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What Is Amazon Sumerian?

Amazon Sumerian is a set of browser-based tools for creating high-quality virtual reality (VR), augmented reality (AR), and 3D applications easily without requiring any programming or 3D graphics expertise. With Sumerian, you can construct an interactive 3D scene without any programming experience, test it in the browser, and publish it as a website that is immediately available to users.

Use the Sumerian library of assets or bring your own. Sumerian also has a library of primitive shapes, 3D models, hosts, textures, and scripts.

**Note**
New to 3D, VR, animation, and scripting? The Sumerian community website has a ton of helpful tutorials for every level of experience.

The Sumerian 3D engine provides a library for advanced scripting with JavaScript but you don't have to be a programmer to create interactive AR, VR, or 3D! Use the built-in state machine to animate objects and respond to user input like clicks and movement.

When you're ready to share your work with the world, you can publish it directly to Amazon CloudFront as a website. For scenes created for Virtual Reality, scenes can be viewed with a WebVR or WebXR-compatible browser. Experiences can be viewed on your desktop, mobile devices, and major VR headsets. Note that Augmented Reality (AR) support remains unchanged, as WebXR support for AR is not yet finalized.
Amazon Sumerian Use Cases and Requirements

At the core of Amazon Sumerian is a web-based editor for constructing 3D scenes with animation, scripted interaction, and special effects. The editor runs in your web browser, and all of your data is stored in AWS. For scenes created for Virtual Reality, the editor outputs scenes to Amazon CloudFront as a website that you can load directly into any WebVR or WebXR-compatible browser and headset, or embed in your website for others to access. Note that Augmented Reality (AR) support remains unchanged, as WebXR support for AR is not yet finalized.

Note
Don't know how to script? The Sumerian editor provides a fully featured state machine for scripting animations and user interactions visually, with no coding required.

WebXR is a group of standards used together to support rendering virtual reality (VR) applications or for adding virtual elements to the real world through augmented reality (AR) experiences. WebXR applications, like any web app, are supported on several desktop and mobile operating systems. This enables you to avoid the need to port your application to different programming languages and package formats to reach all users. Sumerian provides tools and components that you can use to add VR to your scene (p. 227). Note that Augmented Reality (AR) support remains unchanged, as WebXR support for AR is not yet finalized.

Sumerian also lets you create augmented reality (AR) applications. An AR application can use your phone's camera or an AR-compatible headset to overlay graphics on the real world. Sumerian provides a template and sample application (p. 228) for creating ARKit applications for iOS and ARCore for Android devices.

Sumerian provides a library of optimized 3D objects and scene templates that you can use to construct scenes without any existing assets. If you do have 3D models, you can import them with their animations and textures by dragging them from your file system into the editor canvas. Sumerian supports models in OBJ and FBX formats.
Amazon Sumerian Permissions

You can use AWS Identity and Access Management (IAM) to grant Sumerian permissions to users and compute resources in your account. IAM controls access to AWS at the API level to enforce permissions uniformly and securely.

IAM Managed Policies for Sumerian

To make granting permissions easy, IAM supports managed policies for each service. A service can update these managed policies with new permissions when it releases new APIs. Sumerian provides managed policies for user permissions needed to use the Sumerian editor.

- AmazonSumerianFullAccess – Permission to use all Sumerian features.

```json
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": 
                [  
                    "sumerian:*"  
                ],
            "Resource": "*"
        }  
    ]
}
```

To add a managed policy to an IAM user, group, or role

1. Open the IAM console.
2. Open the role associated with your instance profile, an IAM user, or an IAM group.
3. Under Permissions, attach the managed policy.

You only need access to Sumerians APIs. Sumerian manages all of the storage (Amazon S3) and content delivery (Amazon CloudFront) related to the scenes that you create outside of your account.

Granting a Scene Access to AWS Services

To use AWS services in a scene, the scene needs credentials as well. You can use Amazon Cognito Identity to create an identity pool that gives the scene access to a role with permission to use AWS. Create a role that has permissions to any services that you will access from scripts, and permissions for components that use AWS services.

To create an identity pool for a Sumerian scene

1. Open the Federated identities page in the Amazon Cognito console.
2. Choose Create new identity pool.
3. Create a pool with the following settings.
• Unauthenticated identities – enabled
4. Choose Edit identity pool to see the pool details.
5. Note the Identity pool ID for later use.

When you create an identity pool, Amazon Cognito prompts you to create two roles, an authenticated role, and an unauthenticated role. Add permissions to the unauthenticated role.

To add permissions to an identity pool role for a Sumerian scene
1. Open the Roles page in the IAM console.
2. Choose the role named Cognito_pool-nameUnauth_Role.
3. Choose Attach policy and add policies for the services that your scene uses.
   • Speech component – AmazonPollyReadOnlyAccess gives the scene permission to use Amazon Polly to render text into audio with the speech component (p. 179).
   • AWS SDK for JavaScript – add policies that grant access to the services that you call with the SDK for JavaScript. For example, AmazonS3ReadOnlyAccess.

Assign the identity pool to your scene under AWS configuration (p. 68) in scene settings.

Restricting Access to a Published Scene

To prevent public access to a scene, embed it in a web app by using AWS Amplify. When you deploy a scene privately (p. 57), Amazon Sumerian packages it for playback but doesn't publish it to a public location. You can then use the Amplify library to load it into your app.

Amplify uses credentials from an Amazon Cognito identity pool to download a scene securely from Sumerian. You can grant your identity pool's role access to all scenes in your account, or just to scenes in a specific project.

To grant access to all scenes, add the following policy to your identity pool's role.

```json
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "sumerian:ViewRelease"
      ],
      "Resource": "*"
    }
  ]
}
```

To grant access to a single project, specify the project by using the Resource key.

```json
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "sumerian:ViewRelease"
      ],
      "Resource": "project-arn"
    }
  ]
}
```
},
]}
]
Amazon Sumerian Tutorials and Samples

You can start working with the Sumerian editor quickly with just a web browser. We recommend using the latest versions of Google Chrome or Firefox.

To get familiar with the Sumerian editor, build a scene by using the getting started tutorial (p. 6). The tutorial introduces entity management, cameras, configuration, and state machines.

Next, learn about working with external assets by downloading and importing a sample character model (p. 16). You can create models with free tools and import them into your Sumerian scene, converting them to Sumerian assets with texture and animation data intact.

Do more with cameras and state machines by recreating the model showcase scene (p. 18). Learn how to configure a camera script and use a state machine to trigger animations in response to user input.

To get started check out the Amazon Sumerian Basics: Create Your First Scene tutorial or take the Sumerian Beginner Video Course.

Topics
- Getting Started with Amazon Sumerian (p. 6)
- Working with a Sample Model (p. 16)
- Building a Model Showcase (p. 18)

Getting Started with Amazon Sumerian

To get started with Amazon Sumerian, assemble a scene from assets in the Sumerian library. In less than an hour, you can create a scene with assets form the Sumerian asset library, state machine animation, and support for virtual reality (VR) headsets. This tutorial also shows basic use of scripting with the speech component, which uses Amazon Polly to render text into audio.

Sections
- Prerequisites (p. 6)
- Create a Project and Scene (p. 7)
- Configure the Scene (p. 7)
- Add and Configure Entities (p. 9)
- Add Behavior (p. 11)
- Add VR Mode (p. 14)
- Publish and View the Scene (p. 15)
- Clean Up (p. 15)
- Next Steps (p. 16)

Prerequisites

To use the Sumerian editor, you need permission to use Sumerian APIs on your IAM user. Additionally, the scene itself needs permission to call Amazon Polly. You provide this permission by creating a role and an Amazon Cognito identity pool. Following the instructions at Amazon Sumerian Permissions (p. 3) to set up both.
You can use the editor in recent versions of Chrome or Firefox. To view the finished scene in VR, use the latest version of Firefox. For VR mode, you also need a compatible headset.

**Supported VR Headsets**

- Oculus Rift
- Oculus Go
- Oculus Quest
- Oculus Rift 5
- HTC Vive
- HTC Vive Pro
- Samsung Gear VR

**Create a Project and Scene**

Create a project and a scene. The project can contain multiple scenes, as well as asset packs and templates that you create from those scenes.

**To create a project and scene**

1. Open the Sumerian dashboard.
2. Choose **Projects**, **New project**.
3. Enter **tutorials** for the project name and then choose **Create**.
4. Choose **Create new scene**.
5. Enter **seesaw** for the scene name and then choose **Create**.

**Configure the Scene**

A skybox is a texture or set of textures that wraps around the scene to provide a background image. Add a skybox from the Sumerian **Asset** library.

**To import a skybox from the Sumerian library**

1. Choose **Import assets** at the top of the screen.
2. Choose **Blue skysphere**. If you don't find it right away, click the skybox icon to filter the list.
3. Choose **Add**.

This adds the skybox asset pack to the **Asset** panel. The pack contains the skybox asset, and the PNG-formatted texture that the skybox uses. Add the skybox to the scene in the scene settings under **Environment**. While you're there, add some fog and snow.

**To configure the scene's environment**

1. Choose the root node (**seesaw**) in the **Entities** panel, or click on the background of the scene in the canvas. The groups of options that appear in the inspector panel on the right side of the screen are **scene settings**.
2. Click the **Environment** section to expand it. Expand the **Skybox**, **Fog & Ambient**, and **Particles** sections under it.
3. Click and drag the **Blue skysphere** skybox from the assets panel to the **Drop skybox** field in the inspector panel to attach it to the scene.
4. Choose **Fog** to enable it and configure its parameters:
   - **Fog near** – 5
   - **Fog far** – 20

   This starts fading in fog at 5 units away from the camera, and completely obscures anything 20 units away or farther.

5. Choose **Snow** to enable it, and then configure its parameters:
   - **Velocity** – 20
   - **Rate** – 30
   - **Height** – 100

6. Click the play button at the bottom of the screen to see the snow fall. Adjust the velocity and rate of the snow to your liking. Changes to these settings are applied immediately during playback mode.

Later in this tutorial, you configure the scene to use Amazon Polly to render text into audio during playback. To do this, your scene needs credentials to use the AWS SDK for JavaScript in the web browser. Give the scene credentials by assigning it the ID of the identity pool that you created in the prerequisites section (p. 6).

**To configure AWS SDK for JavaScript credentials**

1. Choose the root node in the **Entities** panel.

![Entities panel](image)

2. Expand the **AWS configuration** section in the inspector panel.
3. Enter the Amazon Cognito identity pool ID.

![AWS configuration panel](image)
Add and Configure Entities

Add some ground to the scene.

**To add a snowy field to your scene**

1. Choose *Create entity*.
2. Under *3D primitives*, choose the quad.
   
   The quad is selected automatically. If you select something else, you can click it in the canvas or entities panel to select it again.
3. The quad's components appear in the inspector panel on the right side of the canvas. Expand the top section and change the name of the entity to *ground*. The change is reflected in the section name and entities panel immediately.
4. Expand the *Transform* section, and then enter the following values:
   - X rotation – –90
   - X, Y, and Z scale – 100
   - Static – enabled

5. Expand the *Material* section and review the settings on each layer. You can click the diffuse or specular colors to choose a different color, or drop image files to add textures.

The space near the camera right now is pretty dark. Add a directional light to light the scene, like the sun is shining in it.

**To add a directional light**

1. Choose *Create entity*.
2. Under *Lights*, choose *Directional*.
3. Expand the *Transform* section, and then enter the following values:
   - Y translation – 10
   - X rotation – –30
• Y rotation – -60
• Static – enabled

4. Expand the Light section and enable Shadows.

Add a blank entity to represent the seesaw, and shapes for the fulcrum and plank.

To add the seesaw
1. Choose Create entity.
2. Under Others, choose Entity.
3. In the inspector panel, change the name of the entity to seesaw.
4. Choose Create entity, and then add a cylinder to the scene.
5. Rename the cylinder to fulcrum, uncheck Uniform scale, and set the Z scale to 0.6. Set the diffuse color to yellow.
6. Add a blank entity. Rename it to plank. This blank entity will serve as the parent to the plank model, as well as a camera and host entity that will move with the plank.
7. Add a box entity. Rename it to plank model. Apply the following transform and set the diffuse color to blue:
   • Y translation – 0.5
   • Z rotation – 12
   • X scale – 4.5
   • Y scale – 0.1
   • Z scale – 0.6
   • Static – disabled

Next, import a host from the Sumerian library. Hosts are Sumerian-provided character models with built-in animation and support for speech.

To add a host
1. Choose Import assets.
3. When the asset pack finishes loading, drag the host entity from the Asset panel to the canvas.
4. Apply the following transform:
   • X translation – 1.95
Add Behavior

You can add behavior to your scene by attaching script or state machine components to entities.

A state machine lets you add behavior visually by choosing actions that are triggered by events, and organizing them into states. Add a state machine to the plank entity to animate it and its children.

To animate the plank with a state machine.

1. Choose the plank in the entities panel.
2. In the inspector panel, choose Add component. Then choose State machine.
3. Click the plus symbol next to the behavior field to create a new behavior. Name it animate.
4. The State machine panel appears with a single state. Name the state up, and then choose Add action.
5. Under Animate, choose Tween rotate. Apply the following properties:
   - Z rotation – 24
   - Relative – disabled
   - Time – 1000
   - Easing type – Linear
   - Direction – In
6. Choose **Add action** again, and then add a **Wait** action. Apply the following properties:
   - Time – 2000
   - Random – 0

7. In the **State machine** panel, choose **Duplicate state** to make a copy of **up**. Double-click the new state to open it in the inspector panel.

8. Change the state's name to **down**, and then change the rotation value from **–24** to **0**.

9. In the **State machine** panel, each state shows two events, one that occurs at the end of the animation, and one that occurs at the end of the wait action. Click the **On wait end** event under **up** and drag a line to the **down** state. Then do the same in the other direction.

10. Play the scene to watch the seesaw animate.

Add a camera to the other end of the seesaw and make it the default camera. During playback, the user will stay in one location and look around the environment. A built-in camera script allows the user to look around with the mouse prior to entering VR mode.

**To add a camera with mouse look controls**

1. Choose **Create entity**, and then add a fixed camera to the scene. Rename it to **user**, and then apply the following transform:
   - X translation – **–2.5**
   - Y translation – **1.2**
   - Y rotation – **–90**

2. In the entities panel, drag the camera onto the **plank** entity to make it move with the seesaw.

3. In the camera's **Camera** component, apply the following properties:
   - Main camera – enabled
- FOV = 35

4. Choose **Add component**, and then add a script component to the camera.

5. Click the plus symbol next to the script field, and then choose **Mouse look control**. This adds an instance of the mouse look built-in script. All instances of a script share the same script code, but have separate parameter values.

6. To prevent the user from looking too low, change the **Min ascent** parameter to \(-40\).

7. Play the scene and confirm the camera's behavior. Click and drag the left mouse button to look around the scene. You can adjust the script's parameters during playback and see how they affect the controls immediately.

---

**To configure speech on the host**

1. Choose the host in the canvas or entities panel.

2. Under **Speech**, drop some text files onto the speech field. You can use the files in this archive: `sonnets.zip`.

3. Choose a voice for the host. See **Available voices** in the *Amazon Polly Developer Guide* for a list of voices sorted by locale.

4. Add a script component to the host.

5. Click the plus symbol next to the script field, and then choose **Custom**.

6. Click edit (pencil icon) in the script instance parameters to open the script in the text editor. You can also press the **J** key to open the text editor at any time.

7. Double-click the script name (**Script**) in the **Documents** list to change the name to **RandomSpeech**.

8. Replace the placeholder **setup** function with the following.

   ```javascript
   var setup = function(args, ctx) {
     sumerian.SystemBus.addListener('aws.sdkReady',
       () => {
         var speechComponent = ctx.entity.getComponent("speechComponent");
         var speeches = speechComponent.speeches;
         var speech = speeches[Math.floor(Math.random() * speeches.length)];
         speech.play();
         true
       },
     true
   );
   }
   ```

   This script waits for the AWS SDK for JavaScript to load and retrieve credentials. Then it gets a reference to the speech component on the same entity (the host), and gets a list of all of the attached speeches. It chooses a speech from the array and plays it.

9. Play the scene to see the host recite a speech.

10. Return to the speech component and click \[\] next to each speech file to add gesture markup.

11. Play the scene again to see the host recite a speech with gestures.
Add VR Mode

So far you've only used a standard camera in playback mode. Add a virtual reality (VR) rig to let users view the scene in 3D with a VR headset and head tracking. Sumerian bundles the entities and scripts required for VR mode in an asset pack named **CoreVR**.

**To add VR mode**

1. Choose **Import assets**, and then add the **CoreVR** asset pack to your scene.
2. When the asset pack finishes loading, drag the **VRCameraRig** entity onto the canvas to add it to your scene.
3. Choose the **VRCameraRig** entity.
4. Choose the **VRCameraRig** component.
5. Choose the **Current VRCameraRig** option to enable the rig.
6. Uncheck the **Start at current camera** option. This enables use of the camera rig where it's placed in the scene, instead of using the location of the non-VR camera when the user enters VR mode.
7. In the entities panel, drag the **VRCameraRig** entity onto the **plank** entity to make it a sibling to the user camera.
8. Choose the **user** camera. Click the cog icon on the **Transform** section, and then choose **Copy** to copy the transform values.
9. Choose the **VRCameraRig**. Click the cog icon on the **Transform** section, and then choose **Paste** to paste the transform values from the user camera.
10. Use the green transform handle to adjust the height of the VR camera relative to the plank.
11. Play the scene and click the VR headset icon to enter VR mode.

Publish and View the Scene

Time to share your scene with the world. Publish the scene with Amazon CloudFront to host it as a website that anyone can see.

To publish the scene
1. Open your scene in the Sumerian editor.
2. Choose Publish.
3. Choose Create public link.
4. Choose Publish.

Clean Up

Your published scene is public and will stay online until you unpublish it.

To unpublish the scene
1. Choose Publish.
2. Choose **Unpublish**.
3. Choose **Unpublish**.

You can keep the Sumerian scene and project around for use with other tutorials, or delete them. You can always restore the deleted items later from the trash menu.

**To delete the project**

1. Open the Sumerian dashboard.
2. Choose a project.
3. Under **Project details**, choose **Delete**.

If you created an identity pool for this tutorial and don’t plan to use it again, delete it in the Amazon Cognito console.

**Next Steps**

Learn more about Sumerian in the next chapter, *Amazon Sumerian Concepts (p. 21)*.

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**Working with a Sample Model**

A sample model in FBX format is available in the amazon-sumerian-user-guide GitHub repository. The model includes animations that you can use to explore animation-related features in Sumerian.

Download the model by using this link: **american-robin.fbx**

**Example Scene**

Click or tap the model to play a random animation.

The model file contains multiple types of data:

- **Mesh data** – The 3D wireframe that defines the shape of the model.
- **Texture data** – The 2D image that wraps around the mesh to color the model.
- **Animation data** – The skeleton that deforms the mesh, and animations that move the skeleton.
- **Other entities** – The file can also include auxiliary entities such as lights and cameras.

When you import a model file, Sumerian processes it and stores the resulting assets in the scene.

**To import the model**

1. Open the Sumerian dashboard.
2. Choose or create a project (p. 23).
3. Create a new scene (p. 24).
4. To import the model, drag it from your computer's file explorer onto the canvas.
5. Sumerian processes the model and adds an asset pack to the **Assets** panel with the following assets:
   - **american-robin.fbx** – The parent entity that represents the model.
   - **american-robin** – The model's texture image.
• **Material** – The material that contains the texture and shader configuration for the model.

• **mesh_Material_Mesh** – The model's wireframe mesh.

• **Skeleton** – The animation skeleton from the model's armature.

• **Armature|BEAK, Armature|HOP, Armature|JUMP, Armature|PECK, Armature|FLAP** – A clip for each animation take in the model file.

• **Animations** – A container for the animation clips that can be applied to an animation component (p. 200).

For more information about each type of asset, see Amazon Sumerian Assets (p. 225).

Adding the model to your scene is a separate step that takes the assets from the model and creates entities that represent them in the scene.

**To add the imported model to your scene**

1. Drag the *american-robin.fbx* entity from the **Assets** panel onto the canvas.

2. Sumerian adds multiple entities to your scene in a hierarchy, as shown in the **Entities** panel:

   • **American-robin.fbx** – An empty entity with an animation component that contains the model's animations.

   • **thrush_Material** – The visible part of the model, contained in an entity that has geometry and material components. The geometry component contains the model's mesh and skeleton. The material component contains the texture file and shader settings. This model uses a diffuse shader with smooth shading.

   • **Light-1, Light-2, Light-3** – Three point lights that light the model. You can drag these to a different location in the hierarchy or delete them and create new lights.

   • **Armature** – An empty entity that represents the armature that was used to rig the model for animation.

Adding the model to your scene creates a copy of the entities that it comprises. The other types of asset in the model, however, are referenced from the scene's assets. So when you add the same model to your scene multiple times, they have independent entity settings, such as location, rotation, and scale. But they also share references to the texture, material, and animation assets.

If, for example, you change the opacity on the material component of the **thrush_Material** entity, it changes the settings on that material in the **Assets** panel, and on any other copies of the model created in the past or in the future. Alternatively, if you change the Y rotation of the entity in the scene, it affects only that instance of the model. And if you change the rotation of the entity in the **Assets** panel, it affects only new copies of the model that you add to the scene after setting the rotation.

Within the **Assets** panel, the model's assets are organized into an asset pack. To create a copy of the asset pack that you can import into other scenes, export it to your project.

**To export the model in an asset pack**

1. Choose the asset library icon to export the asset pack.

2. Choose a category for the pack. For models with multiple types of asset, you can choose **Entities** or **Other**.

3. Choose **Add to asset library**.

You can now import the model into other scenes by choosing **Import assets** at the top of the scene. Each time you import or export an asset pack it creates a copy with no references or links to other scenes.
Learn how to make the model interactive and customize the scene camera in the next topic (p. 18).

Building a Model Showcase

To showcase the sample model (p. 16), the example scene uses a state machine and one of the built-in camera types. The state machine waits for user input (click or touch), and triggers one of the animations included in the model at random. The orbit camera type supports both mouse and touch input for orbiting, zooming, and panning.

