# LevelEditor User's Guide

"" , "PLAYSTATION" , "PlayStation" , "PS3" , "PS4", "PSP" , "PS one" , "  " , "  " ,

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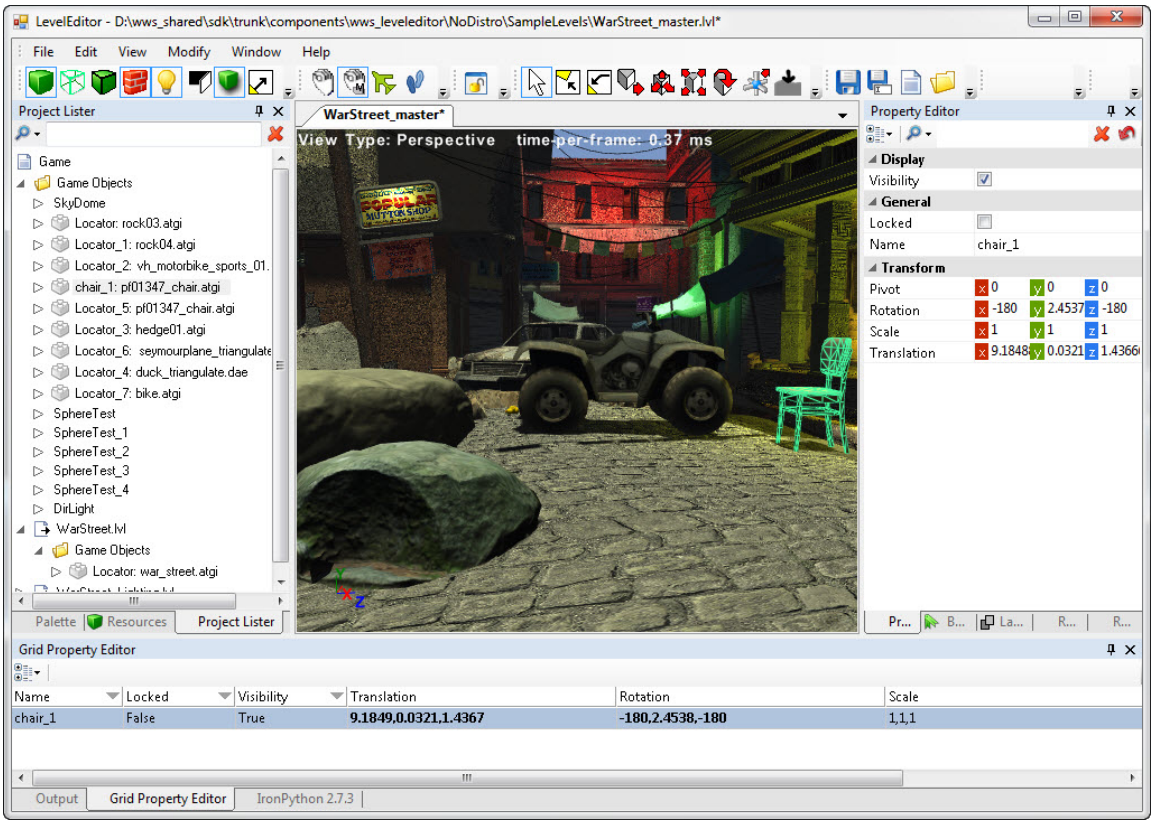
# 1 Overview

The LevelEditor is a powerful tool for constructing and assembling game levels. It provides a WYSIWYG interface (as shown in Figure 1) and tools for creating robust game levels. You can also add plug-ins that customize and extend the LevelEditor. The LevelEditor is based on the Sony Computer Entertainment (SCE) Worldwide Studios (WWS) LevelEditor tool.

**Figure 1 LevelEditor WYSIWYG interface**




This guide describes LevelEditor components and features, tells you how to use the LevelEditor to build levels, and explains where to find additional information.

The following LevelEditor features help you construct game levels efficiently and collaboratively:

- Work with a variety of file formats
- Associate assets with game objects
- Position, rotate, scale, and snap game objects precisely
- Edit game object properties
- Show or hide groups of game objects to unclutter the view as you work
- Construct Linears (lines and curves)
- Add defined behaviors to game objects with a StateMachine plugin
- Create custom terrains using the Terrain Editor

## Additional Resources for LevelEditor Users

For general information about the Sony LevelEditor, see the Wiki pages on GitHub: https://github.com/SonyWWS/LevelEditor/wiki

For developers who have access to the Sony SHared Information Portal (SHIP) for Sony Computer Entertainment (SCE) Worldwide Studios (WWS) game development, you can visit the LevelEditor SHIP page.

## LevelEditor System Requirements

You can use the LevelEditor on a computer that provides the following required functionality:

- Microsoft Windows® 7 operating system (64-bit)
- Microsoft DirectX® 10 (or later) compatible graphics card

In addition, the LevelEditor has the Authoring Tools Framework (ATF) tool as a prerequisite; the required ATF code is included with the LevelEditor download package. See the ATF GitHub site for more information about ATF.

To modify the LevelEditor, you also need Microsoft Visual Studio® 2010, including all current Service Packs. See the *LevelEditor Programming Guide* for more information about modifying the LevelEditor.

## Installing the LevelEditor

The LevelEditor can be installed from the GitHub site or using the Sony Package Manager; see Installing the LevelEditor.

## What's New for LevelEditor 3.5

LevelEditor 3.5 is a standalone tool, independent of the ATF. This version of the LevelEditor provides the following advantages and new features, compared with the ATF Level Editor 3.2:

- Support for 64-bit Windows operating systems.
- Native rendering (the rendering is done in C++ with DirectX 11).
- Integration with GameEngine through a bridge API.
- Level resources are loaded using a background thread.
- Support for different types of light sources that can be placed anywhere in the level.
- Dynamic shadows to help object placement.
- Can fully or partially use game engine code for rendering.
- Can easily add new shaders.
- Faster level loading.
- Can easily add new file format using native API (Collada DOM, Atgi lib, in-house binary format).

## What's New for LevelEditor 3.6

LevelEditor 3.6 adds the following features:

- Package Manager. You use the Package Manager to install LevelEditor.
- Integration of StateMachine with the LevelEditor. You can use StateMachine assets within the LevelEditor to define specific behaviors for game objects.
- Prototype assets. You can save one or more game objects as a prototype asset that you can then reuse in any game level. This feature replaces the previous version's Prototypes feature.

- Rendering normals. You can render game object normal vectors to help debug an object's geometry.
- Pick-cycling for overlapped objects. You can easily select objects that overlap or are visually obscured by other objects.
- Extension manipulator. You can extend or stretch an object along a single axis.
- Move pivot point command. You can quickly move an object's pivot point to one of several predefined locations.
- Pick filter. You can apply a simple filter to control which objects can be selected in the Design View.
- Sublevel object placement. You can easily drag objects to the Design View and have them appear within a particular sublevel, rather than at the top main level hierarchy.
- Bezier spline linear. You can define a linear as a Polyline, a CatmullRom spline, or a Bezier spline.

## What's New for LevelEditor 3.7

LevelEditor 3.7 adds the following features:

- Open Source. The LevelEditor is available as Open Source from GitHub.
- Prefab assets. You can save one or more game objects as a prefab asset that you can then reuse in any game level. You can define both prefab assets and prototype assets.
- Terrain Editor. You can define and edit terrains based on a height map, layers, and decoration maps.
- Visual Studio solution. The solution for the rendering engine is now included in the base LevelEditor solution, and is no longer a standalone solution.

# 2 Getting Started

This chapter describes some of the basic features of the LevelEditor and how to use them to perform basic tasks associated with designing a game level. It uses one of the sample levels to show how you can work with existing content, as well as how to add your own content based on existing resources (game assets). This chapter describes how to start the LevelEditor, open a sample level, get around within the level, learn about and manipulate game objects, and how to place objects in the level.

The LevelEditor provides additional features beyond those described in this chapter. See the later chapters in this book for a description of what the LevelEditor can do and how you can use it to design sophisticated game levels.

## Installing the LevelEditor

You can install the LevelEditor from the GitHub site or using the Sony Package Manager.

### GitHub

From the LevelEditor GitHub site, perform one of the following tasks:

- Click the **Download ZIP** button to download a ZIP file for the LevelEditor project. Unzip this file to an appropriate directory, such as `C:\LevelEditor37`.
- Click the **Clone in Desktop** button to make a local clone of the LevelEditor repository.

Note that both the ZIP file and the repository clone include the prerequisite Authoring Tools Framework (ATF) code. See the ATF GitHub site for more information about the ATF.

### Package Manager

Use Package Manager to install the LevelEditor distribution. You can download it from the Package Manager download page on SHIP. For more information about Package Manager, see WWS SDK Package Manager on SHIP.

To install the full release, perform the following tasks:

(1) Create a folder in which to install LevelEditor, such as `C:\LevelEditor37`.

(2) Open a Windows Command Prompt window, and enter the following command:

```
wwspm install wws_leveleditor -path C:\LevelEditor37
```

(3) If the following prompt appears, enter `y` (for "yes") and press Return:

```
No WWS SDK installation found. Would you like to create a new one at
"C:\LevelEditor37" ?
[yn]:
```

(4) Package Manager finds the components needed for LevelEditor and displays the following messages:

```
WWS SDK installation found at "C:\LevelEditor37".
Analyzing components...
Components to install:
[wws_atf,3.7]
[wws_leveleditor,3.7]
Would you like to proceed? [yn]:
```

(5) Enter `y` and press Return. Package Manager installs the components needed for LevelEditor and lists the installed components:

```
Retrieving components...
Deploying component [wws_atf,3.7] to "C:\LevelEditor37"...
Deploying component [wws_leveleditor,3.7] to "C:\LevelEditor37"...
```

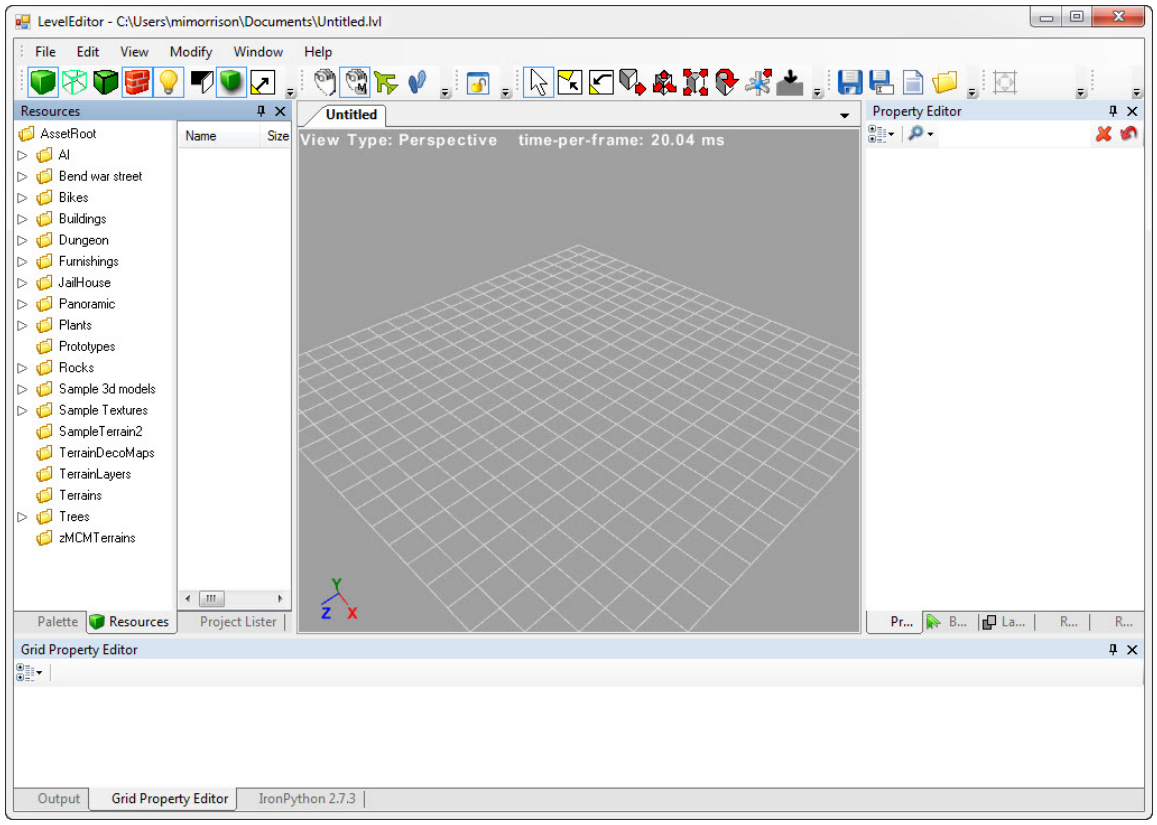
You can run the LevelEditor as soon as the installation is complete.

## Starting the LevelEditor

To start the LevelEditor, navigate to the folder into which you installed LevelEditor and double-click the **LevelEditor.exe** file.

The LevelEditor opens the default workspace for an untitled level, as shown in Figure 2.

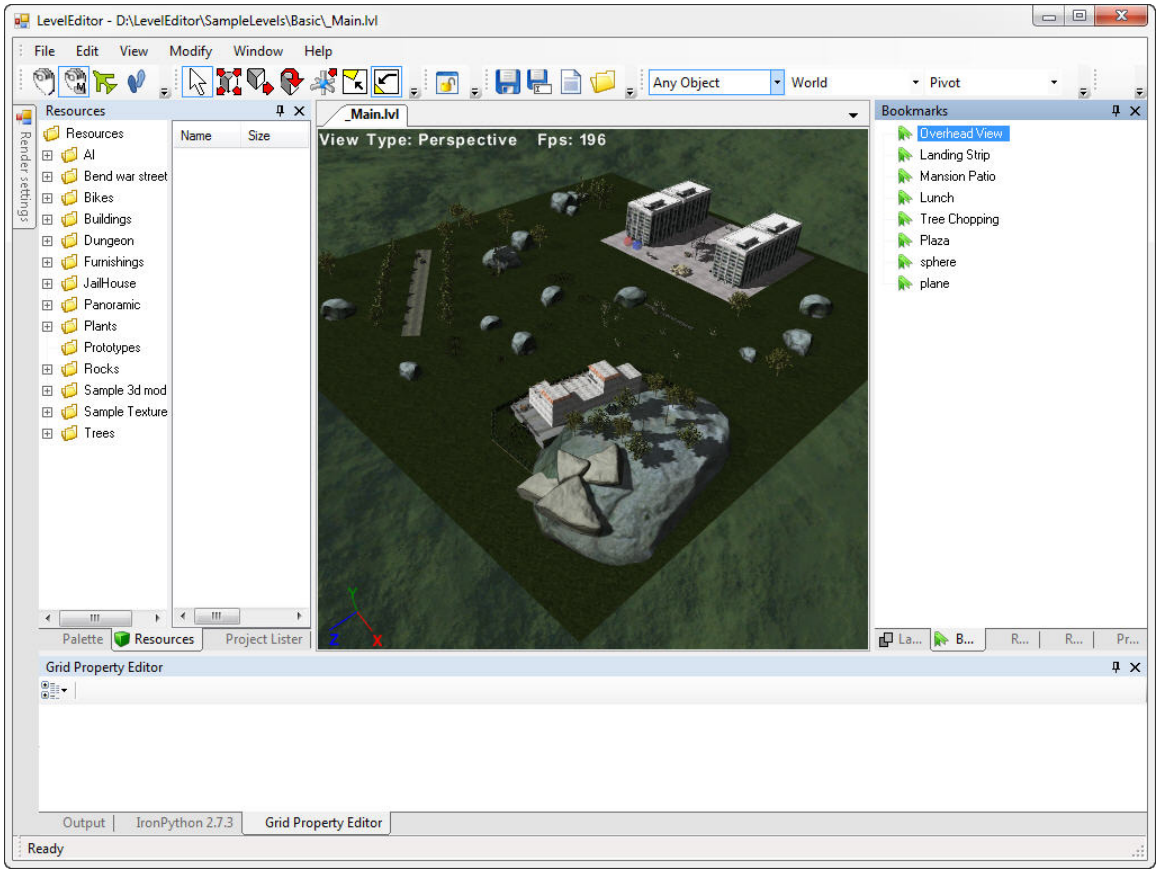
**Figure 2 Untitled level**




## Opening a Sample Level

To open a sample level, select **File > Open Game**, navigate to the folder that contains the Basic sample level (for example, **\SampleLevels**), select the **BasicLevel.lvl** file, and click **Open**. The LevelEditor opens the main level of the Basic sample. Figure 3 shows a sample level with a number of visual elements, including an office complex, a mansion, and an airplane landing strip.

**Figure 3 Overhead view of a sample level**

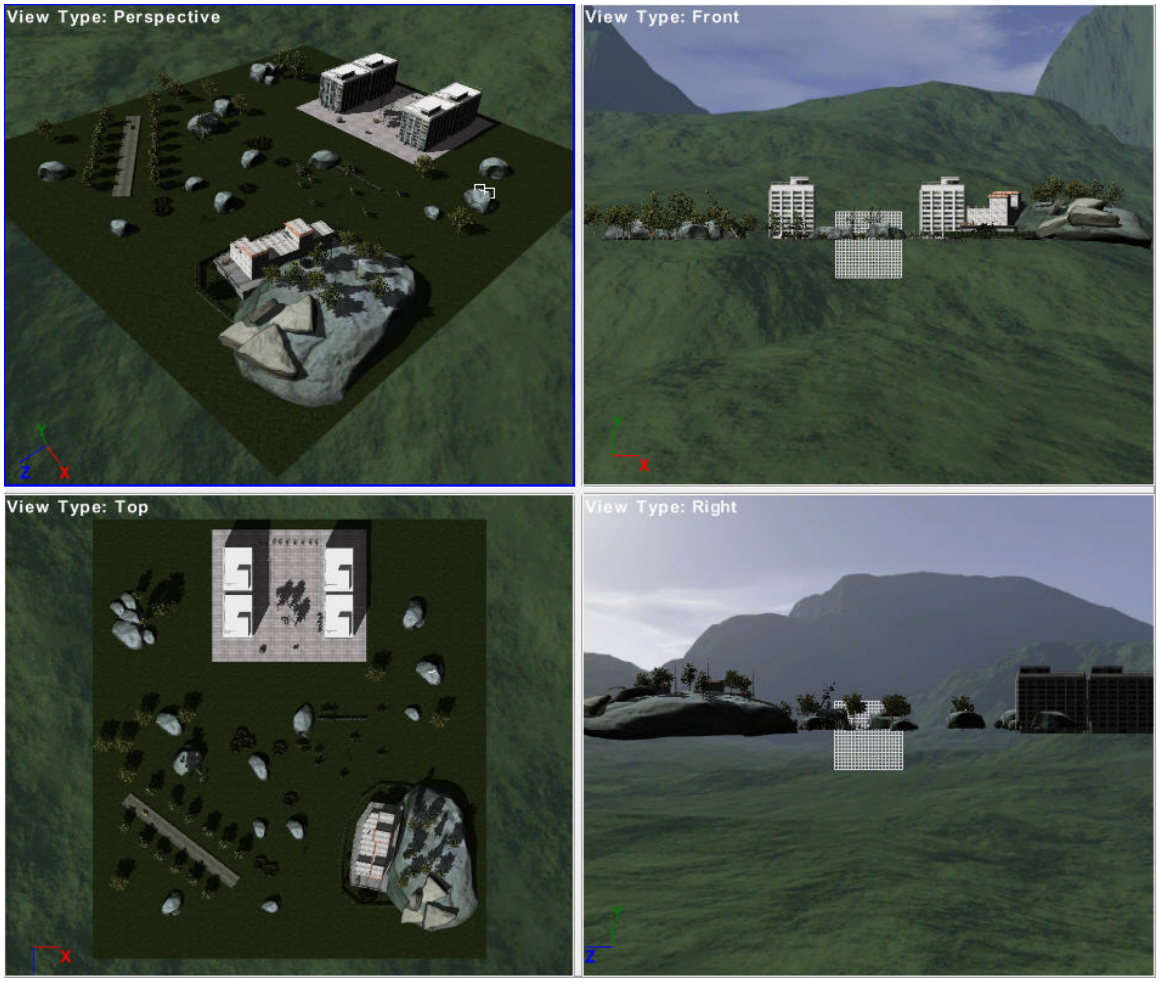



## Getting Around

The central pane of the user interface that shows the game objects and scenery of a level is called the Design View. By default, a level is displayed using a three-dimensional perspective view. You can specify the following views (called projections) for the game world within the Design View: perspective, top, bottom, right, left, front, and back.

To specify the projection for a view, right-click anywhere within the Design View, select **Projection**, and then select the view that you want to use. For example, Figure 4 shows four views of a sample level: perspective, front, top, and right.

**Figure 4 Four views of the sample level**




For more information about displaying different views, see Working in Design View.

The sample level also includes a number of predefined bookmarks, which allow you to switch to one of several saved views quickly; for example, overhead view, the landing strip, the mansion patio, a lunch scene, a tree chopping scene, and the plaza. To change the view shown in the Design View to one of the bookmark views, click one of the bookmarks in the Bookmarks pane to the right of the Design View. Figure 5 shows four of the bookmarked views for the sample level.

**Figure 5 Four of the bookmarked views within the sample level**


You can also create your own bookmarks for your own views; see Using Bookmarks to Save Frequently Used Views.

Within a particular view, you can zoom in or change the camera angle, so that you can see any part of the game world, from up close or from far away. The LevelEditor has several modes that let you use the mouse (or other pointing device) to zoom, rotate, and pan your view of the world: Arcball, Maya® Style Trackball, Fly, and Walk. Each of these modes varies in what it can do and how you use it; see Working in Design View.

**Note:** The following examples assume that your Design View is set to the perspective projection view and that you use the Maya style Trackball mode. To specify this mode, click the Maya icon ( ) in the Camera toolbar at the top of the LevelEditor window.

While in perspective view using the Maya camera, you can zoom in or out of the game world using either of the following techniques:

- Hold down the ALT key down, then drag while pressing and holding the right mouse button (you can drag up or left to zoom out, and you can drag down or right to zoom in)
- Scroll the mouse wheel

Figure 6 shows four different zoom levels of the Lunch bookmark view within the sample level. The first zoom level is the default bookmark view; each of the other zoom levels shows increasingly more of the world as the camera zooms out.

**Figure 6 Four zoom-level views of the Lunch bookmark view within the sample level**

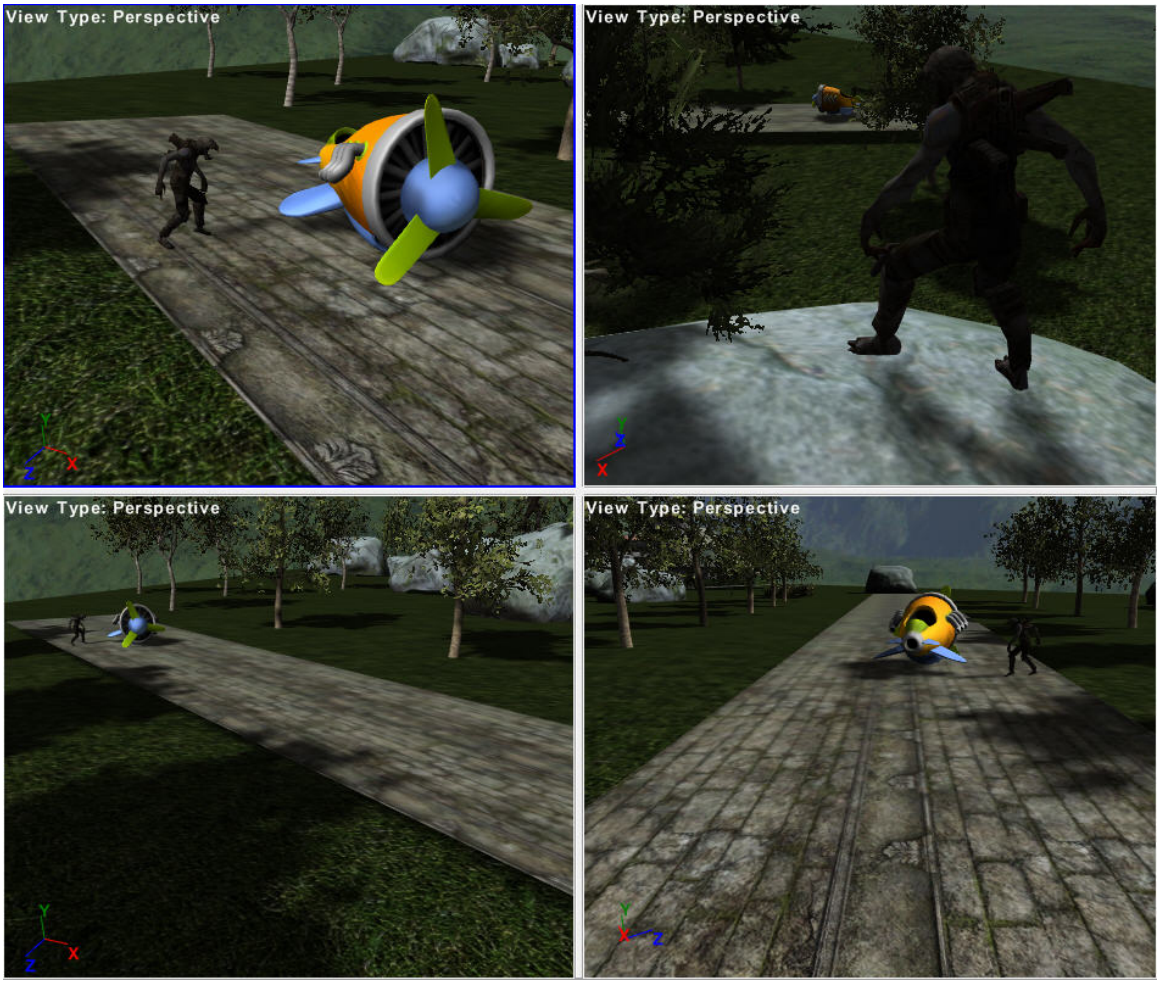

While in perspective view using the Maya camera, you can rotate the view of the game world and pan the view of the game world. To rotate the world view around the camera, press and hold the ALT key and drag while pressing and holding the left mouse button:

- Dragging left and right rotates the world around a vertical axis.
- Dragging up and down rotates the world up and down around a horizontal axis.

To pan the world view around the camera, press and hold the middle mouse button while dragging up and down (for vertical movement). For horizontal movement, drag left and right.

Figure 7 shows four different rotation and pan views (with some zoom changes) of the Airfield bookmark within the sample level. The upper-left image shows the default bookmark view of the airfield.

