lock on the Inspector Window. ● In the Project Window select all of the Scriptable Objects in your <i>ScriptableObjects</i> folder and drag them onto the Levels variable in the <i>Level</i> 	10 min	

	<i>Tracker</i> script. This will automatically set the Size and load the list with your Scriptable Objects .		
Demo 2.3	Build and Test <ul style="list-style-type: none"> Demonstrate how to change Build Settings to enable Scene loading and unloading. Demo the Scenes. 	5 min	
Challenge 2.3	Build and Test <ul style="list-style-type: none"> Open the Build Settings by going to <i>File>Build Settings</i> or pressing Ctrl+Shift+B. Add the open <i>BaseScene</i> and all of your <i>SubLevelx_x</i> scenes to the build list. Now you can play the <i>BaseScene</i> and walk around. You can see the scenes load as you walk forwards or turn around and walk backwards to watch them unload. 	10 min	
	Review and Transition	5 min	
Activity 6: Develop and Manage Multiple Scenes		60 minutes	Instructor Notes
Activity Session	Create Your Own Multiple Scene System <ul style="list-style-type: none"> Try to create your own system in the Capstone project. You can use the scene you have been working in as the <i>BaseScene</i> or create a new <i>BaseScene</i> and use this as the next level after you solve the <i>Quizmaster's</i> test. Tips for the Capstone Project <ul style="list-style-type: none"> Try using the sub-Scenes to just load buildings and decorative objects. The <i>BaseScene</i> should contain all of your <i>NPCs</i>, <i>POIs</i>, the <i>Player</i> and any animated objects that travel across your sub-Scenes' borders. When you are baking a NavMesh, load your sub-Scenes into the Hierarchy and make sure the <i>BaseScene</i> is set as the active Scene so the NavMesh knows where these objects in the sub-Scene will load, but the NavMesh will exist in the <i>BaseScene</i>. When you bake your lighting you will want to load your sub-Scenes into the Hierarchy before you start the bake. 	60 min	Check in with participants periodically to see how they are doing.

Office Hour Session		20 min	
	<p>Review each participant's Capstone Project goals and progress.</p> <p>Ask for a demonstration of their work with coding, user interfaces, and animation.</p>		<p>Share the workload of Office hours and Activity questions with TAs.</p>

Session 7: Lighting 3D Scenes		120 minutes	Instructor Notes
Overview	In this session, you and the participants will: <ul style="list-style-type: none"> Review the lighting types in Unity Add Directional, Spot, and Point lights to a Scene. Bake a Lightmap. 		Files needed to conduct this session:
Outcome	When you're done, participants will have: <ul style="list-style-type: none"> A prototype Scene with several lights and a baked Lightmap. 		
Objectives	By the end of this session, participants will be able to: <ul style="list-style-type: none"> Identify the right lights for their projects Insert and place lights into a Scene Identify which lights are more effective to render in real time or from a Lightmap. Bake a Lightmap. 		
Welcome Activity	Chat prompt: What are some examples of beautiful mobile games?	~	Complete this activity while waiting for participants to join the session
Introduction	Follow the slides for: <ul style="list-style-type: none"> Welcome and Introduction Today's agenda Today's objectives Ground rules 	5 min	Ground rules include instructions on how to ask questions and use the conference technology. Add your customized information to the existing slide deck.
Lesson 1: Lighting Types in Unity		55 min	
Lecture 1.1	Types of Lights in Unity <ul style="list-style-type: none"> Review and discuss the uses of Directional, Point, Spot, and Area lights in Unity. Instruct participants to open the <i>GamingWorkshop/Scenes/Activity7Start</i> Scene. 	10 min	The slides contain some detail about lighting types. More detail is found in the Detailed Instructor Notes.
Demo 1.2	Directional Light <ul style="list-style-type: none"> Explain or review the concept of baking lights and why it is important to optimize mobile game performance. Demonstrate adding a Directional Light and adding shadows. 	10 min	
Challenge	Configure Directional Light	10 min	