Example Model Showcase

Use the following procedures to recreate the sample scene.

To add the state machine behavior

1. Choose the parent entity, and then choose Add component, State machine.
2. To create a behavior, choose the plus symbol in the state machine panel. Add the following states and actions.

   Example States for triggering animation

   - initialize – Pause animation pauses all animations on the entity. This prevents the default animation from playing when the scene starts. Click/tap on entity transitions to the next state when the user interacts with the model.
   - randomizer – Random transition chooses between two states. Chain multiple randomizer states together to link to all available animations.
   - animate – Set animation sets the active animation. After the animation plays for the specified number of loops, it transitions to the next state. Resume animation plays the animation.
The scene camera has an *orbit and pan* script that supports the following controls.

**Controls**

- **Orbit** – Right-click and drag, or touch and drag.
- **Pan** – Middle-click and drag, or two-finger touch and drag.
- **Zoom** – Mouse wheel or pinch.

Add the camera to the scene and configure it to orbit around the origin point, where the model is.

**To add the camera**

1. To add a camera to the scene, choose **Create entity, Orbit camera**.
2. In the transform component, apply the following settings:
   - **X translation** – 5.5
   - **Y translation** – 3.5
   - **Z translation** – 4
   - **X rotation** – -20
   - **Y rotation** – 50
3. In the camera component, apply the following settings:
   - **Main camera** – enabled
   - **FOV** – 30
4. In the script component, apply the following setting:
   - **Look at distance** – 7.65

The *look at distance* is the distance from the camera to the model, so the model stays in the center of the screen as you click-drag or touch-drag to move the camera around. If you move the camera to a different starting point, you can recalculate the look at distance by taking the square root of the sum of the squares of the camera's X, Z, and Y translations.

Set the background color in the scene's **environment settings (p. 72)**.

**To set the background color**

1. Choose the root node in the **Entities** panel.
2. Expand the **Environment** section in the inspector panel.

3. Choose the background color square.
4. To choose a color, use the color picker or enter a hex or RGB color code. The example scene uses color hex **adcac8**.

Play the scene in the editor, or [publish it](#) (p. 57).
Amazon Sumerian Concepts

Amazon Sumerian lets you create virtual reality (VR), augmented reality (AR), and 3D scenes that are made up of components and entities, organized into projects. Let’s look closely at the concepts used in the Sumerian editor and this guide.

**Scenes**

A scene is a 3D space that contains objects and behaviors that define a VR or AR environment. Objects include geometry, materials, sounds that you import from a supported file format, and objects that you create in the scene like lights, cameras, and particle effects. Behaviors include state machine behaviors, animations, timelines, and scripts.

When you’re ready to show off your scene, export it directly to Amazon CloudFront as a static website that you can open in a browser.

See [Scenes](p. 24) for more information.

**Components and Entities**

All objects and behaviors are components that combine to create entities. For example, when you import a 3D model and add it to a scene, the editor creates an entity that has a geometry component, a material component, a transform component, and an animation component. You can then use the editor to add a rigid body, colliders, and other components to the entity.

See [Amazon Sumerian Entities and Components](p. 80) for more information.

**Assets**

Assets are the images, sounds, scripts, models, and documents that you import into Sumerian to use in a scene. You can manage assets independently of the scenes that use them in the asset library. Assets can belong to a user or project.

See [Asset Packs](p. 25) for more information.

**Hosts**

A host is an asset provided by Sumerian that has built in animation, speech, and behavior for interacting with users.
Hosts use Amazon Polly to speak to users from a text source. You can use hosts to engage users and guide them through a virtual experience.

See Amazon Sumerian Host Component (p. 177) for more information.

Projects

Projects are an organizational tool for managing scenes, assets, and templates.

See Projects (p. 23) for more information.

Templates

Templates let you save a copy of a scene to use as a starting point for other scenes. Templates belong to a project. Sumerian provides several templates, which you can access from the dashboard.

See Templates (p. 26) for more information.
The Amazon Sumerian Dashboard

The Dashboard is the first thing you see when you open Amazon Sumerian. This is where you manage your projects, scenes, asset packs, and templates.

Projects

Projects collect scenes and the templates and asset packs that you export from them. You can create draft projects outside of a project, but you must have a project to export templates and assets.

When you open a scene in the editor, it is locked to prevent other users from modifying it. The dashboard manages locks and lets you steal a lock if the other user leaves a scene open by accident.

Topics

- Projects (p. 23)
- Scenes (p. 24)
- Asset Packs (p. 25)
- Templates (p. 26)
- Trash (p. 26)
- Locks (p. 27)

Projects

Projects collect the scenes that you are working on. You can create up to 1,000 projects per region.
To create a project
1. Open the Sumerian dashboard.
2. Choose Projects.
3. Choose New project.
4. Enter a project name and choose Create.

Once you have a project, you can use the dashboard to make a copy or delete it.

To manage a project
1. Open the Sumerian dashboard.
2. Choose a project.
3. Under Project details, use one of the following options.
   • Thumbnail – Choose Browse to upload a thumbnail image.
   • Name – Change the project name.
   • Description – Change the project description.
   • Actions – Move or Copy the project. Delete the project to send it to the Trash.
   • Published URLs – Choose View URL List to get links to all of the project’s scenes that have been published in Amazon CloudFront.

Scenes
A scene is a 3D space that you manage in the dashboard and work on in the Sumerian editor. Sumerian provides several templates that you can use as a starting point.

Scenes can be drafts, or part of a project. You can create up to 10,000 scenes per region.

To create a scene
1. Open the Sumerian dashboard.
2. Choose the location to create the scene.
   • Home – Create a draft scene.
   • Drafts – Create a draft scene.
   • Project – Create a scene in one of your projects.
3. Choose Create scene.
4. (optional) Choose a template (p. 26).
5. Enter a scene name and choose Create.
When you create a scene, it opens in the Sumerian editor (p. 29) for immediate use. Once you have a scene, you can use the dashboard to make a copy or delete it. Choose the Sumerian icon in the upper left corner to leave the scene and return to the dashboard.

To manage a scene
1. Open the Sumerian dashboard.
2. Locate your scene under Recent scenes, Drafts, or a project.
3. Choose the scene by clicking its thumbnail.
   
   **Note**
   If you click on the name of the scene or double-click the thumbnail, the scene opens in the Sumerian editor.
4. Under Scene details, use one of the following options.
   - **Thumbnail** – Choose Browse to upload a thumbnail image.
   - **Name** – Change the scene name.
   - **Description** – Change the scene description.
   - **Tags** – Add tags to the scene for use with filters.
   - **Actions**
     - **Open** – Open the scene in the Sumerian editor.
     - **View published** – (public scenes) Open the published version of the scene hosted in Amazon CloudFront.
     - **Download Amplify JSON** – (private scenes (p. 57)) Download the Amplify configuration file.
     - **Move** – Move the scene to a different project.
     - **Copy** – Copy the scene to a different project.
     - **Duplicate** – Create a copy of the scene in the same project.
     - **Delete** – Send the scene to the Trash

   Additional options for scenes are available in the Sumerian editor scene settings (p. 66).

### Asset Packs

The Assets page for a project shows asset packs that have been exported from a scene.

In the dashboard, you can change the name and description of a pack, and copy or move it to another project.

To manage an asset pack
1. Open the Sumerian dashboard.
2. Choose a project.
3. Choose Assets.
5. Under Asset details, use one of the following options.
   - **Thumbnail** – Choose Browse to upload a thumbnail image.
   - **Name** – Change the asset pack name.
   - **Description** – Change the asset pack description.
   - **Tags** – Add tags to the asset pack for use with filters.
   - **Actions**
• **Move** – Move the asset pack to a different project.
• **Copy** – Copy the asset pack to a different project.
• **Delete** – Send the asset pack to the Trash

Additional options for asset packs are available in the Sumerian editor (p. 226).

## Templates

Templates are scenes that have been exported from a project for use as a starting point for other scenes. In addition to the templates provided by Sumerian, the dashboard lets you manage templates that you have exported from a scene.

You can use the dashboard to create a scene from a template, or move or copy templates between scenes. Sumerian also provides a library of templates.

### To create a scene from a template

1. Open the Sumerian dashboard.
2. Choose Create new scene.
3. Choose one of the Sumerian Templates, or choose My templates to use a template from one of your projects.
4. Enter a name for your scene and choose Create.

Create templates from your scenes from the scene settings section (p. 66) in the Sumerian editor. You can then copy your templates to other projects from the Templates section of the scene's project page in the dashboard.

### To manage a template

1. Open the Sumerian dashboard.
2. Choose a project.
3. Choose Templates.
4. Choose a template.
5. Under Template details, use one of the following options.

   • **Thumbnail** – Choose Browse to upload a thumbnail image.
   • **Name** – Change the template name.
   • **Description** – Change the template description.
   • **Tags** – Add tags to the template for use with filters.
   • **Actions**
     • **Move** – Move the template to a different project.
     • **Copy** – Copy the template to a different project.
     • **Delete** – Send the template to the Trash

### Trash

When you delete a scene, project, template, or asset pack, Amazon Sumerian moves it to the trash. Items in the trash are retained indefinitely and you can restore them at any time.
You use the trash menu to restore deleted items or delete them permanently.

**To restore a deleted item**

1. Open the Sumerian dashboard.
2. Choose Trash.
3. Choose an item, and then choose Restore.

Restored items are returned to their original project.

To avoid paying storage costs for deleted items, delete them permanently.

**To delete items permanently**

1. Open the Sumerian dashboard.
2. Choose Trash.
3. Choose an item, and then choose Delete.
   
   or

   Choose Empty trash.
4. Choose Delete.

**Locks**

The Amazon Sumerian editor uses locks to control modifications to a scene. When you open a scene, the editor creates a lock on the scene and refreshes it periodically. If you try to open the scene in a different browser while the lock is active, you will see an error.
You can force Sumerian to discard the lock if you are sure that no one else is working on the scene, or create a copy of the scene and work on that.
Amazon Sumerian Editor

The Sumerian editor provides an interface for easily importing assets, building a scene, and publishing the scene on the internet.

When you load a scene in the Sumerian editor, you can see a menu bar at the top of the screen, the entities panel, the assets panel, the canvas, and the inspector panel. This menu bar provides menus for navigating between scenes, accessing tools, and publishing.

**Top bar**

- **Scene** – Return to the dashboard, open a recent scene, or export the scene.
- **Tools** – Access the text editor, behavior editor, and timeline editor.
- **Create entity** – Add a shape, light, camera, or blank entity to the scene.
- **Import assets** – Open the asset library.
- **Help** – View the shortcut list or submit feedback.
- **Username** – Log out.

The status bar at the bottom of the screen shows updates about save, import, and rendering operations.

**Status bar**
- **Progress bar** – Shows information about the current activity, such as model uploading.
- **Path** – The current user, project, and scene.

The following topics describe the menu options in each of the areas of the editor.

**Panels and Menus**
- Amazon Sumerian Editor Canvas (p. 30)
- Importing Assets From the Asset Library in the Amazon Sumerian Editor (p. 36)
- Using the Assets Panel in the Amazon Sumerian Editor (p. 37)
- Using the Entities Panel in the Amazon Sumerian Editor (p. 39)
- Using the Inspector Panel in the Amazon Sumerian Editor (p. 44)
- Using the Tools in the Amazon Sumerian Editor (p. 47)
- Keyboard and Mouse Controls for the Amazon Sumerian Editor (p. 52)
- Publishing Scenes in the Amazon Sumerian Editor (p. 57)
- Exporting to glTF from the Amazon Sumerian Editor (p. 62)

**Amazon Sumerian Editor Canvas**

The WebGL-rendered viewport is located in the center of the Sumerian editor. Here you can navigate, inspect, and preview the contents of your scene.
The menu bar at the top of the canvas has options for camera, playback, and rendering. Many of the buttons also have equivalent keyboard commands (p. 52).

**Canvas Menu**

- Change the transform handles to translate mode.
- Change the transform handles to rotation mode.
- Change the transform handles to scale mode.
- Switch between relative and absolute positioning.
- Choose the render mode for the canvas.
- Show or hide the skybox (p. 231) texture.
- Show or hide the grid.
- Show or hide post effects.
- View the scene with a preset camera.
- Fill the canvas with the selected entity.
- Fill the canvas with all entities in the scene.
- Fill the screen with the canvas.
- Hide or show side panels.
- Preview the rendered scene in the canvas.

**Editor Camera Controls**

**Editor Camera Mouse and Keyboard Controls**

- **Right-Drag** – Orbit around the position in the center of the canvas.
- **Left-Drag + SHIFT + Option(Mac)/Alt(Windows)** – Pan left or right, up or down.
- **Middle-Drag** – Pan left or right, up or down.
- **Scroll Wheel** – Zoom in/out. Note that the editor camera can only zoom in as far as transform value of the selected entity.
Note: Trackpads are supported by Sumerian. Trackpad controls will use the respective mouse actions defined by the settings on your computer.

By default, middle-clicking in Firefox enables autoscroll. To use the middle button to pan within a Sumerian scene, you will need to change your browser settings:

1. Open up a new tab in your browser.
2. Type in `about:config` in the URL search bar.
4. Once `general.autoScroll` populates, double-click the `true` value to make it false.

Multi-Selecting Entities

Sumerian now supports the ability to select multiple entities. To select multiple entities using the canvas, Left-Drag your cursor to create a blue bounding box. All entities whose individual bounding boxes intersect, or are enclosed in the box, will be selected. Additional entities can be added to the selection by holding SHIFT + Left-Drag to create another bounding box. Entities can be subtracted from the selection by selecting them while holding CMD(Mac)/Ctrl(Windows).
Once multiple entities are selected each entity will be highlighted.
If multiple entities are selected you can perform the following actions:

- Delete all entities by clicking the delete button in the **Entities** panel.
- Duplicate all entities by clicking the duplicate button in the **Entities** panel.
- Change **Transform** values by moving the canvas handles. The **Transform** handles will be placed at the average position of all selected entities.

Note that if multiple entities are selected, the **Inspector** panel will be disabled.
Importing Assets From the Asset Library in the Amazon Sumerian Editor

You can use the Sumerian editor's asset library to import assets from the Sumerian library, your local machine, or from asset packs (p. 226) that you export from a scene.

To import assets

1. Open a scene in the Sumerian editor.
2. Choose Import assets.
3. Choose an asset type (p. 225) to filter the available assets by type.
4. Choose an asset pack, and then choose Add to add it to your scene's assets.
5. After the editor finishes importing the asset pack, drag the entity that it contains (look for the hexagon icon) from the assets panel (p. 37) onto the canvas to add it to your scene.

Using the Assets Panel in the Amazon Sumerian Editor

The assets panel shows all assets that belong to the scene. Assets are portable versions of entities or entity components. You can create them from external files or from entities that you create within the editor.
To create an asset, drop a file from your machine, or an entity from the entities panel, onto the assets panel. Depending on the type of file, you may be able to split the file into multiple assets.

The **Default Pack** is included in every Sumerian scene. This pack is used to store default assets and any other assets that do not belong in a specific pack.

Sumerian now supports the ability to select multiple assets. To select multiple assets using the Assets panel select an asset, hold SHIFT and click another entity to select all the sequential entities between the two selected assets. Hold the CMD(Mac)/Ctrl(Windows) key to toggle the selection state of individual, or non-sequential assets.

Asset packs can also be imported using the import button (i.e. folder icon).
Available Actions Using the Assets Panel

- Filter assets using the asset icons at the top of the panel
- Create, manage, and move packs and assets
- Drag and drop entity assets to canvas or **Entities** panel to add them to your scene
- Drag and drop assets to **Inspector** panel to apply the asset to selected entities
- Assets can also be applied to other assets, such as adding a behavior to a state machine component, or editing an entity-type-asset that is not in the scene
- Assets that do not appear in the scene can be selected and edited in the **Inspector** panel

Action Buttons for Assets

The following buttons will appear when hovering over an asset.

- Edit button to edit assets in the **Inspector** panel. This is only applicable to some assets
- Dependencies button to show asset dependencies (other assets that depend on the selected asset)
- Duplicate button to duplicate assets
- Delete button to delete assets. Note that assets used in the scene cannot be deleted

Action Buttons for Asset Packs

The following buttons will appear when hovering over an asset pack.

- Create a new asset and add it to the selected pack
- Add asset packs to the Asset Library
- Delete unused dependencies from the selected pack
- Delete the selected asset pack

For more information, see **Amazon Sumerian Assets (p. 225)** or check out the **Assets Panel Deep Dive tutorial**.

Using the Entities Panel in the Amazon Sumerian Editor

The entities panel shows you a scene's entities in a hierarchy, starting with the scene itself. An entity can be a child of the scene or of another entity. When you choose the scene in the entities panel, the **inspector panel (p. 44)** (on the right side of the editor) shows the scene's settings. When you choose an entity, the inspector panel shows the entity's components.
Organize your entities by their physical or logical relationship to other entities. An entity's position, rotation, and scale are relative to its parent. When you move the parent, the child moves as well. To change an entity's parent, drag and drop it onto the new parent in the entities panel.

**Entities panel controls**

- Collapse the entity to hide its children in the entities panel.
- Hide or show an entity in the canvas.
- Duplicate an entity.
- Delete an entity.
- Undo or redo changes.

Double click an entity's name to rename it. Double click the entity's icon to frame it in the canvas.

**Hierarchy Navigaton using the Arrow Keys**

Use the keyboard arrows to navigate selections in the **Entities** panel. The UP and DOWN arrows move the selection up and down through displayed entities in the hierarchy when a single entity is selected.

The LEFT/RIGHT arrow keys navigate up/down to sibling entities (entities that share the same parent). If a parent entity is expanded the LEFT arrow keys in the hierarchy. will collapse it. If a parent entity is not expanded the RIGHT arrow keys will expand the entity to display the child entities.

Lastly, if an entity is selected but hidden by a collapsed parent or grandparent entity, clicking any of the four arrow keys will make the selection visible on the first click. After this expansion, the arrow keys will return to their normal functions.

Note that when multiple entities (non-siblings) are selected the arrow keys cannot be used to navigate.

**Multi-Selecting Entities**

Sumerian now supports the ability to select multiple entities. To select multiple entities in the **Entities** panel select an entity, hold SHIFT and click another entity to select all the sequential entities between
the two selected entities. The scene node (the top level entity) cannot be included in a selection of multiple entities.

Hold the CMD(Mac)/Ctrl(Windows) key to toggle the selection state of individual, or non-sequential entities.
Once multiple entities are selected each entity will be highlighted in the canvas.
If multiple entities are selected you can perform the following actions:

- Delete all entities by clicking the delete button in the Entities panel
- Duplicate all entities by clicking the duplicate button in the Entities panel
- Change Transform values by moving the canvas handles
- Reparenting - moving child entities from one parent to another

Note that if multiple entities are selected, the Inspector panel will be disabled.
Using the Inspector Panel in the Amazon Sumerian Editor

Use the inspector panel to manage scene settings, entities, and assets. When you select any of these elements in the Sumerian editor, you get the following properties in a section named after the element.
When you choose the scene in the entities panel (p. 80), or click the scene's background in the canvas, the inspector panel shows several additional sections for settings that apply to the entire scene. These include environmental settings, post-processing effects, and AWS SDK credentials. See ??? (p. 66) for more information.

**Generic properties**

- **Thumbnail** – The thumbnail image for the element. Drop an image onto the drop input. Alternately, pause your cursor over the drop input and choose **Take screenshot** to save an image of the current view of the canvas.
- **Name** – The name of the element.
- **ID** (read-only) – A unique identifier for the element.
- **Type** (read-only) – The type of element: scene, entity, or an asset type (p. 225).
- **Description** – Description of the element.
• **Tags** – Key-only metadata that you can use in scripting. You can read tags or search for entities with specific tags by using the context object (p. 244).

• **Custom attributes** – Key-value metadata that you can use in scripting. You can read attributes by using the context object (p. 244).

The inspector panel contains the components and settings for all your entities. As seen in the image above, if the root entity (or scene entity) is selected, you will see global components and properties. If another entity within the scene is selected, you will see components specific to that entity. For example, select the *Default Camera* in the entities panel and you will see the components attached to the camera entity. Choose **+ Add Component** to add more components.

When you choose an entity in the entities panel, or click it in the canvas, the inspector panel shows a section for each component on the entity. At a minimum, every entity has a transform component that determines its location, rotation, and size. Entities you create by dropping assets onto the scene have additional components based on their type. You can add components to any entity in the inspector panel by choosing **Add component** at the bottom of the panel. See ??? (p. 80) for more information.

When you choose an asset in the assets panel (p. 37), the inspector panel shows sections for only components that apply to every instance of the asset in the scene. For example, a script asset only has code, but a script component on an entity can have parameters that customize that instance of the script. A material asset, however, has all of the material component (p. 92) properties. Modifying any of these properties changes every instance of the material in the scene.

Note that if multiple objects are selected, the **Inspector** panel will be disabled.
Using the Tools in the Amazon Sumerian Editor

The Sumerian editor has three tool panels for working with complex assets and components:

- The **Text** editor provides an interface for authoring scripts, JSON documents, and speech files.
- The **Timeline** editor animates entities between keyframes.
- The **State Machine** editor lets you visually construct and connect state machine behaviors and actions.

**Text Editor**

The text editor lets you view and modify all text assets in the scene, including scripts, JSON documents, and speech files.
To use the text editor, choose **Tools, Text editor**. Or press the J key.

The **Documents** panel lists the text assets in your scene. Click one to open it in a tab. To rename an asset, highlight it and click the pencil icon.

When you open a script, the **External Resources** panel appears. You can use this panel to import libraries from the internet that your script depends on. See **External Dependencies (p. 248)** for more information.

**State Machine Editor**

The state machine editor provides a visual representation of the actions and behaviors attached to a state machine component (p. 220).
To use the state machine editor, click the pencil icon next to a behavior in the assets panel or on a state machine component.