**Figure 7 Four different rotation and pan views of the Airfield bookmark view within the sample level**



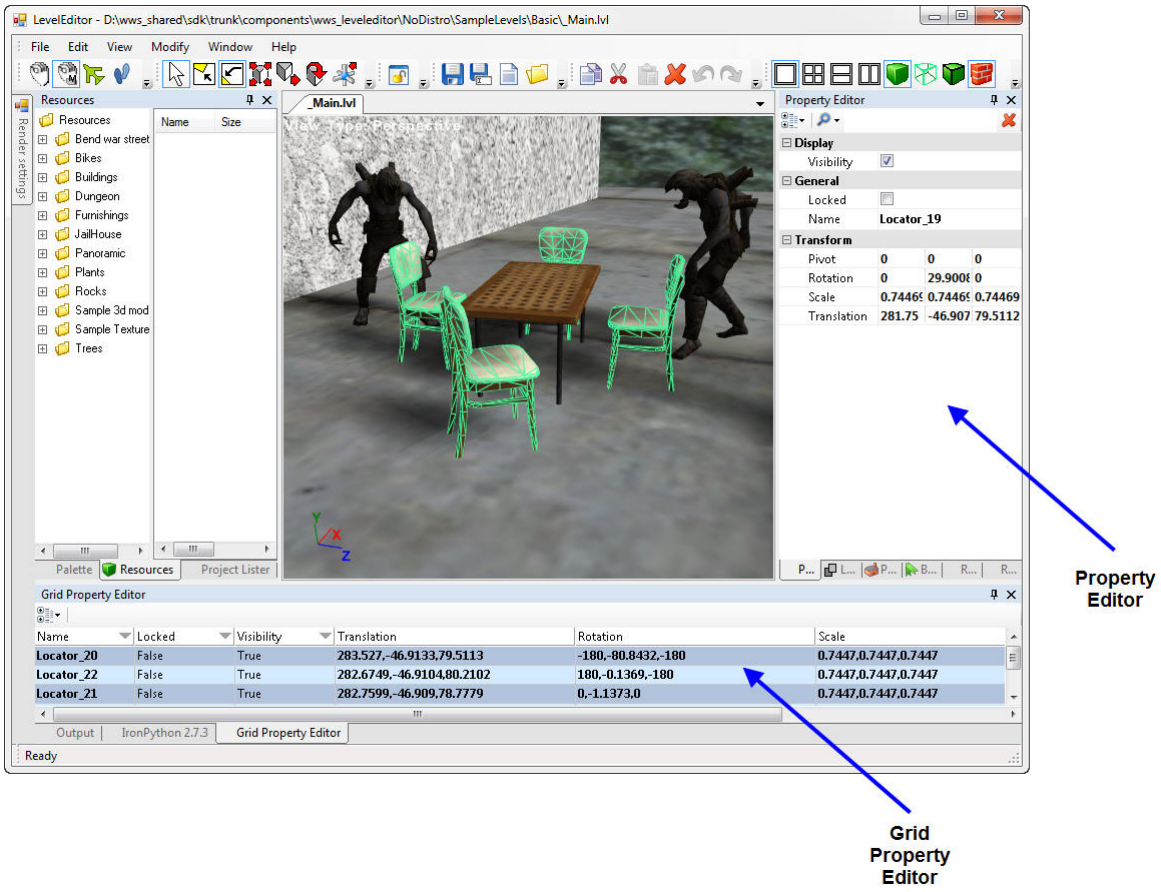

See Working in Design View for more information about rotating and panning the world view.

## Learning about Game World Objects

For each object within the game world, you can view and modify the object's properties. To view an object's properties, click on the object in the Design View, then select the Properties tab (typically to the right of the Design View) to display the Property Editor. You can also use the CTRL button to select multiple game world objects, and use the Grid Property Editor to view the properties of all selected objects. Click the Grid Property Editor tab (typically below the Design View) to display the Grid Property Editor.

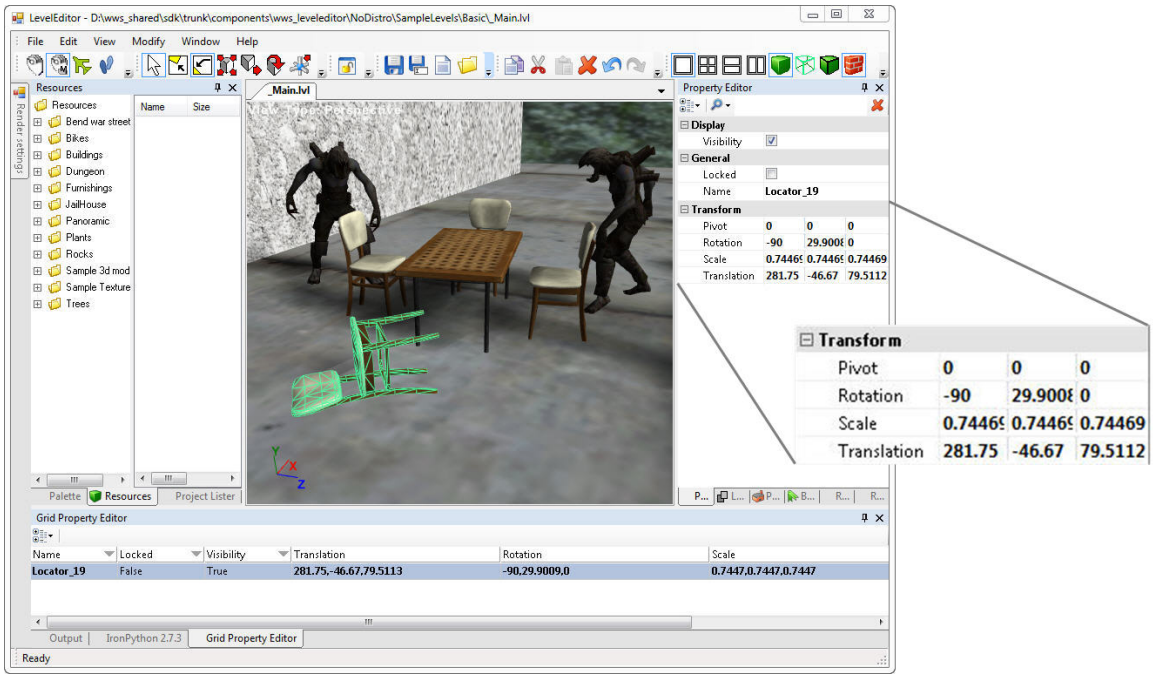
Figure 8 shows both the Property Editor and the Grid Property Editor for selected objects in the sample level. The arrows indicate the locations of the Property Editor and the Grid Property Editor. The Property Editor shows the properties of the most recently selected object (the front-most chair in the figure below). The Grid Property Editor shows the properties of all four selected chairs.

**Figure 8 The Property Editor and Grid Property Editor for objects within the sample level**




Within either the Property Editor or the Grid Property Editor, you can click on any field to modify the selected property of the specific object. For example, for the chair object shown in Figure 9, modifying its Rotation properties (angular position within the world) and its Translation properties (position within the world) causes the chair to appear to have been knocked over. To achieve this effect, the Rotation property was changed from "0, 29.9009, 0" to "-90, 29.9009, 0", and the Translation property was changed (slightly) from "281.75, -46.9076, 79.5112" to "281.75, -46.67, 79.5112". Note that neither the Pivot property nor the Scale property was modified for this example.

**Figure 9 Modifying the properties of an object using the Property Editor**




You can also use the mouse to manipulate certain properties of objects, such as their position and rotation, as described in the next section.

See The LevelEditor Workspace for more information about the Property Editor or the Grid Property Editor.

## Manipulating Objects

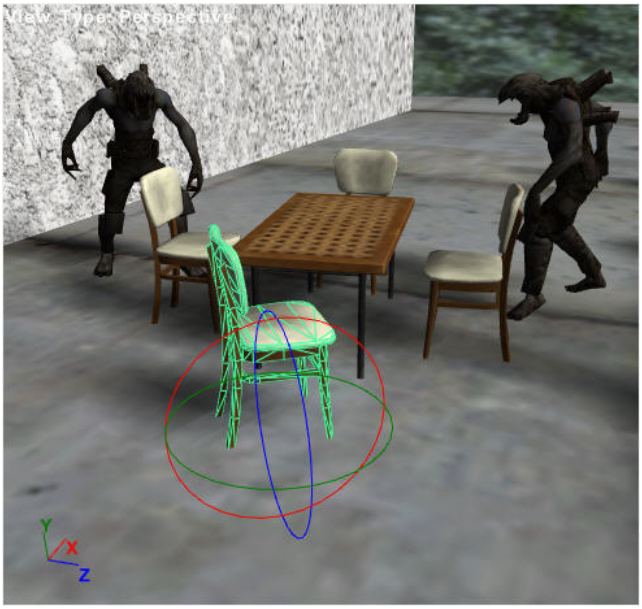
You can use the mouse to manipulate the position, rotation, and scale of an object. To reposition an object in the X, Y, or Z directions, click the Move icon (  ) in the Select toolbar at the top of the LevelEditor window. When you select an object in the game world, its Move manipulator is displayed, as shown in Figure 10.

**Figure 10 An object's Move manipulator**

Using the three arrows of the Move manipulator, you can move an object up or down, left or right, and front or back.

To modify an object's roll, pitch, and yaw, click the Rotate icon ( ) in the Select toolbar at the top of the LevelEditor window. When you select an object in the game world, its Rotation manipulator is displayed, as shown in Figure 11.

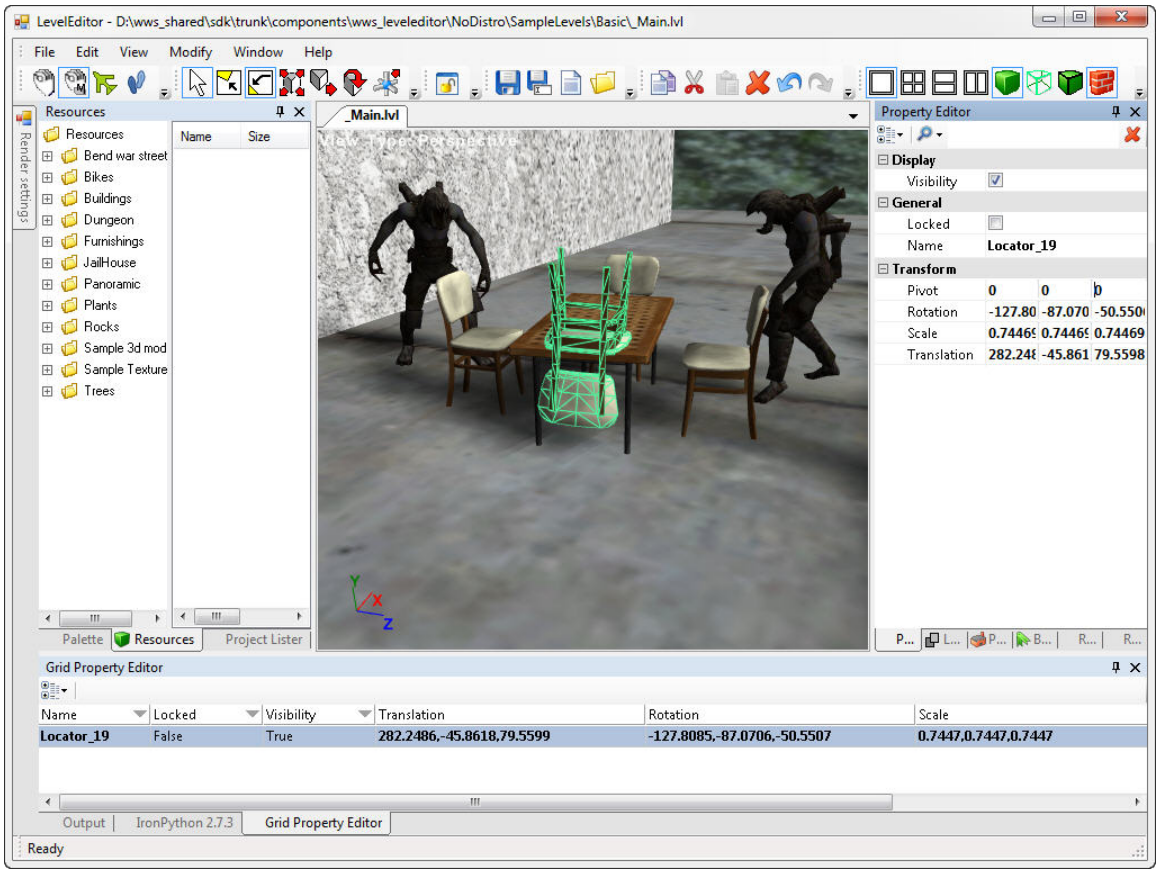
**Figure 11 An object's Rotation manipulator**



Using the three circles of the Rotation manipulator, you can move an object side to side (roll), forward or back (pitch), and left or right (yaw). Each of these rotations is relative to a fixed point (the object's pivot point).

Alternately using the Move manipulator with the Rotation manipulator, you can move an object to any position within the game world. For example, you can use the Move manipulator and the Rotation manipulator to place a chair on the table in the Lunch scene of the sample level, as shown in Figure 12.

**Figure 12 Moving and rotating an object**




For more information about moving or rotating an object, see Working in Design View.

## Placing Objects in the Level

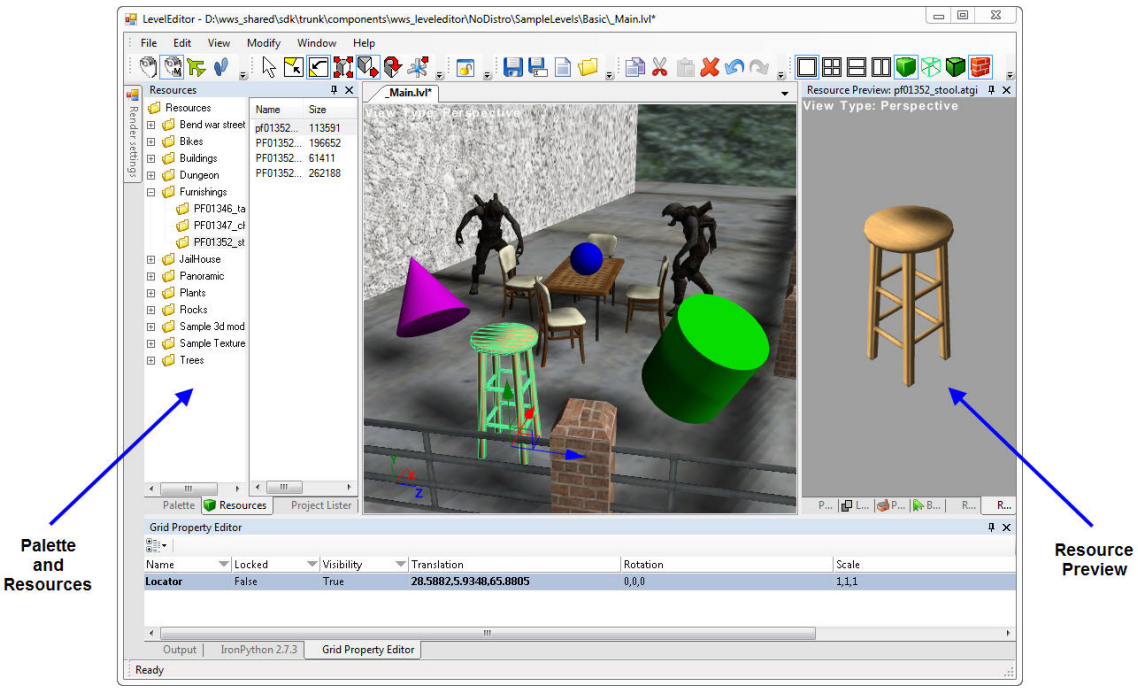
You can place objects into an empty level or into an existing level (such as one of the sample levels). You can use either the Palette or the Resources list to add objects to the level. The Palette contains basic game object types that you use to create game objects; to view the Palette, select the Palette tab (typically to the left of the Design View). The Resources list displays all of the assets in the **ResourceRoot** folder; to view the Resources list, select the Resources tab (typically to the left of the Design View). See The LevelEditor Workspace for more information about the Palette or the Resources list.

To add an object to the level, select an object from either the Palette or the Resources list, and drag it to the Design View. Then use the Move manipulator (and optionally, the Rotation manipulator) to place the object precisely where you want it to appear. You might also need to rotate or pan the world view to verify the object's location. Use the Property Editor for fine-tuned modifications to the object's placement.

Figure 13 shows the Lunch scene of the sample level, with three objects added from the Palette (the SphereTest, the ConeTest, and the CylinderTest), along with an object added from the Resources list (PF01352_stool from the **Furnishings** folder). Each of these objects has been moved, resized, or rotated. Use the Resource Preview pane to view a Resources object before you place it in the level. Use the

Property Editor to change the colors of the three Palette objects (by default, they appear white). The view is slightly zoomed out from the Lunch bookmark view.

**Figure 13 Adding objects to the level using the Palette and Resources**




See Placing Game Objects in the World for more information about placing objects, including how to snap objects to other objects.

# 3 Basic Concepts

In general, the LevelEditor uses concepts and terminology that should be familiar to game designers, but certain concepts and terms might have slightly different meanings for the LevelEditor. Therefore, this chapter describes relevant game design concepts and terminology as used in the LevelEditor.

## Resources

A *resource* (also called an *asset*) is content from an external file that was created in an application other than the LevelEditor. Although resources can be of any file type, they are typically files that you use in a level, such as models made with the Autodesk® Maya animation software, behaviors written in a text editor, and textures created with Adobe® Photoshop® software. The LevelEditor provides built-in support for the resource file types described in Using Supported Resource File Formats.

When you drag and drop a resource from the Resources list to your LevelEditor document, the LevelEditor creates a reference to that resource. You can also drag-and-drop files from the Windows Explorer with the same result.

The Resources list displays Resources that are in a folder known as the *Resource Root*. The default Resource Root folder is the .**AssetRoot** folder. To specify a different folder, select **Edit > Preferences > Resources > ResourceRoot**. For more information, see Resource Root Folder.

LevelEditor documents (**.lvl** files) use a relative path from the Resource Root folder to save the reference to the Resource. Thus, an **.lvl** file can always find a resource, regardless of where you save the **.lvl** file.

For more information about resources, see Working with Resources.

To add assets to the LevelEditor:

(1) Open the LevelEditor.

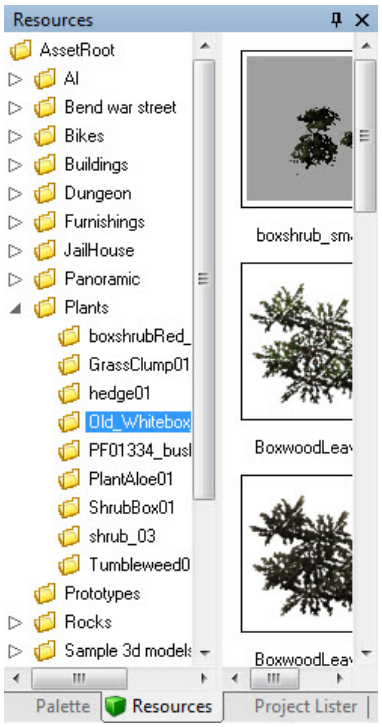
(2) If the Resources list is not open, select the **Window > Resources** menu item.

(3) Specify the thumbnail view for the Resources list: Right-click in the Resources list. If the **Thumbnail View** menu option appears, select it. If, when you right-click the Resources list, the **Details View** menu option appears, the thumbnail view is already active and you can click anywhere in the LevelEditor to dismiss the menu option.

(4) Navigate to a folder that contains resources, as shown in Figure 14.

The left pane shows the directory tree for the assets. Thumbnail images of available resources appear in the right pane. Depending on the software installed on your computer, some asset types might not show a thumbnail view.

**Figure 14 Assets in the Resources list**




(5) Optionally, you can open the Resource Preview pane, select an ATGI file from the Resources list, and view a preview of the object in the Resource Preview pane. In addition, the Resource Metadata pane displays metadata about the selected resource.

## Game Objects

A game object is any object that has all of these characteristics:

- A location in the world.
- A listing in the Project Lister.
  Game objects always appear in the **Games Objects** folder in the Project Lister.
- A set of values for game object properties.
  Available game object properties vary according to the type of game object. Typical properties include position, scale, rotation, and whether the game object is visible.

A game object can have one or more resource slots, which associate assets with the game object. A slot appears in the Project Lister tree as a child of a Game Object; you might have to expand a Game Object node to see its available slots.

To associate an asset with a game object, drag the asset to the appropriate resource slot. The XML schema that defines a particular type of game object specifies its available properties and the kinds of assets that can be associated with it. Common assets include geometry, texture, and behaviors. For example, the Orc example in the Palette's Examples pane is defined as having four types of assets that can be associated with it and specific properties that can be set.

A programmer can create other game object types by creating an XML schema to define that type. For more information about XML schemas, see the *ATF Programmer's Guide: Document Object Model (DOM)* (available from https://github.com/SonyWWS/ATF/tree/master/Docs).

To see how a game object appears in the Project Lister and how its properties appear in the Property Editor, perform the following tasks:

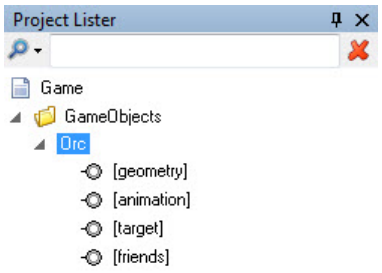
(1) Open the Project Lister, Property Editor, and Palette windows.

(2) Open the **Examples** section of the Palette window.

(3) Drag the **Orc** example to Design View. Because it has no geometry associated with it, the Orc appears as a cube.

(4) In the Project Lister, expand the tree for the **Orc** example game object, as shown in Figure 15.

**Figure 15 Project Lister with one Orc example game object**




When you dragged the Orc example to Design View, the LevelEditor created an Orc game object. The Orc game object has four resource slots (geometry, animation, target, and friends) because its XML schema defines these slots. You can assign resources to each of these slots. For example, to make the orc look less like a cube, and more like a creature, you can drag a Hybrid model to the **geometry** resource slot of the Orc in the Project Lister. Figure 16 shows the Orc game object before applying the Hybrid resource to the Orc's geometry, and after applying the resource to the geometry. If you want a larger orc, you can use the Scale manipulator to resize the orc.

**Figure 16 The Orc game object – before and after applying a Hybrid to its geometry**

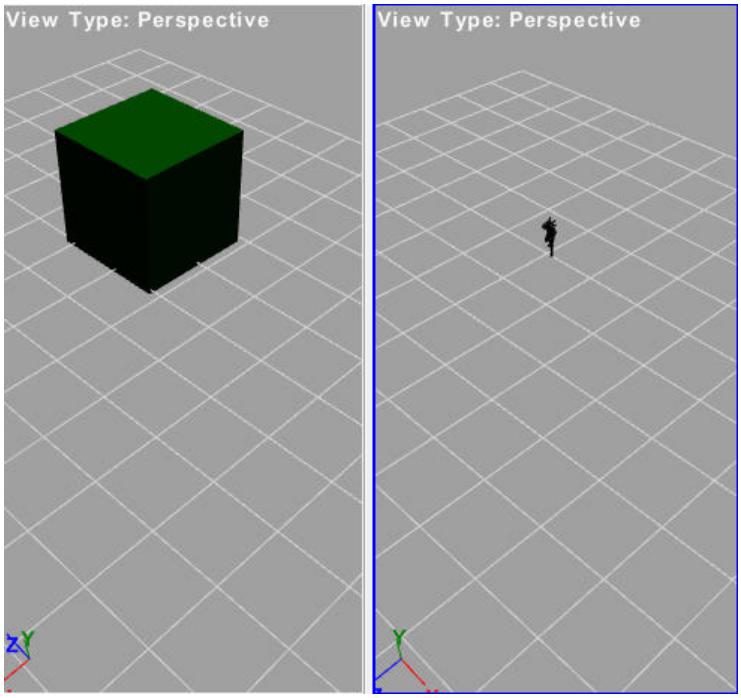



Figure 17 shows the Project Lister for the Orc game object after adding the Hybrid model to the Orc's geometry resource slot.

**Figure 17 Project Lister with the Orc example game object after applying the Hybrid geometry**

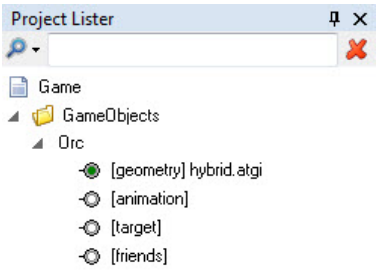
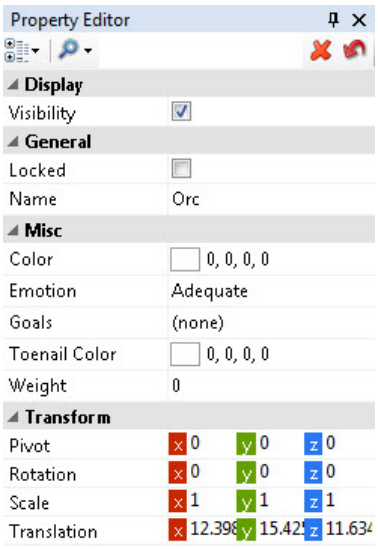



Figure 18 shows the Property Editor window for the Orc game object.

**Figure 18 Orc properties in the Property Editor**




## XML Schema Basics

A game designer does not need to write or interpret XML schemas to work with the LevelEditor, but it is useful to understand their relationships to assets, game objects, and levels.

In general, a schema is an outline or diagram that describes an object. An XML schema uses XML elements and attributes to describe an object's data structure. The LevelEditor uses this description to interpret objects presented as assets.

The LevelEditor uses a variety of XML schemas to interpret objects. For example, the LevelEditor can work with ATGI files because an XML schema is available that describes the data in an ATGI file. To interpret a particular object, the LevelEditor requires an XML schema that describes all objects of that type. For example, the ATGI schema describes the structure of any ATGI object; the LevelEditor refers to this schema whenever it manipulates any ATGI object.

By writing or annotating XML schemas, an XML programmer can add features such as new game object types, new, attributes, new resource slots for existing game objects, and support for additional types of assets.

For information about writing XML schemas to define additional game object types, see the *LevelEditor Programming Guide* or the *ATF Programmer's Guide: Document Object Model (DOM)* (available from https://github.com/SonyWWS/ATF/tree/master/Docs).

## Documents

The LevelEditor saves a level as an XML document that contains descriptions of everything about the level. A level file has the **.lvl** file extension.

These are some items commonly found in an LVL file:

- References to files that the level uses as assets
- Game objects in the level, their associated assets, and property settings

To create an LVL file:

(1) With the document that you worked with in Game Objects still open, select **File > Save As** from the menu bar.

(2) Use the Save As dialog box to name and save the file.

You can use any text editor to view the XML source within an LVL file.

**Important:** Do not modify the content of the LVL file outside the LevelEditor. Changing the XML within this file can corrupt the saved level.

The XML content of the document that you worked with in Game Objects should look similar to the XML shown below:

```
<?xml version="1.0" encoding="utf-8"?>
<game      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"      xmlns:xs="http://www.w3.org/2001/XMLSchema"
name="Game" xmlns="gap">
          <gameObjectFolder name="Game Objects" visible="true" locked="false" displayFlags="0">
                    <gameObject xsi:type="orcType" transform="1 0 0 0 0 1 0 0 0 0 1 0 8.148263 8.635567 8.18291 1"
translate="8.148263  8.635567  8.18291"  rotate="0  0  0"  scale="1  1  1"  pivot="0  0  0"  name="Orc"  visible="true"
locked="false" weight="0" emotion="0" goals="0" color="0" toeColor="0">
                              <geometry uri="Sample 3d models/Atgi assets/hybrid.atgi" />
                    </gameObject>
          </gameObjectFolder>
          <prototypeFolder name="RootProtoFolder" />
          <layers />
          <bookmarks />
          <grid size="20" subdivisions="20" height="0" snap="false" visible="true" />
</game>
```

This LVL file is fairly short because it contains only a single game object. LVL files with additional resources and objects are more complex.

## Locators

A *locator* is an object that can have a specific position in space and one associated resource. The resource can be any type, but typically the resource is a geometry that you want to place in the world. Like any game object, a locator has additional properties that are available in the Property Editor.

A locator provides a way to position geometries that do not reference additional assets, such as behaviors or textures. For example, you could use locator game objects to position rocks on a hillside or streetlights along a street.

To create a locator, perform either of the following actions:

- Drag a resource directly to the Design View or to the **Game Objects** folder in the Project Lister. The resource that you drag becomes associated with its own locator's single slot.

- Drag the predefined Locator object from the Palette to the Design View or to the **Game Objects** folder in the Properties Lister. When you create a Locator in this way, no resource is associated with it until you assign one to the single slot that the locator provides.

When you drag to the Design View, the initial position of the object is wherever you drop it. When you drag to the **Game Objects** folder, the locator game object's origin is at 0, 0, 0. Either way, you can subsequently drag the object to a new position in the Design View or edit its position coordinates in the **Translation** field of the Property Editor.

For more information about locators, see Working with Game Objects.

To create a locator game object directly from a resource:

- Using the level that you created in Game Objects, drag a resource from the Resources list to the Design View.
  The new game object appears in the Project Lister and the Property Editor displays its position as Translation properties. The resource is associated with the game object's resource slot.

To create a locator game object from the Locator object in the Palette:

- Drag the Locator object from the Palette to the Design View.
  The new game object appears in the Project Lister and the Property Editor displays its position as Translation properties. The locator game object has one resource slot, but no resource is associated with it.