1.2	<ul style="list-style-type: none"> Create a Directional Light and set the Mode to <i>Baked</i>. This will allow us to bake the shadows into a texture and will help us increase performance. Select all the Game Objects in the Scene and mark them as Static. For Baked lights you want to make sure all non-moving objects are marked as Static. To see the lights in your Scene, click the lightbulb icon at the top of the Scene Window. To add shadows, set the Shadow Type on the Directional Light to <i>Soft Shadows</i>. 		
Demo 1.3	Spot Lights <ul style="list-style-type: none"> Discuss how Spot Lights are typically used. Demonstrate adding Spot Lights. 	5 min	
Challenge 1.3	Add Spot Lights <ul style="list-style-type: none"> Create a Spot Light and place it under one of the street light objects in the Scene. <ul style="list-style-type: none"> Set the Range to 15. Set the Inner/Outer Spot Angle to 10 and 80. Set the Mode to <i>Baked</i>. Set the Intensity to 100. Set the Shadow Type to <i>Hard Shadows</i>. Set the Color to a soft yellow/white. Duplicate this Spot Light and place one under each street light object. 	10 min	Bonus Challenge: Add Spot Lights as headlights to the car.
Demo 1.4	Point Lights <ul style="list-style-type: none"> Discuss how Point Lights are typically used. Demonstrate adding Point Lights. 	5 min	
Challenge 1.4	Add Point Lights <ul style="list-style-type: none"> Add a Point Light to the scene and move it on top of one of the small globes next to the statue. <ul style="list-style-type: none"> Set the Color to a light blue. Set the Mode to <i>Baked</i>. Set the Intensity to 10. Leave the Shadow Type at <i>No Shadows</i>. Duplicate this light and place one above each globe. 	10 min	TIP: These are accent lights and we do not want to add any calculations for shadows because they would not be noticeable anyway.
Lesson 2: Baking Lightmaps		55 min	

Demo 2.1	Configuring Lights for Baking <ul style="list-style-type: none"> Explain the concept of lightmap baking and how it improves performance. Demonstrate the steps for changing the lighting settings. 	10 min	
Challenge 2.1	Configure Lights for Baking <ul style="list-style-type: none"> Open up your Lighting Settings by going to <i>Window<Rendering<LightingSettings</i>. <ul style="list-style-type: none"> In the Sun Source, add our Directional Light. In the Mixed Lighting section, make sure Baked Global Illumination is checked. Set the Realtime Shadow Color a little darker, but keep it in the blue spectrum for a cooler feel. In the Lightmapping Settings: <ul style="list-style-type: none"> Make sure the Lightmapper is set to <i>Progressive CPU</i>. Set the Lightmap Resolution to 40 texels per unit. Set Lightmap Size to 512. 	15 min	TIP: Increasing the Lightmap Resolution and Lightmap Size will improve lightmap quality, but increase baking times.
Demo 2.2	Baking Lightmaps <ul style="list-style-type: none"> Demonstrate the final steps to bake the lightmap. Emphasize that time it can take to bake a lightmap in a complex scene. Explain that while lightmaps are a great way to optimize performance on mobile devices, some real-time lighting effects can enhance the user's experience. Discuss the trade-offs. Explain that the quality of lightmaps depends on the quality of the UVs in the assets. Describe the shadow streaking that can occur when an asset has poor UVs. 	15 min	
Challenge 2.2	Bake Your Lightmap <ul style="list-style-type: none"> In the Lighting Settings window click the Generate Lighting button. After baking, turn off all the Lights in your Hierarchy. The lights and shadows will remain in our scene because they have been baked into a texture. 	15 min	<p>This build should not take more than five to ten minutes to bake.</p> <p>You will notice after the bake the lights in our scene look much brighter and a little blocky. We turned up the intensity on our lights to accentuate the results so you can clearly see what is happening.</p>
	Review and Transition	5 min	