The State Machine editor is used to create behaviors. Each behavior has one or more states, represented by a box. Each state has one or more actions. You can select which action transitions to another state, represented by an arrow that connects the action to the target state. Click an action and drag the cursor to another state to create a transition between the two.

To add an action to a state, select the state and in the inspector panel choose **Add Action**.

Select an action from the **Action Library**.
Timeline

Use timelines to move, rotate, or change the scale of entities over time. You can set the start and end values of these properties, and add keyframes to control the speed or direction of the animation along the way. The timeline can also emit custom events, which can be consumed from a state machine or script.

For more information, see Amazon Sumerian State Machine (p. 234), the State Machine Basics tutorial, or the Amazon Sumerian Basics tutorial.
For more information, see Amazon Sumerian Timeline Component (p. 222) or the Timeline Basics tutorial.

Keyboard and Mouse Controls for the Amazon Sumerian Editor

The default camera that Sumerian adds to every scene supports mouse controls for pan, zoom, and orbiting around the camera's anchor point. It is identical to the Orbit camera type. To move the camera, press and hold a mouse button while you move the mouse. If you only have one mouse button, you can use a keyboard key plus mouse button combination to perform the same movements.

For more information about cameras and camera control, see the Camera and Light tutorial or the the Camera Deep Dive tutorial.

To see a list of keyboard shortcuts within the editor, select the Help menu drop down list and select Shortcut List.
The **Shortcut List** contains a list of all the current camera controls and keyboard shortcuts.
Editor Camera Movement

- Zoom in or out – Mouse wheel scroll up or down
• Pan – Shift+Left-Drag+Option(Mac)/Alt(Windows) or Middle-Drag
• Orbit – Right-Drag, or Alt+Left-Drag

By default, middle-clicking in Firefox enables autoscroll. To use the middle button to pan within a Sumerian scene, you will need to change your browser settings:

1. Open up a new tab in your browser.
2. Type in about:config in the URL search bar.
4. Once general.autoScroll populates, double-click the true value to make it false.

The Sumerian editor provides keyboard equivalents of most of the canvas menu buttons (p. 30). Use the bottom row of keys to switch between preset camera views, and the F key to fill the canvas with a single entity. The space bar hides the side panels to let the canvas fill the screen.

Camera

• Frame selection – F
• Frame all – Shift+F
• Bottom and top views – V
• Back and front views – C
• Left and right views – X
• Editor camera view – Z
• Show and hide side bars – Space

Select entities by clicking them in either the editor or the Entities panel. With an entity selected, use the following commands to speed up editing.
Editing

- **Delete entity** – Backspace or Delete
- **Duplicate entity** – Ctrl+D
- **Translate handles** – W
- **Rotation handles** – E
- **Scale handles** – R
- **Switch between global and relative transform** – G
- **Cycle between gizmo handles** – Q
- **Undo** – Ctrl+Z
- **Redo** – Ctrl+Shift+Z

Selecting Entities in the Canvas

Sumerian now supports the ability to select multiple entities. To select multiple entities using the canvas, Left-Drag your cursor to create a blue bounding box. All entities whose individual bounding boxes intersect, or are enclosed in the box, will be selected. Additional entities can be added to the selection by holding SHIFT + Left-Drag to create another bounding box. Entities can be subtracted from the selection by selecting them while holding CMD(Mac)/Ctrl(Windows).

Keyboard Navigation for Entities Panel

- **Entity Selection** – Up/Down arrows
- **Collapse/Expand Parent Entity** – Left/Right arrows

Use the following commands to open the text editor, timeline editor, and publishing menu.

Tools

- **Text editor** – J
- **State Machine editor** – M
- **Timeline** – T
- **Publish** – Ctrl+Shift+P

With the timeline open, use the following commands to adjust keyframes and playheads.

Timeline

- **Move keyframe left** – Left (fast), Ctrl+Left (slow)
- **Move keyframe right** – Right (fast), Ctrl+Right (slow)
- **Move playhead left** – Shift+Left (fast), Ctrl+Shift+Left (slow)
- **Move playhead right** – Shift+Right (fast), Ctrl+Shift+Right (slow)
- **Align keyframe left** – Ctrl+Alt+1
- **Align keyframe center** – Ctrl+Alt+2
- **Align keyframe right** – Ctrl+Alt+3
- **Move keyframe to start** – Home
- **Move keyframe to end** – End
Publishing Scenes in the Amazon Sumerian Editor

Publish your Amazon Sumerian scene to share it with users on the internet. When you publish a scene, Sumerian creates a static website with your scene and hosts it on Amazon CloudFront. You can link users directly to the scene, or embed it in a frame in your website.

You can also deploy a scene for use with AWS Amplify. When you choose a private deployment, Sumerian generates a configuration file that you can load into your web app to embed a scene that can only be accessed with credentials from Amazon Cognito.

To publish a scene

When you create a scene and are ready to share it, you need to publish the scene in order for it to be accessible to your end users.

1. Open your scene in the Sumerian editor.
2. Choose Publish.
3. Choose Create public link or Host privately.

![Create public link and Host privately options]

4. Choose Publish.

For a public scene, open the URL to view it. This URL is publicly hosted with Amazon CloudFront and can be viewed by anyone.

**To republish a scene**

When you modify a scene that has already been published, you need to republish the scene for your changes to take effect in the published version. Republishing also allows you to capture release updates in the Sumerian engine.

1. Open your scene in the Sumerian editor.
2. Choose Publish.
3. Choose Republish.
Your existing URL will now reflect the latest scene changes and engine updates.

**To unpublish a scene**

1. Open your scene in the Sumerian editor.
2. Choose **Publish**.
3. Choose **Unpublish**.
4. Choose **Unpublish** again.

For a private scene, load the configuration file into your Amplify app with the XR module. For more information, see [AWS Amplify](https://aws.amazon.com/amplify/).

With Amplify, access to your scene is granted to users who log in with Amazon Cognito. For details about adding permissions to your app's identity pool, see [Restricting Access to a Published Scene (p. 4)](https://aws.amazon.com/amplify/).
Exporting to glTF from the Amazon Sumerian Editor

glTF (GL Transmission Format) is a file type standard developed by the Khronos Group for the efficient transmission of 3D content. With glTF, users have a common format for working with and publishing 3D assets across a variety of authoring tools, engines, and services.

Sumerian provides you the option to export a scene as a glTF file.

Sections

• Export a Scene to glTF (p. 62)
• glTF Export Contents (p. 63)
• Additional Export Options (p. 64)
• Materials (p. 64)

Export a Scene to glTF

To Export to glTF

1. Open your scene in the Sumerian editor.
2. Choose Scene.
3. Choose Export to glTF...
4. Select additional entities and assets to include in the export.
5. Choose **Export to glTF** to initiate the export and download.

**glTF Export Contents**

The following will be included in the export by default:

- Entity Geometries
- Materials (Classic and PBR)
- Scene Layout
- Textures

The following will always be excluded from the export:
Additional Export Options

You can opt to include the following assets in the exported glTF:

- **Cameras**
  
  If the **Cameras** option is checked, **Cameras** and **Camera components** will be included in the export. If the **Cameras** option is unchecked, then all entities with a Camera component will export without the Camera component. When importing a glTF file into some glTF viewers, you may be expected to calculate and apply the camera aspect ratio yourself by dividing canvas width by height.

- **Lights**
  
  If the **Lights** option is checked, the following **Lights** and **Light components** will be included in the export:
  - Directional
  - Spot
  - Point
  
  If the **Lights** option is unchecked, all entities with a Light component will export without the Light component. Not all tools and engines handle lighting data the same way, so your scene's lighting may require some adjustment after importing it to another program.

- **Image-Based Lighting (IBL)**
  
  If the **Image-Based Lighting (IBL)** option is checked, any environment lighting placed on the scene will be included in the export as a .hdr file. You can set or adjust the environment lighting in your scene from the **Environment component** of the top-level scene entity. If the **Image-Based Lighting (IBL)** option is unchecked, no environment lighting will be exported.

- **Unused Assets**
  
  If the **Unused Assets** option is checked, then any entity or texture assets that are not placed within the scene but exist within the **Assets** panel will be included in the export. If the **Unused Assets** option is unchecked, only entities and textures that have already been added to the scene will be included.

Materials

The core glTF specification only supports Physically-Based Rendering (PBR) materials, specifically the metallic roughness material model. The following is how each Sumerian material is handled for glTF:

- **PBR Metalness** materials map directly to the glTF PBR metallic roughness specification. However, not all texture channels available in Sumerian are currently officially supported by the glTF specification. Here is how Sumerian will handle the different textures on your PBR Metalness material upon export:
• **Base Color (Albedo):** Exported as-is
• **Metalness:** Combined with Roughness channel
• **Roughness:** Combined with Metalness channel
• **Normal:** Exported as-is
• **Specular FO:** Not currently supported by the glTF specification
• **Emissive:** Exported as-is
• **Ambient Occlusion:** Combined with Cavity channel
• **Cavity:** Combined with Ambient Occlusion channel
• **Clear Coat:** Not currently supported by the glTF specification

**PBR Specular:** Uses the glTF extension `KHR_materials_pbrSpecularGlossiness`, which is supported by many engines including Babylon.js and Three.js. However, not all texture channels available in Sumerian are currently officially supported by the glTF specification. Here is how Sumerian will handle the different textures on your PBR Specular material upon export:

• **Diffuse:** Exported as-is
• **Specular:** Combined with Glossiness channel
• **Glossiness:** Combined with Specular channel
• **Normal:** Exported as-is
• **Emissive:** Exported as-is
• **Ambient Occlusion:** Combined with Cavity channel
• **Cavity:** Combined with Ambient Occlusion channel
• **Clear Coat:** Not currently supported by the glTF specification

**Classic:** All Classic materials will be converted to PBR metallic roughness. However, some properties will be dropped in the conversion, sometimes changing the appearance of the material. These Classic material properties include:

• **Ambient**
• **Culling**
• **Depth**
• **Reflectivity**
• **Refractivity**
• **Shading**

**Note**

Only .JPG and .PNG images are supported for export at this time. Other image formats will not be included in the glTF bundle.

To learn more about how to export in glTF, see the [Exporting to glTF tutorial](#).
Amazon Sumerian Scene Settings

In addition to the options available in the dashboard (p. 24), the Sumerian editor contains many options for configuring a scene. In the inspector panel, you can configure credentials for the AWS SDK for JavaScript, adjust the canvas size and grid, and configure global settings like fog, background image, and post-processing effects.

**To configure a scene**

1. Open a scene in the Sumerian editor.
2. Choose the root node in the **Entities** panel.

3. Modify scene settings in the inspector panel.
   - **Details** – Update the scene's name and description.
   - **Tags** – Add metadata tags to the scene.
   - **Custom attributes** – Add metadata key-value pairs to the scene.

You can save a copy of your scene as a **template** to use as a starting point for creating other scenes. If your scene is saved to a project, the template is saved to the same project. Otherwise, you must choose a project to hold the template.

**To create a template**

1. Open a scene in the Sumerian editor.
2. Choose the root node in the **Entities** panel.
3. Expand the scene settings in the inspector panel.
4. Choose **Save scene as template**.
5. If the scene is a draft, choose a project for the template.

You can copy or move templates between scenes (p. 26) in the dashboard. You can update a template by creating a template again from the same source scene or from a scene created from the template. When you save a template, you can choose to create a new template or update the existing template.

Collapse the scene settings section by choosing the name of your scene.

### Sections
- Configuring AWS Credentials for Your Amazon Sumerian Scene (p. 68)
- Creating Snapshots of Your Amazon Sumerian Scene (p. 69)
- Configuring the Canvas for Your Amazon Sumerian Scene (p. 71)
- Configuring Environment Settings for Your Amazon Sumerian Scene (p. 72)
- Configuring Post-Processing Effects for Your Amazon Sumerian Scene (p. 74)
Configuring AWS Credentials for Your Amazon Sumerian Scene

The AWS configuration section lets you configure credentials to use with the AWS SDK for JavaScript. You can set an Amazon Cognito identity pool ID, which Sumerian uses to retrieve credentials when the scene is loaded. The identity pool must have an unauthenticated role with permission to use the AWS APIs that your scripts access.

**Note**
If you don't have an identity pool, follow the instructions under Amazon Sumerian Permissions (p. 3) to create one.

**To configure AWS SDK for JavaScript credentials**

1. Open a scene in the Sumerian editor.
2. Choose the root node in the Entities panel.
3. Expand the AWS configuration section in the inspector panel.
4. Enter an Amazon Cognito identity pool ID.

To use the credentials, create a script that listens for `aws.sdkReady` before initializing an SDK for JavaScript client. The following example lists the contents of an Amazon S3 bucket named `mybucket` in
the browser console. To test its functionality, create a script (p. 243), attach it to an entity, and play the scene.

**Example S3listobjects script**

```javascript
'use strict';

var setup = function(args, ctx) {
    sumerian.SystemBus.addListener('aws.sdkReady',
    () => {
        let s3 = new AWS.S3();
        s3.listObjects({Bucket: "mybucket"}, function(err, data) {
            if (err) {
                console.log('ERROR', err, data);
            } else {
                console.log('DATA', data);
            }
        });//, true
    });
};
```

### Creating Snapshots of Your Amazon Sumerian Scene

You can use the Snapshots feature to create a copy of your scene that you can use to restore your scene later. Create snapshots to set a restore point prior to trying new features or making sweeping changes to your scene.

**To create a snapshot**

1. Open a scene in the Sumerian editor.
2. Choose the root node in the **Entities** panel.
3. Expand the **Snapshots** section in the inspector panel.
4. Enter a description.
5. Choose **Create**.

**To restore or delete a snapshot**

1. Open a scene in the Sumerian editor.
2. Choose the root node in the **Entities** panel.
3. Expand the **Snapshots** section in the inspector panel.
4. Choose a snapshot.
5. Choose **Restore** or **Delete**.
Configuring the Canvas for Your Amazon Sumerian Scene

You can use the document settings to configure the size of the WebGL canvas and grid color. These settings are useful for optimizing your scene for specific devices and display ratios.

To configure the canvas using document settings

1. Open a scene in the Sumerian editor.
2. Choose the root node in the Entities panel.
3. Expand the Document section in the inspector panel.
4. Choose from the following options:
   - **Grid** – Change the color of the grid.
   - **Stretch** – Stretch the canvas to its container.
   - **Aspect ratio** – Stretch the canvas to its container, but keep the aspect ratio.
   - **Resolution** – Set a fixed size of the canvas.

**Configuring Environment Settings for Your Amazon Sumerian Scene**

Use environment settings to configure your scene's background image, ambient lighting, and weather.

**To configure environment settings**

1. Open a scene in the Sumerian editor.
2. Choose the root node in the **Entities** panel.
3. Expand the Environment section in the inspector panel.

4. Configure the following settings:
   - **Background** – Set the background color of the scene, and its opacity.
     
     To make the background transparent, set Opacity to 0. If you add a skybox, background settings have no effect.
   - **Skybox** – Use an image as the background of the scene. You can drop an existing skybox from the assets panel, or choose the plus icon to create a new skybox (p. 231).
   - **Ambient** – Add ambient light to light all objects in the scene. Ambient light doesn't affect the skybox.
   - **Fog** – Add fog to the scene. Fog starts occluding objects in the scene at Fog near units from the camera, and strengthens until Fog far units, where the fog becomes completely opaque.
   - **Particles** – Add animated snow-like particles to the background of the scene.

**Properties**

- **Velocity** – The speed of the falling particles.
- **Rate** – The number of particles that appear per second.
• **Height** – The height at which the particles will appear, relative to the camera height.

For more information about the Environment, see the Environment Basics tutorial.

### Configuring Post-Processing Effects for Your Amazon Sumerian Scene

In the post effects section of the inspector panel, you can add rendering effects like antialiasing and motion blur. Post effects are not compatible with VR mode.

**To add post effects**

1. Open a scene in the Sumerian editor.
2. Choose the root node in the **Entities** panel.
3. Expand the **Post effects** section in the inspector panel.
4. Choose **Add effects**.
5. Choose one or more effects, and then choose **Add**.
6. Adjust the settings for each effect in the inspector panel.
7. See how post effects affect rendering by clicking the post effects icon in the canvas toolbar to toggle them on and off.

Post effects properties

- **Antialias** – Add FXAA-based antialiasing to smooth out jagged edges.
- **Span** – The area of the smoothing effect.
- **Bloom** – Make bright background colors bleed over the edges of foreground objects.
  - **Opacity** – The amount of bloom applied.
  - **Size** – The size of the glow area.
  - **Gain** – The amount of brightness added.
  - **Intensity** – The amount of contrast.
- **Bleach** – Alter input color by its luminance.
  - **Opacity** – The blending multiplier for the effect.
- **Blur** – Blur the entire scene to make it appear out of focus.
  - **Amount** – The amount of blending that causes the blur.
  - **Size** – The size of the blur area.
- **Contrast** – Adjust the brightness, contrast, and saturation.
  - **Brightness** – Remove or add brightness.
  - **Contrast** – Adjust the contrast.
  - **Saturation** – Adjust the color saturation.
- **Dot** – Add a black-and-white lattice effect.
  - **Angle** – The angle of the lattice.
  - **Scale** – The thickness of the lattice.
  - **SizeX** – Skew the lattice on the X axis.
  - **SizeY** – Skew the lattice on the Y axis.
- **Edge detect** – Add a difference of Gaussians-based edge detection.
  - **Gauss Sigma** – The base of the two Gaussian kernels.
  - **Threshold** – The edge detection tolerance value.
  - **Background %** – The amount of blending between the background and edge colors.
  - **Edge Color** – The edge color.
  - **Background Color** – The background color.
- **Film grain** – Add noise and resolution lines.
  - **Noise** – The amount of noise.
  - **Line Intensity** – The sharpness of the lines.
  - **Line Count** – The number of lines.
- **Hatch** – Render the scene in black and white, with a lattice effect over black areas.
  - **Width** – The width of the lattice lines.
  - **Spread** – The distance between the lattice lines.
- **HSB** (hue, saturation, and brightness) – Adjust colors of the scene.
  - **Hue** – Adjust the hue.
  - **Saturation** – Adjust the color saturation.
  - **Brightness** – Adjust the image brightness.
- **Levels** – Apply gamma correction to the image.
  - **Gamma** – Adjust the gamma level.
• **Min input** and **Max input** – The gamma input range.
• **Min output** and **Max output** – The gamma output range.
• **Motion Blur** – Apply a blur effect to objects that moved since the previous rendered frame. If the camera moves, the entire image blurs.
  • **Amount** – The amount of blending.
  • **Scale** – Overlay the previous frame on top of the current frame at a different scale to create a zooming or flying effect.
• **Noise** – Add signal noise to the image.
  • **Noise** – The amount of signal noise.
• **Overlay** – Overlay a texture on the image.
  • **Texture** – The texture asset.
  • **Blend mode** – The method of blending the overlay and background.
  • **Amount** – The amount of blending.
• **Radial** – Add a radial blur to the image.
  • **Offset** – The blur offset.
  • **Multiplier** – The blur multiplier.
• **RGB shift** – Split the image into red, green, and blue layers with an offset between layers.
  • **Amount** – The distance between the layers.
  • **Angle** – The angle in radians between the layers.
• **Sepia** – Add a sepia color filter.
  • **Amount** – The intensity of the effect.
• **Tint** – Apply a color filter to the image.
  • **Color** – The tint color.
  • **Amount** – The intensity of the effect.
• **Vignette** – Add a dark gradient around the edges of the image.
  • **Offset** – The size of the gradient.
  • **Darkness** – The strength of the gradient.

### Calculating the Size of Your Amazon Sumerian Scene

The **Scene Size** feature calculates how much data your scene is using. You can see the number of kilobytes from JSON, mesh data, and binaries.

**To view your scene’s size**

1. Open a scene in the Sumerian editor.
2. Choose the root node in the **Entities** panel.
3. Expand the **Scene Size** tab in the inspector panel.

The numbers shown reflect the uncompressed size of the scene. When a scene is served from Amazon CloudFront, the contents are compressed. To see the compressed size, open your scene and use the network tab of the browser developer tools to find the amount of data transferred.

**Viewing Performance Information for Your Amazon Sumerian Scene**

The **Scene Stats** section gives you some performance statistics about the current scene.

**To view your scene's stats**

1. Open a scene in the Sumerian editor.
2. Choose the root node in the **Entities** panel.
3. Expand the **Scene Stats** feature in the inspector panel.

**Stats**

- **FPS** – The number of frames rendered per second.
- **Draw calls** – The number of draw calls made per frame.
- **Entities** – The number of visible entities.
- **Lights** – The number of lights being rendered.
- **Shadow casters** – The number of shadow casters being rendered.
- **Shaders** – The number of shaders being rendered.
- **Texture size** – The current texture size measure in MB.
- **Triangles** – The number of triangles being rendered.

Sumerian performs additional rendering optimization during playback. Play the scene to see how the number of draw calls varies between editor mode and playback mode. You can improve performance
during playback by re-using materials, flagging entities as static (p. 82), and limiting use of shadows and post effects.
Amazon Sumerian Entities and Components

Entities are a kind of container in Sumerian that you use to collect and organize assets in your scene. For example, when you add a 3D model to your scene, the editor splits it into mesh, texture, and animation assets and assigns them to an entity with the corresponding Sumerian geometry, material, and animation components. Your scene can contain up to 1,000 entities.

Entities can be cameras, lights, or containers for other entities. The Entities panel (p. 39) organizes entities into a hierarchy. You can use it to attach entities to one another in parent-child relationships.

Components are the configurable parts of an entity that determine its appearance and behavior during playback. To make a lamp model light the scene, add a light component. To move or change the entity during playback, add a state machine, timeline, or script component.

**To create an entity and add components**

1. Open a scene in the Sumerian editor.
2. Choose **Create entity**.
3. Choose a shape or built-in object. For a blank entity, choose **Entity**.
4. Choose the new entity in the entities panel.
5. In the inspector panel, expand the **Details** section. Enter text in the fields to change the entity name, description, tags, and attributes.
6. To place the entity in the scene, use the X, Y, and Z axis handles in the canvas. Or expand the **Transform** section and enter absolute coordinates.
7. Choose the plus icon, and then choose a component type to add a component to the entity.

