PyUnity

Release 0.6.0

Jun 23, 2021

Contents:

PyUnity is a Python implementation of the Unity Engine, written in C++. This is just a fun project and many features have been taken out to make it as easy as possible to create a scene and run it.

CHAPTER 1

Installing

To install PyUnity for Linux distributions based on Ubuntu or Debian, use:

```
> pip3 install pyunity
```

To install PyUnity for other operating systems, use pip:

```
> pip install pyunity
```

Alternatively, you can clone the repository here to build the package from source. Then use *setup.py* to build. Note that it will install Cython to compile.

> python setup.py install

Its only dependencies are PyOpenGL, Pygame, GLFW, Pillow and PyGLM.

To install PyGame on Linux, use:

> pip3 install pygame

After installation, run an example using this command:

> python -m pyunity 3

1.1 Releases

1.1.1 v0.4.0

Small release that has large internal changes.

New features:

- Added logger
- Moved around files and classes to make it more pythonic
- Rewrote docs

- Fixed huge bug that broke all versions from 0.2.0-0.3.1
- Clarified README.md

Download source code at https://github.com/rayzchen/pyunity/releases/tag/0.4.0

1.1.2 v0.3.1

Bugfix on basically everything because 0.3.0 was messed up.

Download source code at https://github.com/rayzchen/pyunity/releases/tag/0.3.1

1.1.3 v0.3.0

After a long break, 0.3.0 is finally here!

New features:

- Added key input (not fully implemented)
- Fixed namespace pollution
- Fixed minor bugs
- Window resizing implemented
- New Scene loading interface
- Python 3.9 support
- Finished pxd files
- LGTM Integration
- AppVeyor is now the main builder
- Code is now PEP8-friendly
- Added tests.py
- Cleaned up working directory

Download source code at https://github.com/rayzchen/pyunity/releases/tag/0.3.0

1.1.4 v0.2.1

Small bugfix around the AudioClip loading and inclusion of the OGG file in example 8.

Download source code at https://github.com/rayzchen/pyunity/releases/tag/0.2.1

1.1.5 v0.2.0

A CI integration update, with automated building from Appveyor and Travis CI.

Features:

- Shaded faces with crisp colours
- PXD files to optimize Cython further (not yet implemented fully)
- Scene changing

- FPS changes
- Better error handling
- Travis CI and AppVeyor integration
- Simple audio handling
- Changelogs in the dist folder of master
- Releases branch for builds from Travis
- Python 3.6 support
- 1 more example, bringing the total to 8

Download source code at https://github.com/rayzchen/pyunity/releases/tag/0.2.0

1.1.6 v0.1.0

Cython update, where everything is cythonized. First big update.

Features:

- Much more optimized rendering with Cython
- A new example
- Primitives
- Scaling
- Tutorials
- New color theme for documentation
- Timer decorator
- Non-interactive mode
- Frustrum culling
- Overall optimization

Notes:

- The FPS config will not have a change due to the inability of cyclic imports in Cython.
- You can see the c code used in Cython in the src folder.
- When installing with `setup.py`, you can set the environment variable `a` to anything but an empty string, this will disable recreating the c files. For example:

```
> set a=1
> python setup.py install
```

Download source code at https://github.com/rayzchen/pyunity/releases/tag/0.1.0

1.1.7 v0.0.5

Transform updates, with new features extending GameObject positioning.

Features:

- Local transform

- Quaternion
- Better example loader
- Primitive objects in files
- Fixed jittering when colliding from an angle
- Enabled friction (I don't know when it was turned off)
- Remove scenes from SceneManager
- Vector division

Download source code at https://github.com/rayzchen/pyunity/releases/tag/0.0.5

1.1.8 v0.0.4

Physics update.

New features:

- Rigidbodies
- Gravity
- Forces
- Optimized collision
- Better documentation
- Primitive meshes
- PyUnity mesh files that are optimized for fast loading
- Pushed GLUT to the end of the list so that it has the least priority
- Fixed window loading
- Auto README.md updater

Download source code at https://github.com/rayzchen/pyunity/releases/tag/0.0.4

1.1.9 v0.0.3

More basic things added.

Features:

- Examples (5 of them!)
- Basic physics components
- Lighting
- Better window selection
- More debug options
- File loader for .obj files

Download source code at https://github.com/rayzchen/pyunity/releases/tag/0.0.3

1.1.10 v0.0.2

First proper release (v0.0.1 was lost).