Activity 7: Add Lighting to your Project	60 minutes	Instructor Notes
<div data-bbox="241 186 793 219">Fill out Office Hours Availability for Session 8.</div> <div data-bbox="241 254 724 287">Experiment with Lighting and Lightmaps</div> <ul data-bbox="294 292 1125 467" style="list-style-type: none"> • In the simple practice Scene: <ul style="list-style-type: none"> ◦ Try reducing the intensity of your lights. ◦ Try increasing your lightmap resolution and size. ◦ Re-bake the lightmap and see the difference. • Keep in mind there is a trade-off between bake time and resolution. <div data-bbox="241 505 737 537">Bake Lightmaps in your Capstone Project</div> <ul data-bbox="294 542 1272 751" style="list-style-type: none"> • Add lighting effects that will enhance your game. • Decide which lighting effects can be baked to increase performance, and which should remain real-time to enhance the visual experience. • Configure your lights for lightmap baking. • Note: If you are baking lighting for a series of sub-Scenes, load your sub-Scenes into the Hierarchy before you start the bake. <div data-bbox="241 792 1262 857">IMPORTANT! Baking Lightmaps for a large level with many objects in it can take hours, sometimes even overnight. Plan accordingly!</div>	60 min	<div data-bbox="1459 186 1984 251">Check in with participants periodically to see how they are doing.</div> <div data-bbox="1459 293 1984 391">Encourage participants to click the Generate Lighting button later, when they have time to allow it to bake.</div>

Session 8: Cinematography and Cutscene Animation		120 minutes	Instructor Notes
Overview	In this session, you and the participants will: <ul style="list-style-type: none"> • Create and configure a Cinemachine dolly track with Waypoints. • Set up a Virtual Camera for a cutscene. • Configure the cutscene animation using Animation and Activation Tracks in the Timeline Window. • Build a keyframe animation for the cutscene. 		Files needed to conduct this session:
Outcome	When you're done, participants will have: <ul style="list-style-type: none"> • A prototype cutscene they can use as a model for their Capstone Projects 		
Objectives	By the end of this session, participants will be able to: <ul style="list-style-type: none"> • Create a Cinemachine camera. • Build a dolly track with Waypoints. • Create a virtual camera to render the cutscene. • Create animation in Timeline to move the virtual camera and other objects. • Add a keyframed animation to the cutscene. • Control and configure animations in Timeline. 		
Welcome Activity	Chat prompt: What mobile games have an effective cutscenes?	~	Complete this activity while waiting for participants to join the session
Introduction	Follow the slides for: <ul style="list-style-type: none"> • Welcome and Introduction • Today's agenda • Today's objectives • Ground rules • Assignment Check for Activity 7 	10 min	Ground rules include instructions on how to ask questions and use the conference technology. Add your customized information to the existing slide deck.
Lesson 1: Configuring Cameras with Cinemachine		25 min	
Demo 1.1	Cutscenes, Cinemachine, and Timeline <ul style="list-style-type: none"> • Explain cutscenes and how they are used in games. • Introduce Cinemachine and Timeline. • Demonstrate creating a dolly camera with track, and moving Waypoints. • Explain that we will be creating an animation where the camera will fade in, orbit the building, then seamlessly transition to the in-game camera. 	5 min	