Managing Entities

Use the entities panel to organize your scene's entities in a hierarchy. When you make an entity a child of another entity, it attaches to the parent. That is, when you move the parent, the child moves, and when you set the child's position, it's relative to the position of the parent.

**To manage entities**

1. Open a scene in the Sumerian editor.
2. Choose an entity in the entities panel.
3. Drag the entity onto another entity to make it a child of that entity.
4. Use the icons next to the entity name to manage it: the eye icon next to an entity to hide it.
   - Hide the entity.
   - Make a copy of the entity.
   - Delete the entity.

Managing Components

Components have properties you can use to configure settings or attach assets. All entities include a transform component that you can use to move the entity around the scene. Depending on the type of entity that you create, other components are also included automatically.

Default Components

- **2D shapes** – Transform, 2d graphics
- **3D shapes** – Transform, geometry, material
- **Cameras** – Transform, camera, script
- **HTML 3D** – Transform, HTML 3D
- **Lights** – Transform, light
- **Particles** – Transform, particles
- **Timeline** – Transform, timeline

To manage components

1. Open a scene in the Sumerian editor.
2. Choose an entity in the entities panel.
3. In the inspector panel, choose a component's name to expand or collapse its properties. See the topics below for each component for details on their available properties.
4. Click the cog icon and use the following options:
   - **Reset** – Restore the default values for the component's properties.
   - **Toggle panel** – Show or hide the component properties.
   - **Remove** – Delete the component.
   - **Copy** (some components) – Copy the component configuration.
   - **Paste** (some components) – Paste the component configuration that you copied from the same component on a different entity.

Some components also have special properties that are affected by the components on their parent. For example, a collider's behavior changes depending on the type of rigid body that's attached to the same entity or parent entity.
The following topics describe the parameters and use of each type of component.

Basic Components

- Amazon Sumerian Transform Component (p. 82)
- Amazon Sumerian Geometry Component (p. 85)
- Amazon Sumerian Material Component (p. 92)
- Amazon Sumerian Camera Component (p. 172)
- Amazon Sumerian VRCameraRig Component (p. 176)
- Amazon Sumerian HMD Camera Component (p. 177)
- Amazon Sumerian VR Controller Component (p. 177)
- Amazon Sumerian Host Component (p. 177)
- Amazon Sumerian Speech Component (p. 179)
- Amazon Sumerian Dialogue Component (p. 191)

Content and Effects

- Amazon Sumerian 2D Graphics Component (p. 194)
- Amazon Sumerian HTML Components (p. 194)
- Amazon Sumerian Sound Component (p. 198)
- Amazon Sumerian Light Component (p. 198)
- Amazon Sumerian Particle System Component (p. 199)

Animation and Physics

- Amazon Sumerian Animation Component (p. 200)
- Amazon Sumerian State Machine Component (p. 220)
- Amazon Sumerian Script Component (p. 221)
- Amazon Sumerian Timeline Component (p. 222)

Amazon Sumerian Transform Component

The transform component defines an entity's position in 3D space. It contains the local transform values of the component –translation, rotation, and scale. The transform is relative to its parent.

Properties

- **Translation** – Position of the object relative to its parent.
- **Rotation** – Rotation of the object in degrees.
- **Scale** – Scaling factor of the object. One unit is approximately equal to one meter in length.
- **Uniform scale** – Maintains scale proportions when a value is modified on any axis.
- **Static** – Flag entities in your scene that do not move. During playback, Sumerian combines static entities with others that use the same material (p. 92) to improve performance. Use scene stats (p. 77) to see how this affects the number of draw calls required to render your scene.

Translation controls the location of an entity within a scene.
Rotation controls how an entity is rotated along its own X, Y, and Z axes.
Scale controls the size of an entity. Entities can scale on the X, Y, and Z axes.
Amazon Sumerian Geometry Component

The geometry component contains a renderable mesh of the entity. When you import a 3D model, or create a primitive from the Create entity menu, it always gets a geometry component.

Together with a material component, you can render the entity to make it visible in the canvas. If you don't have a material component, the geometry is invisible.

The panel looks different for different kinds of meshes and primitives, but in general, they have these settings:

Properties for Primitive Objects

When adding a primitive object to a scene from the Create entity menu, you will notice differences in the geometry component property types and values.
• **Samples**: Some primitives may have X or Y sample options. Increasing this value increases the number of times the object is subdivided along the corresponding axis. Lowering this value decreases the number of times the primitive is subdivided along the corresponding axis. This property can be found on the sphere, cone, torus, disk, and cylinder.

• **Texture Mode**: Changes the method used to project a 2D image onto the 3D object. For example, the uniform option on the box places the 2D image identically on each face of the box whereas the unfolded option places each face on a different part of the image. Note that the property options will change based on the shape of the object. This property can be found on the sphere and box. Below are some examples of how texture mode affects the way a checkered image displays on a sphere and a box.

*Sphere with a projected texture mode*
Sphere with a polar texture mode
Box with a uniform texture mode
Box with a unfolded texture mode
• **Height**: Defines the distance between the tip and base of the cone. This property can be found on the cone.

• **Pointiness**: Adds and controls the length of a central protrusion on the disk, turning it into a cone. This property can be found on the disk.

• **Pipe Radius**: Defines the size of the radius on a torus. This property can be found on the torus.

• **Shadows**: Controls how an object casts and receives shadows.

• **Cast shadows**: Causes the object to cast shadows.

• **Receive shadows**: Causes the object to reflect shadows from other objects.

**Properties for 3D Models**

Whether imported from Sumerian or a third party library, non-primitive objects will also have a geometry component. Such models could include a host or furniture, for example. However, the values will be different from primitive models.

- **Mesh**: The input that contains the mesh file for the model. The mesh is the visible asset for the model. If the mesh is removed, the model will not be visible.

- **Skeleton**: The input that contains the skeleton for the model. Not all models have a skeleton as they are used to animate the model. If the skeleton is removed, any animations attached to the model will break but will still be visible.
Amazon Sumerian Material Component

When you add a 3D model to your scene, it has at least three components. The Transform component defines the positioning of the model in 3D space, the Geometry component defines the shape of the model, and the Material component defines its textures and rendering properties.

Amazon Sumerian currently supports two different shading models. The first is the Classic Model, which uses the dynamic lights and the Classic shader in the Material component. The second is Physically Based Rendering which uses PBR shaders and an Environment Light to create a more photo-real appearance.

Classic Shader

The Classic shader in the Material component is one type of material supported in Sumerian. It is good for achieving a stylized look and requires less memory intensive material than a PBR shader.

Properties

Color (Diffuse) – The base color of the surface.

• Color – The base diffuse color. This defines the base color of the object.
• Texture – The diffuse color from a texture. A texture is an image file that is placed on the object based on the UV layout.

Normal – A type of bump map. Normal maps are a special kind of texture that you use to add surface detail such as bumps, grooves, and scratches to an object. These details catch the light as if they are represented by real geometry. You set the normal map via the Texture input, and you can alter its magnitude by setting the Strength value.

Specular – Specular effects are the direct reflections of light sources in your scene. These typically show up as bright highlights or shininess on the surface of object, though specular highlights can be subtle or diffuse. You can set the base specular color Color, use a Texture, and set the Shininess value.

Emissive – The self-illumination color of an object, which can be described as the amount of “glow” an entity emits. You can set the emissive color by using the Color input and/or by using a Texture.

Ambient – The color and value of an object without considering light information. This property drives additional light into the material.

• Color - The base ambient color.
• Texture - Ambient map that identifies areas on a mesh that are exposed or hidden from ambient lighting.

Opacity – Defines the transparency/opaqueness of an object. You can use Strength to input a value between 0 and 1, where 0 represents completely transparent and 1.0 represents fully opaque.

• Threshold – Used to indicate when a surface is completely transparent and can be discarded from rendering.
• Dual Transparency – Renders both front and back surfaces of the material.

Reflectivity – Defines how much and what is reflected by the material.

• Texture – The image that will be reflected off the material based on the object’s UV information.
• Environment – Map that creates a spherical projection. This is image that the material will be visibly reflected off the surface of the object. If not selected, the current Skybox is used.
Physically Based Rendering (PBR) and Environment Lighting (HDRI)

Physically based rendering (PBR) is the method of shading and rendering that more accurately represents how light interacts with surfaces. This means that metal and dielectric (non-metal) objects will render closer to their real world counterparts.

A high dynamic range image, or HDRI, is used to reproduce a greater dynamic range of luminosity. The image format is .hdr. In the section below we will take a look at how to setup the Environment Light properties under the global scene settings. When using the Environment Lighting (HDR) component, a scene will be lit with luminosity information from an image (the HDRI) instead of, or in combination with, the existing dynamic lights in Sumerian. The reflections are also based on the HDRI making the scene more physically accurate.
Environment Light (HDR)

To setup the Environment Light in Sumerian you will first need to get an HDRI image. Once you have your scene created and your object imported you can access the HDRI assets by pressing **Import Assets** at the top of the Editor. Search for “HDRI” and look for an HDRI you want to use to light the scene. After you have imported your HDRI look for the image in the **Assets** panel. Make sure you’re at the scene root by clicking the top node in the **Entities** panel (the top level entity that carries the name you gave to your scene). Click and drag the HDRI from the **Assets** panel into the **Environment Lighting (HDR)** property on the right hand side of the editor.

Alternately you can use the **Default Lighting: PBR** template when you create a new scene and use the HDRI already setup in that scene.

Keep in mind that .hdr images are much larger than a normal .jpg image and you may need to reduce the size of the image in order to have a performant web Sumerian scene. It is recommended to use a 2k or 4k HDRI to light your scene. Reducing the size of your HDRI (.hdr) will lower the quality of your reflections but should increase performance on devices with reduced capacity, such as mobile. The quality reduction is usually mitigated by the smaller screen format but the scene should be tuned to create the best results.

*Note: The .hdr asset type can only be applied to the Environment Lighting HDR property and cannot currently be used as a texture for anything else in Sumerian. Conversely, image format types that are of any other type than .hdr cannot be used in the Environment Lighting HDR property.*

**Setting up the light**

Once you have imported your HDRI, click the scene level entity in the **Entities** panel to access the **Environment Lighting (HDR)** options. The scene below has an HDRI and it can be seen in the asset panel in the lower left of the editor. It is marked with the new light bulb icon to denote it as an HDRI texture vs a regular texture image.

*Note: Currently the sphere is completely black as there are no lights in use in the scene.*
Once you have accessed the **Environment Lighting (HDR)** property you can either:

- Drag your HDRI image onto the HDR drop input
- Click the **Browse** button and load an HDRI from a file on your local computer

This will load the HDRI into the scene. Below we can see the HDRI has been loaded into the scene and the sphere is now lit by the HDRI.
If we adjust the **Brightness** slider in the **Environment Lighting (HDR)** property we can see the results of how the lighting is changed on the sphere.
The HDRI can be seen in the lighting and reflections of our sphere's material. We can use this image as the Skybox texture by choosing Set as Skybox.
To discontinue the use of either the Skybox or HDR texture, click Remove Textures in either the Skybox or Environment Lighting (HDR) property and it will remove the corresponding texture.
Note that it is possible to drop a different texture into the **Skybox** texture input other than the one used for your HDR light. However, the reflections of the material will still be based on the HDRI and won't match the texture used for the **Skybox**.

The **Skybox** and **Environment Lighting (HDR)** components can each be rotated 360 degrees through the **Rotation(Y)** property. Rotating the HDRI will spin the image around the center of the scene. This allow one to control which direction the light is coming from to better refine the lighting in the scene. If you want the **Skybox** rotation to be synced with the **Environment Lighting (HDR)** rotation then press the **Sync Skybox** checkbox. This will ensure that the reflections in the materials match the lighting.
PBR Materials

Now that your light is setup we can now look at how PBR shaders work.

Sumerian supports two different PBR materials, Metalness (PBR metal/roughness) and Specular (PBR specular/glossy). These two materials use different equations for calculating how the specular reflections are displayed on the material but they also share several properties. These shared properties are listed below in the two different PBR material descriptions.

In choosing which PBR material to use keep the following in mind:

- Using the PBR Specular material will give more control over the reflectivity of non-metal materials providing a full color input for reflective (specular) color. The PBR Specular material may be preferred by artists with heavy experience in traditional shaders because the maps and methods used are more similar.
- The PBR Metalness material simplifies metals vs. non-metals (dielectric) which can make it easier to author content. However, the material transitions (places where the material changes from metal to dielectric) can sometimes leave a white line artifact. It's best to try to break up your metal and dielectric objects into different materials if this occurs.
- The PBR Metalness material uses the Base Color property (the color of the object before specular reflections are calculated), the Metalness property (how and where the material is metal), and the Roughness property (the shape of the specular reflection), and the Specular F0 property (to modify the reflectivity of non-metal objects).

The PBR Metalness Material

Base Color - Similar to the Diffuse. It is the main color that will appear on the object. It can be modified in two ways.

- Color - Color picker. If no texture is applied will be the color of the object.
- Texture - A texture map can be uploaded and displayed on the object for the Base Color. The Color is multiplied over the texture. This means that the texture can be “tinted” a different color if the Color value is not a grey scale value. The texture can also contain transparency through the use of a .png file. See the section below on Opacity to see how to use this property.

Base Color Only
Base Color Using the Texture Slot
Base Color using both the Color Swatch and Texture. Notice how the texture is now tinted. The color black will not tint as the color is multiplied over the texture.
Metalness - Used to determine which parts of the object are metal and which are not.

- **Texture** - This texture should be grey scale map (a texture without color information) which creates a value where the metal parts are white and the non-metal or dialectic parts are black. Values of grey can be used but usually this map will be only black or white. It can also be a combined `Metallic_roughness_map` with metallic in B channel.

- **Strength** - This is a multiplier of the texture. The value should be set to 1 if a texture is applied. If the value is set to less than 1 then the textures values are reduced and the object will appear progressively less metal as the strength approaches 0. If no texture is used then a value of 0 is non-metal and a value of 1 is full metal.

*Metalness Value of 0 means the material is non-metal or dielectric.*
Metalness Value of 1 means the material is metal.
As the Roughness Strength is increases you will see the specular highlights soften and the object will appear less glossy and rougher.
Amazon Sumerian User Guide
The PBR Metalness Material
If we want to achieve a colored metal such as gold or copper, the Base Color can be adjusted to tint the reflection of a metal object.
If we add a texture to the texture slot for Metalness then we can see how the white parts of the texture appear as metal (value of 1) and the black parts of the texture appear as non-metal (value of 0). Notice how the metal parts of the texture are highly reflective and deep in color despite the white Base Color of the material. The metallic areas of the object are still using the white Base Color.
Roughness - Modifies how the object reflects light. If the value is high the reflection is blurred across the object and the object will appear rough in nature. If the value is low the object will appear smoother and the reflection will be clear.

- Texture - This is a grey scale map where black is a low roughness value (object will appear smooth and reflective) and white is a high roughness value (the object will appear rough with blurred reflections). It also can be a combined metallic_roughness_map which is single texture that contains information for both Metalness and Roughness in one texture instead of two with Roughness in green channel and Metalness in the blue channel.

- Strength - This is a multiplier of the texture. The value of the strength should be set to 1 if a texture is applied. If the value is set to less than 1 then the textures values are reduced and the object will appear progressively smoother as the Strength approaches 0.

As the Roughness value is increased you can see the object change from glossy to rough. Keep note of the Strength value for the Roughness property and how it affects the specular highlight.
The PBR Metalness Material
If we place a texture into the texture slot of the Roughness property we can see how the specular highlight is affected. Note how the specular highlight is tight or glossy where the roughness value is black (value of 0) and the highlight is broad to the point where it's almost not visible in the white sections of the texture (value of 1), where the material has been tinted red to better show the highlight.
Specular F0 - This is a scalar value that modifies the reflectivity of the object if it is non-metallic (dielectric). A value of 1 is fully reflective and a value of 0 is non-reflective.

- Texture - This is a grey scale texture that can be used to modify the reflectivity of the object. It will be a multiplicative value where white creates full reflectivity and black removes reflectivity.
- Strength - This is a multiplier of the texture (if used). If no texture is used then the Strength value will set the reflectivity of the whole object. A value of 0 is no reflectivity with increasing reflectivity up to a value of 1 which is full reflectivity.

In the following two images we can see the effect, or lack thereof, on a metallic material. This material has the Metalness value set to 1. We can see that the Specular F0 Reflectivity value has no effect on a metallic material.
The Specular F0 controls the reflectivity of non-metallic material. The material Base Color has been turned black and the specular reflections are clearly visible. Note how the highlight intensity changes from non-existent, when the reflectivity is set to 0, to visible when the reflectivity is set to 1.
Amazon Sumerian User Guide
The PBR Metalness Material
You can also place a texture into the texture slot of the Specular F0 to control the reflectivity of an object. Note how the black sections (value of 0) of the texture are non-reflective and the white sections (value of 1) are highly reflective.
The PBR Specular Material

The PBR Specular material is different from the PBR Metalness material. There are three main properties to use in the PBR Specular material: **Diffuse** (similar to Base Color), **Specular** (controls the value of the specular reflectivity as well as its color), and **Glossiness** (controls how tight or broad the specular reflections appear in the material). You may think of the Glossiness property as being the inverse of Roughness in the PBR Metalness material as the texture maps are the inverse of each other.

In Specular there is no Metalness property. This means that in order to achieve a metal looking material the **Diffuse Color** will be set to a dark color (usually black), and the **Specular** color will be used to determine the tint of the specular reflections of the metal. The Glossiness value will most likely be high in order to create a highly reflective metal. It can also be lowered to achieve a more tarnished or dusty metal.

**Diffuse** - Similar to the Base Color of the object. It is the main color that will appear on the object. The diffuse color can be modified in two ways.

- **Color** - This is a color picker and if no texture is applied will be the color of the object.
- **Texture** - A texture map can be uploaded and displayed on the object for the **Diffuse**. The **Color** is multiplied over the texture. This means that the texture can be tinted a different color if the **Color** value is not a grey scale value. The texture can also contain transparency through the use of a .png file. Make sure to enable **Opacity** if a texture with transparency is used. This will ensure that the map with transparency displays correctly.

*In this image the Diffuse Color has been changed to red.*

*Checkered texture with no Diffuse Color.*
Diffuse Color Red and Diffuse texture set to a checkered pattern. You can see that the white areas of the texture have been tinted by the color swatch.
Specular - Controls the amount of reflection on an object.

- **Color** - Specular reflections can be tinted through the color picker. The **Color** property will also multiply over the texture placed into the specular texture property.
- **Texture** - A texture map can be uploaded to apply color to the specular of an object. Lighter color textures will make the object more reflective. Darker colors will make the object less reflective: Black is non-reflective and white is fully reflective.

*Here we can see the specular reflections change from highly reflective to non-reflective as we change the Specular Color from white (value of 1) to black (value of 0). Please note that the shape of the specular reflections do not change. They remain sharp because that is controlled by the glossiness value which remains at 1 throughout this set of images.*
When using a texture in the Specular texture slot we can see the same result. The white parts of the texture are rendered with a high specular reflectivity and the black parts of the texture are rendered non-reflective.
Specular values can also take color information. When the color swatch is used it will tint the texture. The white sections of the texture are now tinted red and the black parts of the texture remain non-reflective.
Similarly, the texture itself can contain color information for the Specular. Here we can see that the colored texture is tinting the specular reflectivity of the material across the object.
Glossiness - Modifies how the object reflects light. If the value is high then the reflection is sharpened across the object and the object will appear glossy or smooth in nature. If the value is low then object will appear more rough and the reflection will be blurred.

- Texture - This is a grey scale map where black equals a low glossiness value (object will appear rough) and white has a high glossiness value (the object will appear smooth with sharp reflections). The Texture can also be a combined specular_glossiness_map, a single texture that contains information for both Glossiness and Specular in one texture instead of two, where Glossiness information is in the alpha channel and the Specular color information in the RGB channels.
- Strength - This is a multiplier of the texture. The value of the Strength should be set to 1 if a texture is applied. If the value is set to less than 1 then the textures values are reduced and the object will appear progressively rougher as the strength approaches 0.

As we move through these series of images please note how the shape of the specular reflections change. They will change from tight spots which make the material appear to be slick or glossy to very broad, which makes the material appear rougher. The specular value remains the same throughout these images so the material has the same brightness of reflections. Only the shape of the specular reflections are changed.
Because Glossiness is a grey scale value the color information in textures has no effect. Only the brightness values (dark to light or black to white) of the texture will control the glossiness of the material. Here we can see that the white sections of the texture are rendered with a tight specular reflectivity and the dark sections of the texture are rendered with a broad or rough reflectivity.
Shared Material Properties

The **PBR Metalness** and **PBR Specular** materials do have some shared properties.

**Normal** - A type of bump map. Normal maps are a special kind of texture used to add surface detail such as bumps, grooves, and scratches to a model. These details catch the light as if they are represented by real geometry.

- **Texture** - Place a normal map texture in this slot to modify the normal values of the object.
- **Strength** - This value modifies the magnitude of the texture map. A value of less than 1 decreases the influence of the texture as the strength approaches 0. A value of 0 is the same as not using a **Normal** texture map. The strength can also be raised over 1 to increase the influence of the normal texture. The strength will only take effect if the texture is applied.

*This image shows how the normal map has changed how the light and shadow are displayed on the object to simulate the existence of more geometry and give the sphere a bumped appearance.*
**Emissive** - The self-illumination color of an object, which can be described as the amount of “glow” an entity emits. This does not mean that the object can be used to light other objects near it. This is only driving more light into the material of that object.

- **Color** - If no texture is used this color will set the overall color value for the self-illumination of the object. A color of black will remove self-illumination. If a texture is used then this color multiplies over the texture values to “tint” the texture.
- **Texture** - A texture map can be uploaded to apply color to the **Emissive** of an object. The color in the texture will tint the **Color** value of the **Emissive**. Black will be non-emissive.