## Prototype and Prefab Assets

Prototype and prefab assets facilitate the creation of large numbers of identical objects, such as a set of cars, a battalion of troops, or trees in a forest. You can create a prototype or prefab asset from one or more game objects, and use that asset as a template for creating identical game objects. For example, you could create a set of tree game objects, save the set as a prototype or prefab asset, and then use the prototype to populate a forest. Each new tree game object that you create has the same properties as the prototype or prefab; that is, all the trees would have the same geometry, size, orientation, and relative position with other trees in the prototype. You can then modify each new tree's properties to create a realistic forest.

For more information about prototype and prefab assets, see Working with Game Objects.

## ControlPoints and Curves

ControlPoint and Curve objects are not intended to be visible to the player of a game. Instead, you use them to create game-play elements that do not have a visible manifestation, such as trigger volumes, and game AI path-finding.

To create an instance of any of these objects, drag it from the Palette and drop it into the Design View or the Project Lister.

For more information, see Working in Design View.

## Terrain Editor

**Advanced topic**

The LevelEditor includes a Terrain Editor for designers who want to create custom terrains within the LevelEditor. With the Terrain Editor, you can quickly add or modify outdoor terrain, such as mountains, rivers, forests, and plains, within a level.

For more information about the Terrain Editor, see Creating New Terrain.

## Scripts

**Advanced topic**

The LevelEditor includes the IronPython programming language and an IronPython console. IronPython is an open-source implementation of the Python™ programming language designed primarily for the Microsoft .NET Framework. See ironpython.net or ironpython.codeplex.com for more information about IronPython. See www.python.org for more information about the Python language.

To open the IronPython command console, select **Window > IronPython**. You can use this window to write Python scripts to implement new commands or macros within the LevelEditor.

## Integration with StateMachine

**Advanced topic**

The Sony StateMachine is an end-to-end solution for authoring, executing, and visually debugging hierarchical and concurrent state machines. The StateMachine is available as part of the Sony Computer Entertainment (SCE) Worldwide Studios (WWS) for game development. The LevelEditor can use StateMachine projects to attach state machine assets to game objects, thus giving designers the ability to change the properties of a game object using GUI controls.

For more information about using StateMachine assets with the LevelEditor, see Preparing StateMachine Assets and Working with StateMachine Assets.

# 4 The LevelEditor User Interface

This chapter introduces the LevelEditor graphical user interface and describes many of the basic features of the LevelEditor.

## The LevelEditor Workspace

The LevelEditor provides a workspace and tools for everything that you need to construct a game level, including a design view, resources list, project list, palette, property editor and grid property editor, output window, script window, layers list, resource metadata lister, resource preview, render settings, and bookmarks.

### LevelEditor Menus

Table 1 lists the LevelEditor menus, and describes the functionality that is provided by each menu.

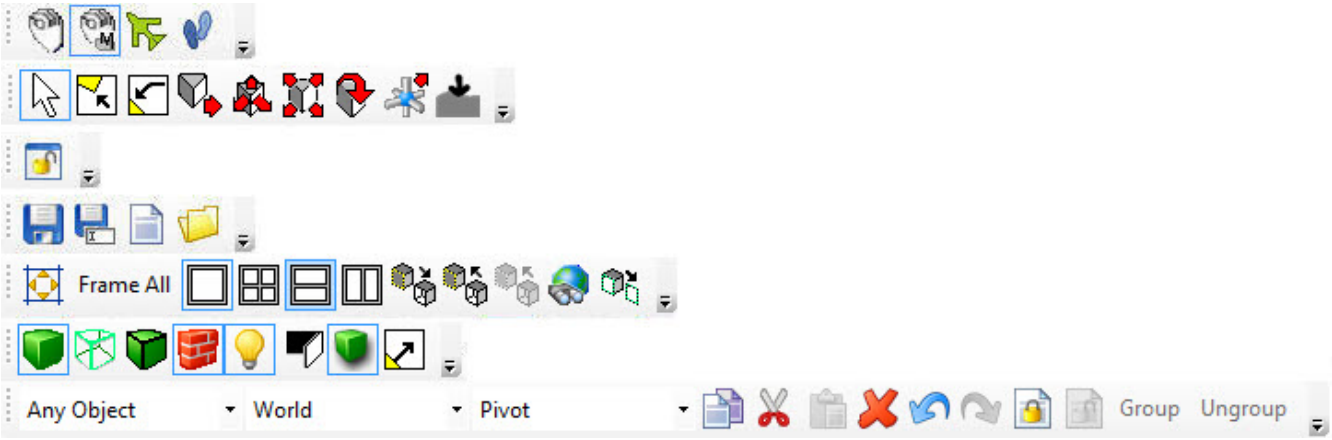
**Table 1 LevelEditor Menus**

| Menu | Description |
|---|---|
| File | Use the File menu to open new or saved game levels, to save current game levels, select or pin recently viewed game levels, and create prototype or prefab objects. |
| Edit | Use the Edit menu to undo or redo recent actions, copy and paste game objects in the Design View, delete selected objects, select or deselect all objects in the level, group or ungroup selected game objects, lock or unlock selected game objects, change keyboard shortcuts, load or save settings, and set LevelEditor preferences. |
| View | Use the View menu to frame selected game objects or all game objects, load or edit a skin for the LevelEditor, hide game objects or show hidden game objects, isolate selected objects, specify the camera view, specify the layout, specify the projection, and specify the render mode. |
| Modify | Use the Modify menu to specify an object's pivot point, specify the currently active manipulation tool, specify the snap behavior of an object, and open the Terrain Editor. |
| Window | Use the Window menu to specify how windows should display, specify which windows are currently visible, manage the user interface layout, and lock the user interface layout. |
| Help | Use the Help menu to display the current version of the LevelEditor. |

### LevelEditor Toolbars

The LevelEditor toolbars provide quick access to commonly used menu options. The toolbars are shown in Figure 19. These toolbars appear at the top of the LevelEditor main window; each is shown separately in the figure.

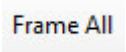
**Figure 19 LevelEditor Toolbars**

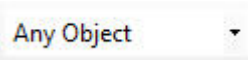
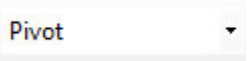


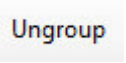

You can click a button on a toolbar to use the feature provided by that button. Table 2 describes the buttons.

**Table 2 LevelEditor Toolbar Buttons**

| Toolbar Button | Description |
|---|---|
|  | Arcball<br>Use this button to select the arcball navigation mode. In this mode, you use the ALT key and left-mouse button to rotate the world camera view, and you use the ALT key and right-mouse button to zoom the camera in or out. You can also scroll the mouse wheel to zoom the camera view.<br>For arcball mode, the world rotates around the camera look-at point. |
|  | Maya style trackball<br>Use this button to select the Maya style trackball navigation mode. In this mode, you use the ALT key and left-mouse button to rotate the world camera view, and you use the ALT key and right-mouse button to zoom the camera in or out. You can also scroll the mouse wheel to zoom the camera view.<br>For Maya mode, the view does not roll when you rotate the world. |
|  | Fly<br>Use this button to select the Fly navigation mode. In this mode, use the W, A, S, and D keys (or the arrow keys) to move the world camera view parallel to the grid and to zoom. Use the mouse wheel to adjust the fly speed.<br>Fly mode is available only in Perspective view. |
|  | Walk<br>Use this button to select the Walk navigation mode. In this mode, use the W, A, S, and D keys (or the arrow keys) to move the world camera view parallel to the grid and to zoom. Use the mouse wheel to adjust the walk speed.<br>Walk mode is available only in Perspective view. |
|  | Select<br>Use this button to allow mouse clicks to select game objects in the Design View. This button also disables any of the currently selected manipulators (scale, move, rotation, extension, or move-pivot). |
|  | Snap to vertex<br>Use this button to snap one object to another object's vertex. Hold the SHIFT key and drag the object to the vertex. |

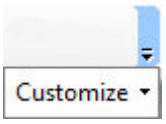
| Toolbar Button | Description |
|---|---|
|  | Rotate on snap<br>Use this button to snap one object to another object's surface. Hold the SHIFT key and drag the object to the surface. |
|  | Move manipulator<br>Use this button to activate the Move manipulator. The Move manipulator allows you to move game objects within the level. |
|  | Extension manipulator<br>Use this button to activate the Extension manipulator. The Extension manipulator allows you to extend or stretch objects in a single dimension at a time. |
|  | Scale manipulator<br>Use this button to activate the Scale manipulator. The Scale manipulator allows you to resize and deform game objects relative to their pivot point. |
|  | Rotation manipulator<br>Use this button to activate the Rotation manipulator. The Rotation manipulator allows you to rotate game objects relative to their pivot point. |
|  | Move-Pivot manipulator<br>Use this button to activate the Move-Pivot manipulator. The Move-Pivot manipulator allows you to move a game object's pivot point. |
|  | Activate terrain editing<br>Use this button to enable editing of the underlying terrain. Only available after you select a height map for the terrain in the Terrain Editor. |
|  | Lock UI layout<br>Use this button to lock the layout of the LevelEditor user interface so that it cannot be changed. |
|  | Unlock UI layout<br>Use this button to unlock the layout of the LevelEditor user interface so that it can be changed. |
|  | Save<br>Use this button to save the current level and all sublevels (if any). |
|  | Save As<br>Use this button to save the current level and all sublevels (if any) with a new file name. |
|  | New document<br>Use this button to open a new, empty, level. |
|  | Open document<br>Use this button to open an existing level. |
|  | Frame selected objects<br>Use this button to display the currently selected game objects in the center of the Design View. Framing an object changes the camera view, but does not change the world rotation or move the selected objects. |
|  | Frame all objects<br>Use this button to display all game objects in the center of the Design View. |
|  | Single view<br>Use this button to show the current game level in the entire Design View. |
|  | Quad view<br>Use this button to show four separate views of the current game level within the Design View. You can change the projection for each of the views independently. |

| Toolbar Button | Description |
|---|---|
|  | Dual horizontal view<br>Use this button to show two separate horizontal views of the current game level within the Design View. You can change the projection for each of the views independently. |
|  | Dual vertical view<br>Use this button to show two separate vertical views of the current game level within the Design View. You can change the projection for each of the views independently. |
|  | Hide selected objects<br>Use this button to hide selected objects from view. |
|  | Show selected objects<br>Use this button to make currently hidden selected objects visible. |
|  | Show last hidden object<br>Use this button to make the most recently hidden object visible. |
|  | Show all hidden objects<br>Use this button to make all objects visible. |
|  | Show selected objects and hide other objects<br>Use this button to make selected objects visible and hide all nonselected objects. |
|  | Solid rendering<br>Use this button to render game objects in the Design View as solid objects. |
|  | Wireframe rendering<br>Use this button to render game objects in the Design View as wireframe objects. |
|  | Solid over wireframe rendering<br>Use this button to render game objects in the Design View as solid objects with a wireframe overlay. |
|  | Textured rendering<br>Use this button to render game objects with their associated textures, if any. |
|  | Lighting<br>Use this button to use a global non-directional light source in the world. Local light sources (and shadows) are overwritten by this global light source. |
|  | Render back faces<br>Use this button to render the back faces of each game object. |
|  | Render shadow<br>Use this button to render shadows from local light sources in the world. The light itself is not affected by turning on or off shadows. |
|  | Render normals<br>Use this button to render normal vectors for each vertex of each visible object in the world. |
|  | Pick-filter selector<br>Use this button to which objects are selected when you click in the Design View. You can select **Any Object**, **Locators**, **Basic Shapes**, or **No Cubes**. |
|  | Move selector<br>Use this button to specify how objects move within the world using the Move manipulator. When you select **World**, you move objects relative to the world. When you select **Local**, you move objects relative to a local X, Y, or Z plane. |
|  | Snap-mode selector<br>Use this button to quickly set the snap point of an object to one of the following predefined settings: **Pivot** (the object's current pivot point). **Origin**, **TopCenter**, **BottomCenter**, **FrontCenter**, **BackCenter**, **LeftCenter**, or **RightCenter**.<br>See Snapping Game Objects. |

| Toolbar Button | Description |
|---|---|
|  | Copy to clipboard<br>Use this button to copy currently selected objects to the clipboard. |
|  | Cut to clipboard<br>Use this button to copy currently selected objects to the clipboard and remove them from the game world. |
|  | Paste from clipboard<br>Use this button to paste objects from the clipboard to the game world or to one of the LevelEditor windows (such as the Layers window). Pasting objects also selects the newly pasted objects. |
|  | Delete selected object<br>Use this button to delete the selected objects. |
|  | Undo last change<br>Use this button to undo the most recent change to the game world. |
|  | Redo last edit<br>Use this button to redo the most recent change to the game world. |
|  | Lock selection<br>Use this button to lock the current selection so that it cannot be changed. |
|  | Unlock selection<br>Use this button to unlock the current selection so that it can be changed. |
|  | Group selected objects<br>Use this button to group selected objects together so that you can perform actions (such as a rotation) to multiple objects at once. |
|  | Ungroup selected objects<br>Use this button to ungroup selected objects. |

You can customize which buttons are displayed for each toolbar. Click the down arrow at the lower right corner of the toolbar to display the **Customize** dropdown list, as shown in Figure 20. From that list, select which buttons you want to display on the toolbar.

**Figure 20 Toolbar customize option**

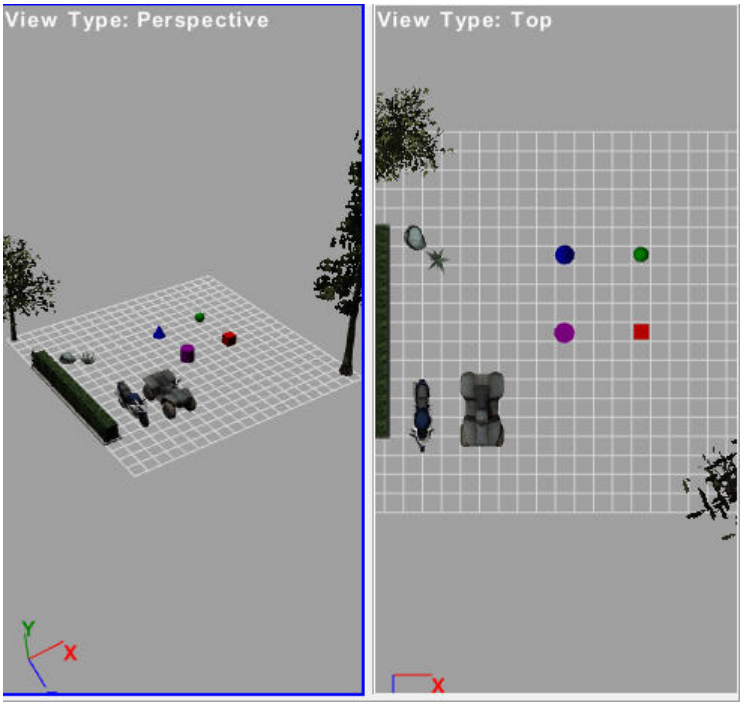



The next several sections describe important panes and palettes in the LevelEditor workspace.

### Design View

The Design View displays a graphical representation of the level. It is the main view that you use to lay out and construct a game level. The Design View enables you to add game objects to the level, arrange game objects within the level, and examine the level from multiple perspectives simultaneously. For example, Figure 21 shows two perspectives of a sample level, with several game objects visible in each perspective.

**Figure 21 Design View example**




The Design View can display **Perspective, Top, Bottom, Left, Right, Front, or Back** view. The grid helps you visualize the world space and dimensions. To show or hide the grid, click **Game** in Project Lister, open the Property Editor, and select the **Visible** property for the Grid. Use the Property Editor to change the size and other properties of the grid.

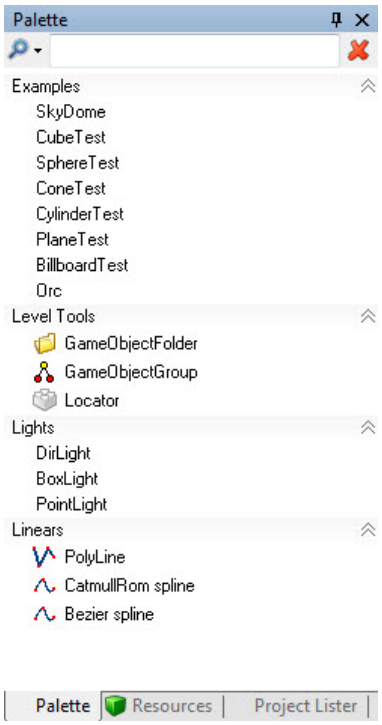
You can also control the way that the LevelEditor renders objects. For example you can render in wireframe, wireframe over solid, textured or untextured, and so on. For more information, see Specifying How to Render Game Objects.

### Palette

The Palette contains game object types that you use to create game objects, as shown in Figure 22. The Palette contains four categories of objects:

- *Examples* contains sample game objects
- *Level Tools* contains objects for creating folders, object groups, and locators.
- *Lights* contains light source game objects.
- *Linears* contains objects for creating polylines and curves.

**Figure 22 Palette**




Dragging an item from the Palette to either the Project Lister or the world in the Design View creates a new game object. If you drag an object directly to the Project Lister, the new game object is automatically placed in the world with its pivot point at 0, 0, 0. For more information about pivot points, see Moving, Rotating, and Scaling Objects.

- To open the Palette, select the **Window > Palette** menu item.
  A checkmark appears next to the **Palette** item in the **Window** menu and the Palette becomes frontmost.
  When the Palette is open, but not frontmost, you can click its tab to make it visible.
- To close the Palette, select the **Window > Palette** menu item again.
  No checkmark appears next to the **Palette** item in the **Window** menu and the Palette is hidden.

For more information about using the Palette, see Working with Game Objects.

**Note:** XML schemas define the objects that appear in the Palette. Creating XML schemas is an advanced topic intended for programmers, but it can be helpful to understand how the LevelEditor uses XML schemas. For more information about uses for XML schemas, see the ATF Annotation Guide in the *ATF Reference* (available from https://github.com/SonyWWS/ATF/tree/master/Docs).

### Output Window

The Output window provides diagnostic messages and other information as you work in the LevelEditor.

### IronPython Window

The IronPython window allows you to write Python scripts to implement new commands or macros within the LevelEditor.

### Property Editor

The Property Editor displays and allows you to edit the properties of a selected object; for example, you can specify an object's name, its rotation and translation, its visibility, and whether it is locked.

- To open the Property Editor, select the **Window > Property Editor** menu item.
  A checkmark appears next to the **Property Editor** item in the **Window** menu and the Property Editor becomes frontmost.
  When the Property Editor is open, but not frontmost, you can click its tab to make it visible.
- To close the Property Editor, select the **Window > Property Editor** menu item again.
  No checkmark appears next to the **Property Editor** item in the **Window** menu and the Property Editor is hidden.

Figure 23 shows the Property Editor display of properties for a sphere game object.

**Figure 23 Property Editor example**

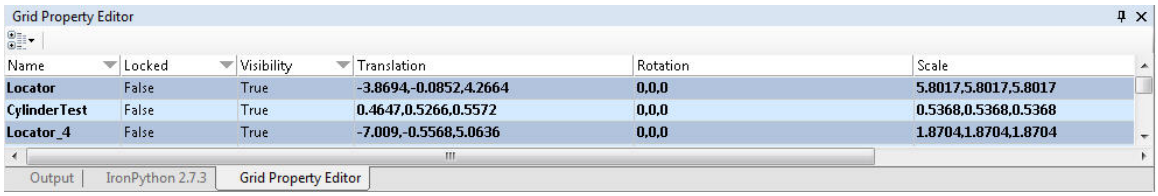

For more information about using the Property Editor, see Working with Game Objects.

### Grid Property Editor

The Grid Property Editor displays the properties for all currently selected objects as a grid, with each row displaying the properties of a different object.

Figure 24 shows the Grid Property Editor display for properties for several game objects.

**Figure 24 Grid Property example**



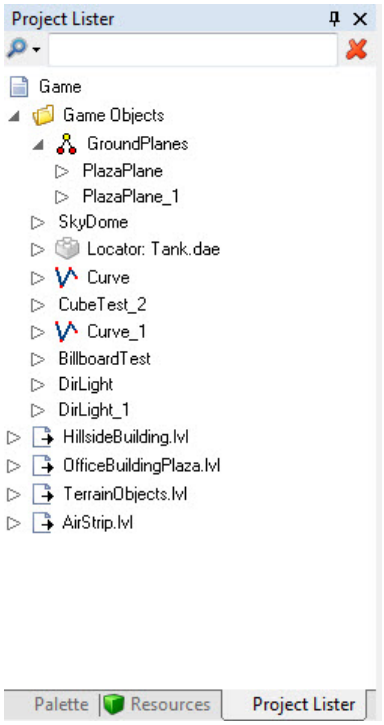

For more information about using the Grid Property Editor to compare and set properties for multiple objects, see Working with Game Objects.

### Project Lister

The Project Lister displays all game objects in the level and sublevels. The directory tree shows the game object's grouping and hierarchy, as shown in Figure 25.

When you open a new level, the Project Lister contains a single folder. The **Game Objects** folder contains all game objects in the level. Sublevel folders are shown in folders at the same hierarchy level as the **Game Objects** folder.

**Figure 25 Project Lister example**




- To open the Project Lister, select the **Window > Project Lister** menu item.
  A checkmark appears next to the **Project Lister** item in the **Window** menu and the Project Lister becomes frontmost.
  When the Project Lister is open, but not frontmost, you can click its tab to make it visible.
- To close the Project Lister, select the **Window > Project Lister** menu item again.
  No checkmark appears next to the **Project Lister** item in the **Window** menu and the Project Lister is hidden.

For more information about game objects, see Working with Game Objects.

### Layers List

The Layers list lets you assign objects to layers that group objects persistently. You can make objects in a layer visible or invisible by selecting or clearing the layer's checkbox in the Layers list. Thus, layers provide a handy way to reduce clutter while working with a particular set of objects. You can also use sublevels to manage large groups of objects.

Figure 26 shows an example of the Layers list.

**Figure 26 Layers list example**


For more information about working with layers or sublevels, see Working in Design View.

### Resources List

The Resources list displays all of the assets in the **ResourceRoot** folder. The Resources list is visible by default, but you can choose its item in the **Window** menu to close and reopen it at will.

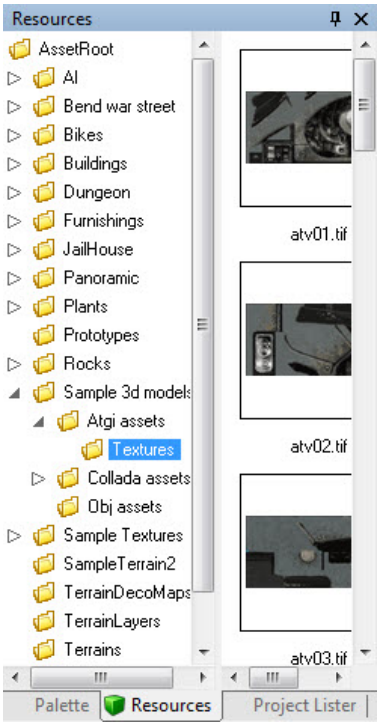
- To open the Resources list, select the **Window > Resources** menu item.
  A checkmark appears next to the **Resources** item in the Window menu and the Resources list appears at the top of the LevelEditor workspace.
  When the Resources window is open, but not frontmost, you can click its tab to make it visible.
- To close the Resources list, select the **Window > Resources** menu item again.
  No checkmark appears next to the **Resources** item in the Window menu and the Resources list is hidden.

When the Resources list is open, its left pane displays a tree view of the contents of the **ResourceRoot** folder. The right pane displays information about the current selection in the tree view. By default, the right pane shows the Details View, which provides Name, Size, Type and Date information. To view thumbnails instead, right-click in the Resources list, and choose **Thumbnail View** item from the

contextual menu; to go back to the Details View, right click in the thumbnail view and choose **Details View** from the contextual menu.

The Resources list example in Figure 27 shows a hierarchical view of folders and subfolders that contain resources. The **Textures** folder is selected, so the right pane displays information about its contents; in this example, the right pane displays thumbnails of the texture files in the folder.

**Figure 27 Resources list example**




For more information about adding and managing assets, see Working with Resources.

### Resource Preview

The Resource Preview pane allows you to view a fully rendered Resources object before you place it in the world. You can move the object within the preview using the same Arcball or Maya navigation that you use within the Design View. In addition, you can change the object's render mode and perspective.

To preview an object:

(1) Open the Resource Preview pane.

(2) Open the Resources list pane.

(3) Within the Resources list, navigate to the object that you want to preview. You can use the Details or Thumbnail view within the Resources list to determine which object you want to select. For example, select the **rock03.atgi** resource within the **\Rocks** folder.

(4) Within the Resources list, select an ATGI object. The selected object appears fully rendered in the Resource Preview pane. For example, for the **rock03.atgi** resource, the Resource Preview displays the rendered rock, as shown in Figure 28.

**Figure 28 Resource Preview example**


You can right-click within the Resource Preview pane to alter the render mode (solid, wireframe, textured, rendered with back faces, or lit) and the view (front, back, top, bottom, left, right, or perspective) for the previewed object. These selections apply to the Resource Preview pane only, and do not affect the render mode or view within the Design View.

### Resource Metadata

Many resources include metadata that you can use when selecting the object to place in the world or apply to another object. For example, artwork files typically have metadata about their compression type and memory layout.

Open the Resource Metadata pane, as shown in Figure 29, to view metadata for any object that you select within the Resources list. The figure shows the metadata for the **Rock03_diff.png** file in **\Rocks** folder.

**Figure 29 Resource Metadata example**


### Resource Root Folder

To make an asset available to the LevelEditor, place it in the **ResourceRoot** folder. The default location of the Resource Root is the folder where the **LevelEditor.exe** runs, but you can change this location.

To change the ResourceRoot, perform the following tasks:

(1) Select the **Edit > Preferences** menu item.
The Preferences window appears.

(2) Click the **Resources** item in the left column.
The **ResourceRoot** preference appears in the right column of the Preferences window.

(3) Specify an absolute or relative path to the new **ResourceRoot** folder:

- To type the pathname yourself, double-click the pathname to edit it.
- To browse to the new location, select the field and click the browse button, navigate to the new location, select it, and click **OK**.

(4) Click **OK** in the Preferences window.
The LevelEditor saves your changes and dismisses the Preferences window. The Resources list displays the resource content of the new Resource Root.

Each level file saves the relative path to the **ResourceRoot** folder, so if you open a level file on a different computer, be sure its path to Resource Root has the same relative structure as the original computer.

For more information about adding, managing, and updating assets, see Working with Resources.

### Bookmarks

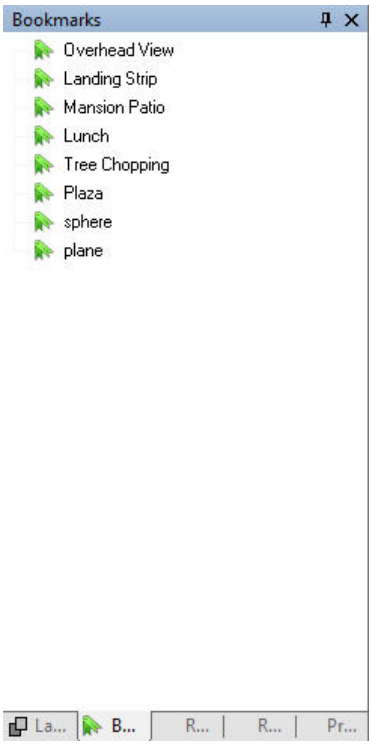
A *bookmark* records a specific view direction and distance for quick access in the Design View.

To list bookmarks, select the **View > Bookmarks** menu item.

To save the current view as a bookmark, right-click in the Bookmarks window and select the **Add > Bookmark** menu item.

Figure 30 shows bookmarks for several locations within a sample level.

**Figure 30 Bookmarks example**




For more information, see Using Bookmarks to Save Frequently Used Views.

### Render Settings

The Render Settings window allows you to specify global preferences for how objects are rendered in the world. These preferences apply to any level file that you open in the LevelEditor.

The Render Settings window list is autohidden by default, but you can choose its item in the **Window** menu to close and reopen it at will.