Features:

- Documentation
- Meshes

Download source code at https://github.com/rayzchen/pyunity/releases/tag/0.0.2

1.2 Tutorials

Here are some tutorials to get you started in using PyUnity. They need no prior knowledge about Unity, but they do require you to be comfortable with using Python.

1.2.1 Tutorial 1: The Basics

In this tutorial you will be learning the basics to using PyUnity, and understanding some key concepts.

1.2.1.1 What is PyUnity?

PyUnity is a Python implementation of the UnityEngine, which was originally written in C++. PyUnity has been modified to be easy to use in Python, which means that some features have been removed.

1.2.1.2 Basic concepts

In PyUnity, everything belongs to a GameObject. A GameObject is a named object that has lots of Components on it that will affect the GameObject and other GameObjects. Components are Python objects that do specific things each frame, like rendering an object or deleting other GameObjects.

1.2.1.3 Transforms

Each GameObject has a special component called a Transform. A Transform holds information about the GameObject's position, rotation and scale.

A Transform also manages the hierarchy system in PyUnity. Each transforms can have multiple children, which are all Transforms attached to the children GameObjects. All transforms will have a `localPosition`, `localRotation` and `localScale`, which are all relative to their parent. In addition, all Transforms will have a `position`, `rotation` and `scale` property which is measured in global space.

For example, if there is a Transform at 1 unit up from the origin, and its child had a `localPosition` of 1 unit right, then the child would have a `position` of 1 unit up and 1 unit to the right.

1.2.1.4 Code

All of that has now been established, so let's start to program it all! To start, we need to import PyUnity.

```
>>> from pyunity import *
Loaded config
Trying GLFW as a window provider
GLFW doesn't work, trying Pygame
Trying Pygame as a window provider
Using window provider Pygame
Loaded PyUnity version 0.4.0
```

The output beneath the import is just for debug, you can turn it off with the environment variable `PYUNITY_DEBUG_INFO` set to `"0"`.

For example:

```
>>> import os
>>> os.environ["PYUNITY_DEBUG_INFO"] = "0"
>>> from pyunity import *
>>> # No output
```

Now we have loaded the module, we can start creating our GameObjects. To create a GameObject, use the `GameObject` class:

```
>>> root = GameObject("Root")
```

Then we can change its position by accessing its transform. All GameObjects have references to their transform by the `transform` attribute, and all components have a reference to the GameObject and the Transform that they belong to, by the `gameObject` and `transform` attributes. Here's how to make the GameObject positioned 1 unit up, 2 units to the right and 3 units forward:

```
>>> root.transform.localPosition = Vector3(2, 1, 3)
```

A Vector3 is just a way to represent a 3D vector. In PyUnity the coordinate system is a left-hand Y-axis up system, which is essentially what OpenGL uses, but with the Z-axis flipped.

Then to add a child to the GameObject, specify the parent GameObject as the second argument:

```
>>> child1 = GameObject("Child1", root)
>>> child2 = GameObject("Child2", root)
```

Note: Accessing the `localPosition`, `localRotation` and `localScale` attributes are faster than using the `position`, `rotation` and `scale` properties. Use the local attributes whenever you can.

1.2.1.5 Rotation

Rotation is measured in Quaternions. Do not worry about these, because they use some very complex maths. All you need to know are these methods:

1. To make a Quaternion that represents no rotation, use `Quaternion.identity()`. This just means no rotation.
2. To make a Quaternion from an axis and angle, use the `Quaternion.FromAxis()` method. What this does is it creates a Quaternion that represents a rotation around an axis clockwise, by `angle` degrees. The axis does not need to be normalized.
3. To make a Quaternion from Euler angles, use `Quaternion.Euler`. This creates a Quaternion from Euler angles, where it is rotated on the Z-axis first, then the X-axis, and finally the Y-axis.

Transforms also have `localEulerAngles` and `eulerAngles` properties, which just represent the Euler angles of the rotation Quaternions. If you don't know what to do, only use the `eulerAngles` property.

In the next tutorial, we'll be covering how to render things and use a Scene.

1.2.2 Tutorial 2: Rendering in Scenes

Last tutorial we covered some basic concepts on GameObjects and Transforms, and this time we'll be looking at how to render things in a window.

1.2.2.1 Scenes

A Scene is like a page to draw on: you can add things, remove things and change things. To create a scene, you can call `SceneManager.AddScene`:

```
>>> scene = SceneManager.AddScene("Scene")
```

In your newly created scene, you have 2 GameObjects: a Main Camera, and a Light. These two things can be moved around like normal GameObjects.