*Here we can see the material without the use of Emissive values because it is set to black. You can also uncheck Emissive Color to ensure that the Emissive property is not in use.*
Here the Emissive color has been changed to red and now the object is self illuminating a red hue.
If a texture is placed into the texture slot of the emissive property then the object will self-illuminate based on the color of the texture. Black creates a lack of Emissive effect. Anything else will cause the object to self-illuminate that particular color.
Here we can see what happens when the color and texture options are used. The black sections of the texture still lack Emissive effect but the white sections of the texture are tinted by the color swatch.
Ambient Occlusion - Determines how much ambient light will affect the object. It is used to approximate medium scale shadow details.

- **Texture** - The texture will be grey scale where black is no light contribution and white is full light contribution. A fully white texture will have no visible effect on the object when compared to the default settings. A full black texture will render darker object as no ambient light is being allow to light the object. The dark areas of the ambient occlusion texture will also reduce the amount of specular reflectivity.

- **Strength** - The strength will modify the texture values where a strength value of 1 is using the full values of the texture and a value of 0 is the same as no texture. The strength will have no effect if no texture is applied.

*Here we can see the material with Ambient Occlusion turned off. When we apply the texture and move the strength to 1 we can see that the Ambient Occlusion is darkening the material where the texture is black and leaving the material the same where the texture is white.*
Cavity - The cavity attribute is used to add shadow details, particularly in the small cracks or joints of an object. It operates much like an Ambient Occlusion texture.

- **Texture** - The texture will be grey scale where dark colors darken the material and white has no effect on the material. A fully white texture will have no visible effect on the object when compared to the default settings. The dark areas of the Cavity texture will also reduce the amount of specular reflectivity.
- **Strength** - Modifies the texture values where a strength value of 1 is using the full values of the texture and a value of 0 is the same as no texture. The strength will have no effect if no texture is applied.

*Here we can see the checker texture applied to the Cavity attribute over a glossy red material. The black sections of the texture darken the material while the white sections have no effect. You can see that the specular reflection is reduced by the black areas of the Cavity texture as well.*
Clear Coat - This is used to simulate a thin reflective layer that sits on top of the surface of your material. This is useful for materials like car paint, wet surfaces or the gloss over polished woods. Conversely, if your object already has a glossy appearance and you want to rough it up a bit you can use the Clear Coat property with a wide specular falloff to add a layer of dust or grime.

- **Color** - Used to determine the tint of the Clear Coat over the object.
- **Texture** - The texture property is used as a grey scale texture map where white will be where Clear Coat is enabled and progressively reduces the strength of the Clear Coat until it's disabled at black.
- **Intensity** - The global value of how bright the Clear Coat specular will be.
- **Thickness** - Used to determine how thick the thin layer of polish over the material will be. Higher values will darken the material as less light is going to be let through the Clear Coat to the base color underneath.
- **Reflectivity** - Used to determine how reflective the surface of the Clear Coat is. Higher reflectivity will reflect more of the HDRI where as lower reflectivity will reflect less.
- **Roughness** - A grey scale map where black creates a low roughness value (object will appear smooth and reflective) and white creates a high roughness value (the object will appear rough with blurred reflections).
• **Strength** - Modifies the texture values where a strength value of 1 is using the full values of the texture and a value of 0 is the same as no texture. If no texture is applied a Strength value of 1 with render a rough specular reflection and a value of 0 will render a glossy specular reflection.

*In this image the Clear Coat has been tinted red over a white sphere. The relatively low Thickness value allows the white material underneath the Clear Coat to partially show through.*

*In this image a texture has been used to modulate the intensity of the Clear Coat. The black areas of the texture are nullifying the Clear Coat and letting the white material show through. The White areas of the texture are full Clear Coat and tinting red.*
Through the next set of images you can see how the Thickness property affects the Clear Coat. A low Thickness will show the material underneath the Clear Coat fairly well with a rim of Clear Coat visible at the glancing edges of the object. A mid value for Thickness will envelope the object. A high value for Thickness will reduce the light allowed through to the material under the Clear Coat and will start to darken the material.
Raising the Reflectivity value will start to reflect more of the environment light.
By modulating the Roughness of the Clear Coat with a texture we can see that the white areas of the texture give the Clear Coat a very broad and blurred specular reflection whereas the black areas of the texture make the Clear Coat glossy and reflective.
Opacity - When enabled this modulates the transparency of an object. This model of transparency is a simple form and will not accurately render more complicated features of transparency like translucency or refraction. The base color texture of the object may also contain opacity and transparency information to control the opacity of different parts of the object. This property is used in conjunction with the Blending properties. The default Blending option will be TransparencyBlending when Opacity is enabled and NoBlending when Opacity is disabled.

Strength - If no texture is used a value of 1 will define the object as fully opaque. The opacity can be progressively lowered to a fully transparent object at a value of 0. If a texture is used it will multiply with the alpha channel in the texture applied to the Base Color or Diffuse property of the material.
**Threshold** - This modifies the clipping of the transparency used in the base color map. A value of 0 will be no clipping and if there are semi transparent values in the texture they will appear correctly. If the Threshold value is increased from 0 to 1 then the opaque sections of the texture will be slowly eroded away until the texture is no longer used and the whole object is transparent when the Threshold reaches a value of 1.

**Dual Transparency** - When enabled this renders both sides of the object.

**Blending** - This is used to set the blending mode when an object uses **Opacity**. The default setting is **NoBlending** when **Opacity** is disabled and **TransparencyBlending** when **Opacity** is first enabled. There are other **Blending** options available:

- **NoBlending** - The object will not use the opacity settings.
- **TransparencyBlending** - The object will become transparent based on the opacity settings. There is no specialized blending that occurs on this setting.
- **Custom Blending** - This allows you to set the equation used for blending (add, subtract, reverse subtract), the source of the opacity information, and the target.
- **AdditiveBlending** - This will take the opaque sections from the **Opacity** property and add their value over rest of the scene. This will create a brightening effect where the opaque sections exist.
- **SubtractiveBlending** - This will take the opaque sections from the **Opacity** property and subtract, or cut them out from the rest of the scene. This means that these sections will no longer be rendered through the camera in a Sumerian scene.
- **MultiplyBlending** - This will take the opaque sections from the **Opacity** property and multiply them over the rest of the scene. This will give a darkening effect where the opaque sections exist.

A .png file has been applied to the Base Color texture slot. The image has a white Sumerian logo with a transparent background. The Opacity is checked to Enabled and the Blending mode was set to **TransparencyBlending** by default. This will be the setup most often used when using Opacity.
If we lower the strength to 0.2 we can see how the opaque sections become more transparent. This is because the Strength slider acts as a global value for the Opacity property and will lower the opacity of the material evenly across the texture.
If we go back to a high strength but also raise the Threshold value we can see that the opaque sections start to clip. The Threshold value is changing the border between the dark and light pixels of the texture.
Dual Transparency. See how the material now renders the front and back faces of the object that are considered opaque as determined by the texture. The front faces rendering more white where the light is hitting them directly and the back faces are rendering darker where as they are shadowed by the front faces.
Transparency Blending. This is the default blending mode and the most commonly used.
MultiplyBlending. The transparent areas of the texture are now rendered white and the opaque areas are rendered black. This is because the opaque sections of the image are now multiplying over the rest of the scene whereas the transparent sections of the texture are not affecting the material.
SubtractiveBlending. This results in the opaque parts of the texture subtracting themselves from the scene and the transparent parts of the texture staying transparent. This can be used in conjunction with the camera of your device so that the subtracted parts of the scene now render what the camera sees.
AdditiveBlending. The opaque areas of the image are added to or lighten the scene whereas the transparent parts of the texture have no effect.
If we use a texture with transparency in the Base Color but turn the Blending mode to NoBlending it will disable the Opacity and the material will no longer display the Opacity properties.
Amazon Sumerian Camera Component

The camera component turns any entity into a camera.

**Properties**

- **Main camera** – Use this camera at the beginning of the scene. If you have multiple cameras, you can switch between them during both edit and playback modes.

- **Follow editor camera** – The editor camera is the camera used to navigate the scene in editor mode. Selecting this property will align the camera position with the editor camera. When a scene is played, the camera will start in the position of the editor camera. This is useful when switching between edit and play modes.

- **Projection** – Control how the camera projects the 3D world on the 2D canvas. The property options for Projection are **Perspective** and **Parallel**.
• **Field of view (FOV)** – This property defines the camera view as wide or narrow. Set the number of degrees from left to right that the camera spans. The default FOV value for a Perspective camera is 45 degrees.

• **Clipping planes** – Set the distance from the camera at which objects are drawn. Objects, or parts of objects, will not be visible if they are closer to the camera than the defined Near value. Anything beyond the defined Far value will not be visible.

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**Editor Camera and Controls**

**Editor Camera Mouse and Keyboard Controls**

• **Right-Drag** – Orbit around the position in the center of the canvas.

• **Left-Drag + SHIFT + Option(Mac)/Alt(Windows)** – Pan left or right, up or down.

• **Middle-Drag** – Pan left or right, up or down.

• **Scroll Wheel** – Zoom in/out. Note that the editor camera can only zoom in as far as the translation value of the selected entity.

**Note:** Trackpads are supported by Sumerian. Trackpad controls will use the respective mouse actions defined by the settings on your computer.

To see a list of camera controls and shortcuts within the editor, select the Help menu drop down list and select Shortcut List.

The Shortcut List contains a list of all the current camera controls and keyboard shortcuts.
Camera Types and Controls

New scenes include a default camera that follows the position of the editor camera. When you play the scene, the view matches what you last saw in the editor. To fix the starting position of the camera during playback, clear the Follow editor camera check box. Zoom out to see the default camera and its viewing frustrum, which you can adjust with the field of view and clipping settings. Additionally, when you select a camera in the Entities panel, the selected camera's point-of-view is provided as a picture-in-picture preview in the bottom left corner of the canvas.

To add a camera to your scene, choose one of the standard camera types from the Create entity (p. 80) menu, or add a camera component to any entity.

Standard Cameras

- **2D cam** – A parallel projection camera with pan and zoom controls.
  - Middle-Drag – Pan.
  - Scroll wheel – Zoom.
- **Fixed cam** – A perspective camera with no built-in controls.
- **Fly cam** – A perspective camera with mouse and keyboard controls to move, “fly”, through the scene. Keyboard and mouse controls can be customized.
  - Left-Drag – Look around.
  - W, A, S, D – Move forward, left, backward, and right. Hold Shift to move slowly.
- **Orbit cam** – A perspective camera with orbit, pan, and zoom controls.
  - Right-Drag – Orbit around the position in the center of the canvas.
  - Left-Drag + SHIFT + Option(Mac)/Alt(Windows) – Pan left or right, up or down.
  - Middle-Drag – Pan left or right, up or down.
  - Scroll wheel – Zoom in/out. Note that the editor camera can only zoom in as far as transform value of the selected entity.

**Note:** Trackpads are supported by Sumerian. Trackpad controls will use the respective mouse actions defined by the settings on your computer

Add or customize camera controls with the built-in camera scripts (p. 244). Parameters on the scripts, which are also used by the standard camera types, let you customize the camera's controls and behavior. Note that trackpads also work for camera controls.

To manage cameras during playback, use a state machine or script.

References

- Camera and Light tutorial
- Camera Deep Dive tutorial

State Machine

To manage cameras, add a state machine (p. 220) to any entity in your scene. Use actions to change the active camera in response to user input.

Example States for camera control

- **Ready** – 4 Key pressed actions listen for number keys and transition to the Ready State.
• **Cam 1** through **Cam 4** – **Switch camera** changes the active camera. **Transition** returns to the ready state.

For more information, see *Audio and Camera State Machine Actions in Amazon Sumerian* (p. 237).

**Amazon Sumerian VRCameraRig Component**

The VRCameraRig component configures a virtual reality (VR) headset and controllers for use in VR mode during playback. When a user has a supported VR device, they can click the VR button to switch between the main camera (p. 172) and the head mounted display (HMD) camera (p. 177) that represents a VR headset.

**Supported VR Headsets**

- Oculus Rift
- Oculus Go
- Oculus Quest
- Oculus Rift 5
- HTC Vive
- HTC Vive Pro
- Samsung Gear VR

You can attach the VRCameraRig component to an entity with child entities for the HMD camera and each VR controller. However, both the *CoreVR asset pack* (p. 227) and the *VR Asset Pack* (p. 227) in the Sumerian library contain a rig entity with an HMD camera and controllers for each supported VR platform. When an entity has the VRCameraRig, HMD component, and the VR Controller components, the entity becomes the rig for creating a VR experience.

**Properties**

- **LoadGamepads** – Deselect to disable controllers.
- **StartAtCurrentCamera** – Deselect to use the camera from its transform location instead of swapping out the main camera for the VR rig when the user enters VR mode.
- **CurrentVRCameraRig** – Select to use this VRCameraRig component in VR mode. This property must be selected to enable VR.
Amazon Sumerian HMD Camera Component

The HMD camera component represents a head mounted display (HMD) in a VRCameraRig. When you attach an entity with an HMD camera component to a VRCameraRig, users can use a VR headset to view the scene in VR mode. However, both the CoreVR asset pack (p. 227) and the VR Asset Pack (p. 227) in the Sumerian library contain a rig entity with an HMD camera and controllers for each supported VR platform. When an entity has the VRCameraRig, HMD component, and the VR Controller components, the entity becomes the rig for creating a VR experience.

Properties

- **Position tracking** – Set to **Enabled** for platforms and devices using 6 degrees of freedom (6DOF). Set to **Disabled** to lock the camera's position and only track the display's rotation or 3 degrees of freedom (3DOF).

See Amazon Sumerian VRCameraRig Component (p. 176) for more information.

Amazon Sumerian VR Controller Component

The VR controller component represents a single virtual reality (VR) controller in a VRCameraRig. When a user enters VR mode with a controller attached, the VR controller component tracks its location in 3D space.

When an entity has the VRCameraRig, HMD component, and the VR Controller components, the entity becomes the rig for creating a VR experience. While VR Controller components can be added individually, both the CoreVR asset pack (p. 227) and the VR Asset Pack (p. 227) in the Sumerian library contain a rig entity with an HMD camera and controllers for each supported VR platform.

See Amazon Sumerian VRCameraRig Component (p. 176) for more information.

Properties

- **Id** – Controller type that this entity represents.

Amazon Sumerian Host Component

A host is an asset provided by Sumerian that has built in animation, speech, and behavior for interacting with users. Add a host to your scene from the asset library (p. 36).
The host component is provided specifically for Sumerian hosts. When you add a host to your scene, it includes a host component for configuring the host's behavior and a speech component (p. 179) that you can use to configure the host's voice and script. Note that a host component can only be used with Amazon Sumerian Host entities.

**Properties**

- **Point of interest** – Set to *Look at entity* to keep the host's eyes trained on a camera or entity. If a point of interest is not defined, the Host's face will be facing straight ahead.
- **Target entity** – Drop an entity here to set it as the host's point of interest.
- **Lip sync** – Play lip sync animations during speech.
- **Gestures** – Play gesture animations during speech.
- **Gesture hold time** – Set the number of seconds a gesture animation is held before transitioning back to an idle animation.
- **Minimum gesture period** – Set the number of seconds to wait after a gesture is complete before another gesture can occur.
Amazon Sumerian Speech Component

The speech component assigns text to an entity for playback using a native integration with Amazon Polly. You assign text to an entity, and play the audio output from Amazon Polly with a state machine or script. The scene calls Amazon Polly at runtime to generate the audio.

To use Amazon Polly during playback, the scene needs AWS credentials from Amazon Cognito Identity. Create an identity pool (p. 3) for your scene, and configure it under AWS configuration (p. 68) in the scene settings.

To add a speech, click the + button.

This will open the Text Editor. In the text editor, type out a speech using plaintext or you can use SSML markup to customize your speech. Make sure to click Save before returning to the Sumerian editor.
By default, Sumerian will use the Standard voice engine from Amazon Polly. To select a different voice engine, click the Voice Engine drop down menu and select Neural. To learn more about Amazon Polly's Neural TTS and region compatibility, visit the Amazon Polly's Neural TTS documentation. Also be sure to check out the NTTS Newscaster Style to see which voices support the Newscaster voice style.
Note
In order to access these features, your scene must be updated and re-published with AWS SDK for JavaScript version 2.503 or higher. Scenes created prior to Sumerian Release 0.26 will need to be manually updated, while newly-created scenes will not require these steps.

To update the AWS SDK for JavaScript:

1. In the Entities panel, select the scene node at the top of the entity hierarchy.

2. Navigate to the Inspector panel expand them AWS Configuration component.
3. Ensure that the version listed is at least 2.503 or higher (e.g., https://sdk.amazonaws.com/js/aws-sdk-2.503.0.min.js).

4. Select the scene menu and save your scene.

5. Refresh your browser and verify that the new SDK is displayed.

6. Re-publish your scene.

**Properties**

- **3D audio** – Adjust the volume of the speech audio based on the distance of the entity from the camera.

- **Voice** – An Amazon Polly voice.

- **Voice Engine** – Choose between Amazon Polly's Standard voice engine or the Neural voice engine.

- **Volume** – Volume of the speech audio.

- **Speech files** – Drop text files here to add them to the component. Click to mark up a speech file with gestures.

- **Gesture map** – A document that maps gestures to words. When you mark up a speech file, the editor uses this mapping to determine where to add gestures. You can modify the gesture map using text editor (p. 47).
To trigger a speech during playback, use a state machine behavior or script component on the same entity.

**Gestures**

**Gestures** is a feature available when using a Sumerian Host. You can automate hand and body gestures based on speech.

To add gestures, expand the **Gesture Map** property and click the + button. This will add a gesture map to your scene, enabling gestures to be referenced in your speech file.
This will add a **DefaultGestureMap** to your scene and will automatically open up the file in the Text Editor. The **DefaultGestureMap** lists out all the available Host gestures. It also lists the words that will trigger the usage of that gesture in automatic SSML generation.
Return to the Sumerian editor. You will see that the `DefaultGestureMap` has been added to the `Gesture Map` property. You can return to the text editor and add SSML markup manually. See the Amazon Polly SSML documentation. Alternatively, you can automatically add gestures and SSML markup by clicking the `Auto-generate gesture marks` button next to a Speech you previously created.
Return to the text editor and open up your Speech file. Notice that your Speech has been marked up with SSML. Additionally, gesture tags have been added next to words that matched the trigger words in the DefaultGestureMap. The wave gesture was added next to the word "Hello". The self gesture was added next to the word "my", "self", and "I". Make sure to click Save to save these additions in your Speech.
## Gestures

### DefaultGestureMap

```
1
2
3
4
5
<speak>
<mark name="abc">
and <mark name="def">
</mark>
</mark>
</speak>
```

### Documentation

**API Reference (Preview)**

**API Reference (Legacy)**

**Save**

**No errors**
See the scene below to see a sample of the available gestures.

In the next sections, you will learn how to start your speech using both the **State Machine** and **Script** components.

## State Machine

To play a speech, add a state machine component (p. 220) to the entity with the speech component. Add a state with the **AWS SDK ready** and **Start Speech** actions.

### Example State Machine

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS SDK Ready</td>
<td>🔄  ✗</td>
</tr>
<tr>
<td>Start Speech</td>
<td>🔄  ✗</td>
</tr>
<tr>
<td>Speech</td>
<td>sonnet-I.txt</td>
</tr>
</tbody>
</table>

## Script

To play a speech using a script component, get a reference to the speech component from the context object. The component has a speeches array that contains the speeches attached to the component. Call play on a speech.

Sumerian calls Amazon Polly when you play a speech, so you must use the `aws.sdkReady` listener to ensure that your scene's AWS credentials are loaded before the call. Note that the following script is using the **Legacy API**.

### Example script – play a random speech

```javascript
'use strict';
var setup = function(args, ctx) {
sumerian.SystemBus.addListener('aws.sdkReady',
() => {
    var speechComponent = ctx.entity.getComponent('speechComponent');
    var speeches = speechComponent.speeches;
    var speech = speeches[Math.floor(Math.random() * speeches.length)];
    speech.play();
},
true
);
};
```

For more information, see the [Using the Host and Speech Components tutorial](#).
Amazon Sumerian User Guide
Dialogue

Amazon Sumerian Dialogue Component

The dialogue component assigns an Amazon Lex chatbot to an entity. You can use this component to enable a host (p. 177) or other entity to converse with a user and collect information.

To use Amazon Lex during playback, the scene needs AWS credentials from Amazon Cognito Identity. Create an identity pool (p. 3) for your scene, and configure it under AWS configuration (p. 68) in the scene settings.

Properties

- **Name** – The name of the Amazon Lex bot.
- **Alias** – The alias that you choose when you publish the bot.

To trigger dialogue during playback use a state machine behavior or script component on the same entity.

State Machine

To use an Amazon Lex bot, add a state machine (p. 220) to an entity with dialogue and speech (p. 179) components. Use actions to capture audio or text, send it to Amazon Lex for processing, play the response, and wait for additional input.
Example States for text input

- **Start** – **AWS SDK ready** waits for the AWS SDK for JavaScript to retrieve credentials from your Amazon Cognito identity pool.
- **Wait for Input** – **DOM Event Listener** adds a DOM event listener on one or many elements (specified by a query selector) and performs a transition on a given event.
- **Get Text Input** – A **Get HTML Text** action that retrieves the contents of the `input` element in an HTML component.
  - **Entity** – An HTML element with an `input` element.
  - **HTML element selector** – The ID of the `input` element. For example, `#LexInput`.
- **Process with Lex** – **Send text input to dialogue bot** sends the text from the previous state to your Amazon Lex bot and relays the response to the next state.

  Transition **On response ready** to **Play response**, and **On processing error** to **Collect text**.

- **Play Response** – **Start speech** action plays the response from Amazon Lex. Transition back to **Wait for Input**.
- **Use Lex response** – Enabled.

Example States for audio input

- **Start** – **AWS SDK ready** waits for the AWS SDK for JavaScript to retrieve credentials from your Amazon Cognito identity pool.
- **Wait for Input** – **Key down** waits for the user to press a key (spacebar).
- **Start Recording** – **Start microphone recording** action starts recording until the **Key Up** action is triggered when the spacebar is released, transitioning to the next state.
- **Stop Recording** – **Stop microphone recording** action completes the audio recording and passes it to the next state.
- **Process with Lex** – **Send audio input to dialogue bot** sends the audio recorded from the previous states to an Amazon Lex bot.
- **Play Response** – **Start speech** plays the audio response from the previous state using the Amazon Lex response. Transitions back to the **Wait for input** state.
• **Use Lex response** – Enabled.