Challenge 1.1	Create a Dolly Camera and Track <ul style="list-style-type: none"> Open the <i>Activity8Start</i> scene in <i>GamingWorkshop/Scenes</i> From the <i>Cinemachine</i> dropdown select <i>Create Dolly Camera with Track</i>. This creates a <i>CM vcam1</i> and a <i>DollyTrack1</i>. In the <i>DollyTrack1</i>, add two more Waypoints to get a total of four. Move these Waypoints in your scene to create an interesting path around the building. 	10 min	
Demo 1.2	Virtual Cameras <ul style="list-style-type: none"> Explain Virtual Cameras and the Cinemachine Brain. Demonstrate creating and configuring the Virtual Camera that will move on the dolly track and view the building. 	5 min	
Challenge 1.2	Set up a Virtual Camera <ul style="list-style-type: none"> From the <i>Cinemachine</i> dropdown, create a Virtual Camera name it <i>CM vcamStart</i>. Place it in the same position and rotation as the Main Camera. The Main Camera Prefab has a Cinemachine Brain on it. Set the Live Camera to <i>CM vcamStart</i>. Select the <i>CM vcam1</i> and set the <i>Look At</i> target to the building. 	5 min	
Lesson 2: Managing Animations with Timeline		50 min	
Demo 2.1	Timeline <ul style="list-style-type: none"> Introduce Timeline and explain what it does. 	5 min	
Challenge 2.1	Create a Timeline <ul style="list-style-type: none"> In your Hierarchy create an Empty Game Object and name it <i>Timeline Manager</i>. Open your Timeline Window by going to <i>Window>Sequencing>Timeline</i>. With the Timeline Window open select the <i>Timeline Manager</i> in the Hierarchy and press the <i>Create</i> button. This adds a Director component to the <i>Timeline Manager</i> and creates a Timeline Asset. 	5 min	Participants can save their Timeline Assets into a new <i>Timeline</i> folder inside the <i>Animation</i> folder they created in Session 5.
Demo 2.2	Building the Timeline <ul style="list-style-type: none"> Explain Animation and Activation Tracks. Demonstrate adding the tracks for the demo animation. 	5 min	

Challenge 2.2	Add Tracks to your Timeline <ul style="list-style-type: none"> In the Timeline itself, click the + to add an Animation track. Select the Fade Panel object as the object to animate. This is the panel in the Canvas in the Main Camera. Right-click the Timeline track. Select <i>Add From Animation Clip</i>. Select FadeTransitionIn to specify how to animate it. Move the clip to the left until it starts at frame 0. 	5 min	FadeTransitionIn is a premade clip that will disable Player movement during the cutscene, then enable movement after the animation is played. It is a panel with a black Sprite that fades in and out.
Demo 2.3	Adding a Cinemachine Track <ul style="list-style-type: none"> Demonstrate adding the Cinemachine track. 	5 min	
Challenge 2.3	Control Cameras with Cinemachine Track <ul style="list-style-type: none"> Add a Cinemachine Track and set it to the Main Camera. Add two Cinemachine Shots to this track: <ul style="list-style-type: none"> On the left, set the <i>Virtual Camera</i> to <i>CM vcam1</i>. On the right, set the <i>Virtual Camera</i> to <i>CM vcamStart</i>. Drag to position the Shots. 	5 min	Note that two camera clips on the same track automatically have a fade transition. Adjust the start and end points to shorten or lengthen the transition. This will direct the Timeline to render the movement of the <i>CM vcam1</i> first, then blend the movements as it fades out the <i>CM vcam1</i> to reveal what <i>CM vcamStart</i> is rendering.
Demo 2.4	Adding Activation Tracks <ul style="list-style-type: none"> Demonstrate adding two Activation Tracks and positioning the cameras on them. Explain Activation Tracks. 	5 min	
Challenge 2.4	Turn Cameras On and Off <ul style="list-style-type: none"> Add two Activation Tracks. Set one to the <i>CM vcam1</i> and the other to <i>CM vcamStart</i>. For both tracks, set the <i>Post-playback state</i> to <i>Inactive</i>. Set both the track lengths to be the same as their corresponding Cinemachine Track lengths. 	5 min	
Demo 2.5	Adding a Keyframe Animation <ul style="list-style-type: none"> Demonstrate adding an Animation Track for an object from the Hierarchy. Instruct them on the Challenge on the following slide. 	5 min	