Next, let's move the camera back 10 units:

```
>>> scene.mainCamera.transform.localPosition = Vector3(0, 0, -10)
```

`scene.mainCamera` references the Camera Component on the Main Camera, so we can access the Transform by using its `transform` attribute.

1.2.2.2 Meshes

To render anything, we need a model of it. Let's say we want to create a cube. Then we need a model of a cube, or what's called a mesh. Meshes have 4 pieces of data: the vertices (or points), the faces, the normals and the texture coordinates. Normals are just vectors saying which way the face is pointing, and texture coordinates are coordinates to represent how an image is displayed on the surface of a mesh.

For a simple object like a cube, we don't need to create our own mesh. Fortunately there is a method called `Mesh.cube` which creates a cube for us. Here it is:

```
>>> cubeMesh = Mesh.cube(2)
```

The `2` means to create a cube with side lengths of 2. Then, to render this mesh, we need a new Component.

1.2.2.3 The MeshRenderer

The MeshRenderer is a Component that can render a mesh in the scene. To add a new Component, we can use a method called `AddComponent`:

```
>>> cube = GameObject("cube")
>>> renderer = cube.AddComponent(MeshRenderer)
```

Now we can give our renderer the cube mesh from before.

```
>>> renderer.mesh = cubeMesh
```

Finally, we need a Material to use. To create a Material, we need to specify a colour in RGB.

```
>>> renderer.mat = Material(Color(255, 0, 0))
```

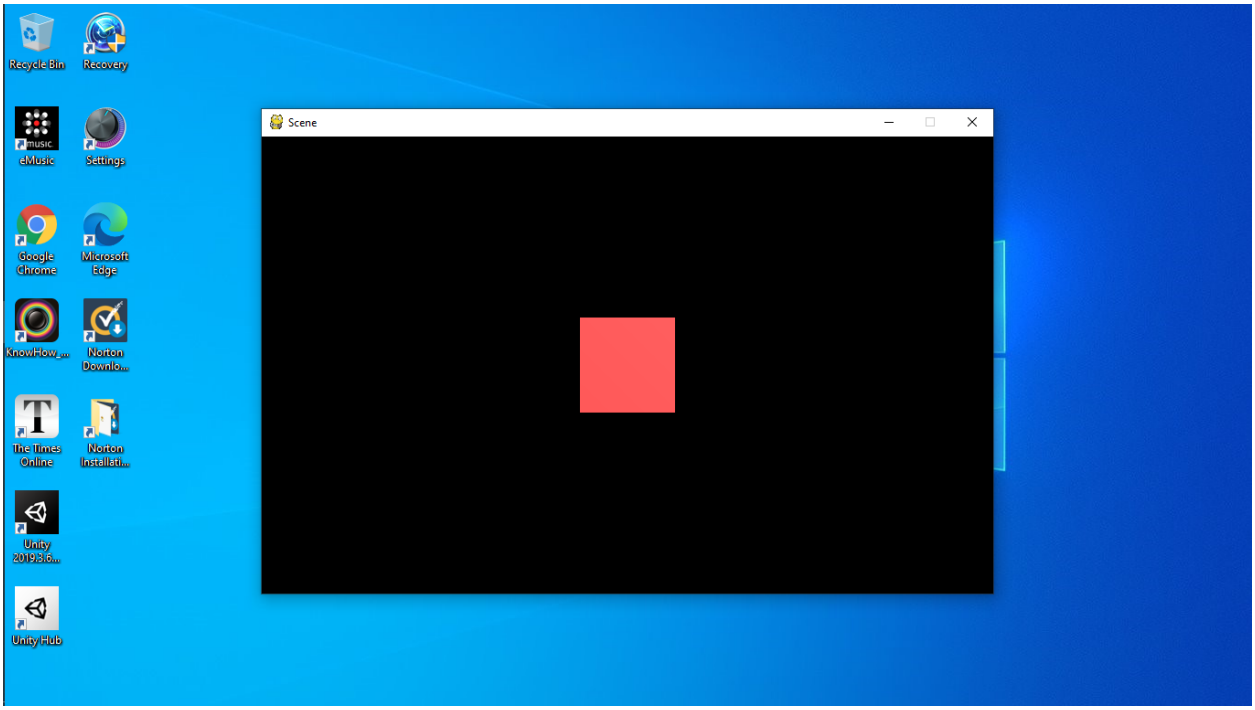
Here I used a red material. Finally we need to add the cube to our scene, otherwise we can't see it in the window:

```
>>> scene.Add(cube)
```