For more information, see *AWS Feature State Machine Actions in Amazon Sumerian* (p. 237). For a more detailed tutorial on building the behaviors above see the Using the Dialogue Component and Amazon Lex to Build a Chatbot tutorial.

## Script

You can use a script to update the configuration of an entity’s dialogue component in response to user input. The following example adds a listener to two buttons to change the active bot when a button is clicked.

### Example Script – Add Event Listener to Buttons

- **Entity** – Host or other entity with a dialogue component.
'use strict';

function setup(args, ctx) {
  ctx.entityData.changeBot = function(event){
    var name = event.target.getAttribute("botname");
    var alias = event.target.getAttribute("botalias");
    ctx.entity.dialogueComponent.updateConfig({name: name, alias: alias});
  }
  document.getElementById("bot1button").addEventListener('click',
  ctx.entityData.changeBot);
  document.getElementById("bot2button").addEventListener('click',
  ctx.entityData.changeBot);
}

Example HTML 3D component – Buttons

```html
<style>
button {
  background-color: #4CAF50;
  border: none;
  color: white;
  padding: 15px 25px;
  text-align: center;
  font-size: 16px;
  cursor: pointer;
}

button:hover {
  background-color: green;
}
</style>

<button id="bot1button" botname="OrderFlowers" botalias="latest" type="button">Order Flowers</button>
<button id="bot2button" botname="BookTrip" botalias="latest" type="button">Book Trip</button>
```

Amazon Sumerian 2D Graphics Component

A two-dimensional image or video.

Properties

- **Tint** – The tint color.
- **Emissiveness** – The emissiveness of the image.
- **Opacity** – The opacity of the image.
- **Reflection** – The reflectivity of the image.

Amazon Sumerian HTML Components

You can use the Amazon Sumerian HTML components to quickly add text and images to your scene. The HTML component overlays a 2D window that maintains the same orientation (camera facing) at all times. The HTML 3D component is a 3D object within the scene and can be viewed from different angles as the camera moves around it.
Note

HTML 3D works well in 2D scenes and in VR with some limitations. HTML 2D doesn't work in VR, and appears as a black box in VR mode. Scene contents between an entity with an HTML 3D component and the camera are rendered normally. However, nothing behind an HTML 3D component is visible, so HTML components should not use transparency.

You can use style attributes on your HTML elements, or include a separate style tag that defines styles.

HTML 2D Component

The HTML component adds a 2D HTML document (a div) to the scene, and you can edit its content in the text editor. You can position the document using the entity transform, or use CSS to position it relative to the viewport.

Properties

- **Move with transform** – Position the HTML document within the scene using the transform component on the same entity. The document is always the same size and faces the camera, but can move relative to the camera. To position the HTML content relative to the viewport, deselect this option and set positioning with a style attribute.
- **Pixel perfect** – When positioning with the entity transform, snap the HTML window to the closest pixel position.
- **Attributes** – Add HTML attributes to the bounding div tag. For example, you can add a style attribute to position the HTML content onscreen.

Choose the Open in editor button to open the HTML document in the text editor.

Example Video Window

HTML properties

- **Attributes** – style: position:absolute;right:50px;bottom:50px

<iframe width="100%" height="100%" src="https://www.youtube.com/embed/DqeUFGpZLUw" frameborder="0" allow="autoplay; encrypted-media" allowfullscreen></iframe>
HTML 3D Component

The HTML 3D component adds a screen-like element to an entity that you can position in the scene. You set the size of the screen by using the X and Y scale on the transform component. The width and height properties determine how much content (in pixels) fits in that space.

Properties

- **Width** – The width of the HTML content, in pixels. The height of the content is determined by the entity’s Y scale.

Example Movie Screen

Transform

- **Translation** – X: 1, Y: 5, Z: -20
- **Scale** – X: 16, Y: 9, Z: 1

HTML 3D properties

- **Width** – 1920. Height is automatically set to 1080 (1920 * 9 / 16).
Using HTML Components with Scripts

You can interact with content in HTML components by using standard JavaScript and HTML DOM events.

The following example HTML and script add buttons that the user can click to change the active Amazon Lex chatbot on a host with a dialogue component (p. 191).

Example HTML 3D component – Buttons

```html
<style>
button {
  background-color: #4CAF50;
  border: none;
  color: white;
  padding: 15px 25px;
  text-align: center;
  font-size: 16px;
}
</style>
```
Example Script – Add Event Listener to Buttons

• Entity – Host or other entity with a dialogue component.

```
'use strict';

function setup(args, ctx) {
  ctx.entityData.changeBot = function(event) {
    var name = event.target.getAttribute("botname");
    var alias = event.target.getAttribute("botalias");
    ctx.entity.dialogueComponent.updateConfig({name: name, alias: alias});
  }
  document.getElementById("bot1button").addEventListener('click',
    ctx.entityData.changeBot);
  document.getElementById("bot2button").addEventListener('click',
    ctx.entityData.changeBot);
}
```

Amazon Sumerian Sound Component

The sound component adds a number of sound assets to the entity. The sound will not play automatically, but you can play it using a script or the state machine. Supported file extensions are wav, mp3, and ogg.

Properties

• Master volume – The volume of all sounds in the component.
• Drop Sound – Drag and drop or click to upload an audio file.

For more details on the sound component and creating state machine behaviors so play audio files, see the Music and Sound Basics tutorial.

Amazon Sumerian Light Component

The light component adds a light source to the entity.

Properties

• Type
  • Point – Emit light in all directions from a point in space, like a flame.
• **Directional** – Emit light uniformly over the entire scene, like the sun.
• **Spot** – Emit light in a cone, like a spotlight.
• **Color** – The color of the light.
• **Intensity** – The intensity of the light (typically between 0 and 1).
• **Specular** – The intensity of the specular light (typically between 0 and 1).
• **Range** (point and spot) –
  • **Cone angle** (spot) – The angle of the cone at the light source, in degrees.
• **Penumbra** (spot) – The intensity of the light near the edges of the cone.
• **Projection** (directional and spot) – Upload a texture to apply to the light.
• **Shadows** (directional and spot) – Cast shadows from objects that the light hits.

## Amazon Sumerian Particle System Component

The particle system component simulates fluid entities such as liquids, clouds, and flames by generating and animating large numbers of small 2D images in the scene.

### Properties

- **General** – The basic behavior of the particle emitter.
  - **Auto play** – Start the emission animation when the scene starts.
  - **Loop** – Loop the animation.
  - **Duration** – Duration of the animation in seconds.
  - **Prewarm** – Load the effect prior to playback.
  - **Max particles** – Limit the number of visible particles.
  - **Gravity** – Vector of the gravity force that applies to particles.
  - **Seed** – Randomization seed. Experiment with values to find a look that you like, or set to -1 to get a different effect each time.
  - **Local space simulation** – Set to true to simulate the particle system within the boundaries of the parent entity, instead of in the entire scene.
- **Emitter shape** – The shape and size of the emitter. Additional settings are specific to each shape.

**Box**
- **Random direction** – Emit each particle in a random direction.
- **Box extents** – The height, width, and length of the emitter.

**Sphere**
- **Radius** – The size of the emitter.
- **Emit from shell** – Emit particles from the outside edge of the emitter.
- **Random direction** – Emit each particle in a random direction.

**Cone**
- **Random direction** – Emit each particle in a random direction.
- **Emit from** – Emit particles from the narrow end of the cone (**Base**), the center of the cone (**Volume**), or the edges of the cone (**Volumeeedge**).
- **Cone radius** – The radius of the cone at the narrow end.
- **Cone angle** – The angle at which the sides of the cone flare out.
- **Cone length** – The length of the sides of the cone.
• **Over duration properties** – Fine tune values that apply to each loop of animation. Each value can be constant, or progress linearly or randomly over the duration.
  - **Emission rate** – The number of particles emitted per second.
  - **Start speed** – The speed of the particles.
  - **Start size** – The size of the particles.
  - **Start color** – The color of the particles.
  - **Start life time** – The number of seconds before each particle disappears.
  - **Start angle** – The angle of particles.

• **Over lifetime properties** – Fine tune values that apply to the entire lifetime of the particle emitter. Each value can be constant, or progress linearly or randomly over the lifetime.
  - **Color** – The color of the particles. Compounds with the duration color.
  - **Size** – The size of the particles. Compounds with the duration size.
  - **Rotation speed** – Rotation of particles in degrees per second.
  - **Local velocity** – Local space velocity in units per second.
  - **World velocity** – World space velocity in units per second.
  - **Texture** – The texture of each particle. Use one of the provided textures or choose **custom** to upload a texture.

• **Texture animation**
  - **Texture tiles** – The number of tiles in the sprite sheet, in X and Y directions.
  - **Cycles** – The number of texture animation cycles to finish over the lifetime.
  - **Frame over lifetime** – A curve specifying when to show which frame in the animation. 0 is the first frame and 1 is the last. A linear curve starting at 0 and ending at 1 traverses all frames in the animation.

• **Rendering** – Customize the rendering behavior.
  - **Billboard** – Particles always face the camera.
  - **Render queue** – Render queue of the particle mesh.
  - **Render queue offset** – Offset added to the render queue.
  - **Blending** – The type of blending (**None**, **Additive**, **Subtractive**, **Multiply**, or **Transparency**).
  - **Depth write** – Write to the depth buffer.
  - **Depth test** – Test against the depth buffer.
  - **Sorting mode** – The draw order for particles (**None** or **Camera distance**). For transparency blending, camera distance sorting is recommended.
  - **Opacity threshold** – The lower alpha threshold at which fragments are discarded.

---

**Amazon Sumerian Animation Component**

You can use the animation component to manage the animations attached to an entity. The animation component organizes animations into layers of **Animation States**. Each state refers to a clip in the **Assets** panel and contains additional configuration options.

When you import a 3D model that has animations, Amazon Sumerian splits it into separate assets for the model, skeleton, and the **Animation Clips** that it includes. The entity that represents the model in the scene uses an animation component to organize and configure the clips. For an example, see **Working with a Sample Model** (p. 16).

The **Animation State** contains information about an animation, such as how many times it should loop, how fast it should run, and if it has any transition. If there's no transition for an **Animation State**, the default transitions at the bottom of the list are used. If you want to switch between **Animation States**, but want the transition between them to be smooth, add a **Transition**.
Transitions

- **Fade** – A transition that blends over a given time from one Animation State to another, beginning with the target clip from local time 0 at the start of the transition. This is best used with two clips that have similar motions.

- **SyncFade** – A transition that blends over a given time from one Animation State to another, synchronizing the target state to the initial state’s start time. This is best used with two clips that have similar motions.

- **Frozen** – A two-state transition that freezes the starting state at its current position and blends that over time with a target state. The target state moves forward in time during the blend as normal.

As long as the imported animation hierarchy is a sufficient match to the one on which the original animation was created, you can import additional or updated animations to an entity without replacing the model. Another advantage is that using a lower joint count animation on a higher joint count rig would decrease download times. The animation system matches joints based on their names rather than index. Matching by name is what allows users to share animations between rigs with different numbers of joints. For example, an animation can be shared between a full body rig with a face and one without a face, or with one with an added ponytail joint. If the animation system encounters joint channels in an Animation Clip that do not exist in the rig the clip is applied to, those channels are ignored. Additionally, the ability to share an Animation Clip between two characters with different but compatible rigs in the same scene also decreases download times, which we discuss below. Drop your animation FBX file onto the Drop Animation State Fire Here input in an animation layer to add the clips from the file to the layer. To replace a single animation, select the clip in the Assets panel and drag the model file onto the Drop Animation State File Here input.

Sections

- Animation Terms (p. 201)
- Animation Layers (p. 202)
- Animation Clip Assets Workflows (p. 208)
- User Interface Elements (p. 208)
- Detailed User Workflows (p. 214)
- Migrating Legacy Scenes and Animation Components (p. 216)

Animation Terms

The following are common animation terms and asset types in Sumerian.

- **Animation Asset** – The container holding all of the layers of animations an entity can perform. You can apply the same Animation asset to multiple entities. This would result in duplicate animation behavior across multiple entities that could be controlled in a single location. If you want entities to have the same animation capabilities but be controlled and played independently you can duplicate the Animation asset.

- **Animation Layer** – The container inside an Animation asset that holds a group of animation states. There can only be one state playing at any given time on a layer. Adding multiple layers with different Blend Weights and layer types allows you to create more complex movements by adding and blending the current state for each layer on top of each other. Animation Layers only exist inside the Animation asset and they cannot be selected or seen inside the Assets panel.

- **Animation State** – A container inside an Animation Layer that controls a single Animation Clip. The state controls playback of the keyframes inside an Animation Clip. Multiple states can be pointing to the same clip and playing back with different timing by setting the time scale to different values on the Animation State. Animation State can only exist inside the Animation Layers, they cannot be selected or seen inside the Assets panel.
Animation Layers

Within the animation component, the layers get evaluated from top to bottom. Sumerian will first evaluate the base Override Layer. Then it will go to the layer on top of that and evaluate it individually. If it is an override layer with a Blend Weight of less than zero it will lerp (linear interpolation) that percentage between the results of the two layers. If it's an Additive Layer it will add the result on top of the base layer. If there is a Blend Weight of less than zero, Sumerian will lerp the Blend Weight percentage between the base layer result and the result of adding the Additive Layer to the base layer. Once it has that result, it evaluates the next layer down in the stack and if needed, blends that with the result of the first two layers. This pattern continues until it reaches the end of the stack.

Below is an example of what a simple additive wave animation would look like if added on top of a standing idle animation. In this example, the wave animation was imported by dragging the wave FBX file onto the drop input of an Additive Layer, which converts the clip content to additive.
Amazon Sumerian User Guide
Animation Layers
When an **Animation Clip** is imported onto an **Additive Animation Layer**, the first frame of animation in the clip is cut off and the values of every other keyframe in the clip are modified by subtracting out the values from the removed keyframe. This produces keyframes that can offset the joints from their current values (values resulting from override layers underneath). If you attempt to play an **Additive Clip** on an **Override Layer**, any of the transformations that were the matching between the first two frames of the original FBX file will now have identity transformations (translation and rotation values of 0, 0, 0, and scale values of 1, 1, 1). This will result in those joints "squishing" down into the same location at the entity's origin.

Below is an example of what that same wave animation would look like if you originally imported it on an **Additive Layer** but then applied to a state on an **Override Layer**.
Alternatively, applying an **Override Clip** to an **Additive Animation Layer** can result in producing double transformations on the joints. As stated above, **Additive Animation Layers** add relative transformations on top of the result of layers higher in the animation asset stack. Because **Override Animations** are meant to set the absolute transformation of each joint, adding these on top of other layers can result in the rig becoming stretched out with undesired rotation values. For example, a limb that starts as 2 units long, applying an override animation as additive would result in it ending up 4 units long even if the length of the limb never changed in the source animation.

Below is an example of what it would look like if you had imported the wave animation straight to the **Assets** panel, which automatically sets it as an **Override Animation Clip** but then applied to a state on an **Additive Layer**.
Animation Clip Assets Workflows

Animation Clips are time indexed sequences of values used to drive animation for joint-based objects in Sumerian. Think of clips as containers for your animations that allows you the flexibility to use them in different layers or on different rigs in your scene. In previous Sumerian releases, Animation Clips were internally stored within the animation component's data, which means they cannot be shared or reused among entities. Converting Animation Clips to assets enables their sharing and reuse.

If you are a returning customer, there have been some changes to the UI documented below that you will need to be aware of as you read through the new workflows.

Common workflows for importing new animations

The following are common workflows for users that have already imported a rig.

- Drag source animation FBX files from your computer onto the Drop Animation State File Here drop input onto an animation layer.
- Alternatively, drag an Animation Clip from the Assets panel onto the Clip asset of an animation component. Clips may be created in the Assets panel either by dragging FBX files from your computer onto the canvas or directly into the Assets panel.

Workflow Tips

- ORGANIZATION – Even though you can keep all your animations in one FBX, doing so can make it a challenge to keep track of content using just the clip name. It is recommended that you name each Animation asset separately, if possible, rather than keeping all takes in one animation FBX. Multiple FBX Animation assets from your local folder can be dragged on the Drop Animation State File Here drop input of an animation layer.
- CLIP MANAGEMENT – You can end up with multiple versions of a clip with the same name. For example, it is possible to have the animation clip called “wave” as an override animation in the Default Animation Layer but also an additive clip called “wave” that was dragged into an additive because each clip can be only one of either override or additive. In the Default Pack, you would see two clips named “wave”. Clicking on each one will show you whether they are additive or override in the Inspector. However, it is helpful to name the Animation States differently. That way when you click on the clip’s dependees list in the Asset Bin, it will be more clear which state(s) is(are) actually using the clip.
- DELETING CLIPS – You can delete clips from the Assets panel by selecting the clip and clicking on the trashcan icon next to it. If your clips have dependencies (assets that depend on them) you will not be able to delete them without first clearing out those dependencies.
- FINDING DEPENDENCIES – Assets that are dependent on clips can be revealed by clicking the dependencies button to the right of the clip in the Assets panel.

- OVERRIDE VS. ADDITIVE ANIMATIONS – The Default Animation Layer is always an override layer. If you drag and drop onto this layer the clip created will be an override clip. If you want an additive style clip, you must have an Additive Blend layer and drop the FBX there. Currently, there is no other way to create an additive clip and the clip type cannot be changed after the fact.

User Interface Elements

Animation Component

- Animation Asset – Drop Animation assets here to change the Animation asset used by the Animation component. Click on the field to edit the properties of the asset. Click on the Duplicate Asset button
on the right to duplicate the Animation asset and update the Animation component to reference the duplicate.

- **Clip** – Drop Clip assets here to change the clip asset used by the Animation State. Click on the field to edit the properties of the Clip asset. Click on the Remove Clip button on the right to remove the reference to the Clip (the clip will still be available in the Assets panel).

- **Drop Animation State File Here** – Drag and drop Animation State files to add additional states. An Animation State is a FBX file containing one or more keyframes on a joint hierarchy.
Animations in the Assets panel

- **Animation Filter** – Click to filter the displayed assets to show only Animation assets.
- **Clip Filter** – Click to filter the displayed assets to show only Clip assets.
- **Animation Asset** – Select to edit the Animation asset properties. Buttons to show which objects depend on the asset, duplicating the asset and deleting the asset are included to the right of the asset when selected.
- **Clip asset** – Select to edit the Clip asset properties. Available buttons/properties will depend on the asset. Duplicating the asset and deleting the asset are included to the right of the asset when selected.

Editing Animation Assets

This panel is displayed when an animation asset applied to an entity with an animation component. Similar to the Materials asset and an entity's component panels, the editing section is the same one that appears in the animation component. The standard asset Details section is included.
Clip Component

The Clip component is displayed when a Clip asset is selected. The standard asset Details section is included.

- **Drop File to Replace Clip**– Drop a file with animation takes, such as an FBX, to replace the contents of this clip with the take. If multiple takes are in the file, Sumerian tries to match the existing Clip Name with the take name and will use that take if a match is found. If a match is not found, or if only one take exists in the file, the first take in the animation stack in the file is used. If no takes exist in the file, an error dialog is shown and the replacement is aborted.

- **Clip Type**– This shows the whether the clip was originally imported as an Override or Additive clip. It is currently not possible to switch between Override and Additive (i.e. it is read-only).
Detailed User Workflows

This section will cover more detailed workflows for the user.
Import a new FBX file containing a rig with one or more animations

1. Drag the FBX file containing animation from your computer's folder into the Sumerian viewport or Assets panel.

2. A new Asset Pack is created in the Assets panel containing an entity named with the FBX filename with an animation component, along with all of the asset types that are generated with the current import behavior. The new pack contains a separate Animation Clip asset for each animation that was saved as a take in the FBX file.

3. The animation component contains a single override Animation Layer with the same number of Animation States as the number of Animation Clip assets. Each Animation State points to one Animation Clip asset in the pack and has the same name as that clip.

4. Each Animation Clip asset has the Additive property disabled.

Import an animation FBX onto an Animation component

1. Drag the animation FBX file onto the Animation State drop field of an existing Animation Layer. This field is labelled Drop Animation State File Here.

2. The Default Pack in the Assets panel contains a separate Animation Clip asset for each animation that was saved as a take in the FBX file. In the context of Sumerian and many other 3D content environments, a take is just another name for an Animation Clip. No other Sumerian assets are created as a result of this import.

3. A new Animation State is created on the existing Animation Layer for each of the Animation Clips assets. Each Animation State points to one Animation Clip asset in the pack and has the same name as that clip.

4. Each new Animation Clip asset has the Additive property set to match the layer type that the FBX was imported on, which will convert the clip's contents to Additive if the property is set to True.

Apply an existing Animation Clip asset from the Assets panel to an existing Animation State

1. Drag an Animation Clip asset from the Assets panel onto the drop input of an Animation State.

2. The drop input now points to the newly specified Animation Clip asset. If it was already pointing to a different clip, that reference is removed.

Create an empty Animation State and add an existing Animation Clip asset to it

1. The user click the Add New Animation State button on an Animation Layer.

2. A new empty Animation State is created on the existing Animation Layer.

3. Drag an existing Animation Clip asset onto the Clip drop field in the empty Animation State.

4. The Additive property on the Animation Clip asset(s) that were dropped remains unchanged.

Replace a single Animation Clip asset with an FBX file containing one or more animations

1. Drag an FBX file containing one or more animation takes onto the drop input in the Inspector panel of an existing Animation Clip asset.

2. If the FBX file contains multiple animations (i.e. takes) the take names are searched for a match to the existing clip name and used if found. If no match is found, the first take in the FBX is used.

3. The contents of the existing Animation Clip asset are overwritten with the contents of the take selected for import.

4. The new Animation Clip asset's Additive property will match the Animation Clip asset it replaced and its import will use this property accordingly.