- To open the Render Settings window, select the **Window > Render Settings** menu item.
  A checkmark appears next to the **Render Settings** item in the Window menu and the Render Settings appears, either as a separate window or at the left of the LevelEditor workspace.
  When the Render Settings window is open, but not frontmost, you can click its tab to make it visible.
- To close the Render Settings window, select the **Window > Render Settings** menu item again.
  No checkmark appears next to the **Render Settings** item in the Window menu and the Render Settings window is hidden.

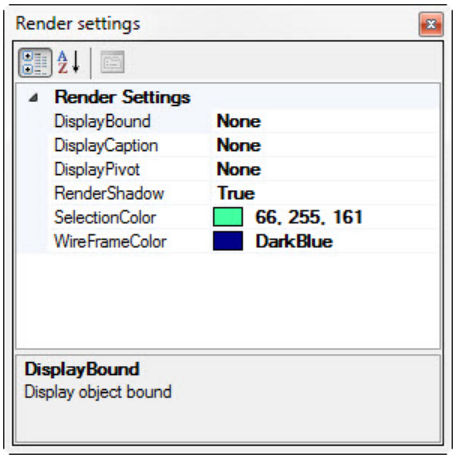
You can specify the following global rendering preferences:

- DisplayBound: Allows you to specify whether objects in the Design View display their bounding boxes. You can specify **None**, **Always**, or **Selection**.
- DisplayCaption: Allows you to specify whether objects in the Design View display a caption. You can specify **None**, **Always**, or **Selection**.
- DisplayPivot: Allows you to specify whether objects in the Design View display their pivot point. You can specify **None**, **Always**, or **Selection**.

- RenderShadow: Allows you to specify whether the Design View renders shadows for local light sources by default. You can specify **True** or **False**. You can override this setting at any time by selecting the **Render shadow** option from the design toolbar.
- SelectionColor: Allows you to specify the color of the wireframe of a selected object.
- WireFrameColor: Allows you to specify the wireframe color for objects rendered as wireframes or solid with wireframes.

Figure 31 shows the Render Settings window.

**Figure 31 Render Settings window**



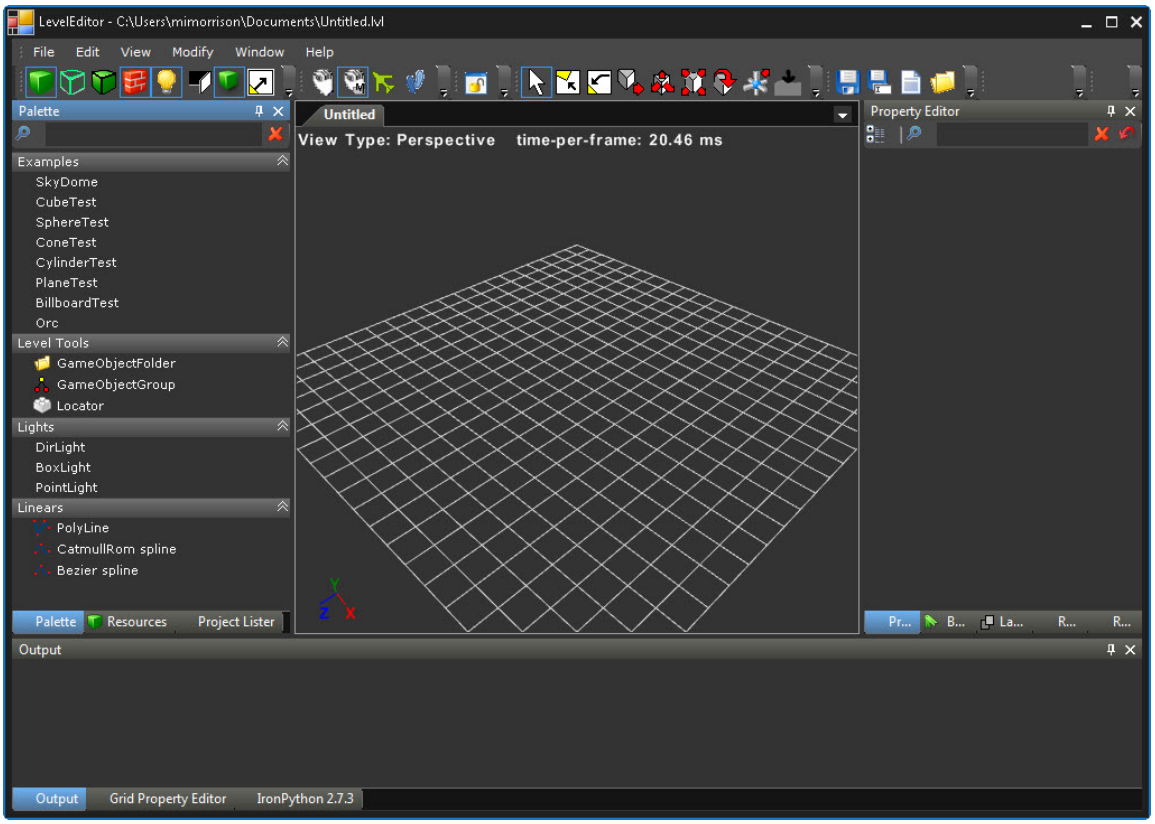

## Customizing the Default Workspace

This document shows the default workspace, but you can customize the workspace in a variety of ways:

- Drag tabs to reorder them.
- Drag a tab out into the workspace to create a floating window.
- Drag palettes to any location you prefer; to dock a palette, drag it to an edge of the workspace and drop it on the button that appears as you near the edge.
- Apply a new skin to alter the appearance of the LevelEditor. Select **View > Load Skin** to apply a new skin, or select **View > Edit Skin** to modify the currently applied skin.
- To enable automatic hide/show of a docked window, click the push-pin icon that appears in its upper-right corner. In this mode, the window disappears when the mouse pointer is not within its boundaries. For example, to show the Render Settings window, move your mouse pointer to the location at which the Render Settings window is pinned.
- To resize a pane or a docked window, drag its edge.
- To close a window permanently, click the X that appears in its upper right corner.
- To open a window or tab that has been closed permanently, choose its name from the Window menu. You can also use the Window menu to activate (make frontmost) a tab or window that is not closed.

Figure 32 shows the LevelEditor with a dark skin applied and many of its main panes open and docked to the main window.

**Figure 32 LevelEditor workspace, with dark skin**



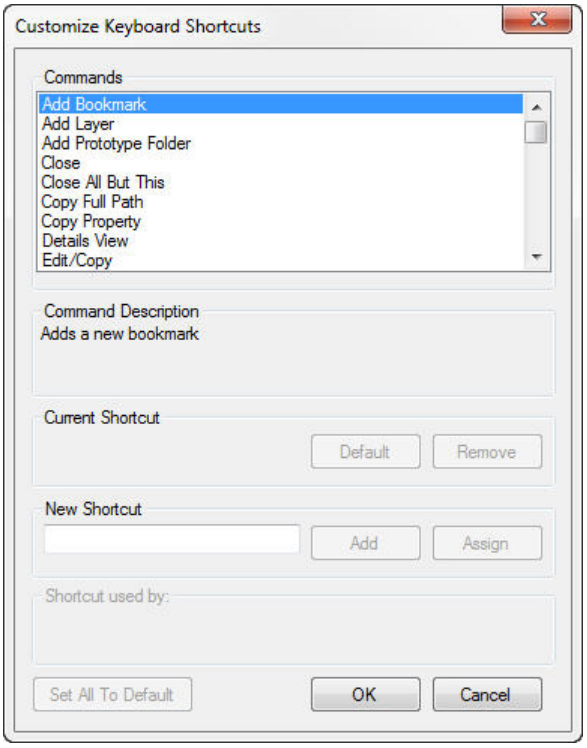

Any changes that you make to the LevelEditor workspace (such as moving and redocking windows, or applying a new skin) are saved only when you exit the LevelEditor. Workspace changes are not saved with level files, and are not saved when you save a level file.

### Keyboard Shortcuts

You can customize the keyboard shortcuts for commands and actions within the LevelEditor. By default, many commands have a keyboard shortcut that allows you to perform the command without using the mouse. Each menu item lists the keyboard shortcut defined for a command, if any.

To set or modify keyboard shortcuts, select the **Edit > Keyboard Shortcuts** menu item. The Customize Keyboard Shortcuts dialog opens, as shown in Figure 33.

**Figure 33 Customize Keyboard Shortcuts dialog**



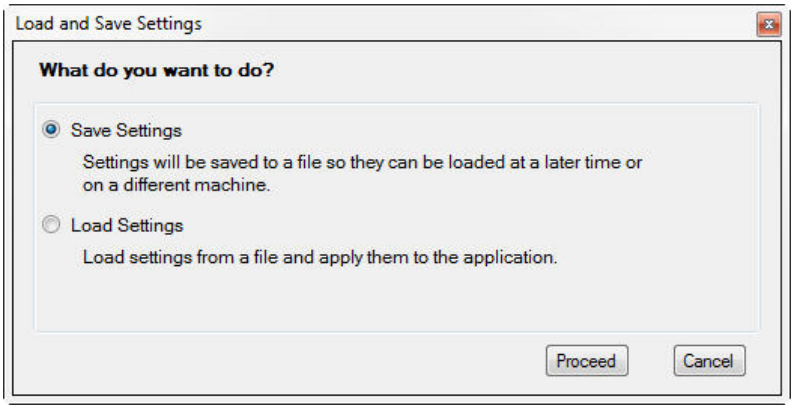

Within the Customize Keyboard Shortcuts dialog, select a command to display its currently defined keyboard shortcut. For each command, you can reset its shortcut to a default setting, remove the shortcut, or add a new shortcut.

### Load or Save Settings

You can save your LevelEditor workspace settings so that you can either use multiple settings for different projects or share the settings with coworkers.

To load or save workspace settings, select the **Edit > Load or Save Settings** menu item. The Load and Save Settings dialog opens, as shown in Figure 34.

**Figure 34 Load and Save Settings dialog**




The workspace settings are saved to an XML file with a name that you specify.

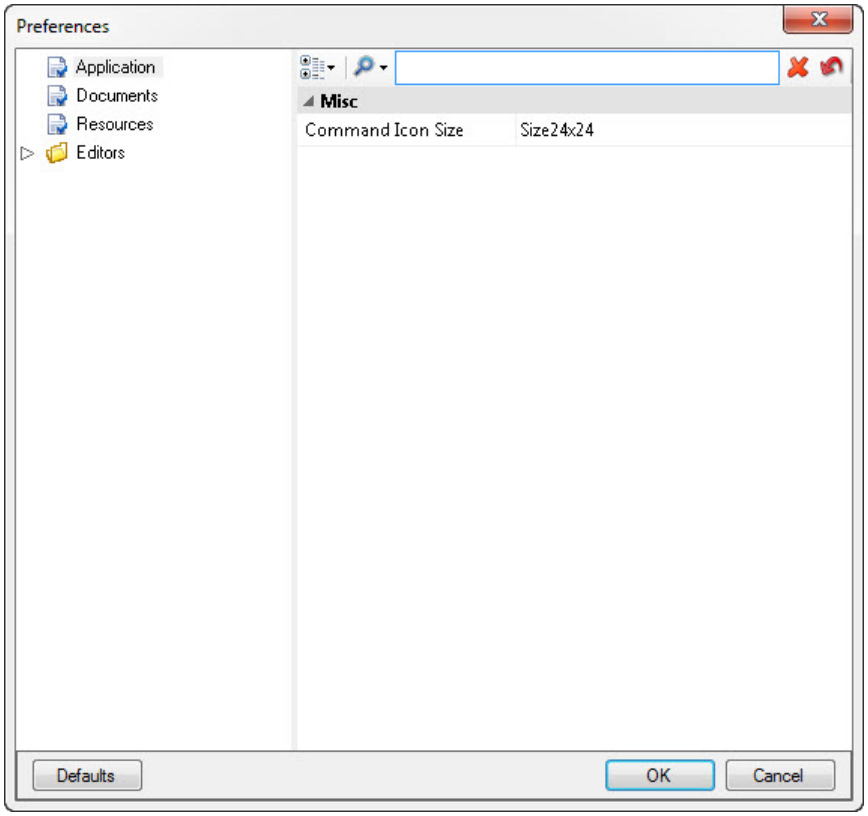
### Preferences

You can specify global settings for the LevelEditor, including:

- Application settings:
  - The size of the icons shown in the toolbars
- Document settings:
  - Whether to create a new document when you open the LevelEditor
  - Whether to autoload recently opened documents
  - The number of recent documents to display in the **File** menu
  - When you load a level, whether to resolve subdocuments (sublevels) that it references
- Resources settings:
  - The **ResourceRoot** folder; see Resource Root Folder.
- Editor settings:
  - The background color for the Design View
  - The default camera navigation mode
  - The camera far plane for the Design View
  - The default setting for Rotate On Snap
  - The default setting for Snap to Vertex

To specify preferences, select the **Edit > Preferences** menu item. The Preferences dialog opens, as shown in Figure 35.

**Figure 35 Preferences dialog**



These preferences are saved in a default preferences file when you exit the LevelEditor. You can also save them to your own preferences file; see Load or Save Settings.

## Using Basic Features

This section describes some of the basic features, commands, and toolbar icons of the LevelEditor to perform basic tasks.

### Managing and Editing Files

The LevelEditor can save one or all documents, create subdocuments, create a new game, or open an existing game. You can also use the LevelEditor to perform basic editing tasks such as cut, paste, undo, and redo, as listed in Table 3.

**Table 3 Managing and editing files**

| To… | Click this icon | Or use this command |
|---|---|---|
| Save the current LVL file |  | File > Save |
| Save the active file under a new name |  | File > Save As |
| Create a new document (level file) |  | File > New Game |
| Open an existing document (level file) |  | File > Open Game |
| Undo the last change |  | Edit > Undo |
| Redo the last change |  | Edit > Redo |

### Setting User Preferences

Using the Preferences dialog box, you can set many aspects of the LevelEditor interface to your personal preference; see Preferences.

The left pane in the Preferences dialog box has a directory tree from which you can choose settings, as listed in Table 4.

To open the Preferences dialog box:

- Select the **Edit > Preferences** menu item.

**Table 4 Setting user preferences**

| To set… | Use this command |
|---|---|
| Toolbar icon image size | Application > Command Icon Size |
| Whether the LevelEditor creates an empty document on startup | Documents > Auto New Document |
| Whether the LevelEditor automatically loads previously open documents on startup | Documents > Auto-load Documents |
| The number of recent files to display in the File menu | Documents > Recent Files Count |
| Whether to resolve references to subdocuments (sublevels) on document load | Documents > Resolve on Load |
| The ResourceRoot folder | Resources > ResourceRoot |
| Background color for the Design View | Editors > Design View > Background Color |
| The default camera navigation mode | Editors > Design View > ControlScheme |

| To set… | Use this command |
|---|---|
| The distance away from the eye point at which objects disappear from view | Editors > Design View > FarZ |
| The default setting for the Rotate On Snap command | Editors > Design View > RotateOnSnap |
| The default setting for the Snap to Vertex command | Editors > Design View > SnapVertex |

### Adding and Organizing Assets

The LevelEditor refers to assets by paths that are relative to the resource root. To place an asset (such as an **.atgi** file) in a level, perform the following tasks:

(1) Create a new level or open an existing **.lvl** file.
The 3D Design View displays the level. If you prefer to work in the Project Lister, click its tab.

(2) Drag an asset from the right side of the Resources window into the 3D Design View or the Project Lister.

### Displaying Different Views of the World

The Design View can project the world from the top, bottom, left or right side, front, back, or in three-dimensional perspective. You can also display one, two, or four of these views simultaneously, as listed in Table 5.

**Table 5 Multiple viewing panes**

| To have… | Click this icon | Or use this command |
|---|---|---|
| One viewing pane |  | View > Layouts > Single View |
| Two views side-by-side |  | View > Layouts > Dual Vertical View |
| Two views, one on top of the other |  | View > Layouts > Dual Horizontal View |
| Four views |  | View > Layouts > Quad View |

To specify the projection for a view:

(1) Click in the Design View.

(2) Choose one of the projections listed in Table 6.

**Table 6 Projections**

| To project the world… | Use this command |
|---|---|
| In three-dimensional perspective | View > Projection > Perspective |
| From the front | View > Projection > Front |
| From the back | View > Projection > Back |
| From the top | View > Projection > Top |
| From the bottom | View > Projection > Bottom |
| From the left side | View > Projection > Left |
| From the right side | View > Projection > Right |

For more information about displaying different views, see Working in Design View.

### Specifying How to Navigate the World

The LevelEditor has several modes that let you use the mouse to zoom, rotate, and pan the world, as listed in Table 7. These modes—Arcball, Maya Style Trackball, Fly, and Walk—vary in what they do and how you use them.

**Table 7 Navigation modes**

| To specify this navigation mode | Click this icon | Or use this command |
|---|---|---|
| Arcball |  | View > Camera > Arcball |
| Maya Style Trackball |  | View > Camera > Maya |
| Fly |  | View > Camera > Fly |
| Walk |  | View > Camera > Walk |

For more information about navigation mode features and uses, see Working in Design View.

### Specifying How to Render Game Objects

You can render the surfaces of a game object as smooth, wireframe, or outlined (smooth with shading and wireframe). You can also enable or disable rendering features such as textures, lighting, whether the LevelEditor renders objects' back faces, and object normals.

Use the commands listed in Table 8 to specify wireframes and surfaces.

**Table 8 Rendering with wireframe or fill**

| To render game objects with | Click this icon | Or use this command |
|---|---|---|
| Wireframes only |  | View > Wireframe |
| Smooth surfaces |  | View > Solid |
| Smooth surfaces with wireframes |  | View > SolidOverWire |

Use the commands listed in Table 9 to enable or disable rendering of textures, lighting, back faces, shadows, and normals.

**Table 9 Rendering textures, lighting, back faces, shadows, and normals**

| To render game objects with | Click this icon | Or use this command |
|---|---|---|
| Textured surfaces |  | View > Textured |
| Lighting |  | View > Lighting |
| Back sides visible |  | View > BackFace |
| Shadows |  | View > Shadow |
| Normals |  | View > Normals |

You can also use the **View > CycleRenderModes** command to cycle the render modes for selected objects.

For more information, see Rendering Game Objects or view the "Rendering Objects" video, either on the GitHub site or on SHIP.

### Moving, Rotating, Scaling, and Extending Objects

To move, rotate, scale, or extend objects, you can use in-world manipulators, the Property Editor, or the Grid Property Editor. You can also use these controls and editors to move an object's pivot point, which is the point around which an object rotates and scales.

A manipulator is an icon that you drag to move or modify an object or a group of objects. When positioning objects, you can snap them to the grid, to a vertex on the grid, or to a point on another game object. You specify snapping points on the moved item and the target item independently.

To move or modify game objects, perform the following tasks:

(1) Select game objects to modify.
To select a single object, click it in the world or in the Project Lister.
To select multiple objects, take any of the following actions:

- Hold the SHIFT or CTRL key while clicking individual objects to add them to the selection.
- Drag a selection rectangle around multiple objects.

(2) Use the appropriate manipulator or edit properties, as listed in Table 10.

**Table 10 Object manipulators**

| To… | Click this icon to activate the manipulator | Or edit these properties |
|---|---|---|
| Move an object |  | Translation |
| Rotate an object |  | Rotation |
| Scale an object |  | Scale |
| Move an object's pivot point |  | Pivot |
| Extend or stretch an object in a single direction |  | Scale and Translation |

For more information about positioning, rotating, and scaling objects, see Working in Design View or view the "Using Manipulators" video, either on the GitHub site or on SHIP.

### Displaying and Hiding Game Objects

To make it easier to see your work in the Design View, you can hide, display, and zoom game objects. You can also assign game objects to layers or save them as sublevels to display and hide sets of game objects easily. Table 11 lists the commands for hiding and showing objects.

**Table 11 Hiding and showing objects**

| To… | Click this icon | Or type this command |
|---|---|---|
| Zoom in on selected game objects in the active viewing pane |  | (Keystroke command equivalent not available) |
| Zoom in on selected game objects in all viewing panes | (No icon available) | (Keystroke command equivalent not available) |
| Hide selected game objects |  | H |
| Show selected game objects |  | SHIFT + H |
| Show the last hidden object |  | CTRL + H |

| To… | Click this icon | Or type this command |
|---|---|---|
| Display only selected game objects |  | I |
| Display all game objects |  | SHIFT + R |

For more information about displaying and hiding game objects and working with layers or sublevels, see Working in Design View.

### Creating Linears

A *linear* is a special type of game object; it defines a geometric shape that provides a set of control points. You can click and drag the control points to modify the linear.

The LevelEditor provides the following tools for creating linears:

- The Palette has Polyline, CatmullRom spline, and Bezier spline objects that you can use to lay out linears.
- Drag control points to move or bend curves and linears.
- Click on the linear to add more control points.

For more information about creating linears, see Working in Design View or view the "Creating Linears" video, either on the GitHub site or on SHIP.

To create Linears in the LevelEditor, perform the following tasks:

(1) Drag a linear object type from the Palette onto the Design View.

(2) Click on the linear to add control points.

(3) Drag control points to manipulate them; notice how the line to either side of the control point changes in response.

(4) (Optional) Open the Property Editor for the linear, and select the **IsClosed** checkbox to add a line between the end control points to close the linear.

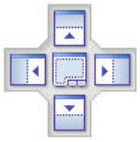
### Grouping and Ungrouping Objects

The LevelEditor can create enduring groups of objects that you can edit simultaneously. The group itself is a game object and appears as a group game object in the Project Lister. Alternatively, you can group objects temporarily by drag-selecting adjacent objects, which remain grouped until you click outside the group.

### Working with Docking Controls

As with all ATF-based tools, you can drag window tabs (or windows) to the docking controls to reposition the tab within the LevelEditor interface. The docking controls, as shown in Figure 36, are visible only while you are dragging a tab or window. The figure shows the main docking controls; additional docking controls appear at the top, bottom, or sides of the window as you drag the tab or window to the top, bottom, or sides of the window.

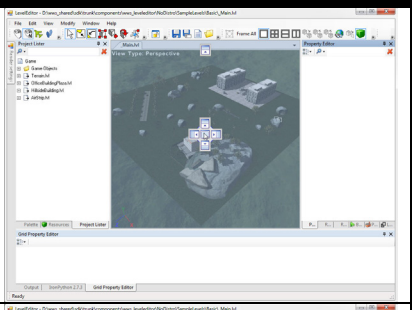
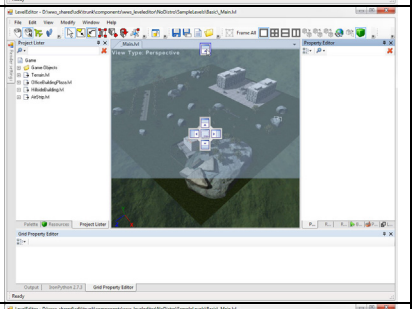
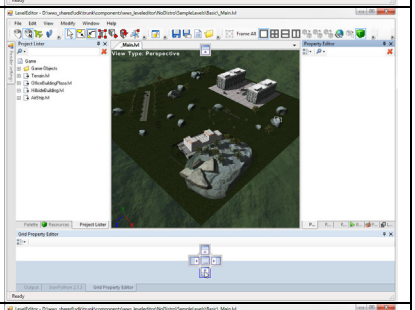
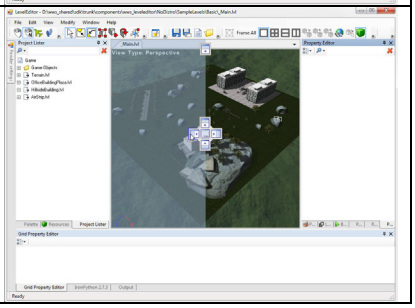
**Figure 36 LevelEditor docking controls**

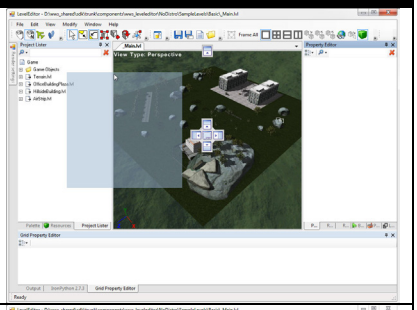
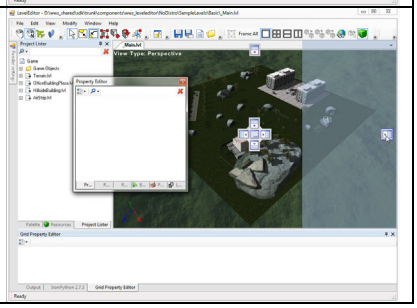


As you drag the tab, parts of the LevelEditor window are shaded light blue to represent the final location of the tab or window when you drop it.

You can drag a tab or window to many different locations within the LevelEditor work space, as described in Table 12. The table assumes that you are moving the various editor tabs (Property Editor, Bookmarks, Layers, Resource Preview, and Resource Metadata), but the table also applies to other tabs groups, docked windows, and floating windows. You can drag into any of the existing window areas, such as the Project Lister or the Output window to create a customized layout.

**Table 12 Working with docking controls**

| To ... | Do this ... | While the docking controls look like this ... |
|---|---|---|
| Move editor tabs to the Design View work area | Drag one editor tab onto the Design View tab |  |
| Move editor tabs to the top (or bottom) of the Design View work area | Drag the tab to the upper docking control within the Design View<br><br>You can also drag the tab to the bottom docking control to place the window at the bottom of the Design View |  |
| Move a tab into another window area | Drag the tab to one of the window areas, using the docking control to specify whether the tab fills the area or splits the area (vertically or horizontally)<br><br>You can drag to any of the window areas |  |
| Split the Design View area vertically | Drag the tab to the left of the central docking control<br><br>You can also drag to the right of the central docking control |  |

| To ... | Do this ... | While the docking controls look like this ... |
|---|---|---|
| Convert a tab to a floating window | Drag the tab to any location other than a docking control<br><br>You can also drag to a location outside the LevelEditor window |  |
| Convert a floating window to a tab | Drag the floating window to one of the docking controls, as described in this table |  |

# 5 Typical Work Flow

Typically, the major tasks involved in building a game level include creating resources, managing project infrastructure, constructing game levels and inspecting them, and creating the final output format of the game level.

## Creating Resources and Project Infrastructure

Most complex game projects require the use of external files, such as those used as resources (also known as assets). Some games also require the creation of XML schemas that describe custom game object types for the LevelEditor. XML schemas are typically written by a programmer. For more information about writing and annotating XML schemas, see the *ATF Reference* (available from https://github.com/SonyWWS/ATF/tree/master/Docs).

Although you can add items to the Resource Root on demand, it is common for a commercial game project to be planned thoroughly before commencing the design work for which the LevelEditor is intended. Thus, the early stages of your game creation process might already have produced numerous assets that you'll use in the creation of levels for the game.

In a team environment, you might place these assets on a networked file share or use a source-control system to manage them.

Thus, before commencing work in the LevelEditor, you'll typically install resources in some appropriate location and set the location of the Resource Root on your own machine to make those resources available in the LevelEditor; see Resource Root Folder.

## Constructing and Inspecting Game Levels

Most features of the LevelEditor help you create game levels and populate them with resources that implement the gaming world that a particular level provides.

Populating a game level with game objects consists of the following general tasks:

(1) Add new resources to the LevelEditor as necessary. To add new resources, add files to the **ResourceRoot** folder or drag files to the Resources list. For more information, see Working with Resources.

(2) Create game objects, associate assets with them, and set their properties. To create sets of identical game objects that have the same properties, use prototype assets. For more information, see Working with Game Objects.

(3) Populate the level with game objects and inspect what you have constructed.
This task involves a variety of subtasks, such as placing and modifying game objects, viewing the world from different directions, and hiding and displaying game objects. For information about the ways that you work in Design View to populate the world, see Working in Design View.

## Creating the Final Output Format

When you finish editing a level, you need to convert it to a format that is usable by your game platform, so that you can test its behaviors or distribute a final product. Typically, the game programming team writes a plugin that converts the level to a platform-specific game format. Alternatively, they can create a build process that converts the saved level file to an intermediate format or to the format used by the game.

For more information about writing plugins that convert a level to a format that a gaming platform can consume, see the *ATF Reference* (available from https://github.com/SonyWWS/ATF/tree/master/Docs).