Challenge 2.5	Add a Track for Keyframe Animation <ul style="list-style-type: none"> Add an Animation Track. Drag the <i>CM vcam1</i> from the Hierarchy into the field on the new track that currently says <i>None (Animator)</i>. You will add a keyframe animation to this track. 	5 min	
Lesson 3: Creating a Keyframe Animation for Your Cutscene		30 min	
Activity	Create Your Keyframe Animation Using the skills you gained in Session 5, create a keyframe animation to tell the CM vcam1 camera to follow the dolly track, based on the Waypoint positions we created in the first part of this lesson. The animation will control the <i>CM vcam1</i> object that controls the <i>Path Position</i> in the <i>cm/Cinemachine Tracked Dolly</i> script. <ul style="list-style-type: none"> In the Animation Window, click the Add Property button and add the <i>cm > CinemachineTrackedDolly>Path Position</i>. Create one keyframe at frame 0 with the value of 0 (for the first Waypoint). Create a second keyframe at the final frame that has the value of 3 (for the fourth Waypoint). Remember that you want to try to match the length of this animation to be about the length of the <i>CM vcam1 Cinemachine Track</i> in your Timeline. Now play your cutscene. Adjust the Timeline, the Dolly Track, and the positions of objects in your Scene to create an interesting cutscene.	30 min	Check in with participants periodically to see how they are doing. As time allows, have participants share their results.
	Review and Transition	5 min	
Activity 8: Cutscene Challenge		60 minutes	Instructor Notes
Activity Session	Use what you have learned to create a compelling cutscene to use in your Capstone. Tip: Storyboard your cutscene to plan animations and camera positions.	60 min	If it is practical, tell participants that they will share their cutscenes in the next session. This should motivate them to create and finish a good product. Check in with participants periodically to see how they are doing.
Office Hour Session		20 min	

Check the use of animations, scene management, and lighting based on previous sessions. Look for overall progress. Answer questions and challenge participants who have mastered the skills to try something more difficult.

Share the workload of Office hours and Activity questions with TAs.

Self-Paced Activity

60 minutes

Instructor Notes

Make sure you have the Android environment set up before the next session. If you need the additional modules, it will take time to download and install them. Follow the instructions here:

<https://docs.unity3d.com/Manual/android-sdksetup.html>

To complete tomorrow's Activity, bring an Android device and a USB cable to connect it to your computer.

60 min

It is important the participants install these modules before the next session, so that valuable session time will not be wasted and participants will not get behind.

Session 9: Optimizing and Publishing for Mobile Platforms		120 minutes	Instructor Notes
Overview	In this session, you and the participants will: <ul style="list-style-type: none"> Use the Profiler to identify performance issues. Learn optimization tips that can help increase the performance of their Capstone Projects. Build and test a practice project on an Android device. 		Supplies needed to conduct this session: <ul style="list-style-type: none"> Android device USB cable
Outcome	When you're done, participants will have: <ul style="list-style-type: none"> A prototype optimized Scene they can use as a model for their Capstone. Their Capstone Project installed as an app on their Android phones. 		
Objectives	By the end of this session, participants will be able to: <ul style="list-style-type: none"> Identify performance issues using the Profiler. Identify and analyze performance problems for mobile games. Build and install their projects on Android devices. 		
Welcome Activity	Chat prompt: How much time do you spend each day playing mobile games on your phone or tablet?	~	
Introduction	Follow the slides for: <ul style="list-style-type: none"> Welcome and Introduction Today's agenda Today's objectives Ground rules 	5 min	Ground rules include instructions on how to ask questions and use the conference technology. Add your customized information to the existing slide deck.
Lesson 1: Identifying Optimization Issues		85 min	
Demo 1.1	Identifying Optimization Issues <ul style="list-style-type: none"> Instruct participants to open the Scene <i>GamingWorkshop/Scenes/Activity9Start</i>. <ul style="list-style-type: none"> This scene has a cube with a NavMesh on it, a NPC so we have a script running, and a sphere with a Rigidbody on it. Demonstrate use of the Profiler Window. 	10 min	
Challenge 1.1	Run the Profiler <ul style="list-style-type: none"> Open the Profiler by going to <i>Window>Analysis>Profiler</i>. 	5 min	The Profiler gathers and displays data on the performance of your application in areas such