5. If the FBX file contains no animation takes at all, an error dialog is shown.
Migrating Legacy Scenes and Animation Components

Legacy scenes have Animation Clips as “unshared” asset types, which duplicates them into the Default Pack when a referencing entity is imported. Converting them to exposed Animation Clips will involve:

1. Setting its Additive and Override property to match the layer Additive/Override property the internal clip was in.
2. Finding the original Animation Clip asset in the Asset Pack containing the Skeleton used in the entity's geometry component and replacing the Animation State references and deleting the clip in the Default Pack, therefore converting the unshared clip asset to a shared one.

This would have to be done at load time by the user with the updated engine.

Batch processing all existing scenes isn't an option because they would not load in 'pinned' scenes or scenes loaded with previous engine versions.

Amazon Sumerian Physics (Collider and Rigid Body)

The primary components that produce physics within Amazon Sumerian are the collider component and the rigid body component. The rigid body component is mainly responsible for tracking the position, rotation, and linear and angular velocity of a physical object. This component carries many properties but at its core, a rigid body component makes an entity respond to gravitational pull. The collider component is responsible for calculating and detecting collisions between physical objects. It tells the Sumerian engine to treat an entity as a physical object. Otherwise, objects would just pass through one another. A collider component can also act as a trigger, or a motion sensor. Other physical objects passing through a collider component trigger a responsive action. Together, these components make it possible to create physical behaviors.

The default physics system used by Amazon Sumerian is Cannon.js. You can also elect to use a different physics system, PhysX, an implementation that is currently in preview for Amazon Sumerian.

Enabling PhysX in Preview

To use PhysX in preview:

1. In the Entities panel, select the root entity.
2. Navigate to the **Inspector** panel and select the details component, the top tab which contains the name of your scene.

![Inspector panel image](image)

3. In this step you will add key-value pairs under **Custom Attributes**. In the **Key** box, type `Sumerian.DisabledEngineFeatures`. In the **Value** box, type `cannonphysics`. Click the + to add the key-value pair.

![Custom Attributes panel image](image)
4. Click the + button again to populate another key-value pair. In the **Key** box, type `Sumerian.EnabledEngineFeatures`. In the **Value** box, type `physxpack`. Click the + to add the key-value pair.

5. Click the scene drop down menu (top left of the editor) and choose **Save**.

6. Refresh your browser.

Your **Custom Attributes** should look like the following:

![Custom Attributes](image)

As we are testing PhysX in preview, please provide us feedback and share your thoughts on how it is performing!

**Collider**

The collider component adds collision geometry to the entity. If used together with a rigid body component, you can create a dynamic, colliding entity. If the collider doesn't have any rigid body component, it becomes a static collision geometry in the physics world. We call this a *static collider*.

If the entity with a collider or any of its parents has a dynamic rigid body component, it will turn into a *dynamic collider*. If the entity with a collider or any of its parents has a kinematic rigid body component, it will turn into a *kinematic collider*.

The collider shapes are rendered with a green wireframe.

**Properties**

- **Shape** – The shape of the collider.
  - Box
  - Sphere
  - Plane
  - Infinite plane
- **Trigger** –

  If the collider is not a trigger, it emits these events during collisions:
  - `sumerian.physics.beginContact`
  - `sumerian.physics.duringContact`
  - `sumerian.physics.endContact`
If the collider is a trigger, it will *not* collide with other physics objects. However, it will emit events when a physics object enters it. Available events are:

- `sumerian.physics.triggerEnter`
- `sumerian.physics.triggerStay`
- `sumerian.physics.triggerExit`

### Friction

- **Friction** – 0 Means no friction. The final friction (and restitution) value used in a collision is computed using multiplication. For example, a sphere with friction=0.5 that collides with a plane with friction=0.5 will get a friction value of 0.25.

### Restitution

- **Restitution** – How much the collider should bounce. 0 is no bounce and 1 is maximum bounce. If you set restitution to a number larger than one, it gains more and more energy for each bounce.

### Half extents

- **Half extents** – The collider's half extents on the X, Y, and Z axises.
Rigid Body

The rigid body component adds physics properties, such as mass and velocity, to the entity. The component will simulate physics for the component and set the position and orientation of the entity accordingly.

Properties

- **Mass** – The mass of the body.
- **Kinematic** – Make the rigid body kinematic instead of dynamic. A dynamic body is affected by external forces such as gravity. Kinematic bodies do not fall or react when hit.
- **Velocity** – The initial linear velocity of the body.
- **Angular velocity** – The initial angular velocity of the body.
- **Linear drag** – Resistance of the body to linear movement, between 0 and 1.
- **Angular drag** – Resistance of the body to angular movement, between 0 and 1.

If you add a collider component to the entity, the collider is used for rigid body collision, with the center of mass being at the same location as the rigid body.

Amazon Sumerian State Machine Component

The state machine component adds a Sumerian state machine to the entity. You can use state machines to create dynamic and interactive scenes that feature animation, physics, special effects. State machines are specific to an entity, so you can have multiple state machines in your scene that trigger on different events.
A state machine has one or more behaviors that organize scene logic into states, actions, and transitions. See Amazon Sumerian State Machine (p. 234) for more information.

Amazon Sumerian Script Component

You can add scripts to any entity. A script component can contain multiple scripts. Scripts run in order from top to bottom and you can adjust the order in the script component properties.

To support reuse, you add an instance of a script to the script component, not the script itself. The instance contains the state and parameters of the script, letting you add multiple instances of the same script with different behavior on each, based on the arguments provided.

Properties

- **Enabled** – Clear the check box to disable a script.
- **Instance of** – Each script instance in the list has a reference to the script it is using. Choose a script to go to the script’s own panel.
- **Parameters** – Any parameters defined in the script’s parameters array (p. 245) appear here. Adjust the values to customize the behavior of this script instance.

To structure your parameters, you can store them in a JSON file. Start by defining the parameters in the script itself. Then add the JSON file and reference it from the script settings.

**Example Script with JSON parameter**

```javascript
var setup=function(args,ctx){
    console.log(args.myJsonParameter); // Prints the parsed JSON data
};

var parameters=[{
    key:'myJsonParameter',
    type:'json'
}];
```

**To create a script with JSON parameters**

1. Create a blank entity (p. 80).
2. Choose **Add component**, and then choose **Script**.
3. Choose **Add script**, and then choose **Custom**.

4. Choose **Edit script**.

5. Replace the default **parameters** declaration with the following.

   ```javascript
   var parameters=[{
       key:'myJsonParameter',
       type:'json'
   }];
   ```

6. Return to the script settings. The settings automatically update to include the JSON parameter.
7. Drop a JSON file in the parameter field.

---

**Amazon Sumerian Timeline Component**

Use timelines to move, rotate, or change the scale of entities over time. You can set the start and end values of these properties, and add keyframes to control the speed or direction of the animation along the way. The timeline can also emit custom events, which can be consumed from a state machine or script.
To create a timeline, choose Create entity, Timeline. You can also add the timeline component to an existing entity, but don't add it to the entity that you want to animate. The timeline can only control entities other than the one to which it is attached.

**Properties**

- **Duration** – Length of the timeline, in seconds.
- **Loop** – Enable to repeat the timeline animation in a loop.
- **Auto start** – To trigger the timeline with a state machine or script, disable this option to prevent the timeline from starting automatically in playback mode.

To open the timeline editor, choose Toggle timeline in the timeline component, or choose Timeline from the Tools menu.

To add entities to the timeline, drag them from the entities panel onto the timeline editor. Each channel in the editor controls one property of the transform, such as the X translation or the Z scale. Click the clock icon next to a property to enable the channel and add the first keyframe.

Add more keyframes to a channel by choosing a time and changing the property's value. During playback, the entity animates between the transform values at each keyframe. By default, changing a property's value automatically creates a keyframe. You can disable this by clicking the key icon next to the Drop entity here box.
Add **Event channels** to the timeline to emit custom events onto the system bus. The name of the channel is the name of the event that Sumerian emits at each keyframe on the event channel. Consume this event from a script with `SystemBus.addListener`, or from a state machine (p. 220) with the **Listen action**.
Amazon Sumerian Assets

The assets panel in Sumerian collects shareable assets in the scene. When you add an asset to a scene, Sumerian automatically adds it to a default pack in the assets panel. Entities that you create are not automatically added, but you can drag them from the entities panel into the assets panel to create an entity asset.

Asset Types

- **Entity** – A Sumerian entity (p. 80). If you import a file or asset pack, drop the entity from the assets panel onto the canvas to add it to your scene.
- **Gesture map** – A document that maps gesture animations to trigger words in a speech asset.
- **Mesh** – A polygon mesh from a 3D model.
- **Skeleton** – A skeleton from a 3D model.
- **Animation** – A collection of animation clips from a 3D model.
- **Clip** – An animation clip from a 3D model.
- **Material** – A material component (p. 92) with textures for each renderable layer generated from a 3D model.
- **Sound** – An audio file for use with a sound component (p. 198).
- **Script** – A JavaScript script that can be instantiated on a script component (p. 198).
- **Speech** – A text file for use with a speech component (p. 179).
- **JSON** – A JSON file that can be used as a parameter input on a script component (p. 198).
- **Skybox** – A collection of textures that can be added to the background of the scene in the scene's environment settings (p. 72).
- **Behavior** – A collection of actions that can be added to a state machine component (p. 220).
- **Texture** – An image file that can be added to layers of a material component (p. 92), a 2D graphics component (p. 194), or a skybox. Textures can also include HDR images used for Environment Lighting.

To add an asset to a scene, you can drag it from your desktop directly onto the canvas. Depending on the file type, the editor creates an entity in the entities panel, and one or more assets. For example, when you add a JPG image to a scene, you get an image entity in the scene, a material asset, and a texture asset.
To add an asset to a scene

1. Open a scene in the Sumerian editor.
2. Drag a file from your desktop file browser onto the canvas.

or

Create a blank asset by clicking the plus icon next to the default pack. To see the icon, select the pack name.

3. Choose the asset in the assets panel and modify it by using the options in the inspector panel.

Amazon Sumerian Asset Packs

You can organize your assets and share them between scenes by creating a pack. Create a pack in the assets panel and move or copy assets into it.

Packs support the following actions:

- Create a new asset in the pack.
- Export the pack to the asset library.
- Delete any assets in the pack that are not used in the scene.
- Delete the asset pack.

Exporting a pack adds it to the project that you choose. If you don’t have a project yet, create one in the dashboard (p. 23). You can then use the dashboard to copy or move the pack (p. 25) to a different scene or project. Exported packs are not tied to the in-scene pack or its assets.

To add an asset to a pack and export it

1. Open a scene in the Sumerian editor.
2. Under Assets, choose Create pack.
3. Choose the pack and modify the name, description, tags, and custom attributes in the inspector panel.
4. Drag an asset from the default pack into the custom pack.

or

Duplicate the item by selecting it and then clicking the duplicate icon. Drag the duplicate into the custom pack.
5. Select the custom pack, and then click the asset library icon or choose Add to asset library in the inspector panel.

6. Choose an asset type (p. 225) for the asset pack.
7. Choose Add to asset library.
8. Choose a project, and then choose Select.

Amazon Sumerian Scene Templates

Sumerian provides scene templates that you can use as a starting point for your scene.

**Sumerian Scene Templates**

- **Augmented reality** – Template for creating augmented reality (AR) scenes with a companion sample app. See Amazon Sumerian Augmented Reality Tools (p. 228) for more information.
- **Default lighting** – An empty scene with a skysphere and three directional lights. This template is used in the interface tutorial.
- **Speech & gestures** – Scene with a Sumerian host (p. 229) configured to use speech with a state machine.

Choose any of these templates in the dashboard (p. 23) to create a draft scene.

Amazon Sumerian Virtual Reality Tools

Sumerian provides a pack of virtual reality (VR)-related assets to make it easy to enable VR in your scene. The asset pack includes a VR camera that lets the user enter VR mode, and VR controllers for interacting with the environment.
Supported VR Headsets

- Oculus Rift
- Oculus Go
- Oculus Quest
- Oculus Rift 5
- HTC Vive
- HTC Vive Pro
- Samsung Gear VR

To enable VR in your scene (Note that the VR Asset Pack is recommended over CoreVR):

1. Open a scene in the Sumerian editor.
2. Choose Import assets.
3. Choose CoreVR, and then choose Add.
4. When the asset pack finishes loading, drag the VRCameraRig entity onto the canvas to add it to your scene.
5. Choose the VRCameraRig entity.
6. Choose the VRCameraRig component.
7. Choose the Current VRCameraRig option to enable the rig.

When a user enters VR mode with a headset and controllers attached, the HMD camera (p. 177) tracks the headset, and the VR controllers (p. 177) track the controllers in 3D space. The VRCameraRig (p. 176) manages the other entities and enables the VR mode button in the scene.

Only the controllers of the type attached are rendered in the scene, so you can leave all of the included entities attached to support both types. You can also replace the included controller models with your own.

See Getting Started with VR for a tutorial that uses these assets.

Amazon Sumerian Augmented Reality Tools

Sumerian provides a template, assets, and sample projects that you can use to develop augmented reality (AR) applications for iOS and Android devices.

The Augmented Reality scene template is available in the dashboard (p. 23). Use it as a starting point for your augmented reality scene.

The scene includes the following resources:
• **AR Camera** – The main camera, with a script that maps it to the device's camera.

• **AR Camera Control** – A script that uses the Sumerian engine AR System to access the device's augmented reality API. You can view this script in the text editor.

• **ARAnchor** – An empty entity that the AR app uses to anchor objects in the scene to the real world.

You can construct an AR scene from this template by adding models and making them children of the ARAnchor entity. Publish the scene, and then use the sample AR Kit project to build an app that uses it.

**Samples**

- Android Sample Project (p. 229)
- iOS Sample Project (p. 229)

**Android Sample Project**

The sample project, amazon-sumerian-arcore-starter-app, is an Android Studio project with an ARCore app that loads a scene created with the AR template. Replace the scene URL in the view controller with the URL of your published scene, build the app, and then run it on a compatible Android device to see it in action.

See the Augmented Reality Using Sumerian and ARCore tutorial to explore how to use these assets.

**iOS Sample Project**

The sample project, amazon-sumerian-arkit-starter-app, is an XCode project with a Swift app that loads a scene created with the AR template. Replace the scene URL in the view controller with the URL of your published scene, build the app, and then run it on a compatible iOS device to see it in action.

See the Augmented Reality Using Sumerian and ARKit tutorial to explore how to use these assets.

**Amazon Sumerian Hosts**

A host is an asset provided by Sumerian that has built in animation, speech, and behavior for interacting with users. Use hosts to engage users in conversation and convey information.

![Hosts](image)

**To add a host to your scene**

1. Open a scene in the Sumerian editor.
2. Choose **Import assets**.
3. Choose one of the following hosts:
   - Cristine
   - Preston
   - Luke
4. Choose **Add**.
5. Drag the host entity from the assets panel onto the canvas.

All of a host's meshes, materials, animations, and scripts are bundled into a single entity with three configurable components:
- **Transform (p. 82)** – The host's location relative to the scene or its parent entity.
- **Host (p. 177)** – Animation and behavior settings.
- **Speech (p. 179)** – Text-to-speech capability with Amazon Polly.

Models and animations for hosts are locked. You cannot modify or extend them.

### Models

Drop a model file on the assets panel to import it. When you import a model, Sumerian converts it into an asset pack that contains the model's meshes, skeletons, materials, and textures. Meshes are triangulated automatically during import. The process can take some time, depending on the model size and format.

You can import models up to 50 MB in size in the following formats.

#### File Formats
- **FilmBox** – `.fbx`
  
  [www.autodesk.com/products/fbx/overview](http://www.autodesk.com/products/fbx/overview)
- **Wavefront OBJ** – `.obj`
  
After the model is imported, drop the model entity from the asset pack onto the canvas. This adds one or more entities to the scene in a hierarchy based on the imported file. At a minimum, the entity has transform, geometry, and material components. If you import a model that has a skeleton and animations, you also get an animation component. The skeleton and polygon mesh are attached to the geometry component, and textures are attached to the material component.

To optimize the model importing process, remove unneeded data by deleting the object history and freezing transformations in your modeling tool. If you can, avoid using geometric transformations. If your model has skeleton animations, bake them during export and avoid using constraints.

The Sumerian engine supports the following model features.

Model Features

- **Vertex colors** – Per-vertex colors or per-face-vertex colors are supported.
  
  When the mesh data contains vertex colors, a slider is available on the mesh’s material panel under the diffuse channel. You can use the slider to blend between the set diffuse map or color and the vertex color.

- **UV maps** – If two are available, you can use the second one, for example, for light maps or ambient occlusion maps.
  
  In the editor, you are able to apply these textures on the ambient channel in the material panel.

- **Tangents** – If no tangent data is provided, it is generated during the conversion.

- **Normals** – If no normal data is provided, interpolated normals are generated during the conversion.

- **Rig** – An animation rig or armature in an FBX file is imported as a skeleton asset. Each vertex can have up to 4 weights. If more are present, the lower valued weights are removed. Minimize the number of joints to improve performance.

- **Animations** – Animation takes in an FBX file are imported as clips attached to an animation asset. See Amazon Sumerian Animation Component (p. 200) for more information.

- **Textures** – When exporting to the FBX binary format, you can embed textures into the resulting file.

Skybox

A skybox is a texture that you apply to the background of a scene to show the sky, space, or an enclosing structure. A skybox can be a single texture that wraps onto a sphere, or six textures that wrap onto a cube. Add a skybox to your scene in the scene's environment settings (p. 72).

To create a skybox

1. Open a scene in the Sumerian editor.
2. Click the plus icon next to the default pack. To see the icon, select the pack name.
3. Choose Skybox.
4. Choose the shape of the skybox.
Skybox Shapes

- **Box** – Six square images that map onto a cube (cube map).
- **Sphere** – A single rectangular image that maps onto a sphere (equirectangular projection).

5. Drop a texture asset or image file on each section of the skybox.

6. Choose the root node in the **Entities** panel.

7. Choose **Environment**.
8. Drop the skybox asset from the assets panel onto the **Skybox** field.
Media

You can import media files into Sumerian to use as textures, audio, or text objects. Sumerian supports the following file formats.

Textures up to 20 MB

- CRN
- DDS
- JPG, JPEG
- PNG
- SVG
- TGA
- MP4
- OGV
- WEBM

Audio up to 10 MB

- OGG
- MP3
- WAVE, WAV

Text up to 1 MB

- JS
- JSON

You can combine multiple asset files into a ZIP archive up to 200 MB in size, as long as each file meets the size requirement for its type when decompressed.
Amazon Sumerian behaviors can be attached to the state machine component (p. 220) of an entity. A behavior is a collection of states that transition between one another based on user interaction, timing, or other events.

Each state in a behavior consists of one or more actions that contain some logic that Sumerian defines. An action on the active state can do things like respond to a user clicking the entity that the behavior is attached to, run a script, or record audio and send it to an Amazon Lex chatbot.
All actions on a state execute simultaneously when the state is entered. If an action has a built-in transition, the transition enters the next state when the action is complete. Some actions modify the entity or scene and don't have a built-in transition. Others perform a calculation or wait for an event, and then fire a transition.

In the previous example, the first state waits for the AWS SDK to get credentials and signal that it's ready. When this occurs, it transitions to a state that waits for the user to press the Spacebar. This transitions to another state that has two actions: one starts recording audio, and a second waits for the user to release the key. When the user releases the key, another state stops the audio recording and transitions to a fifth state that sends the recorded audio to an Amazon Lex chatbot.

The chatbot action has three transitions, and can respond differently depending on the result of the call to Amazon Lex. Finally, the sixth state plays the audio response from the chatbot and transitions back to the second state to wait for another key press. For more information on this example, see Amazon Sumerian Dialogue Component (p. 191).

Sumerian provides many actions, organized into the following categories.
State Machine Actions

- **Animation** (p. 236) – Animate and transform entities.
- **Audio and Camera** (p. 237) – Control audio settings and the scene camera.
- **AWS Features** (p. 237) – Control Sumerian features that call other AWS services, including speech (Amazon Polly) and dialogue (Amazon Lex).
- **Keyboard and Mouse** (p. 238) – Respond to keyboard, mouse, and touch events.
- **Effects and Lighting** (p. 239) – Modify scene lighting or add special effects.
- **Materials and Rendering** (p. 239) – Modify entity textures and visibility.
- **Physics and Collision** (p. 240) – Apply physics and check for collisions.
- **Logic and Transitions** (p. 240) – Run scripts, respond to events, and add transitions to a state.
- **Attributes and Tags** (p. 241) – Manage entity metadata and perform transitions based on the value of a string, number, or boolean.

Animation State Machine Actions in Amazon Sumerian

You can use state machine actions to animate and transform entities in Sumerian.

Transform actions change the translation, rotation, and scale of the entity. Tween actions change the same values smoothly over a configurable amount of time.

**Transform Actions**

- **Look at** – Rotate the entity to face a point in space.
- **Tween look at** – Smoothly rotate the entity to face a point in space over time.
- **Face current camera** – Rotate the entity to face the active camera.
- **Move**, **Rotate**, and **Scale** – Move, rotate, or scale the entity immediately.
  - **(move) Oriented** – If the entity is rotated, move relative to the current rotation. For example, moving a host 1 unit on the X axis with oriented always moves the host to their right, on the host’s X axis. If not oriented, the host moves on the world X axis, regardless of which direction it faces.
  - **Relative** – Move, rotate, or scale relative to the current transform values. Uncheck to set new transform values absolutely.
  - **On every frame** – Repeat a relative transform while the state is active, spreading the specified values over each second that passes. For example, you can add 90 degrees of rotation relative, and on every frame. If the scene renders at 60 frames per second, the entity rotates 1.5 degrees every frame until a transition occurs.
- **Tween move**, **Tween rotate**, **Tween scale** – Smoothly move, rotate, or scale the entity over time.
- **Shake** – Shake the entity.

Animation actions control the entity’s animation component.