# 6 Working with Resources

The LevelEditor lets you bring in and manage the resources (also called assets) that you use to create a level. This chapter explains the basics about working with resources.

## Using Supported Resource File Formats

A resource is an external file created in an application other than the LevelEditor. Resources can provide geometries, behaviors, textures, and similar items.

You can use almost any type of asset to create a game object: If you drag an asset to the Design View, the LevelEditor creates a Locator game object that is associated with the asset. Whether the asset is visible depends on how the LevelEditor supports the asset file type.

The LevelEditor includes plugins that support common geometry, image, and texture file formats. The only exception is for specific unsupported versions of model or texture files. For example, if the plugin for ATGI version 1_20_3 is not available to the LevelEditor, you cannot drop a version 1_20_3 ATGI file into the Design View from the Resources list.

The LevelEditor does not create thumbnails for every texture format that it supports. For example, the LevelEditor does not generate a thumbnail in the Resources list for a TIFF file, but you can still use a TIFF file as a game object texture.

Table 13 lists the types of objects that the Resources list supports. These types of objects have geometry and can be dropped into the Design View.

**Table 13 Supported asset file formats**

| Model files | Image files | Texture files |
|---|---|---|
| ATGI | JPG, JPEG | JPG, JPEG |
| DAE *(Collada)* | BMP | BMP |
| | PNG | PNG |
| | TIF, TIFF | TIF, TIFF |
| | GIF | GIF |
| | PSD | DDS |
| | PCX | TGA |
| | PNM | |
| | SGI | |
| | PPM | |

## Managing Resources on Multiple Computers

Development teams typically work on a variety of computers, so it is important that the LevelEditor can locate resources regardless of their location on individual computers.

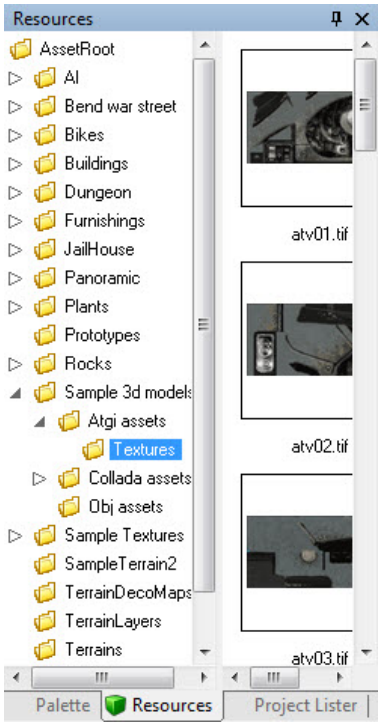
The LevelEditor refers to resources by paths that are relative to the resource root. Thus, the LevelEditor can locate resources regardless of the resources' position on a specific computer. However, the folder and file structures within the **Resources** folder on each computer must be consistent.

The default Resource Root folder is the **.\AssetRoot** folder. To set a different folder, select **Edit > Preferences > Resources > ResourceRoot**. For more information, see Resource Root Folder.

## Adding Resources to a Level

The Resources list displays all resources (also called assets) available from the Resource Root. The right pane displays a list view of the selected folder's resources or thumbnail views of them, as shown in Figure 37. To change between these two views, right-click in the Resources list and choose **Details View** or **Thumbnail View** from the context menu that appears.

**Figure 37 Resources list**




You can add resource references to your level by dragging-and-dropping from the Resources list into the Design View or into the Project Lister. If a window is not visible, you can drag to the tab to bring the window to front so that you can drop into it. You can also drag-and-drop resources from Windows Explorer.

## Selecting an Individual Resource

You often need to select an individual resource, such as when you associate the resource with a game object.

To select an individual resource:

(1) Navigate in the directory tree in the Resources List to the folder that contains the resource. The right pane displays thumbnails or a list view of the folder's resources.

(2) Click an individual resource to select it.

# 7 Working with Game Objects

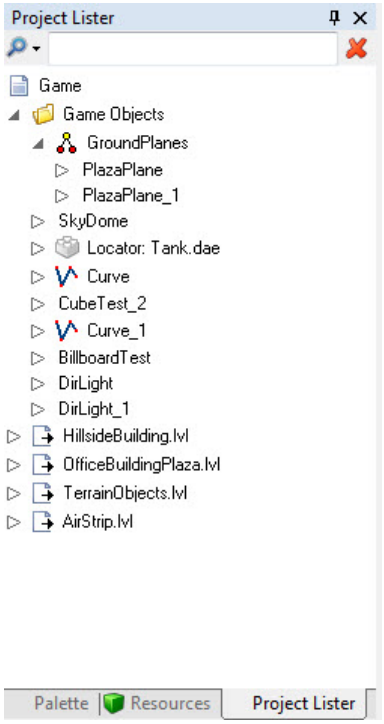
Game objects are a level's building blocks. There are many different types of game objects: game characters, static background objects, and so on. The LevelEditor provides tools for working with game objects to build a level.

This chapter describes the ways you can work with game objects using the LevelEditor.

## Viewing Game Objects in the Project Lister

The Project Lister displays every game object in a level or sublevel, as shown in Figure 38. Expanding a game object in the Project Lister shows the hierarchy of resources associated with the game object. Some game objects, such as a GameObjectGroup, might have other game objects as children. These, too, can be viewed by expanding the parent game object.

**Figure 38 Project Lister**




XML schemas define the available game object types, including the game object's properties and the resources with which a game object can be associated. These XML schemas are typically written by programmers and should be available before you start building a level.

## Creating Game Objects

To create a game object manually, drag it from the Palette or the Resources list into the Design View or the Project Lister, as described in Table 14:

- Dragging an object directly to Design View creates a game object at the point where you drop it.
- Dragging an object directly to the Project Lister creates a game object centered at 0, 0, 0 on the grid.

**Table 14 Creating game objects**

| To create a game object | Do this… |
|---|---|
| Positioned at a specific point in the world | Drag an object to the desired location in the Design View. |
| Positioned at 0,0,0 | Drag an object to the Project Lister. |

The object that you drag creates a game object that has the resource slots already defined for that type of game object. For example, the Orc object in the Palette creates a game object that has resource slots for associating a geometry resource, an animation, an additional game object as a target, and additional game objects as friends.

If you drag a resource from the Resources list, the LevelEditor creates a Locator game object that has that resource associated with its sole resource slot.

### Using the Palette as a Source of Game Objects

The Palette contains example objects from which you can create game objects:

- SkyDome – a 360° background image for the world
- CubeTest – a simple cube
- SphereTest – a simple sphere
- ConeTest – a simple cone
- CylinderTest – a simple cylinder
- PlaneTest – a simple plane
- BillboardTest – a simple billboard, onto which you can place an image that always faces the viewer, regardless of camera view
- Orc – a simple object with properties that are representative of game creatures

Each object creates a game object of a specific type with predefined properties and slots for resources. The types of objects available in the Palette are defined in XML schemas.

You can use Palette objects as the starting material for building game objects. After you create a game object from a Palette object, you associate resources with it and set its properties, for example:

- For the cube, sphere, cone, and cylinder, you can set the object's properties (such as its color), as well as scale the object, to create interesting and useful game objects.
- For the plane, you might want to turn on **Render back faces** to be able to see both sides of the plane as you change the camera view. The plane can be useful as a wall, floor, or ceiling surface onto which you add a texture.
- For the billboard, you can add a texture (as its **Diffuse** property) and specify its brightness (its **Intensity** property).
- For the orc, you can associate a geometry object, an animation, a target, and friends, as well as set its various properties.

The Palette also provides tools for organizing your project or levels within the project:

- GameObjectFolder – a folder for grouping objects in the Project Lister; objects within the folder are not grouped in the world, but are grouped only within the Project Lister (and the level file XML)
- GameObjectGroup – a meta-object that allows you to work with several objects as a group
- Locator – a meta-object that acts as a container for a resource (see Using Locators to Create Game Objects)

Finally, the Palette provides Light objects (see Adding Light Objects) and Linear objects (see Using Linears to Lay Out Lines and Boundaries).

### Using Prototypes and Prefabs to Create Similar Game Objects

Often, you want to create a large number of identical objects: a set of cars, a battalion of soldiers, or trees in a forest. Prototype assets and prefab assets provide a convenient way to make multiple objects that are identical. The LevelEditor treats a prototype or prefab asset as any other game resource or asset, and you can place as many of the prototype or prefab assets in the world as you need. Table 15 describes the similarities and differences between prototype assets and prefab assets.

**Table 15 Comparing Prototypes and Prefabs**

| Prototype Assets | Prefab Assets |
|---|---|
| When you drag and drop a prototype asset to the Design View, LevelEditor *creates a copy* of the base prototype object as the newly created object.<br><br>If you edit the properties of a base prototype asset, those *changes do not affect* any instances (copies) of that prototype in the game level. | When you drag and drop a prefab asset to the Design View, LevelEditor *creates a reference* from the base prefab object to the newly created object.<br><br>If you edit the properties of a base prefab asset, those *changes also affect* all instances of that prefab in the game level.<br><br>If you edit the properties of an instance of a prefab asset, those changes remain local to that instance (they override those of the base prefab, but do not affect the base prefab itself). |

To create a prototype or prefab asset, you must first create one or more game objects, set properties for each object, and associate resources with them. You then create a prototype or prefab asset from the game objects, and use the prototype or prefab asset as a template.

To create a prototype asset:

(1) Select one or more existing game objects in the Design View.

(2) Select **File > Create Prototype** to save the selected objects as a prototype asset. The Save As dialog opens so that you can define the prototype asset's file name and folder location. Save the prototype asset within your Resource Root folder.
**Recommendation**: Define a folder named "Prototypes" within your Resource Root folder to store your prototypes. Define subfolders within this new "Prototypes" folder as needed for each type of prototype asset.

To create a prefab asset:

(1) Select one or more existing game objects in the Design View.

(2) Select **File > Create Prefab** to save the selected objects as a prefab asset. The Save As dialog opens so that you can define the prefab asset's file name and folder location. Save the prefab asset within your Resource Root folder.
**Recommendation**: Define a folder named "Prefabs" within your Resource Root folder to store your prefabs. Define subfolders within this new "Prefabs" folder as needed for each type of prefab asset.

To use a prototype or prefab asset to create additional instances of a game object or set of game objects:

(1) Open the Resources list.

(2) Select the appropriate folder in the Resources list; for example, select the **Prototypes** folder or the **Prefabs** folder.

(3) From the right-hand pane of the Resources list, select the prototype or prefab asset. You can use the Resource Preview window to display the fully rendered view of the asset.

(4) Drag the prototype or prefab asset to the world. The copy of the prototype or prefab asset appears as a game object in the world and is added to the Project Lister.

Game objects created from prototype assets appear in the Project Lister within a GameObjectGroup object, with each copy of the prototype as a child of the GameObjectGroup, whereas game objects created from prefab assets appear in the Project Lister as child objects of the prefab instance. You can work with each object individually by selecting the object; to work with the objects as a group, select the prototype's GameObjectGroup or the prefab instance in the Project Lister.

### Using Locators to Create Game Objects

A Locator is useful for placing an instance of a geometry resource into the level. Like all game objects, a Locator has a position. However, the only additional property it has is a resource slot.

To create a locator, perform any of the following tasks:

- Drag a resource to Design View.
  The LevelEditor creates a locator game object. The point at which you drop the locator becomes the locator game object's position. Pressing the SHIFT key while you drag snaps the locator game object to another object in the level. Pressing the CTRL key while you drag snaps the locator game object to the grid.
- Drag a locator game object from the Palette to Design View.
- Drag a locator game object from the Palette to the Project Lister.

## Associating Resources with Game Objects

Many game objects have slots for associating assets with the game object. You associate an asset with a game object by dragging the asset to the appropriate slot for the game object in the Project Lister.

The types of assets that a slot can accommodate depend on how the slot was set up; you can associate only assets of a type that the slot can accept. For example, the geometry slot for the Orc example can accept only geometry assets. If you drag a behavior or texture asset to the geometry slot, the LevelEditor does not accept the asset.

- To associate an asset with a slot, drag the asset to the game object's slot in the Project Lister. You can overwrite an existing asset by dragging a new asset to the slot.
- To remove an asset from a slot, select the asset in its assigned slot and select the **Edit > Delete** menu item.

## Working with Game Object Properties

You can view and edit game object properties in either the Property Editor or the Grid Property Editor.

Different types of game objects can have different properties, thus the properties that appear for a specific type of game object can vary. However, the following properties are typical for game objects:

- *Name* specifies the object name.
- *Visibility* specifies whether the LevelEditor displays the object in the Design View.
- *Locked* specifies whether the object properties are locked and unavailable for editing.
- *Display Properties* specifies additional information that appears when the object is selected. When selected, the options have the following effect:
  - *Box* displays the bounding box.
  - *Pivot* displays the pivot point.
  - *Caption* displays the name.
- *Translation* specifies the object's X, Y, and Z coordinates in the world. You can reposition an object by editing the X, Y, and Z values.
- *Rotation* specifies how much the object is rotated around its pivot point.

- *Scale* specifies how much the object size is scaled in X, Y, and Z dimensions. When the object is its original size, its Scale value is 1, 1, 1.
- *Pivot* specifies the offset, in the object's local coordinate system, from the object's origin to its pivot point. The Rotate Manipulator rotates the object around this pivot point. The Scale Manipulator scales the object around this pivot point.

### Using the Property Editor to View and Edit Properties

The Property Editor displays properties of the selected game object. If multiple game objects are selected, the Property Editor displays only properties that are common to all selected game objects. The values shown are those of the most-recently selected game object. Editing a value modifies all selected game objects.

The Property Editor example in Figure 39 shows available properties for a sphere game object.

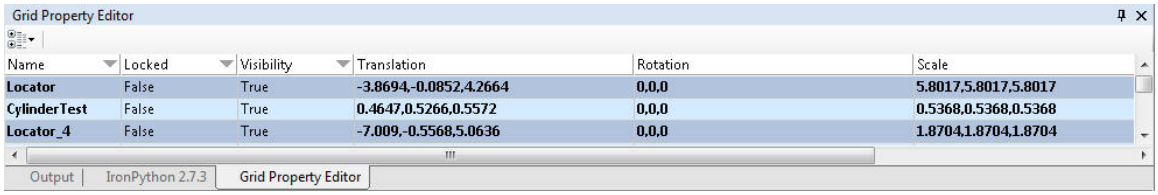
**Figure 39 Property Editor**


### Using the Grid Property Editor to View and Edit Properties

The Grid Property Editor displays common properties for a set of selected game objects. The properties are displayed in a grid that makes it easier to compare different property values for a selection of game objects.

Figure 40 shows a Grid Property Editor that displays the properties for several selected game objects.

**Figure 40 Grid Property Editor**



## Locking Game Objects

Locking a game object ensures that other developers cannot accidentally edit its properties. The ability to restrict unintentional edits can be crucial for distributed work flows. To lock a game object's properties, set its **Locked** property to **True**.

To lock a game object's properties:

(1) Select the object.

(2) Click the Lock icon (  ).
—Or—
Set the object's **Locked** property to **True**.

To unlock a game object's properties:

(1) Select the object.

(2) Click the Unlock icon (  ).
—Or—
Set the object's **Locked** property to **False**.

## Preparing StateMachine Assets

States, transitions, and state machines can have associated properties that you set within the Sony StateMachine Editor. Objects can have additional properties defined that are accessible to other tools, such as the LevelEditor. The LevelEditor can read StateMachine Editor project files (**.stmproj**) directly.

Within the StateMachine Editor, each game object has a category in the **Properties** window that lists its properties in the state machine project. Each property has a control for changing its value to refine the object's behavior. For example, the aggression level of a soldier game object could be adjusted using a slider bar. This aggression level becomes the default state for game objects in the LevelEditor that use the soldier state machine. Within the LevelEditor, you can then modify the default state properties for each instance of the soldier game object.

Using StateMachine and LevelEditor together in this way, designers can quickly test and iterate their designs without needing programmer intervention. For more information about setting properties, see the *StateMachine Editor User's Guide*.

To run state machines in the LevelEditor, perform the following tasks:

(1) In your state machine designs, create instance properties using the StateMachine Editor **Properties** window or **Property Table** window. These properties will be visible and modifiable in the LevelEditor.

(2) Copy StateMachine Editor project files (**.stmproj**), state files (**.stm**), and Lua scripts (**.lua**) to the LevelEditor Resource Root folder.

The designer can then work with the LevelEditor, as described in Working with StateMachine Assets.

# 8 Working in Design View

The Design View is your workspace for constructing and inspecting a complete game level. You can use it to view the scene from different directions, to position and modify game objects, and to inspect the assembled scene.

The LevelEditor also allows you to display and hide game objects, control how game objects are rendered, and build linears quickly.

This chapter describes tasks you can perform in the Design View to build a scene.

## Displaying Different Views of the World

Design View can have one, two, or four views open simultaneously:

- *Single View*  displays one view in one pane.
- *Quad View*  displays four views arranged in quadrants.
- *Dual Horizontal*  displays two wide views, one on top of the other.
- *Dual Vertical*  displays two tall views, side by side.

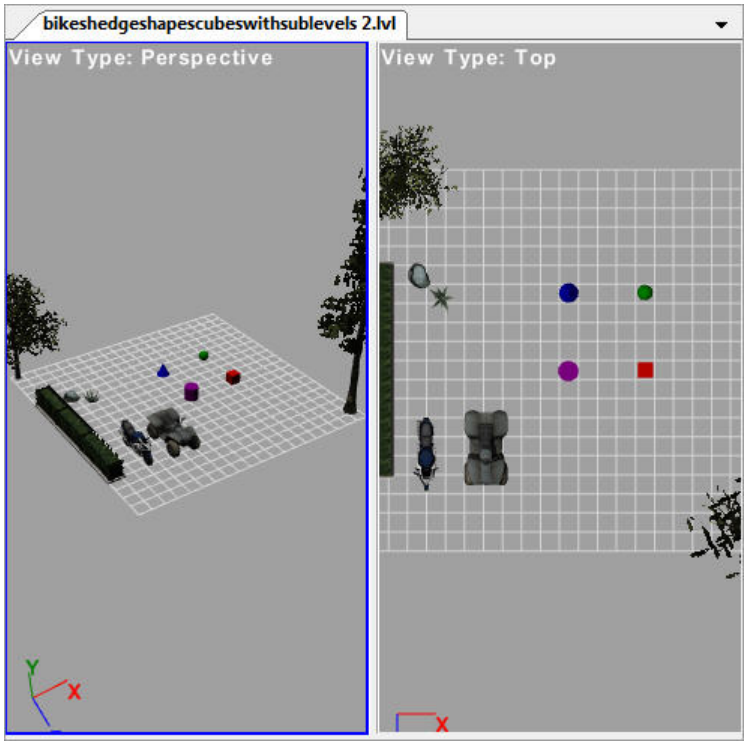
When multiple views are open, the LevelEditor divides the Design View into separate viewing panes. The pane that was clicked last is the active one and has a blue border. Each viewing pane can use one of the following projections to display the world:

- *Perspective* displays the world as a three-dimensional space.
- *Front* and *Back* display the world in the X-Y plane.
- *Top* and *Bottom* display the world in the X-Z plane.
- *Right* and *Left* display the world in the Y-Z plane (side view).

**Note:** The Design View shows a set of axes in the lower left corner of each view to represent the current orientation of the X, Y, and Z axes.

Figure 41 shows the Design View in Dual Vertical display. The left pane's projection is in perspective; the right pane's projection is from the top, looking down at the X-Z plane along the Y-axis. The left pane has a blue border because it is the active pane.

**Figure 41 Design View example**




To specify how many viewing panes the Design View displays:

- Select the **View > Layouts** menu item, then choose a layout from the submenu.

To specify the view projection within an individual pane:

(1) Click in the pane to make it active.

(2) Select the **View > Projection** menu item, then choose a projection from the submenu.
—Or—
Right-click in the pane, select **Projection** from the pop-up menu, and then choose a projection from the submenu.

**Advanced Topic**

If you think of the Design View world in terms of observation points, the following factors determine the Design View display:

- The *eye point* is the point from which you are viewing the world when you look at Design View.
- The *camera look-at point* is the point in the center of the viewing pane and is a specific distance from the eye point.
- The *look-at distance* is the distance from the camera look-at point to the eye point. Changing the look-at distance makes the world zoom in and out.
- The *look-at direction* is the direction from the eye point to the camera look-at point.

Moving the eye point and camera pivot-point while maintaining their relative positions pans the world.

## Navigating in the Design View

You can adjust Design View to display the world from different directions and distances. The ways that you can navigate in Design View depend on the navigation mode:

- *Arcball* mode  lets you drag freely to rotate the world, zoom in and out, and pan. In Arcball mode, the world rotates around the camera look-at point.
- *Maya Style Trackball* mode  behaves the same as Arcball mode, except that the view does not roll when you rotate the world.
- *Fly* mode  lets you pan left and right, and zoom in on and out of the world. You can pan past any game objects that appear between the eye point and the camera look-at point. Fly mode is available only in Perspective view.
- *Walk* mode  lets you pan left, right, forward, and back in the world while staying in a plane parallel to the grid. Walk mode is available only in Perspective view.

To specify a navigation mode:

(1) Click in the pane to make it active.

(2) Select the **View > Projection** menu item, and choose the projection that suits your navigation needs.

(3) Click one of the four navigation mode buttons in the navigation toolbar.
—Or—
Select the **View > Camera** menu item, and select one of the four navigation modes.

### Zooming the World Using the Mouse

You can use the mouse to zoom in on and zoom out of the world. The way that you use the mouse to zoom in or out depends on the navigation mode. The zoom is toward or away from the center of the active viewing pane, and is possible from any viewing angle. For a demonstration of how to zoom the world, view the "Zooming the World" video, either on the GitHub site or on SHIP.

To zoom in on specific game objects, use the **Frame** and **Frame All** commands. For information about zooming specific game objects, see Zooming Specific Game Objects.

To zoom in or out of the world:

(1) Click in the viewing pane to make it active.

(2) Take one of the actions listed in Table 16, depending on the navigation mode.

**Table 16 Zooming the World**

| In this mode | Zoom in this direction | By doing this… |
|---|---|---|
| Arcball | In | Pressing ALT and the right mouse button while dragging down or right.<br>—Or—<br>Rolling the middle mouse button down. |
| | Out | Pressing ALT and the right mouse button while dragging up or left.<br>—Or—<br>Rolling the middle mouse button up. |
| Maya | In | Pressing ALT and the right mouse button while dragging down or right.<br>—Or—<br>Rolling the middle mouse button down. |

| In this mode | Zoom in this direction | By doing this… |
|---|---|---|
| | Out | Pressing ALT and the right mouse button while dragging up or left.<br>—Or—<br>Rolling the middle mouse button up. |
| Fly | In | Pressing the W key or Up arrow key. |
| | Out | Pressing the S key or Down arrow key. |
| Walk | In | Pressing the W key or Up arrow key. |
| | Out | Pressing the S key or Down arrow key. |

In both Fly and Walk mode, use the mouse wheel to adjust the zoom speed.

### Rotating the World

You can drag to rotate the world around the camera look-at point by pressing ALT and the left mouse button while dragging:

- Dragging left and right rotates the world around a vertical axis through the camera look-at point.
- Dragging up and down rotates the world up and down over a horizontal axis through the camera look-at point.

You can also rotate the world around the eye point in Fly or Walk navigation mode by pressing the left mouse button while dragging. This gives the illusion that the world is moving around you as you rotate your head.

How the world rotates depends on the distance to the camera look-at point:

- At a shorter distance, the world rotates around a point that is closer to you. This is useful for inspecting nearby objects from various directions.
- At a longer distance, the world rotates around a point that is farther away. This is useful for rotating an entire scene to see large sections of it from different directions.

Clicking a different point in the world resets the look-at distance. The distance from the eye point to the point you click becomes the new look-at distance.

**Note:** The point you click does not become the new camera look-at point. The camera look-at point is always in the center of the screen. However, clicking points that are nearby or far away changes the look-at distance.

When you click to reset the look-at distance, you can click without selecting the object at the cursor.

To rotate the world around the camera look-at point:

(1) Choose Arcball or Maya Trackball navigation mode.

(2) Press ALT and the left mouse button while dragging the world.

To rotate the world around the eye point:

(1) Choose either Fly or Walk navigation mode.

(2) Press the middle mouse button while dragging the world.

To change the look-at distance:

- Click a point that is at a distance similar to what you want for the look-at distance.

To change the look-at distance without selecting an object when you click:

- Press ALT while clicking the point.

### Panning the World

When the Design View is in Perspective view, you can pan the world. The way that you pan depends on which navigation mode is selected. Table 17 summarizes the ways that you can pan in different navigation modes.

**Table 17 Panning in different navigation modes**

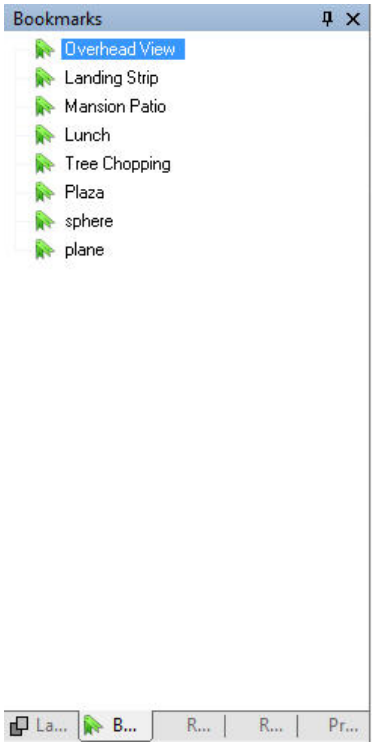
| In this mode | Pan in this direction | By doing this… |
|---|---|---|
| Arcball | Vertically | Pressing the middle mouse button while dragging up and down. |
| | Horizontally | Pressing the middle mouse button while dragging left and right. |
| Maya | Vertically | Pressing the middle mouse button while dragging up and down. |
| | Horizontally | Pressing the middle mouse button while dragging left and right. |
| Fly | Toward or away from the center point | Pressing the W and S keys or the Up and Down arrow keys. |
| | Horizontally | Pressing the A and D keys or the Left and Right arrow keys. |
| | Up and down | Pressing ALT and the middle mouse button while dragging up and down. |
| Walk | Forward and back in a plane parallel to the grid | Pressing the W and S keys or the Up and Down arrow keys. |
| | Horizontally | Pressing the A and D keys or the Left and Right arrow keys. |
| | Up and down | Pressing ALT and the middle mouse button while dragging up and down. |

### Using Bookmarks to Save Frequently Used Views

Bookmarks save your favorite views of the world so that you can return to them quickly. When you click a bookmark in the Bookmark window, the Design View (or the currently selected pane of the Design View) displays the world from the direction and distance saved in the bookmark.

Figure 42 shows bookmarks for a sample level.

**Figure 42 Bookmarks window**




For the sample level, the Overhead view shows the entire level. The other bookmarks are views of specific locations in the level.

You create bookmarks by navigating to the view you want, opening the Bookmarks window, right-clicking in the window and selecting **Add Bookmark**. The default bookmark name is "New bookmark," which you can rename. To delete a bookmark, right-click the bookmark and select **Delete**.

Existing bookmarks cannot be edited: You create a modified version of a bookmark by modifying the view, then creating a new bookmark for that view.

To save the current view as a bookmark, right-click in the Bookmarks window and select **Add Bookmark**.

To rename a bookmark, **c**lick the bookmark's name in the Bookmarks window, and then edit the name.

To go to the view saved in a bookmark:

(1) Select the **Window > Bookmarks** menu item to open the Bookmarks window.

(2) Click the bookmark to view.

To delete a bookmark:

(1) Select the bookmark.

(2) Select the **Edit > Delete** menu item.
Alternatively, you can right-click the bookmark and choose **Delete** from the contextual menu. Yet another approach is to select the bookmark and press the DELETE key.

## Placing Game Objects in the World

You can create game objects from any object in the Palette or Resources list by dragging the object to the Design View.

The LevelEditor lets you place the object at any point in space or at a specific point on the grid or on another game object. For example, you can stack a group of boxes on top of each other, lay out a road over a curving hillside, or position one object within another.