	<ul style="list-style-type: none"> • Turn on the <i>Clear On Play</i> button. • Run the Scene, wait for about two seconds, and stop playing the Scene. 		as the CPU, memory, renderer, and audio. It's a useful tool to identify areas for performance improvement in your application.
Demo 1.2	Analyze Profiler Results <ul style="list-style-type: none"> • Demonstrate the Profiler results, particularly the spike at Frame 0. • Explain: <ul style="list-style-type: none"> ◦ The FPS dips down below 30 at the start of the level, but we can see that it only occasionally dips below 60FPS a few times in that 2 second recording. ◦ On the spikes, we can also see the CPU is running at ~19ms while in the valleys it runs at 8-9ms. • Explain that as the Scene scales to include more objects, these issues will intensify: <ul style="list-style-type: none"> ◦ On about frame 36 there is a giant spike that takes our FPS to almost 15, our CPU spikes to 317.64ms. This spike is mostly due to the Physics calculations. ◦ On the spikes we can also see the CPU is now running at ~25ms while in the valleys it runs at 9-10ms. ◦ This is not a huge change but you can see how it will scale. 	10 min	
Challenge 1.2	Analyze and Test Profiler Results <ul style="list-style-type: none"> • Examine the Profiler results, particularly FPS and CPU. • In the scene, duplicate the <i>SpherePrefab</i> and <i>NPC</i> about 10 times each, and move the duplicates so they are not on top of each other. • Run the Scene in the Profiler again, and observe the differences. 	5 min	
Demo 1.3	Optimizing the Scene <ul style="list-style-type: none"> • Explain and demonstrate that you will optimize the Physics spikes. 	5 min	
Challenge 1.3	Improve Physics Performance <ul style="list-style-type: none"> • Select all of the <i>SpherePrefabs</i>. Notice that there are two types of Colliders on these objects. • Remove the Mesh Collider and leave the Sphere Collider. <ul style="list-style-type: none"> ◦ Mesh Colliders are more expensive than primitive colliders • In the Rigidbody component, switch Collision Detection to Discrete to increase performance. 	10 min	

Demo 1.4	Improving Performance <ul style="list-style-type: none"> Explain and demonstrate the additional optimization enhancements you can make. 	5 min	
Challenge 1.4	Improve Performance <ul style="list-style-type: none"> Delete half of the <i>NPCs</i> in the Scene. Select the Cube and set it to Static. Select the Directional Light, set the Mode to <i>Mixed</i>. Open your Lighting Settings and Generate the lighting with the default values. 	5 min	TIP: Limiting the number of AI who are calculating pathfinding or running Update methods will increase performance. TIP: If this was a more involved level with a lot of static objects, we would notice a large performance boost from using lightmaps.
Demo 1.5	Analyze Performance Improvements <ul style="list-style-type: none"> Play and re-examine the Scene in the Profiler. Explain: <ul style="list-style-type: none"> The only time we go below 30 FPS is at the first few frames (initialization) and the last few frames (garbage collection). Spikes are barely dipping below 60 FPS, with the CPU at about 17ms with valleys between 8 and 10ms. 	5 min	
Challenge 1.5	Analyze your Performance Improvements <ul style="list-style-type: none"> Run the Scene, wait for about two seconds, and stop playing the Scene. Examine the Profiler results, particularly FPS and CPU. 	10 min	
Lecture 1.6	Discuss the Optimization Tips on the slide.	5 min	A longer and more detailed list of Optimization Tips is in the Detailed Instructor Notes. For more Optimization Tips, search “Mobile Optimization” in the Unity manual (docs.unity3d.com).
Lesson 2: Publishing Your Project		25 min	
Demo 2.1	Configuring Build Settings <ul style="list-style-type: none"> Explain that they will now publish their Capstone Project to an Android device. Walk through the build settings. 	10 min	