**Animation Actions**

- **Copy joint transform** – Copy a joint transform from another entity, and apply it to this entity. This entity must be a child of an entity with an animation component.
- **Pause animation** – Pause skeleton animation.
- **Resume animation** – Continue playing skeleton animation.
• **Set animation** – Transition to a selected animation.
• **Set animation offset** – Change the animation clip offset.
• **Set animation time scale** – Change the time scale for the current animation.

Host actions configure a Sumerian host to play an emote or look at another entity.

**Host Actions**

• **Play emote** – Play a host emote.
• **Set point of interest target** – Change the target entity of a host.

---

### Audio and Camera State Machine Actions in Amazon Sumerian

You can use state machine actions in Amazon Sumerian to control audio settings and the scene camera.

**Audio Actions**

• **Mute, Toggle mute, and Unmute** – Mute or unmute sounds in the scene. **Toggle mute** mutes if sound is currently unmuted and vice-versa.
  
  • **Audio system** – Mute all audio in the scene, just sound component (p. 198) audio, or just speech component (p. 179) audio.

• **Play sound, Pause sound, and Stop sound** – Play, pause, or stop a sound from the entity's sound component.

• **Sound fade in and Sound fade out** – Start or stop a sound with a fade.

• **Start microphone recording** – Start recording audio from microphone input.

• **Stop microphone recording** – Stop recording audio from microphone input and store it on the entity. The audio can then be used by the **Send audio input to dialogue bot** (p. 237) action.

Camera actions interact with the entity's camera component.

**Camera Actions**

• **Dolly zoom** – Perform a dolly zoom.

• **Switch camera** – Switch to a different camera.

---

### AWS Feature State Machine Actions in Amazon Sumerian

You can use state machine actions to control Sumerian features that call other AWS services, including speech (Amazon Polly) and dialogue (Amazon Lex).

**AWS Feature Actions**

• **AWS SDK ready** – Wait for the AWS SDK for JavaScript to get credentials before using features that call AWS services. See **Configuring AWS Credentials for Your Amazon Sumerian Scene** (p. 68) for details.
Keyboard and Mouse State Machine Actions in Amazon Sumerian

You can use state machine actions in Amazon Sumerian to respond to keyboard, mouse, and touch events.

Keyboard actions transition in response to a specific key press. You can add multiple keyboard actions to the same state to respond to multiple inputs. The first key press that satisfies any keyboard action on the state triggers a transition to the next state.

**Keyboard Actions**

- **Key down** – Press a key.
- **Key up** – Release a key.
- **Key pressed** – Press a key.
- **Arrow key** – Press up, down, left, or right on the arrow keys.
- **WASD key** – Press W, A, S, or D.

Mouse actions listen for click, hover, and touch events on the entity or its children, and then transition to a new state.

**Mouse Actions**

- **Click or tap on entity** – Choose an entity by clicking or tapping it.
- **Hover enter** – Move the mouse cursor over an entity.
- **Hover exit** – Move the mouse cursor off of an entity.
- **Mouse move** – Move the mouse cursor.
- **Mouse down or touch start** – Press a mouse button, or touch the screen. Has separate transitions for touch and each mouse button.
- **Mouse up or touch end** – Release a mouse button, or stop touching the screen. Has separate transitions for touch and each mouse button.
- **Mouse pressed** – Press a mouse button. Choose Left, Middle, or Right. Has one transition for the selected button.
- **Pick** – Click or tap an entity and then release, without moving away from the entity.
- **Pick and exit** – Click or tap an entity, and then release to open a link in a new window.
Effects and Lighting State Machine Actions in Amazon Sumerian

You can use state machine actions in Amazon Sumerian to modify scene lighting or add special effects.

**Effects and Lighting Actions**

- **Add light** – Add a point light to the entity.
- **Set light properties** – Modify a light component's properties.
- **Remove light** – Remove the entity's light component.
- **Tween light** – Smoothly transition between two light colors.
- **Fire FX** – Make the entity emit fire. To extinguish the fire, use the **Remove particles** action.

- **Smoke FX** – Make an entity emit smoke. To cancel the smoke emitter, use the **Remove particles** action.

- **Start particle system** and **Stop particle system** – Start or stop a particle emitter.
- **Pause particle system** – Pause a particle system.
- **Remove particles** – Remove any particle emitter attached to the entity
- **Toggle post effects** – Enable or disable all post effects in the scene.

Materials and Rendering State Machine Actions in Amazon Sumerian

You can use state machine actions in Amazon Sumerian to modify entity textures and visibility. Remove or hide entities that are no longer in use to save resources.

**Materials and Rendering Actions**

- **Hide** and **Show** – Hide or show the entity and its children.
- **Remove entity** – Remove the entity from the scene.
- **Set material color** – Change the color of the entity's material. If the material is PBR-based material, the actions will update the **Base Color in PBR material** and **Color (Diffuse) in PBR material**.
- **Set render target** – Render what a camera sees on the entity's texture.
- **Sprite animation** – Start a sprite animation.
- **Tween material color** – Smoothly change the material color. If the material is PBR-based material, the actions will update the **Base Color in PBR material** and **Color (Diffuse) in PBR material**.
• **Tween material opacity** – Smoothly change the material's opacity.
• **Tween texture offset** – Smoothly change the material texture offset.

**Physics and Collision State Machine Actions in Amazon Sumerian**

You can use state machine actions in Amazon Sumerian to apply physics and check for collisions.

**Physics Actions**

• **Apply force on rigid body** – Apply a force to the entity's rigid body.
• **Apply impulse on rigid body** – Apply an impulse to the entity's rigid body.
• **Apply torque on rigid body** – Apply a torque to the entity's rigid body.
• **Set rigid body angular velocity** – Change the angular velocity of a rigid body.
• **Set rigid body position** – Change the position of a rigid body.
• **Set rigid body rotation** – Change the rotation of a rigid body.
• **Set rigid body velocity** – Change the velocity of a rigid body.

Collision actions detect changes in an object's position and transition to a new state.

**Collision Actions**

• **Camera distance** – The entity is at a distance from the current camera or a point in space.
• **In box** – The entity is within a box bounded by two points at opposite corners.
• **Trigger enter** – The entity's collider enters a trigger volume.
• **Trigger leave** – The entity's collider leaves a trigger volume.

**Logic and Transition State Machine Actions in Amazon Sumerian**

You can use state machine actions in Amazon Sumerian to run scripts (p. 243), respond to events, and add transitions to a state.

Logic actions perform calculations, run scripts, or interact with the page document.

**Logic Actions**

• **DOM listen** – Add a DOM event listener on one or many elements (specified by a query selector), and perform a transition on a given event.
• **Emit message** – Emit a message (a ping) to a channel on the bus. Messages can be listened to by the **Listen** transition action, or by scripts using the `SystemBus.addListener(channel, callback)` function.
• **Execute script** – Run a script (p. 243), and transition on success or failure. Use the `enter` and `exit` functions in your script to run code when the state is entered and exited. To trigger a transition, call `ctx.transitions.success()` or `ctx.transitions.failure()` on the context object (p. 244).
• **Execute script condition** – Evaluate an expression, and transition on a true or false result.
• **Execute script expression** – Execute a statement.
• **Get HTML text** and **Set HTML text** – Read or change the contents of an HTML element.
• **Log message** – Print a message in the debug console of your browser.
• **Toggle full screen** – Expand the scene to fill the screen. For browsers to allow this, the previous state must have a [Click or tap on entity (p. 238)](#) action that transitions to the state that runs this action.

Timeline actions interact with the entity's timeline component.

**Timeline Actions**

• **Pause timeline** – Pause a timeline.
• **Set timeline time** – Jump to a point on a timeline.
• **Start timeline** and **Stop timeline** – Start or stop a timeline.

Transition actions move from one state to another. Many actions include transitions. Use transition actions if the actions on a state don't include one, or to add branching behavior to your state machine.

**Transition Actions**

• **In view** – Perform a transition based on whether the entity is in a camera's frustum.
• **Listen** – Perform a transition on receiving a system bus message on a channel.
• **Random transition** – Perform a random transition.
• **Transition** – Transition to a different state.
• **Transition on next frame** – Transition to a selected state on the next frame.
• **Wait** – Perform a transition after a specified amount of time, or a random amount of time between 0 seconds and a specified maximum number of seconds.

**Attribute and Tag State Machine Actions in Amazon Sumerian**

You can use state machine actions in Amazon Sumerian to manage attributes and tags on an entity.

Attribute actions manage attributes on the state machine's entity or transition based on the value of an attribute.

**Attribute Actions**

• **Duplicate attribute** – Copy the value of an attribute into the value of a second attribute.
• **Toggle boolean attribute** – Change the value of an attribute from true to false, or vice versa.
• **Set boolean attribute**, **Set numeric attribute**, **Set string attribute** – Set the value of an attribute.
• **Log attribute** – Log the value of an attribute.
• **Attribute math**, **Attribute math with constant** – Modify the value of an attribute by doing arithmetic using a number or using the value of second attribute.
• **Check boolean attribute**, **Compare boolean attributes**, **Compare numeric attribute to constant**, **Compare numeric attributes**, **Compare string attribute to constant**, **Compare string attribute with regex**, **Compare string attributes** – Transition based on the value of an attribute.

Tag actions modify an entity's tags, or transition based on the presence or absence of a tag.
Tag Actions

- **Add tag, Clear tag** – Add or remove a tag.
- **Toggle tag** – Add a tag if it isn't present; remove it if it is present.
- **Check for tag** – Transition based on the presence of a tag.
Scripting

You can use scripts to dynamically update a scene, create complex state machines, integrate a scene with the AWS SDK for JavaScript, or access the DOM.

**Note**
The preview version of the new Sumerian engine API is now available. The new scripting format provides you with higher level abstractions that you can use to write scripts that leverage the same actions that are available in visual State Machine behaviors, as well as your own custom actions. These actions can be configured dynamically and orchestrated by scripts in powerful ways, beyond what can be done easily using the visual State Machine component.

To create a blank script

1. Open a scene in the Sumerian editor.
2. Create a blank asset by clicking the plus icon next to the default pack and then click either **Script (Preview)** or **Script (Legacy)**. Select the pack name to see the icon.
3. Press `j` to open the text editor.
4. Choose the new script under documents. Use the pencil icon next to the script name to change its name.

**New API:** The new (preview) API provides a Sumerian Getting Started Guide that will help familiarize you with how to write scripts that interact with the Sumerian engine. Reference documentation for the new API is available [here](#).

**Legacy API:** The script template includes 7 methods and a `parameters (p. 245)` array. The methods correspond to a scene's lifecycle events and are called by the engine at the following times. Reference documentation for the Sumerian legacy engine library is available on the Sumerian website

- `setup` – When scene playback starts.
- `fixedUpdate` – On every physics update.
- `update` – On every render frame.
- `lateUpdate` – After calling all `update` methods in the scene.
Built-in Scripts

The editor also has several built-in scripts that provide standard functionality like camera, keyboard, and mouse controls.

Camera scripts

- **Orbit camera control** – Enables the user orbit the scene by holding a mouse button and moving the mouse.
- **Orbit and pan control** – Enables the user orbit the scene with one mouse button and pan the camera with another.
- **Fly control** – Enables the user zoom and pan with the keyboard.
- **Axis-aligned camera control** – Move the camera to a fixed distance away on the X or Z axis.
- **Pan camera control** – Enables the user pan the camera by holding a mouse button and moving the mouse.
- **Mouse look control** – Enables the user look around by holding a mouse button and moving the mouse.
- **WASD control** – Enables the user walk around on the XZ plane with the keyboard.
- **Augmented reality camera script** – In an augmented reality (AR) scene, follow the device camera.

Object scripts

- **Button** – Enables the user click on an object to open a URL.
- **Pick and rotate** – Enables the user grab an object and manipulate its orientation.
- **Lens flare** – Generates a lens flare when the user looks at an object.

The Context Object

**Note**

The preview version of the new Sumerian engine API is now available. The new scripting format provides you with higher level abstractions that you can use to write scripts that leverage the same actions that are available in visual State Machine behaviors, as well as your own custom
actions. These actions can be configured dynamically and orchestrated by scripts in powerful ways, beyond what can be done easily using the visual **State Machine** component.

You can use the context object, `ctx` to store your script data during the script life time. The context is created upon `setup()` and cleared on `cleanup()` and is passed into all of the script functions. It has the following properties:

**Properties**

- `entity` (*Entity*) – The entity to which the script is attached.
- `entityData` (*Object*) – A data object shared between all scripts on the entity.
- `activeCameraEntity` (*Entity*) – The currently active camera entity.
- `playTime` (*number*) – The elapsed time since scene start.
- `transitions` (*Object*) – Transition functions used to signal the success or failure of an **Execute script** action on a **state machine** (p. 234).
- `viewportHeight` (*number*) – The height of the canvas.
- `viewportWidth` (*number*) – The width of the canvas.
- `world` (*World*) – The world object.
- `worldData` (*Object*) – A data object shared between all scripts in the world.

Some of the properties on `ctx` are shared between scripts. `entityData` is shared by all scripts on the entity and `worldData` is shared by all scripts. They are all initially empty, and can be used to store any kind of data.

For example, if we'd like to define a property called `acceleration`, we could make it available on three levels:

```javascript
// Only accessible to the script that defined the property
ctx.acceleration=9.82;

// Accessible to all scripts on the entity
ctx.entityData.acceleration=9.82;

// Accessible to all scripts
ctx.worldData.acceleration=9.82;
```

The built-in context properties also contain some convenience functions. For example, the `world` object lets you search for entities based on their tags. You can get all entities with a specific tag with `ctx.world.by.tag`:

```javascript
var entities = ctx.world.by.tag('myTag');
```

---

**Parameters and Arguments**

**Note**
The preview version of the new Sumerian engine API is now available. The new scripting format provides you with higher level abstractions that you can use to write scripts that leverage the same actions that are available in visual **State Machine** behaviors, as well as your own custom actions. These actions can be configured dynamically and orchestrated by scripts in powerful ways, beyond what can be done easily using the visual **State Machine** component.
Parameters let you create scripts that are customizable by adding fields to the script properties in the editor. For example, the following script defines a parameter named Velocity that takes 3 numbers (a vec3 parameter (p. 247)). The setup function gets the value of the parameter from the args object.

```javascript
var setup = function(args, ctx){
    console.log(args.velocity);
};

var parameters = [
    {
        name : "Velocity",
        key : "velocity",
        type : "vec3",
        default : [1,0,0]
    }
];
```

During the setup phase, the script reads the parameter values from the args object and prints them to the console.

When you add an instance of the above script to an entity, the editor shows a Velocity field that accepts three values and reflects the default value.

### Parameter Format

Parameters are objects with the following required and optional fields.

**Required fields**

- **key [string]** – a unique key used to store and retrieve the parameter values in the args object.
- **type [string]** – the parameter type (p. 247).
- **default** – the default value or values for the parameter.

**Optional fields**

- **name [string]** – the label for the parameter field shown on instances of the script. If you don’t specify a name, the key is used to generate the label.
- **control [string enum]** – the control type.
  - **slider** – a slider control.
Parameter Types

The type property must be set to one of a few predefined strings, each corresponding to a type of parameter.

- **int** – Integer number variable (e.g. 1).
- **float** – Number variable (e.g. 3.14).
- **string** – String (e.g. “HelloGoo”).
- **boolean** – boolean (true or false).
- **vec2, vec3, vec4** – an array of 2, 3, or 4 numbers.
- **texture, sound, entity, camera, animstate, json** – an asset of the specified type (p. 225).

The following example parameter declaration shows all of the available types.

```javascript
var parameters = [
    {type: 'int', key: 'int', 'default': 1, description: 'Integer input'},
    {type: 'float', key: 'float', 'default': 0.1, description: 'Float input'},
    {type: 'string', key: 'string', 'default': 'Hello!', description: 'String input'},
    {type: 'boolean', key: 'boolean', 'default': true, description: 'Checkbox'},
    {type: 'vec2', key: 'vec2', 'default': [0, 0], description: 'Vector2 input'},
    {type: 'vec3', key: 'vec3', 'default': [0, 0, 0], description: 'Vector3 input'},
    {type: 'vec4', key: 'vec4', 'default': [0, 0, 0, 0], description: 'Vector4 input'},
    {type: 'texture', key: 'texture', description: 'Texture asset drop area'},
    {type: 'sound', key: 'sound', description: 'Sound asset drop area'},
    {type: 'entity', key: 'entity', description: 'Entity drop area'},
    {type: 'camera', key: 'camera', description: 'Camera drop down'},
    {type: 'animstate', key: 'animation', description: 'Animation state from the animation component on a parent entity'},
    {type: 'json', key: 'json', description: 'JSON asset drop area'},
    {type: 'float', control: 'slider', key: 'floatSlider', 'default': 10.1, min: 5, max: 15, exponential: false, decimal: 1, description: 'Float slider input'},
    {type: 'int', control: 'slider', key: 'intSlider', 'default': 10, min: 5, max: 15, exponential: false, description: 'Integer slider input'},
    {type: 'vec3', control: 'color', key: 'vec3Color', 'default': [1, 0, 0], description: 'RGB color input'},
    {type: 'vec4', control: 'color', key: 'vec4Color', 'default': [1, 0, 0, 1], description: 'RGBA color input'},
    {type: 'string', control: 'select', key: 'select', 'default': 'a', options: ['a', 'b', 'c'], description: 'Dropdown/select'},
    {type: 'int', control: 'jointSelector', key: 'jointSelector', description: 'Joint select from the animation component on a parent entity')
];
```
External Dependencies

If your script uses external JavaScript libraries from the web into your script, declare them in the External resources section of the text editor.

To declare external dependencies

1. Open a scene in the Sumerian editor.
2. Press J to open the text editor.
3. Choose a script asset in the Documents list.
4. Under External resources, enter a URL starting with // (excluding the protocol).
5. Click the plus icon to add the library to the list.

The editor loads libraries as soon as you add them to this list. To reload a library, choose Refresh resources. In your published scene, all dependencies are loaded and executed during the loading phase.

Debugging

To debug a script in the Sumerian editor, use the built in tools in your browser. In Google Chrome, open Developer Tools by pressing Opt-CMD-J on Mac or F12 on Windows. In Firefox, open the Web Console by pressing CMD+Opt+K on Mac or CTRL+SHIFT+K on Windows.
Open the **Sources** panel at the top of Devtools. To the left you can see all scripts loaded in the browser. If you have a script in your scene, it will be listed in below as `sumerian/home/edit`. Choose your script to view it.

The simplest way to start debugging a script is by adding a `debugger;` statement in your Custom Script in the editor. If you have Devtools open, and this statement is executed, Devtools will automatically go to the file and line where your statement is.
Troubleshooting Issues with Amazon Sumerian Scenes

This topic lists common errors and issues that you might encounter when using the Sumerian editor and player. If you find an issue that is not listed here, you can use the Feedback button on this page to report it.

**Issue:** (Chrome) Can't enter virtual reality mode.

If using Oculus Rift or Oculus Rift S, you may need to set the following flags to use virtual reality mode in Chrome.

- **Oculus hardware support** – #oculus-vr to Enabled
- **XR device sandboxing** – #xr-sandbox to Disabled

If using OpenVR hardware such as HTC Vive or HTC Vive Pro, you may need to set the following flags to use virtual reality mode in Chrome.

- **OpenVR hardware support** – #openvr to Enabled
- **XR device sandboxing** – #xr-sandbox to Disabled

To access Chrome flags, type chrome://flags into your search bar.

**Issue:** Browser uses the wrong GPU for hardware acceleration.

If you have multiple graphics cards, you may need to configure your system to use the right GPU for browser applications. For example, the NVIDIA control panel has an option named **target GPU** that you can set for each application.

Profiling Amazon Sumerian Scenes

You can use browser performance analysis tools to measure your Amazon Sumerian scene's performance during playback and to identify issues. For additional insight, you can use a cookie to configure Sumerian to record detailed timing information about the engine’s update and render loops for each frame.

Use **Chrome DevTools** to set the cookie and profile your scene.

**To profile a scene in Chrome**

1. Open a scene in the Sumerian editor.
2. In the **Entities** panel, choose the root node of your scene to access **scene settings** (p. 66). In the scene panel, expand the **Details** section, and then choose **View scene** to open the scene in a new tab.
3. Open the **Console** panel in Chrome DevTools as follows:
- Windows, Linux, Chrome - Ctrl+Shift+J
- Mac – Command+Option+J

4. To set the cookie, run the following statement at the console prompt.

   ```javascript
   document.cookie = 'sumerianProfiling=useSystemTimingMarks;path=/'
   ```

5. Reload the page.

6. Choose **Performance** in the navigation bar of the DevTools panel.

7. Click the record button to start a recording. Use your scene for a few seconds, and then click the record button again to stop recording.

8. The top section of the performance graph shows the scene's frames per second (FPS) in green. Locate a section where the frame rate dropped. Click and drag to zoom in on a few frames.
Amazon Sumerian User Guide

Profiling

The image shows a performance monitoring interface with timelines for frames, interactions, user timing, and main activities. It displays metrics such as frame times, interaction times, and user timing events. The interface is divided into sections for frames, interactions, user timing, and main activities, with detailed breakdowns of functions and their associated times.
The Sumerian profiling information appears under **User Timing**. Each frame has an **updateWorld** phase, where the engine logic runs, and a **render** phase, where the user's view of the world is generated.

Under the **updateWorld** section, a second timeline shows the timings for each subsystem that's engaged by the engine during this phase. Use this information to identify components in your scene, like scripts and state machines, that take a long time to update. If the render phase is too long, reduce the visual complexity of your scene or reduce the number of lights.

When detailed profiling is enabled, the Sumerian engine uses additional resources. When you're done profiling, unset the cookie to disable it.

```javascript
document.cookie = 'sumerianProfiling=;path=/'
```

For Oculus Go and other Android devices, put your device in developer mode and connect to it from the **DevTools** menu. For Oculus Go, see Device Setup - Oculus Go. For other devices, see Get Started with Remote Debugging Android Devices.

For Firefox, you can use the Gecko Profiler Add-on. Use the same commands in the browser console to set and unset the cookie. See Profiling with the Gecko Profiler for more information.