When you drag an object to the Design View and release the mouse to drop the object, the LevelEditor places the object close to the top of any existing object nearest to the mouse pointer. If there is no existing object at the mouse pointer when you drop the object, the LevelEditor places the object in space at a distance of approximately 6*$R$ from the mouse pointer location, where $R$ is the radius of the object.

The game object's Translation properties listed in the Property Editor are the game object's X, Y, and Z coordinates.

To move a game object that is already in the world, drag its Move manipulator or edit its Translation properties in the Property Editor. For more information about moving game objects, see Moving Objects.

### Placing an Object at any Point in the World

To place a new object manually at any point in the world:

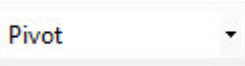
- Drag an object from the Palette or Resources list and release it at the desired location. The object is added to the top-most **Game Objects** folder.

To add a new game object to a specific sublevel (rather than to the top of the game object hierarchy), you can perform either of the following tasks:

- Drag the object to the Project Lister and drop it within the **Game Objects** folder of the specific sublevel. The object is placed at location 0,0,0 of the world, but is included within the sublevel.
- Select an object that is already within the sublevel, then drag and drop a new object anywhere within the world. The object has the location you specify, and is also included within the sublevel.

See Using Sublevels to Manage Large Game Worlds for more information about working with sublevels.

### Snapping Game Objects

If you are snapping objects, the **Snap Mode** combo box ( 

) specifies which part of the moving object snaps to the target object surface.

You can specify one of the following snap points:

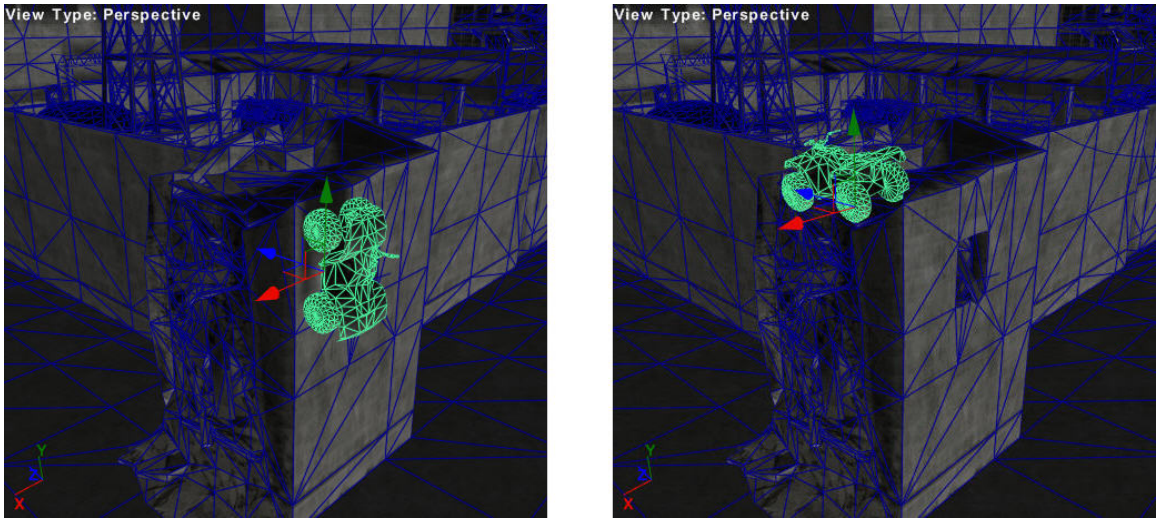
- *Pivot* snaps the pivot point.
- *Origin* snaps the origin.
- *TopCenter* snap the center point of the top.
- *BottomCenter* snaps the center point of the bottom.
- *FrontCenter* snaps the center point of the front.
- *BackCenter* snaps the center point of the back.
- *LeftCenter* snaps the center point of the left.
- *RightCenter* snaps the center point of the right.

Pressing CTRL while dragging constrains the Snap Mode point to the grid.

Pressing SHIFT while dragging constrains the object to the surface of the target object. If Rotate on Snap is turned on, the moved object also rotates so that its Up axis is parallel to the target object's normal axis. This feature is unavailable for some proxy objects because they do not have surface normals.

Figure 43 shows how Rotate on Snap rotates objects when they are snapped to another object. In both cases, the vehicle object was snapped to a vertex on the model. Because Rotate on Snap was turned on, the LevelEditor rotated the object so that its Up axis was kept normal to the target object's surface.

**Figure 43 Rotate on Snap example**




You can also specify how the snapping occurs:

- Turning on Snap to Vertex ( ) aligns the snap point to a vertex on the target object.
- Turning on Rotate On Snap ( ) rotates the object so that its Up axis is parallel to the normal axis of the target object.

For example, if you specify **Bottom Center** for Snap Mode and turn on Rotate On Snap, you can precisely stack an object on top of another by pressing SHIFT while dragging the object on the surface of the target object.

### Snapping a Game Object to the Surface of Another

For more information about snapping existing game objects, see Moving Objects.

To snap a game object to the surface of another:

(1) In the **Snap Mode** combo box, specify which point of the moving object you want to snap to the target.

(2) Press SHIFT while dragging the object to the target object.

To snap a game object to a vertex of another object:

(1) In the **Snap Mode** combo box, specify the point that you want to snap to the target.

(2) Turn on Snap to Vertex.

(3) Press SHIFT while dragging the object to the target object.

To rotate the moving object so that its Up axis is parallel to the normal axis of the target object when it snaps to a vertex:

- Before snapping the object to the vertex of another object, select the **Modify > RotateOnSnap** menu item to turn Rotate on Snap on.

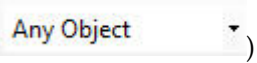
## Selecting Game Objects

Using the mouse, you can select a group of game objects, a single game object, or a component within a single game object.

Select a group of game objects by drawing a selection rectangle. All objects whose bounding boxes fall within the rectangle are selected.

Select a single game object or a component within a game object by clicking it.

### Controlling Which Objects Are Selected

You can control which types of objects are selected when you click in the Design View or use the mouse to select multiple objects in the Design View. The **Pick Filter** combo box ( 

) allows you to set a filter for what the LevelEditor selects when you click within the Design View:

- *Any Object* allows you to select any game object. This selection is the default and is equivalent to setting no filter.
- *Locators* allows you to select only locator objects.
- *Basic Shapes* allows you to select only basic shapes.
- *No Cubes* allows you to select any type of game object except those based on the CubeTest example object from the Palette.

With a pick filter active, if you click on an object that is not included within the filter, your click is passed to objects behind or within that object. For example, if you specify the "Basic Shapes" pick filter, and click on a linear that is in front of a cube, the cube is selected rather than the linear; the linear is not selectable. Using the filter allows you to select one or more basic shapes to work with them (for example, to rotate them) without affecting the linear (or any other object that is not a "basic shape") that is near these objects.

These pick filters are provided as examples; a programmer can add additional pick filters that are specific to your game development project. For example, you might want to add a filter for "No Terrain Objects" so that you can easily click objects on a terrain without ever accidentally selecting the terrain itself.

### Selecting Obscured Objects

The pick-cycling feature enables you to select an object that is obscured by another object. It is intended to help you select an object that intersects another object, or that is hidden inside, behind, or beneath another object.

To use the pick-cycling feature, click repeatedly on the obscured object in the Design View without moving the mouse. Each click selects a different object beneath the cursor in turn, one at a time.

**Recommendation**: Turn off any currently active manipulator (for example, the Move manipulator) for objects near the cursor to ensure that each click selects an object rather than a manipulator.

## Moving, Rotating, and Scaling Objects

You can use the LevelEditor to move, rotate, and scale objects in the following ways:

- By dragging their Move, Scale, Rotation, and Extension manipulators
- By setting their Translation, Scale, and Rotation properties in the Grid Property Editor

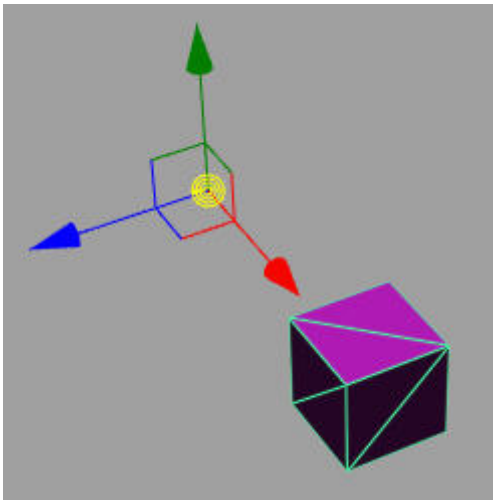
For a demonstration of how to move, rotate, and scale objects, view the "Using Manipulators" video, either on the GitHub site or on SHIP.

### Using Pivot Points to Control Rotation and Scaling

The LevelEditor scales and rotates an object around its pivot point. The default pivot point is at the object's origin, but you can reposition the pivot point by dragging its Move-Pivot manipulator, using the Move Pivot command, or editing the **Pivot** property in the Property Editor.

The cube in Figure 44 has its pivot point positioned away from the object's origin and placed outside the cube.

**Figure 44 Cube with repositioned pivot point and Move-Pivot manipulator active**



For grouped game objects, the group has its own pivot point, which is independent of the pivots for the individual game objects that belong to the group.

For a demonstration of how you can use pivot points to control scaling and rotation, view the "Moving Pivot Points" video, either on the GitHub site or on SHIP.

To position an object's pivot point using the mouse:

(1) Select the **Modify > MovePivot** menu item to turn on the Move-Pivot manipulator.

(2) Select the object whose pivot point you want to move.

(3) Drag a Move-Pivot manipulator axis to move the pivot point in that direction. Drag a shaded (yellow) square to move the pivot point freely in two dimensions.

To position an object's pivot point using the Move Pivot command:

- Use the **Modify > Move Pivot > X** menu item to set the object's pivot point along the X axis:
  - **Min** sets the pivot point to the object's minimum along the specified axis (for example, at "-0.5" for an object whose axis is 1 unit in length).
  - **Center** sets the pivot point along the center of the specified axis for the object (for example, at "0" for an object whose axis is 1 unit in length).
  - **Max** sets the pivot point to the object's maximum along the specified axis (for example, at "+0.5" for an object whose axis is 1 unit in length).
- Use the **Modify > Move Pivot > Y** menu item to set the object's pivot point along the Y axis. Select **Min**, **Center**, or **Max**.
- Use the **Modify > Move Pivot > Z** menu item to set the object's pivot point along the Z axis. Select **Min**, **Center**, or **Max**.
- Select **Modify > Move Pivot > All > Center** to set the object's pivot point to the object's center (typically, the point "0, 0, 0").

You can also use the keyboard shortcuts (**1**, **2**, **3** to move the pivot along the X axis; **4**, **5**, **6** to move the pivot along the Y axis, **7**, **8**, **9** to move the pivot along the Z axis, and **0** to move the pivot to the object's center.

To position an object's pivot point using the Property Editor:

(1) Select the object.

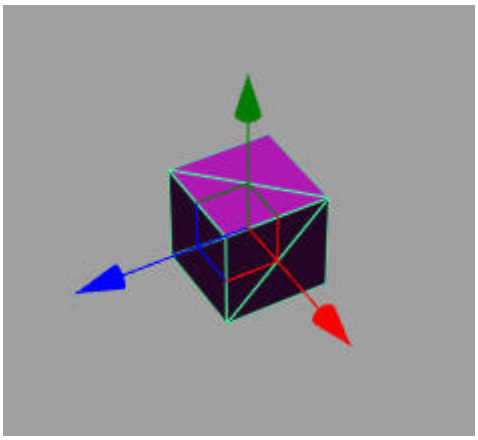
(2) Open the Property Editor, and edit the values for the **Pivot** property. The value 0, 0, 0 represents the object's origin.

### Moving Objects

You can move an object, or group of objects, by dragging its Move manipulator or editing its **Translation** properties in the Property Editor.

The Move manipulator is a three-arrowed icon with shaded squares at the center. Each arrow controls movement along one axis. Each square (highlighted in yellow when you mouse over it) controls movement in a plane. The cube game object in Figure 45 has its Move manipulator active.

**Figure 45 Cube with Move manipulator active**



When you move a group of objects, there is only one Move manipulator. The objects in the group maintain their positions relative to each other.

The **Translation** property's parameters in the Property Editor specify the X, Y, and Z position of the object's origin.

To move objects by dragging their Move manipulator:

(1) To use the Move manipulator, select the **Modify > Move** menu item.

(2) Select the objects that you want to move.

(3) The Move Manipulator appears in the selected object.

(4) Drag a Move Manipulator axis to move the object in that direction. Drag one of the shaded (yellow) squares to move the object freely in two dimensions.

(5) Holding SHIFT down while clicking on the shaded squares snaps the object (or objects) to the underlying object.

(6) Holding SHIFT down while clicking and dragging on one of the axis arrows will snap the object (or objects) along the axis in the direction of the drag.

To move an object by editing its **Translation** properties:

(1) Choose the **View > Properties** menu item to open the Property Editor.

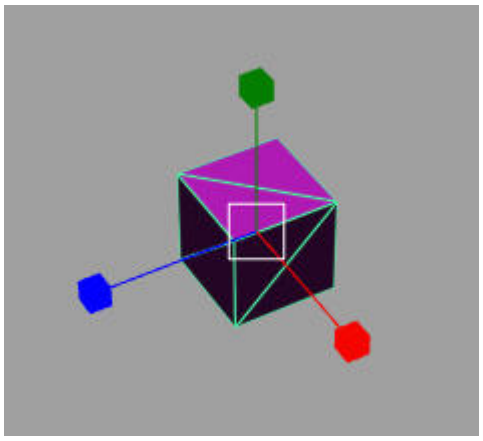
(2) In the **Translation** fields, edit the X, Y, and Z coordinates to specify new values.

### Scaling Objects

You can scale a game object, or group of game objects, by dragging its Scale manipulator or setting its **Scale** properties in the Property Editor.

The Scale manipulator is a three-arrowed icon with a yellow square. Each arrow scales the object along one axis. The yellow square controls scaling in all three dimensions. The cube game object in Figure 46 has its Scale manipulator active.

**Figure 46 Cube with Scale manipulator active**



The **Scale** property parameters specify the amount of scaling in the X, Y, and Z directions. The **Scale** property values are measured relative to the original dimensions of the object, with 1, 1, 1 representing its original size.

Scaling equally in all three dimensions maintains the object's overall proportions. Scaling along an individual axis deforms the object. For example, making one axis of a sphere shorter would create an ellipsoid (or flying saucer).

An object scales away from its pivot point. Thus, when the pivot point is at the origin, scaling expands or contracts the object in or out from its origin.

Placing the pivot point away from the origin lets you set a boundary for the object's scaling. For example, if you want to scale a monster standing on the ground, position its pivot on the ground. Scaling will occur away from the pivot point, and the monster will still stand on the ground (rather than scaling into and through the ground).

If you scale a group of game objects, each game object scales by the same amount around its own pivot point; the objects' pivot points do not move farther apart or closer together.

If you scale a game object through zero to negative values, the game object inverts.

To scale game objects and maintain their proportions:

(1) Select the **Modify > Scale** menu item.
(2) Select the game objects.
(3) Drag the yellow box. Drag to the left to make the object smaller; drag to the right to enlarge it.

To deform a game object:

(1) Select the **Modify > Scale** menu item.
(2) Select the game objects.
(3) Drag one axis of the Scale manipulator.

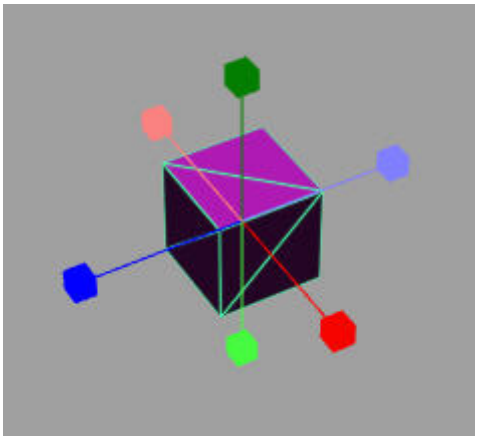
The game object shrinks or enlarges along that axis, but the other dimensions remain constant.

### Extending Objects

You can use the Scale manipulator to scale an object from its pivot point. However, if you want to extend or scale an object in a single direction, and not from its pivot point, you can use the Extension manipulator. For example, you can easily extend a cube so that it has a rectangular shape, without having to reposition its pivot point.

The Extension manipulator is a six-arrowed icon. Each arrow extends the object along one side of an axis. The controls at the end of the axes are colored to represent the positive and negative sides of each axis, where a darker color represents positive, and a lighter (pastel) color represents negative. The cube game object in Figure 47 has its Extension manipulator active.

**Figure 47 Cube with Extension manipulator active**

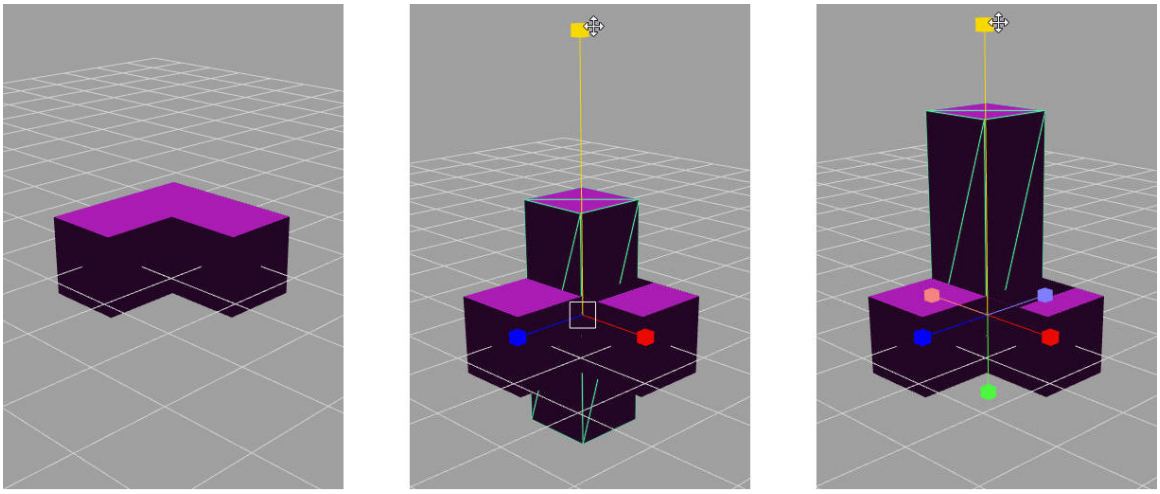


When you extend an object, you deform it along one axis, making it longer or shorter in that direction. Only the end of the object that you drag extends, however; the other end does not move. You can achieve similar effect by resetting the pivot point and using the Scale manipulator.

In general, the Extension manipulator is most useful for simple objects, such as cubes, cylinders, spheres, and so on. More complex objects are not typically designed to be extended along a single axis and retain visual integrity.

Figure 48 shows a comparison of using the Scale manipulator (along one axis) and using the Extension manipulator. The pivot point remains at each object's origin for all three panels. The first panel of the figure shows three cubes. The second panel shows how the Scale manipulator deforms the object along the Y axis, both upward and downward. The third panel shows how the Extension manipulator extends the object in only one direction along the Y axis, upward.

**Figure 48 Comparing the Scale manipulator and the Extension manipulator**



Three Cubes

Three Cubes
with Scale Manipulator

Three Cubes
with Extension Manipulator

You can also adjust an object's **Scale** property and **Translation** property parameters to specify the amount of extension for an object. You must adjust both parameters because the **Scale** parameter acts like the Scale manipulator, and scales the object from its pivot point. Thus, after you adjust an object's **Scale** parameter, you must adjust its **Translation** parameter for the same axis by an appropriate amount. For example, to achieve the same result as shown in the third panel of Figure 48, you could adjust the cube's **Scale** parameter for the Y axis to from 1 to 3 and then adjust its **Translation** parameter for the Y axis from 0 to 1.

If you extend a group of game objects, each game object extends by the same amount along the selected axis.

If you extend a game object through zero to negative values, the game object inverts.

To extend game objects:

(1) Select the **Modify > Extension** menu item.

(2) Select the game objects.

(3) Drag one of the six axes to extend the object.

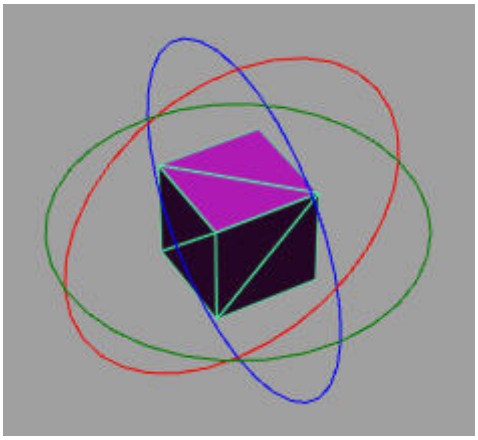
### Rotating Objects

The Rotation property parameters specify the amount of an object's rotation in the X, Y, and Z directions. Rotation property values are measured in degrees.

You can rotate an object by dragging its Rotation manipulator or setting its Rotation properties in the Property Editor. The Rotation manipulator has three concentric circles. The red, blue, and green circles control rotation around individual axes.

Figure 49 shows a cube object with its Rotation manipulator active. Rotation occurs around the object's pivot point.

**Figure 49 Cube with Rotate manipulator active**



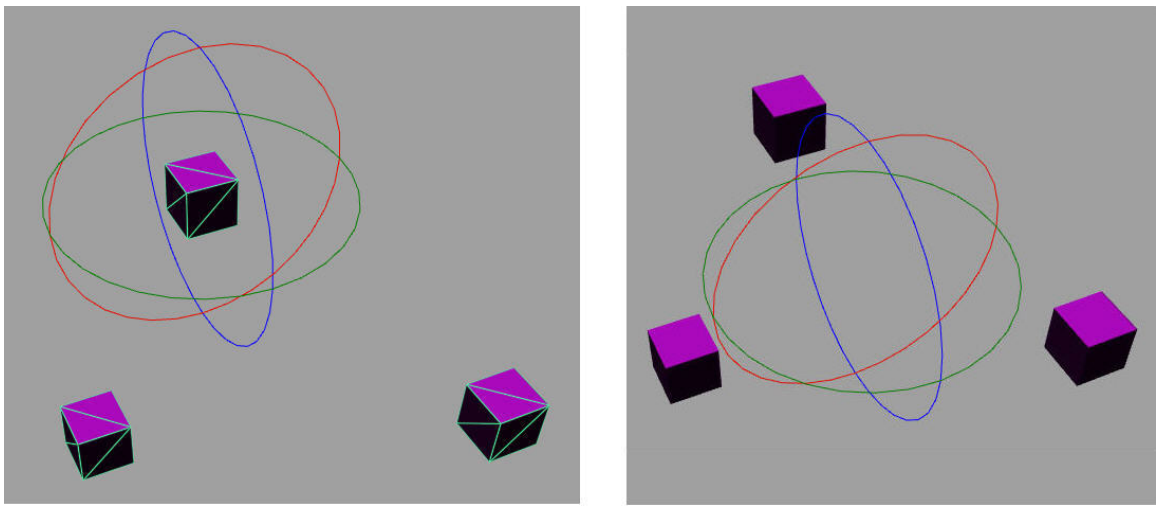
You can rotate multiple game objects at the same time. Which pivot point the objects rotate around depends whether the objects belong to the same group object or are selected by clicking and dragging.

Grouped game objects rotate around the group's pivot point. Only one rotation manipulator appears for the grouped game object.

Figure 50 shows three cubes selected for rotation:

- The cubes on the left were selected by dragging a selection rectangle over all three objects; the Rotation manipulator is displayed for only one cube, and each cube will rotate about its own pivot point. None of the cubes will change their translation values (that is, they will not move in the X, Y, or Z directions).
- The cubes on the right are a group; the Rotation manipulator is positioned at the group's pivot point, and all three cubes will rotate together about the common group pivot point. Depending on how the group is rotated, at least one cube will change its translation values (that is, move in the X, Y, or Z directions). Each cube will maintain its orientation relative to the other two cubes.

**Figure 50 Cubes selected together and as a group for rotation**



**Three cubes selected together with Rotation manipulator**

**Three cubes as a group with Rotation manipulator**

To rotate a game object:

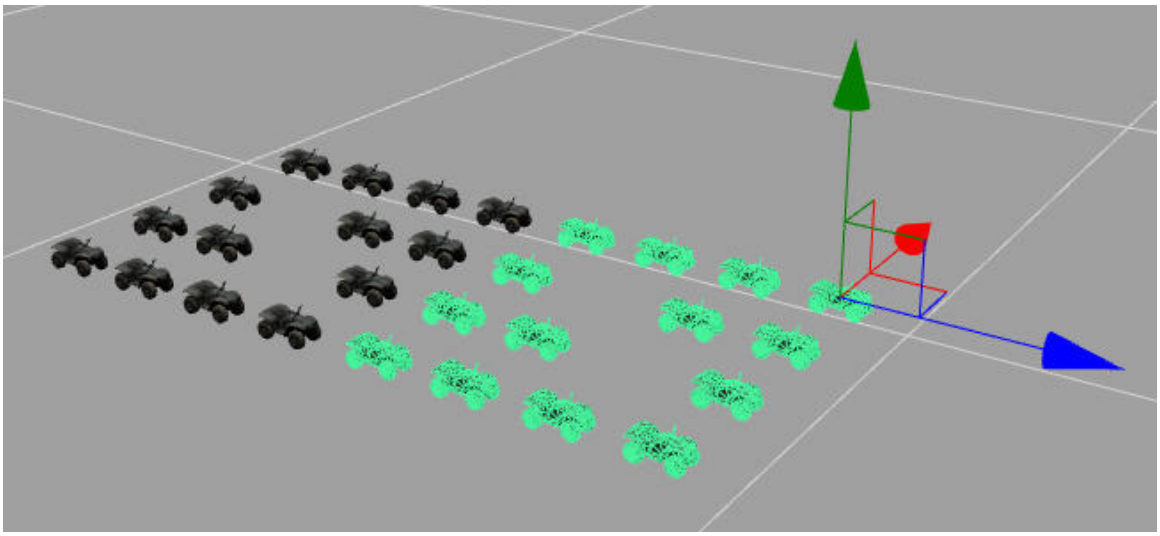
(1) Select the **Modify > Rotate** menu item.
(2) Select the game object.
(3) Drag the circle that controls rotation around a particular axis.

## Duplicating Game Objects

The LevelEditor duplicates game objects if you press the SHIFT and CTRL keys while you click the Move manipulator. You can then drag the Move manipulator to position the new game objects in the Design View.

If you duplicate a set of game objects, the objects maintain the same relative positions they had in the original set. For example, in Figure 51, the selected game objects are duplicates of the others. The duplicate game objects have the same relative positions as the original game objects.

**Figure 51 Duplicate set of game objects**



To duplicate game objects:

(1) Select the Move manipulator.
(2) Select the game objects in the Design View.
(3) Press the SHIFT and CTRL keys while you click the Move manipulator.
(4) Drag the Move manipulator to reposition the duplicate game object (or objects).

For a demonstration of how to duplicate game objects using the LevelEditor, view the "Duplicating Objects" video, either on the GitHub site or on SHIP.

## Rotating Game Objects to Face a Nearby Surface

Using the Rotate on Snap feature, you can have a game object automatically orient itself to the surface to which it is snapping if you hold down SHIFT while you click the Move manipulator's shaded squares. If you orient a set of game objects, each game object rotates individually to face the surface polygon that is nearest to it.

For example, Figure 52 and Figure 53 show the same game objects in different locations on the bus. The game objects always rotate to face the surface of the bus that is nearest to them.