Challenge 2.1	Configure Build Settings <ul style="list-style-type: none"> Open your Build Settings window and add all of the scenes you want to have in your game to the Scenes In Build list. Click on the Player Settings button: <ul style="list-style-type: none"> Set the Company Name to your name, the Product Name to <i>Gaming Workshop</i>. At Default Icon, select an existing file or import your own icon into your project add select it. In Resolution and Presentation, check or uncheck options that make sense for your project. In Other Settings>Identification, make sure the package name is <i>com.MyName.GamingWorkshop</i>. Set the Minumum API Level to the lowest version you want to support. We will leave this at <i>API Level 19 (Kit Kat)</i>. 		The JDK, SDK, and NDK installation should have been done previously. See “Prepare for the next session” at the end of Session 8.
Demo 2.2	Checking Modules <ul style="list-style-type: none"> Walk through the build settings related to the Android platform. 	5 min	
Challenge 2.2	Check for Required Modules <ul style="list-style-type: none"> Open <i>Edit>Preferences</i>, External Tools tab, and make sure your Android section has paths for the JDK, Android SDK, Android NDK, and Gradle installed. In Build Settings, if the Switch Platform button appears (and the Build and Run button is grayed out), click Switch Platform. This might take some time if Unity reimports the Assets in formats for Android. 		
Demo 2.3	Configuring Build Settings <ul style="list-style-type: none"> Walk through the build and installation process. Troubleshoot as needed. 	10 min	
Challenge 2.3	Build and Install <ul style="list-style-type: none"> In the Build Settings, press Build. You will be prompted to and save the APK (Android Package) to your computer. Save it on your Desktop. Connect your phone to your computer with a USB cable and transfer the APK file to your phone. Install the APK as an app on your phone. <ul style="list-style-type: none"> If you cannot run the APK make sure you have enabled Developer tools on your phone and that you have set your device to Allow Install Unknown Apps. 		

	Review and Transition	5 min	
Activity 9: Complete Capstone Project	60 minutes		Instructor Notes
	<p>Fill out Office Hours Availability for Session 10.</p> <p>Optimize performance: Address any performance issues you can identify in your Capstone Project. Continue working on your project to prepare it for a final presentation in the next session.</p> <p>Prepare for the next session: In our final session, you will have a chance to ask questions and put the finishing touches on your Capstone Project. To save time, complete these time-intensive processes <i>before</i> the session:</p> <ul style="list-style-type: none"> • NavMesh baking • Lightmap baking 	60 min	Emphasize the importance of performing time-intensive processes before Session 10 to save class time.

Session 10: Capstone Reviews		120 minutes	Instructor Notes
Overview	In this session, you and the participants will: <ul style="list-style-type: none"> Review Capstone Projects Use the Unity Recorder to capture in-Editor footage of your project Use Unity Connect to share your work and connect with employers 		Files needed to conduct this session:
Outcome	When you're done, participants will have: <ul style="list-style-type: none"> A completed Capstone Project of a mobile game or app. A Unity Connect account. A recording of their Capstone Project published to Unity Connect. 		
Welcome Activity	Chat prompt: What advertising "tag line" would you use to market the Capstone Project you have created?	~	Complete this activity while waiting for participants to join the session
Introduction	Follow the slides for: <ul style="list-style-type: none"> Welcome and Introduction Today's agenda Today's objectives Ground rules 	5 min	Ground rules include instructions on how to ask questions and use the conference technology. Add your customized information to the existing slide deck.
Demo 1	Explain expectations for the final adjustments and build of the Capstone Project. Demonstrate how to use the Recorder to record in-Editor footage.	20 min	
Challenge 1	Prepare your Final Build <ul style="list-style-type: none"> Take this time to debug, playtest, and make adjustments to your project. Please reach out to us with any questions! Using the built-in Recorder, record two or three 30-second clips of the major features you highlighted in your design document in Play Mode. You will be using this for your presentation! 	40 min	
Demo 2	Demonstrate how to post projects on Unity Connect.	10 min	
Challenge 2	Create an account on Unity Connect <ul style="list-style-type: none"> Go to connect.unity.com to set up your Unity Connect profile! Post your Capstone Project, including a description and screenshots. Think - what kind of projects would you like to work on in the future? Aside from this project, what other projects did you have in mind that you'd love to share? 	20 min	
	Review and Transition	5 min	

Activity 10: Capstone Project Review		60 minutes	Instructor Notes
Activity Session	Present your project to the team.	60 min	It's all right if the Capstone Projects are not finished or "production ready." Encourage participants to continue to develop their projects to enhance their portfolios.
Office Hour Session		30 min	
	Provide a final review of the Capstone Project. Address any final questions or challenges.		