**Figure 52 ATVs facing their nearest surface polygon**

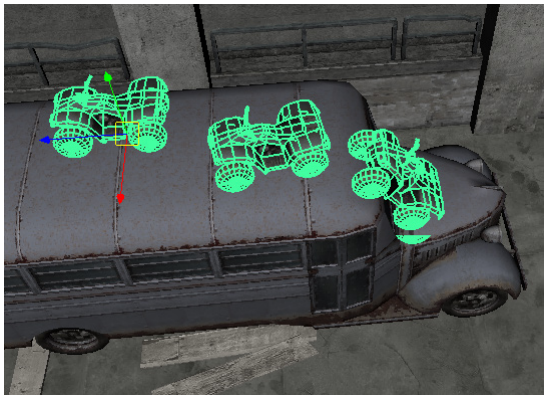
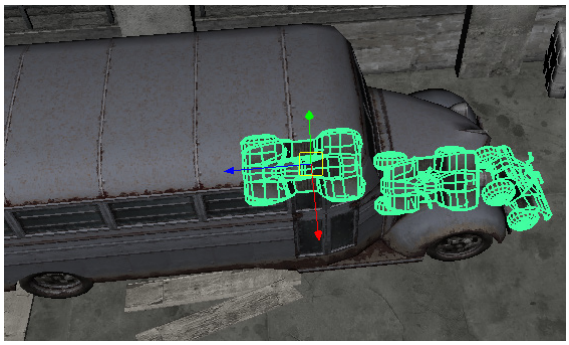


**Figure 53 ATVs rotated to face a new surface polygon**



To rotate an object to the nearest surface:

(1) Select the **Modify > RotateOnSnap** menu item.

(2) Select the Move manipulator.

(3) Select the game objects to rotate.

(4) Press SHIFT while you drag the Move manipulator's shaded squares to re-position the game objects.

For a demonstration of how to use **Rotate on Snap** in the LevelEditor, or view the "Rotating Objects to Face a Nearby Surface" video, either on the GitHub site or on SHIP.

## Displaying and Hiding Game Objects

The LevelEditor can display and hide game objects in the following ways so that you can focus on different game objects as you work:

- Hide selected game objects
- Display selected game objects only
- Display all game objects
- Display previously hidden game objects

When a game object is visible, its **Visibility** property is set to **True**. When a game object is invisible, its **Visibility** property is set to **False**.

To hide selected game objects:

(1) Select the game objects to hide.

(2) Select the **View > Hide** menu item.

To display selected game objects and hide all others:

(1) Select the game objects.

(2) Select the **View > Isolate** menu item.

To make all objects visible:

- Select the **View > Show All** menu item.
  —Or—
- Select the **View > Show Last Hidden** menu item.
  —Or—
- Set the objects' **Visibility** property to **True**.

You can also assign objects to layers or sublevels, which both provide an efficient way to hide and display sets of game objects. For information about layers, see Using Layers to Unclutter the World and Using Sublevels to Manage Large Game Worlds.

## Zooming Specific Game Objects

In addition to zooming in and out on the world, the LevelEditor can also zoom in closely on selected game objects by fitting them to fill an entire viewing pane. You can frame game objects in all open viewing panes or in only the active pane, leaving other viewing panes unchanged.

To zoom in and frame game objects in the active viewing pane only:

(1) Select the game object or group.

(2) Select the **View > Frame Selection** menu item.

## Rendering Game Objects

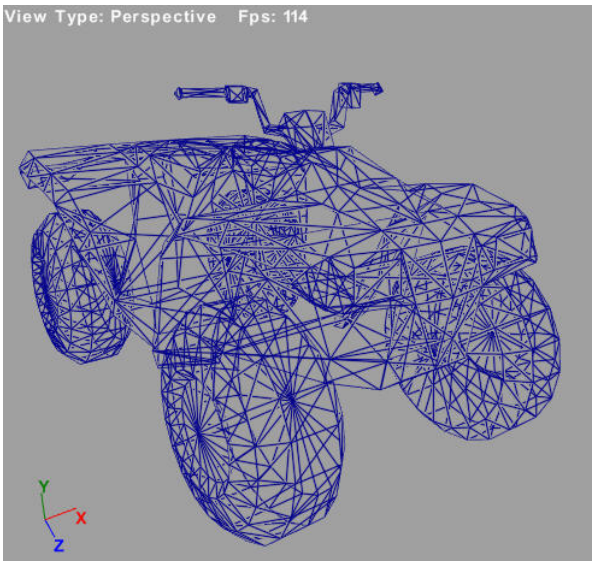
The LevelEditor lets you render game objects in different styles to visually simplify the Design View display. None of these render options has a significant impact to overall rendering times.

For a demonstration of the different rendering modes that are available in the LevelEditor, view the "Rendering Objects" video, either on the GitHub site or on SHIP.

You can render game objects with the following features:

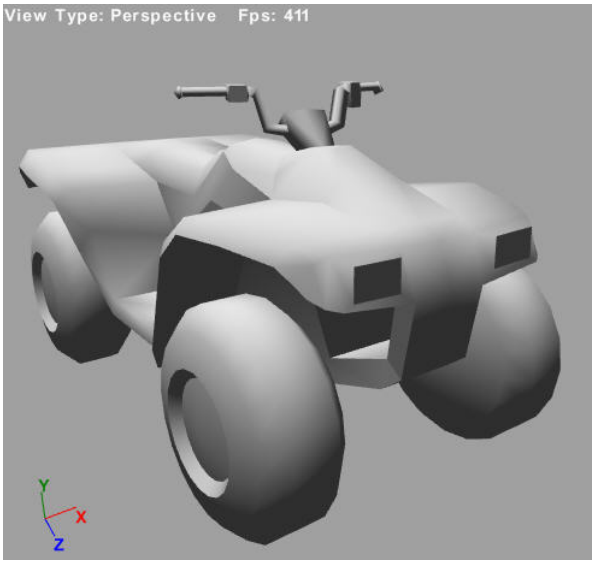
- *Wireframe* displays all game objects as wireframes without fills, as shown in Figure 54. This option can be useful for seeing game objects that are hidden behind or within other game objects.

**Figure 54 Game object with wireframes only**



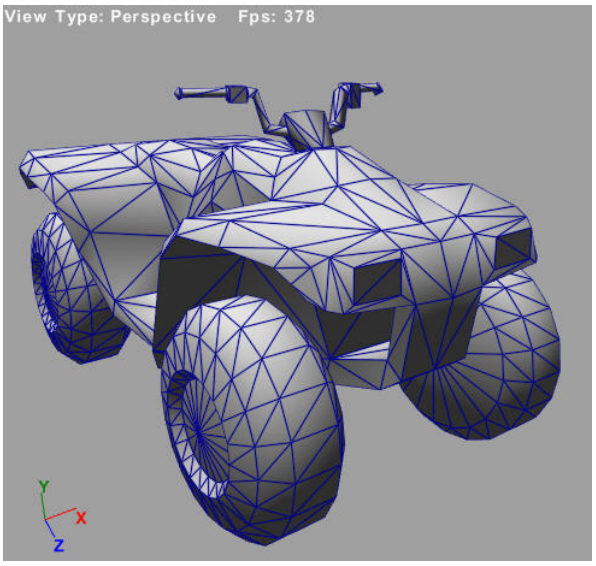

- *Smooth* renders the surface, as shown in Figure 55. If the game object has no texture associated with it, the surface is a smooth solid.

**Figure 55 Game object with filled surface but no texture**




- *Solid over wireframes* renders the outer surface with its wireframe outline, as shown in Figure 56. Selected game objects always display wireframes, but this feature displays wireframes for all game objects in the world. When all game objects display wireframes, the selected game object's wireframes are green; the unselected game objects' wireframes are blue.

**Figure 56 Game object with filled surfaces and wireframes**

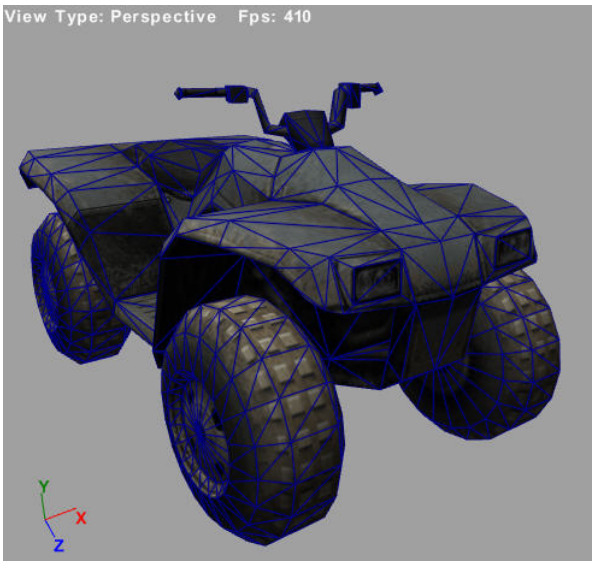



- *Textured* lets you see how the final scene looks, as shown in Figure 57. However, turning textures off can sometimes make it easier to see spatial relationships among game objects.

**Figure 57 Game object with texture**


- *Textured* together with *Solid over wireframes* lets you see how the final scene looks and adds the wireframe outlines so you can see the object's structure, as shown in Figure 58. However, turning textures off can sometimes make it easier to see spatial relationships among game objects. Note that selected objects show their wireframes (in green); this option shows all wireframes (in blue).

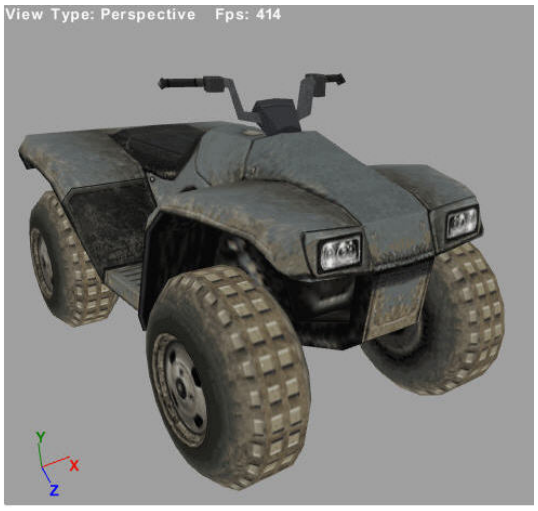
**Figure 58 Game object with texture and wireframes**




- *Lighting* makes contours and shapes more obvious by allowing local light sources to provide shadows, as shown in Figure 59. Without lighting, the object appears bright or dark according to its associated texture.

**Figure 59 Game object with lighting on and with lighting off**


**Bike with Lighting On**




**Bike with Lighting Off**

- *Render shadow* lets local light sources render shadows onto and from an object, as shown in Figure 60. The effect is more pronounced with a nearby Light object.

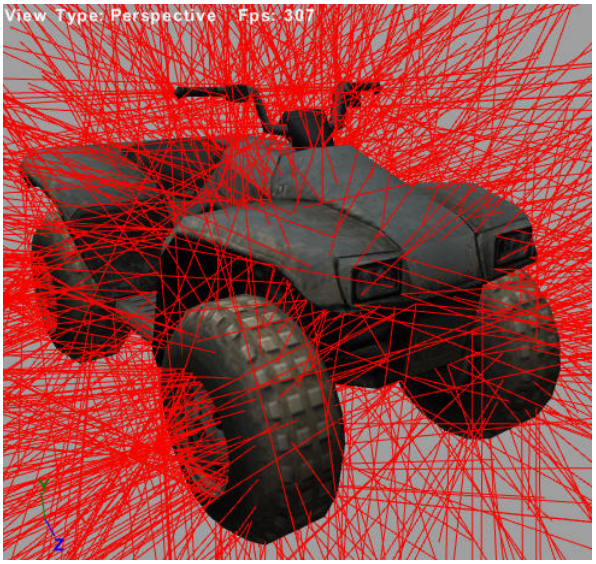
**Figure 60 Game object with shadows rendered**


Bike without shadows


Bike with shadows

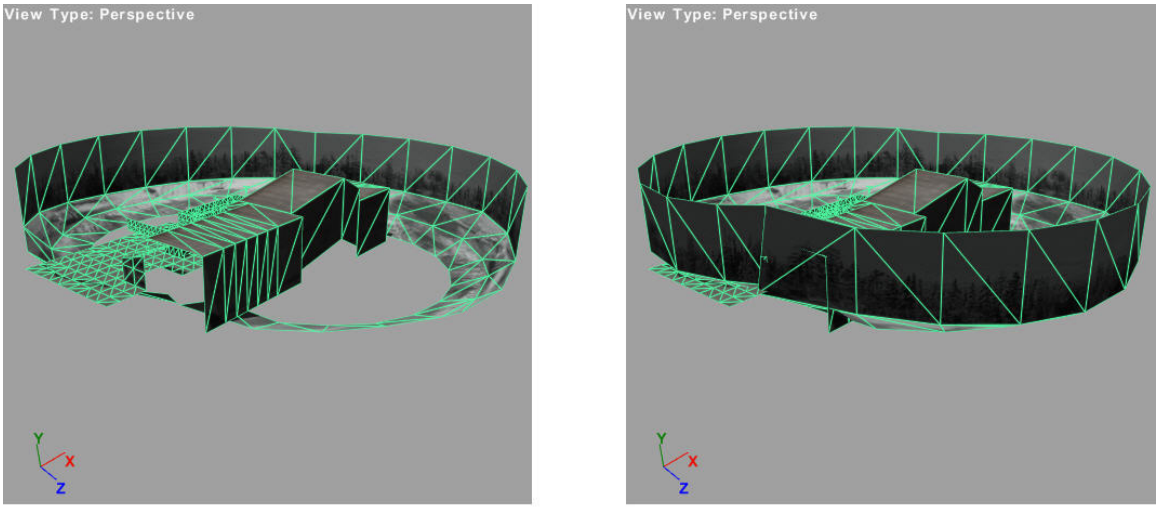
- *Normals* renders the normal vector for each surface polygon, as shown in Figure 61. LevelEditor renders a normal vector at each vertex of a game object. The rendered normal vector represents an average normal vector for each of the vertex's adjacent polygon surfaces (faces). You can use rendered normals to verify that a game object's model is correctly rendered in the world.

**Figure 61 Game object with normals rendered**




- *Back Face* renders the back-facing polygons of a model so that you can better see how the game object fills the space. Figure 62 shows the same landscape scene rendered with and without back-facing polygons.

**Figure 62 Model with and without back faces rendered**




Backfaces Off

Backfaces On

Use the **View** menu to choose how objects appear in the world. Table 18 summarizes how to choose a render mode.

**Table 18 Specifying rendering style**

| To render game objects with | Choose |
|---|---|
| Wireframes only | **View > Wireframe**<br>—Or—<br>Click  |
| Smooth surfaces but no wireframes | **View > Solid**<br>—Or—<br>Click  |
| Smooth surfaces with wireframes | **View > SolidOverWire**<br>—Or—<br>Click  |
| Textured surfaces | **View > Textured**<br>(The Smooth or Outlined option must already be selected)<br>—Or—<br>Click  |
| Lighting effect | **View > Lighting**<br>(The Smooth or Outlined option must already be selected.)<br>—Or—<br>Click  |
| Shadow effect | **View > Shadow**<br>—Or—<br>Click  |

| To render game objects with | Choose |
|---|---|
| Normals | **View > Normals**<br>—Or—<br>Click  |
| Back-faces rendered | **View > BackFace**<br>(The Smooth or Outlined option must already be selected.)<br>—Or—<br>Click  |

You can also cycle through each of the rendering options to quickly compare how the world looks in each mode:

- Select the **View > CycleRenderModes** menu item.
  —Or—
- Press the space bar.

## Using Layers to Unclutter the World

Unlike a group of objects selected by clicking or dragging, a layer embodies a persistent grouping of objects. As you work in the Design View, you might find it convenient to show or hide layers as one way to display or hide groups of objects quickly.

Layers are not game objects, and they do not appear in the Project Lister. However, they are distinct objects that appear in the Layers list, as shown in Figure 63.

**Figure 63 Layers list example**

The checkbox next to the name of a layer controls the display of objects in that layer. When a layer's checkbox is selected, the LevelEditor displays objects in that layer. Clearing the checkbox hides objects in that layer.

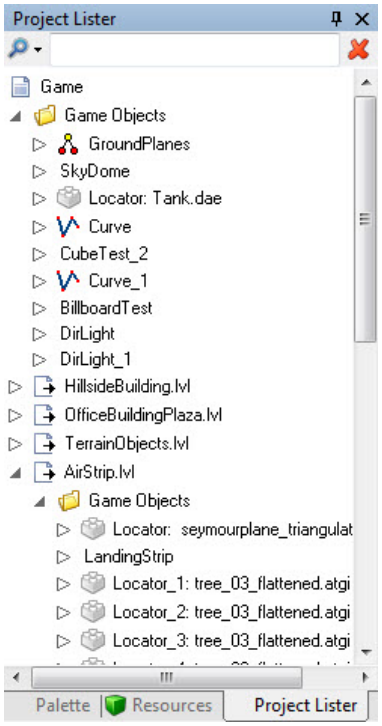
- To show the Layers list, select the **Window > Layers** menu item.
- To create a new layer, right click in the Layers window and select **Add Layer** from the contextual menu. The LevelEditor creates a new layer object in the Layers window with the name "New Layer"; select the layer to enter a new name.
- To add a sub-layer under the current level, select an existing layer, right-click it, and select **Add Layer** from the contextual menu.
- To assign Game Objects to a layer, perform any of the following tasks:
  - Drag and drop objects from the Project Lister to a layer in the Layers list
  - Select one or more objects in the Project Lister or Design View, and copy/paste them into a layer
- To display objects in a layer, select the checkbox next to the layer name to show its objects
- To hide objects in a layer, clear the checkbox next to the layer name to hide its objects.

## Using Sublevels to Manage Large Game Worlds

Like a layer, a sublevel (or subgame) is a persistent grouping of game objects. As you work in the Design View, you might find it convenient to show or hide sublevels as one way to display or hide groups of objects quickly.

Unlike layers, however, sublevels are game objects, and they do appear in the Project Lister, as shown in Figure 64. In the figure, the main game level is at the top of the project hierarchy (the **Game** node), and four sublevels are shown: HillsideBuilding, OfficeBuildingPlaza, TerrainObjects, and Airstrip. A single game world can be divided into many sublevels.

**Figure 64 Sublevels shown in the Project Lister**



Each sublevel is a separate LVL file; your main game LVL file includes a reference to each of the sublevel LVL files. Thus, you can work on sublevels independently of the main game level, as needed, or share sublevel files with other designers to create a large game world in parallel. Or, you can use the sublevels to partition the game world into more easily managed sections that you can show or hide as needed.

Because the sublevels are separate LVL files, you can dynamically resolve (render in the Design View) them in the main game level, include or exclude them in the main game level, or simply load them outside of the main game level and work on them separately. When a sublevel is included and resolved in the main game level, you work with it in the same way as the main game level, adding or modifying game objects as desired.

You can add new game objects to a sublevel by performing either of the following tasks:

- Drag the object to the Project Lister and drop it within the **Game Objects** folder of a sublevel. The object is placed at location 0,0,0 of the world, but is included within the sublevel.
- Select an object that is already within the sublevel, then drag and drop a new object anywhere within the world. The object has the location you specify, and is also included within the sublevel.

When you save a game level that includes sublevels, any changes to the sublevels are saved at the same time as the main level. If you do not want to accidentally modify objects in a sublevel, you can lock the objects, as described in Locking Game Objects.

To add a new sublevel:

(1) Right-click the **Game** node (or any existing sublevel node) in the Project Lister.
(2) Select **Add new SubGame** from the context menu.
(3) Specify a file name for the new sublevel in the Save As dialog.

The new sublevel appears in the Project Lister below the **Game** node (or existing sublevel node) with the name that you specified.

To add an existing level as a sublevel:

(1) Right-click the **Game** node (or any existing sublevel node) in the Project Lister.
(2) Select **Add existing SubGame** from the context menu.
(3) Select the sublevel file from the Open dialog.

The added sublevel appears in the Project Lister below the **Game** node (or existing sublevel node).

To exclude a sublevel:

(1) Right-click a sublevel in the Project Lister.
(2) Select **Exclude SubGame** from the context menu.

**Note:** When you exclude a sublevel, the reference to it is removed from the main game level. If you want to include the sublevel at a later time, you must add it as an existing sublevel.

To unload a sublevel:

(1) Right-click a sublevel in the Project Lister.
(2) Select **Unresolve Subgame** from the context menu.

The sublevel and all of its game resources are removed from the Design View. However, the main game level retains the reference to the sublevel. You can use the unresolved feature to quickly hide all objects of a sublevel. Another method of hiding the objects of a sublevel is to select the sublevel's **Game Objects** folder, open the Property Editor, and deselect its **Visible** property.

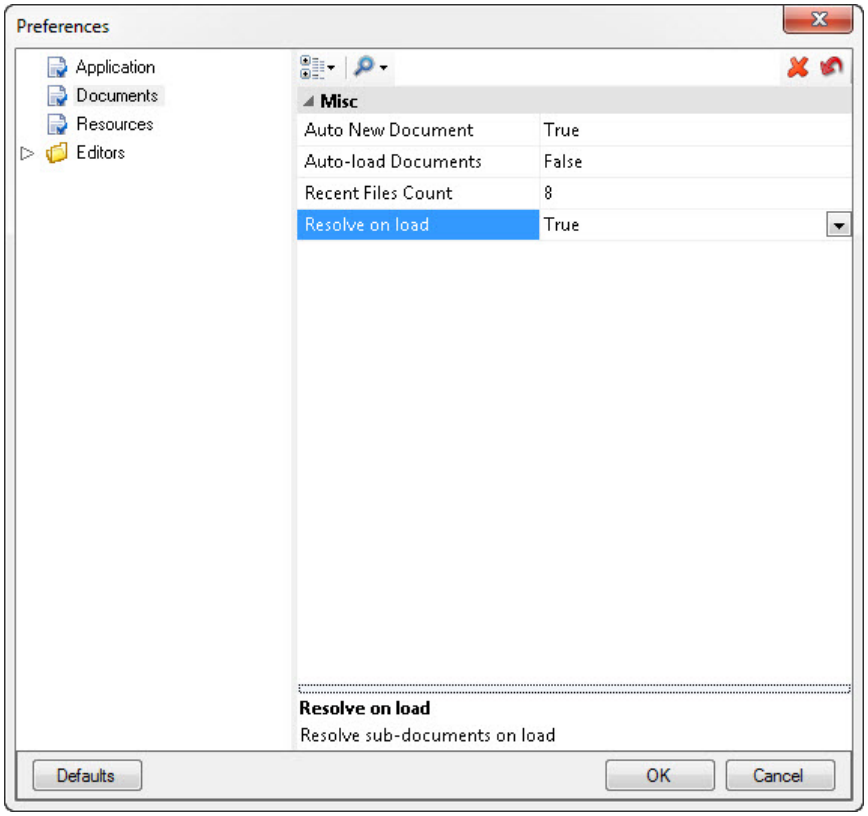
To reload an unresolved sublevel:

(1) Right-click an unresolved sublevel in the Project Lister.
(2) Select **Resolve Subgame** from the context menu.

The sublevel and all of its game resources are added to the Design View.

By default, all sublevels are automatically resolved when you open a main game level. You can use the Preferences dialog to specify that subdocuments are not automatically resolved: select the **Edit > Preferences** menu item to open the Preferences dialog. Select **Documents**, and then select **Resolve on load**, as shown in Figure 65. If you specify **Resolve on load** as **False**, sublevels are not automatically resolved when you open a main game level. You can selectively resolve referenced sublevels as needed.

**Figure 65 Preferences dialog for Resolve on load option**




See Preferences for more information about specifying LevelEditor preferences.

For a demonstration of how to use sublevels, view the "Using Sublevels" video, either on the GitHub site or on SHIP.

## Using Linears to Lay Out Lines and Boundaries

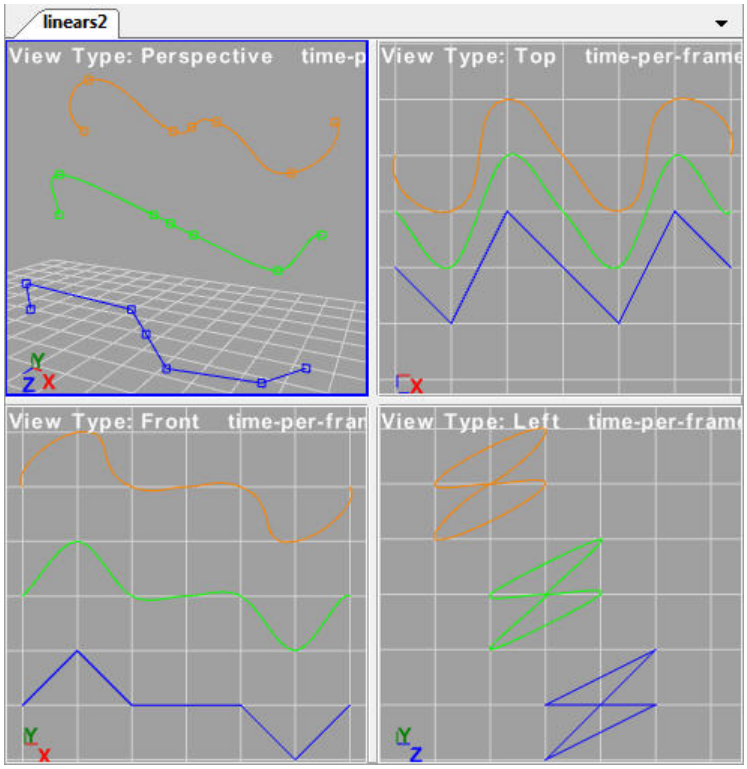
A *linear* is a special type of game object; it defines a geometric shape that has a set of control points.

The Palette provides an object for creating lines and curves:

- A Polyline object that defines a set of connected lines (a polygonal chain).
- A CatmullRom spline object that defines a centripetal Catmull–Rom spline curve.
- A Bezier spline object that defines a Bézier spline curve.

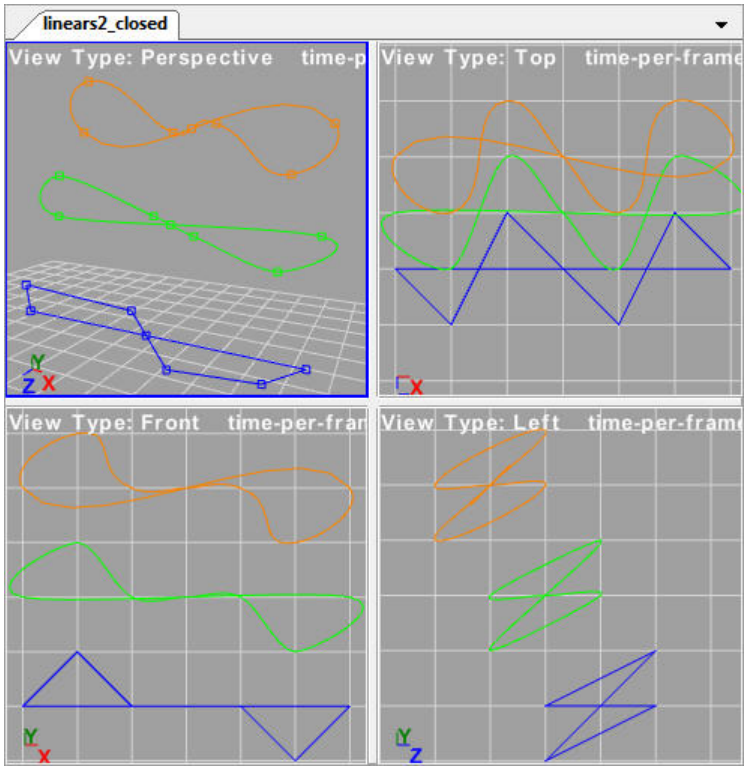
Polylines and spline curves have endpoints that anchor the object's two ends in the world. Dragging a polyline's or curve's endpoint repositions it. Figure 66 shows three linears in the Design View, each with five control points in addition to their endpoints. Each linear is defined with the same parameters; the blue one is a polyline, the green one is a CatmullRom spline, and the orange one is a Bezier curve. The figure shows the linears from four different projection views: perspective, top, front, and left. These linears could represent a short, but complex, flight path of a game object.

**Figure 66 Three linears: a polyline and two curves**




You can create closed polylines and curves by selecting the linear, opening the Property Editor, and setting the **Is Closed** property to **True**. Closing a linear connects the linear's two end control points to form a closed shape. Figure 67 shows the same three linears as in Figure 66, but the linears are now closed.

**Figure 67 Three closed linears**




When laying out a linear onto another surface, you can snap the control points to other surfaces the same way you snap to any other object.

For a demonstration of how to create linears, view the "Creating Linears" video, either on the GitHub site or on SHIP.

To create a straight-sided linear:

(1) Open the Palette, and drag a polyline object to the world.

(2) Use the Move manipulator to drag the curve or its endpoints to the beginning and end locations that you want.

To create a curved linear:

(1) Open the Palette, and drag a CatmullRom spline object or Bezier spline object to the world.

(2) Use the Move manipulator to drag the curve or its endpoints to the beginning and end locations that you want.

To adjust a curve or polyline:

(1) Shift-click on the curve or polyline to create additional control points.

(2) Use the Move manipulator for each control point to shape the linear.

Wherever you shift-click a linear, the LevelEditor creates a control point. Moving a control point repositions that section of the linear. Moving a control point only affects the line segments or curve segments between the control point that you are moving and their nearest adjacent control points.

To close a curve or polyline:

(1) Select the curve or polyline.

(2) Open the Property Editor and set the object's **Is Closed** property to **True**.

Closing a linear adds an additional line segment or curve segment between the two end control points of the linear. You can add additional control points to reshape the newly closed linear, but these new control points are added to the original linear, not to the closing line (that is, the new control point moves the end control point and shortens the closing line).

## Adding Light Objects

The Palette provides three sample Light objects:

- DirLight – a directional light source of unlimited range
- BoxLight – a directional light source that is limited in range to a box boundary
- PointLight – an omnidirectional light source that is limited in range to a spherical boundary

You can place each of these light sources anywhere in the world, as needed. After you specify the properties for the light source, you typically deselect its **Visibility** property; the light remains in the world even if the Light object itself is not visible.

All of the Light objects have the following properties to specify the color of the light:

- Ambient – specifies the ambient color for the light from the source
- Diffuse – specifies the color of light that reflects off other game objects; diffuse reflections are multidirectional
- Specular – specifies the color of light that reflects off other game objects; specular reflections are monodirectional, directly in line with the viewer

**Recommendations:**

- For natural light effects, specify a grey color, such as RGB 75,75,75 for the **Ambient** property.
- To use a Light object as a source of darkness, specify a dark color, such as RBG 0,0,0 for the **Diffuse** property.
- When you place a Light object in the world, consider turning on the **Render shadow** option.

For a demonstration of how to use Light objects, view the "Using Lights in a Game Level" video, either on the GitHub site or on SHIP.

### Directional Light

Because the Directional Light has unlimited range, you can place it anywhere in the world; you set its properties to specify the direction of the light.

Set the Directional Light object's **Direction** property to specify the direction of the light source in the X, Y, and Z directions of the world. You can specify positive or negative values.

### Box Light

The Box Light has a specified range, so you should place the object in the world at the location where you want the light to appear.

Use the Scale manipulator to specify the size of the Box light object's boundary. The boundary is a cube, which makes this object ideal for uniformly lighting a room or similar area.

Set the Box Light object's **Direction** property to specify the direction of the light source. You can specify positive or negative values.

Set the Box Light object's **Attenuation** property to specify the brightness of the light source in the X, Y, and Z directions of the world. You can specify positive or negative values. If the **Ambient** and **Diffuse** property values specify different colors, the **Attenuation** property can alter the mix of the two different colors.

### Point Light

The Point Light has a specified range, so you should place the object in the world at the location where you want the light to appear.

Set the Point Light object's **Range** property to specify the range of the light source. You can specify positive or negative values. The object's boundary is a sphere, which makes this object ideal for lighting outdoor areas.

Set the Point Light object's **Attenuation** property to specify the brightness of the light source in the X, Y, and Z directions of the world. You can specify positive or negative values. If the **Ambient** and **Diffuse** property values specify different colors, the **Attenuation** property can alter the mix of the two different colors.

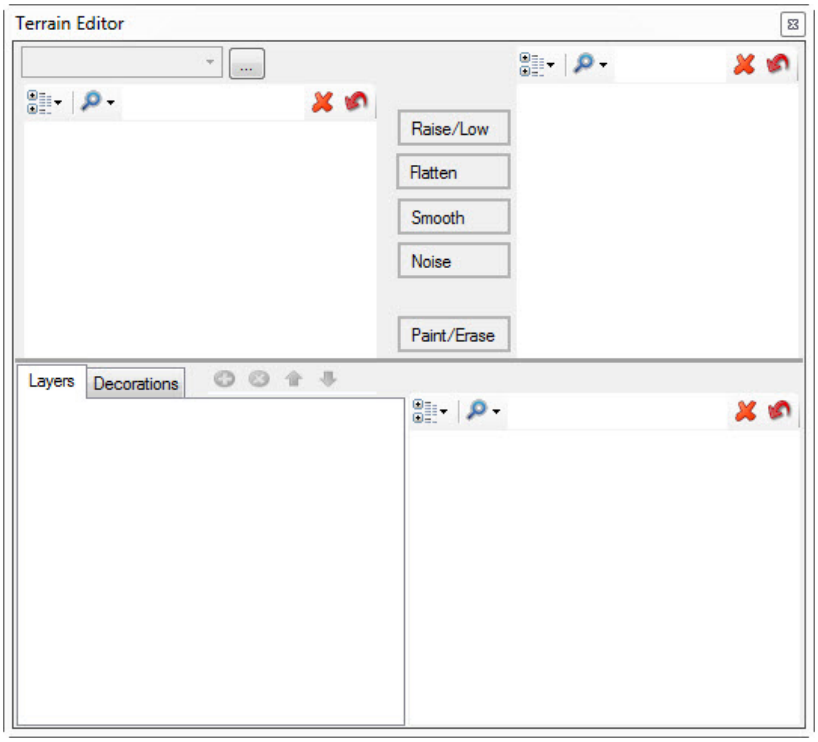
## Creating New Terrain

You can use the LevelEditor Terrain Editor to create custom terrains. For example, you can quickly add or modify outdoor terrain, such as mountains, rivers, forests, and plains, within a level. Starting with an empty level or a level that already has some basic terrain defined, you can use the Terrain Editor to:

- Raise or lower terrain
- Flatten terrain
- Smooth terrain
- Add noisy terrain
- Add decorations and layers to terrain

Figure 68 shows the Terrain Editor window.

**Figure 68 Terrain Editor window**

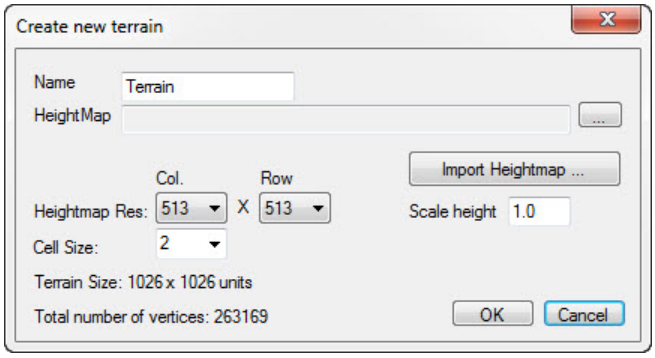



To create new terrain, perform the following tasks:

(1) Open the Terrain Editor window: Select **Window -> Terrain Editor**.

(2) Click the **Browse** button ( ) at the top left of the Terrain Editor window to open the Create New Terrain dialog, as shown in Figure 69.

**Figure 69 Terrain Editor Create New Terrain dialog**




(3) Specify a name for your terrain in the **Name** field. This name allows you to switch quickly between defined terrain types using the dropdown listbox at the top left of the Terrain Editor window.

(4) Specify a height map for your terrain. Click the **Browse** button ( ) for the **HeightMap** field to open a Windows Save As dialog to specify a new height map for the terrain. Click **Save** in the Save As dialog to specify the new height map file; this file is not created until you click **OK** to close the Create New Terrain dialog.

(5) You can import an existing height map to define the resolution, cell size, and scale height for the terrain or you can specify custom values:

(a) To specify an existing height map for the terrain, click **Import HeightMap** to open a Windows Open dialog. Select the height map file and click **Open**. Height map files typically have a **.dds** file type. The existing height map defines the resolution, cell size, and scale height for the terrain.

(b) To specify custom values for the resolution, cell size, and scale height for the height map:

- Specify the number of units for the vertical (**Col**) and horizontal (**Row**) dimensions of each cell.
- Specify the cell size.
- Specify a scale height for the height map.

As you modify the height map resolution and cell size, the Create New Terrain dialog shows the terrain size and total number of vertices for the terrain.

(6) Select **Activate terrain editing** ( ) to enable terrain editing within the Design View. See the following sections for more information about editing terrain.

In general, smaller values for resolution and cell size define smaller levels, whereas larger values define larger levels. A larger scale height lets you raise or lower terrain more quickly, with less granularity, whereas smaller values require more clicks or drags to achieve a similar effect with greater granularity.

For a demonstration of how to use the Terrain Editor, view the "Terrain Editor Features" video, either on the GitHub site or on SHIP.

### Raising and Lowering Terrain

To raise or lower terrain, perform the following tasks:

(1) Select **Activate terrain editing** ( ) to enable terrain editing within the Design View.

(2) Within the Terrain Editor window, click **Raise/Lower**.

(3) Optionally, specify a custom brush radius, a brush softness, and a height:

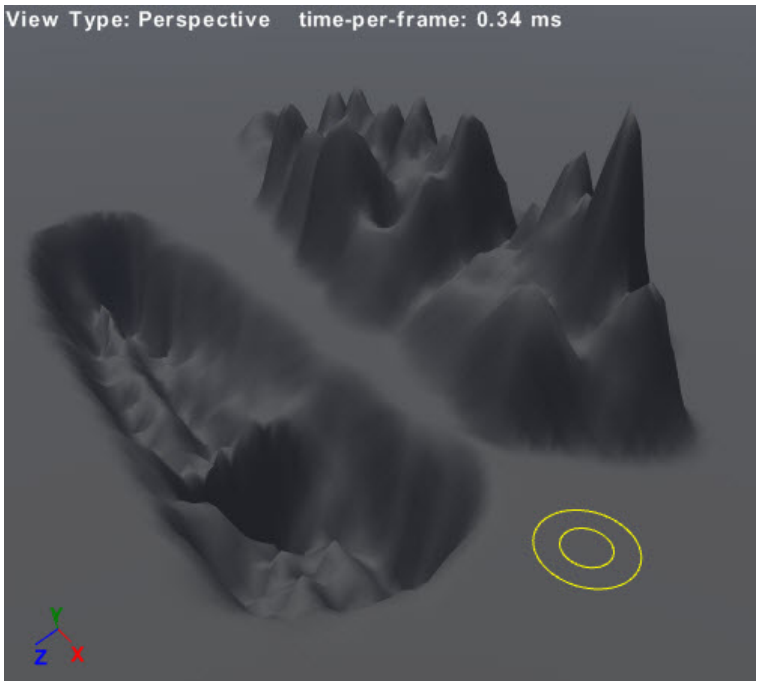
- Brush radius: In the **Brush Radius** field, specify the brush radius value. A small number defines a small radius for the brush cursor with which you raise or lower terrain, and a larger number defines a larger radius. A small radius allows you to design fine detail, whereas a large radius allows you design large areas quickly.
- Brush softness: In the **Brush Softness** field, specify the brush softness value. A small number defines a harder brush, which produces harsher lines for the raised or lowered terrain, whereas a larger number defines a softer brush, which produces more rounded contours for the raised or lowered terrain.
- Height: In the **Height** field, specify the height value. The height defines how much terrain is raised or lowered with each click (or click and drag). A smaller number raises or lowers the terrain by a small amount, whereas a larger number raises or lowers the terrain by a large amount.

(4) To raise terrain: Within the Design View, position the cursor where you want to raise terrain and left-click. You can also left-click and drag to raise areas of terrain.

(5) To lower terrain: Within the Design View, position the cursor where you want to lower terrain and Control-left-click. You can also Control-left-click and drag to lower areas of terrain.

Figure 70 shows some raised and lowered terrain (a chasm and some mountains) using the default settings.

**Figure 70 Raised and lowered terrain**




### Flattening Terrain

To flatten terrain, perform the following tasks:

(1) Select **Activate terrain editing** (  ) to enable terrain editing within the Design View.

(2) Within the Terrain Editor window, click **Flatten**.

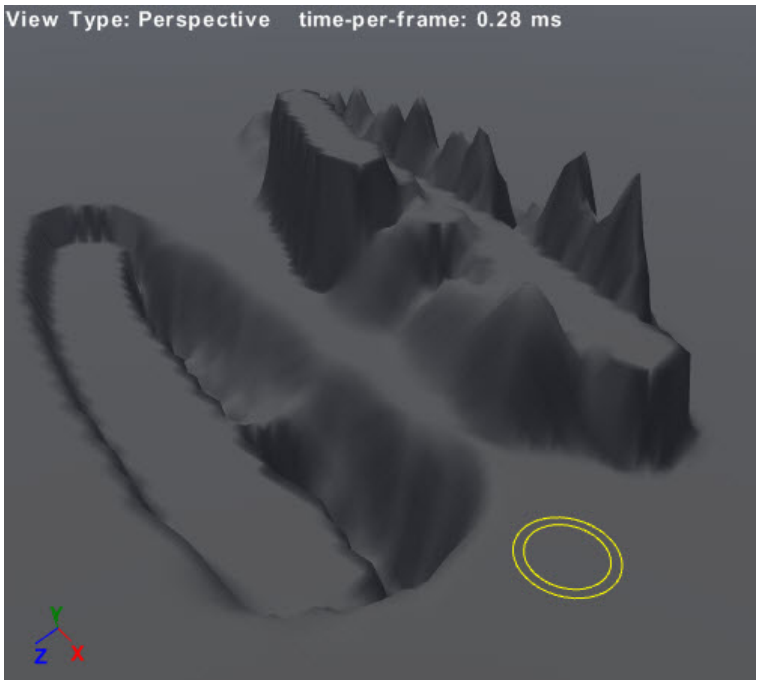
(3) Optionally, specify a custom brush radius and a brush softness:

- Brush radius: In the **Brush Radius** field, specify the brush radius value. A small number defines a small radius for the brush cursor with which you flatten terrain, and a larger number defines a larger radius. A small radius allows you to design fine detail, whereas a large radius allows you design large areas quickly.
- Brush softness: In the **Brush Softness** field, specify the brush softness value. A small number defines a harder brush, which produces harsher lines for the flattened terrain, whereas a larger number defines a softer brush, which produces more rounded contours for the flattened terrain.

(4) To flatten terrain: Within the Design View, position the cursor where you want to flatten terrain and left-click. You can also left-click and drag to flatten areas of terrain.

Figure 71 shows some flattened terrain (based on the same chasm and mountains from Figure 70) using the default settings.

**Figure 71 Flattened terrain**




### Smoothing Terrain

To smooth terrain, perform the following tasks:

(1) Select **Activate terrain editing** (  ) to enable terrain editing within the Design View.

(2) Within the Terrain Editor window, click **Smooth**.

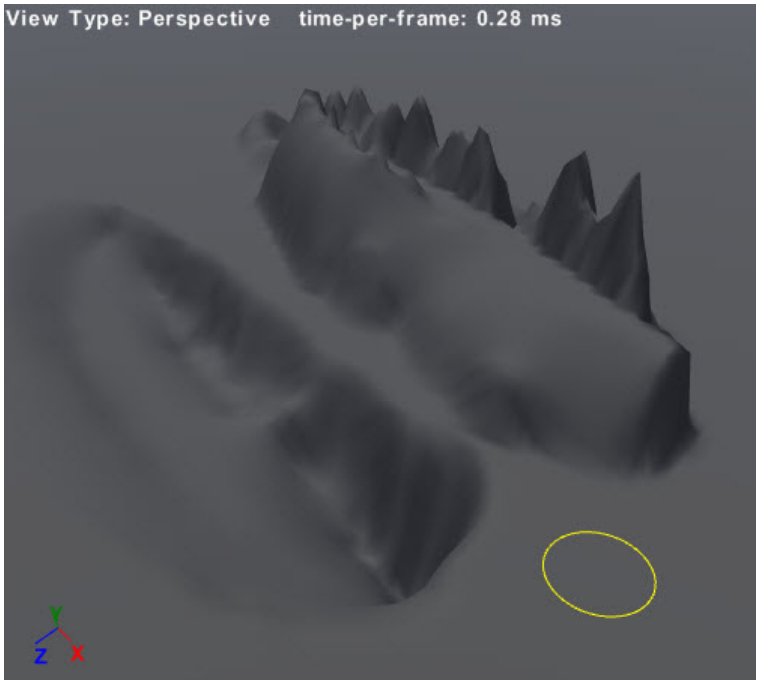
(3) Optionally, specify a custom brush radius and a brush softness:

- Brush radius: In the **Brush Radius** field, specify the brush radius value. A small number defines a small radius for the brush cursor with which you smooth terrain, and a larger number defines a larger radius. A small radius allows you to design fine detail, whereas a large radius allows you design large areas quickly.
- Brush softness: In the **Brush Softness** field, specify the brush softness value. A small number defines a harder brush, which produces harsher lines for the smoothed terrain, whereas a larger number defines a softer brush, which produces more rounded contours for the smoothed terrain.

(4) To smooth terrain: Within the Design View, position the cursor where you want to smooth terrain and left-click. You can also left-click and drag to smooth areas of terrain.

Figure 72 shows some smoothed terrain (based on the same flattened chasm and mountains from Figure 71) using the default settings.

**Figure 72 Smoothed terrain**




### Adding Noise to Terrain

To create terrain with added noise, perform the following tasks:

(1) Select **Activate terrain editing** ( ) to enable terrain editing within the Design View.

(2) Within the Terrain Editor window, click **Noise**.

(3) Optionally, specify a custom brush radius, a brush softness, a number of features, the feature scale, a number of octaves for the features, and the persistence of the features:

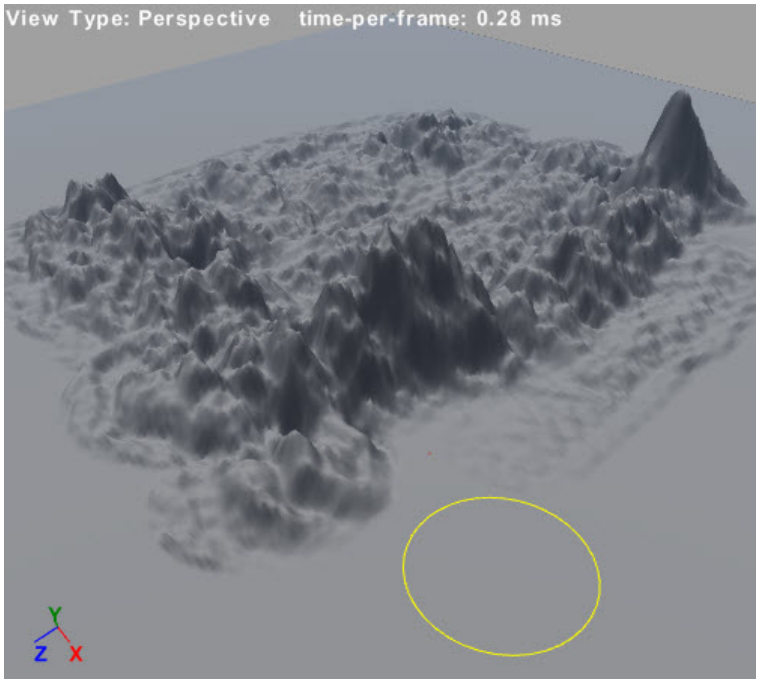
- Brush radius: In the **Brush Radius** field, specify the brush radius value. A small number defines a small radius for the brush cursor with which you define noisy terrain, and a larger number defines a larger radius. A small radius allows you to design fine detail, whereas a large radius allows you design large areas quickly.
- Brush softness: In the **Brush Softness** field, specify the brush softness value. A small number defines a harder brush, which produces harsher lines for the noisy terrain, whereas a larger number defines a softer brush, which produces more rounded contours for the noisy terrain.
- Features: In the **Features** field, specify the features value. A small number defines a smaller number of noise features, which produces a less noisy terrain, whereas a larger number defines a larger number of noise features, which produces much noisier ("bumpier") terrain.
- Feature Scale: In the **FeatureScale** field, specify the feature scale value. The feature scale defines the height of each noise feature defined with each click. A small number defines shorter noise features, whereas a larger number defines taller noise features.

- Octaves: In the **Octaves** field, specify the octaves value. The octave number defines the number of iterations of the features. A small number defines fewer iterations of the features, which produces less pronounced noise features, whereas a larger number defines more iterations of the features, which produces more pronounced noise features.
- Persistence: In the **Persistence** field, specify the persistence value. The persistence defines the shape of the noise features. A small number defines smoother features, whereas a larger number defines sharper ("spikier") features.

(4) To create noisy terrain: Within the Design View, position the cursor where you want noisy terrain and left-click. You can also left-click and drag to define areas of noisy terrain.

Figure 73 shows some noisy terrain (different terrain than shown in previous sections, and with a different zoom level to accommodate a larger brush radius) using the default settings.

**Figure 73 Noisy terrain**




### Adding Layers and Decorations to Terrain

After defining basic terrain, you can add layers and decorations to make the world look more realistic. Layers allow you to paint textures on the terrain, and decorations allow you to add features on top of a terrain.

To add layers or decorations to terrain, perform the following tasks:

(1) Select **Activate terrain editing** ( ) to enable terrain editing within the Design View.

(2) Within the Terrain Editor window, select the Layers tab or the Decorations tab.

(3) Click **Add** ( ) to open the Create New Terrain Map dialog.

(4) Specify a name for your terrain map in the **Name** field. This name allows you to differentiate defined terrain maps.

(5) Specify a map mask in the **Map Mask** field. Click the **Browse** button (  ) to open the Windows Save As dialog to specify the path and file name for the map. Click **Save** in the Save As dialog to specify the new map file; this file is not created until you click **OK** to close the Create New Terrain Map dialog.

(6) Specify a mask resolution as width and height. These values specify the granularity of the masked textures for the terrain. The mask resolution need not match the resolution that you specified for the height map.

(7) Optionally, click **Import Mask** to open the Windows Open dialog to specify the path and file name for an existing mask. An existing mask defines the mask resolution and layout of the mask.

(8) Optionally, you can use the **Move Up** or **Move Down** buttons from the action bar (  ) to position the layer or decoration in an order that is appropriate for the terrain. Use the **Delete** button to remove a layer or decoration.

(9) Click **OK** to create the terrain map and close the dialog.

For each defined layer or decoration, you can specify associated properties. For example, for a layer, you can define the texture scale, a diffuse texture, and a normal texture; for a decoration, you can define the texture scale, the number of decorators, the line-of-sight (LOD) distance for the texture, a diffuse texture, and a normal texture.

To add a layer or decoration to a terrain:

(1) Select **Activate terrain editing** (  ) to enable terrain editing within the Design View.

(2) Within the Terrain Editor window, select the Layers tab or the Decorations tab.

(3) Select the layer or decoration that you want to add.

(4) Click the Diffuse, Normal, or Specular texture with which you want to paint to the terrain.

(5) Click **Paint/Erase** to enable painting of layers and decorations.

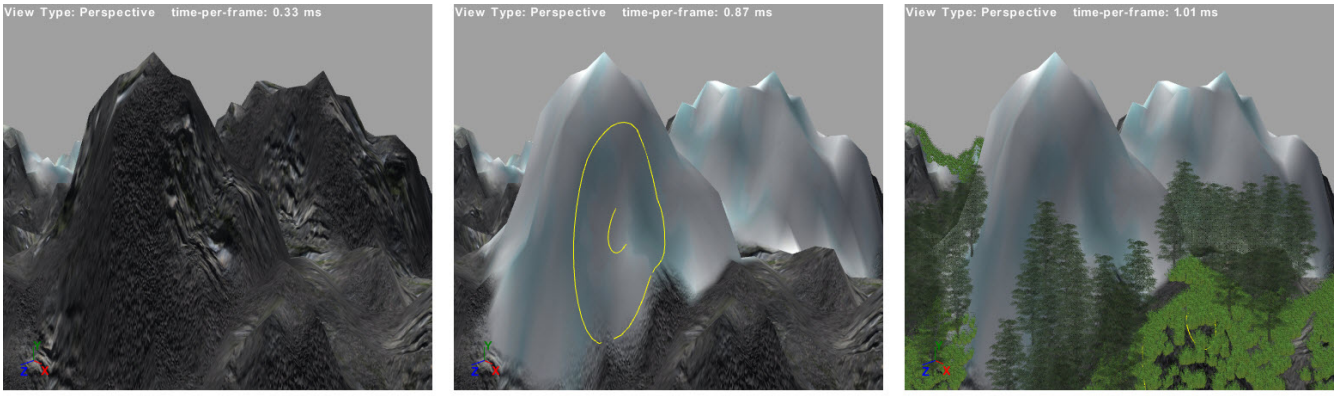
(6) To paint terrain: Within the Design View, position the cursor where you want to paint the terrain and left-click. You can also left-click and drag to paint areas of terrain.

(7) To erase terrain: Within the Design View, position the cursor where you want to erase the added layer or decoration and Control-left-click. You can also Control-left-click and drag to erase areas of terrain. To ensure that you do not make unintentional erasures, you can only erase a layer or decoration that you've selected from the Layers or Decorations tab.

You can paint textures on any terrain within the level. However, some layer or decoration properties, such as Max Slope, can restrict the painting of a layer or decoration on a particular terrain. Any layers or decorations that you paint on a terrain are additive, based on the order of the layer or decorations within the Layers or Decorations tabs, and thus allow you to create very realistic scenes.

Figure 74 shows mountainous terrain (a close up view of some of the noisy terrain from Figure 73, with an added rock texture) before and after painting it with a snow texture layer and with some tree and shrub decorations.

**Figure 74 Terrain with added layer and decorations**




A mountainous terrain

A mountainous terrain with a snow layer

A mountainous terrain with a snow layer and tree decorations

## Working with StateMachine Assets

For game objects that include a state machine reference, you can drag and drop state machine assets onto game objects in the LevelEditor Project Lister. The game object's behavior is then determined by the state machine to which it is bound. For each individual game object that includes a state machine reference, you can modify its state machine properties to specify the object's desired behavior in the game environment.

To add state machines to a game object, perform the following tasks:

(1) Add the game object to the project, and select it in the Project Lister. Ensure that the object has a state machine reference (**stmRef** property).

(2) Drag a StateMachine Editor project file (**.stmproj**) from the "AI" folder of the Resources list to the game object's **stmRef** property in the Project Lister, as shown in Figure 75.

**Figure 75 A game object's stmRef property in the Project Lister**


(3) Select the game object's **stmRef** property and open the Property Editor (or Grid Property Editor) to modify the object's state machine properties, as shown in Figure 76. The figure shows a state machine for a tank object.

**Figure 76 A game object's state machine properties**

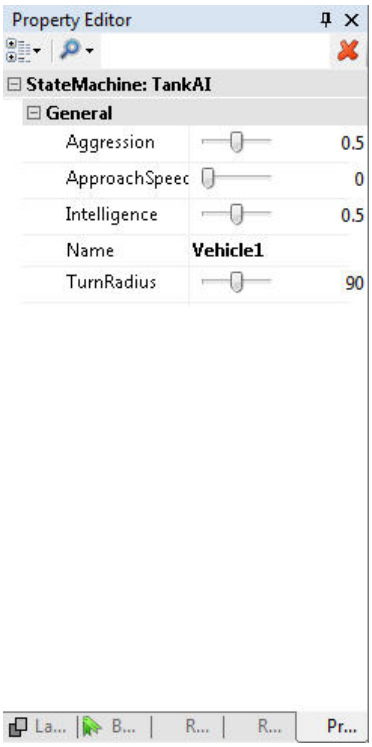



Figure 77 shows a tank object with an associated state machine that specifies the object's name, aggression, approach speed, intelligence, and turn radius. You can change the default state values using the slider bars in the Property Editor, or you can edit them directly in either the Property Editor or Grid Property Editor. You can select a state property to view a description of that property; these descriptions are defined as annotations in the StateMachine Editor.

**Figure 77 A tank object with an associated state machine**