The full code:

```
>>> from pyunity import *
Loaded config
Trying GLFW as a window provider
GLFW doesn't work, trying Pygame
Trying Pygame as a window provider
Using window provider Pygame
Loaded PyUnity version 0.4.0
>>> scene = SceneManager.AddScene("Scene")
>>> scene.mainCamera.transform.localPosition = Vector3(0, 0, -10)
>>> cubeMesh = Mesh.cube(2)
>>> cube = GameObject("Cube")
>>> renderer = cube.AddComponent(MeshRenderer)
>>> renderer.mesh = cubeMesh
>>> renderer.mat = Material(Color(255, 0, 0))
>>> scene.Add(cube)
```

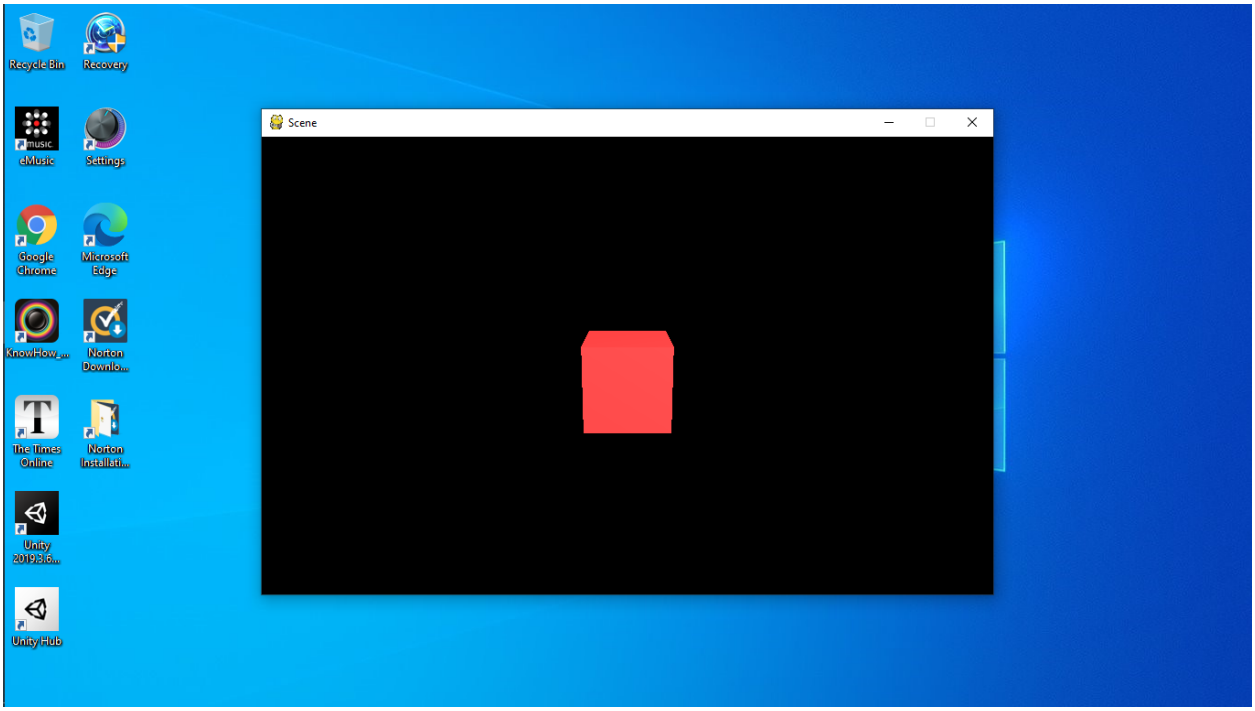
Then, to run our scene, we use `scene.Run()`. And now we have a cube:



To see it better, let's move the camera up a bit and tilt it downwards. Replace the third line with this:

```
>>> scene.mainCamera.transform.localPosition = Vector3(0, 3, -10)
>>> scene.mainCamera.transform.localEulerAngles = Vector3(15, 0, 0)
```

Now we can see it better:



Let's say we want to place an image onto the cube. To do this, we need to change the Material and add a Texture.

```
>>> renderer.mat = Material(Color(255, 255, 255), Texture2D("python.png"))
```

Place `python.png` in the same folder as your script and run the code. Here is the image for reference:

And here is the complete code:

```
from pyunity import *
scene = SceneManager.AddScene("Scene")
scene.mainCamera.transform.localPosition = Vector3(0, 0, -10)
cubeMesh = Mesh.cube(2)
cube = GameObject("Cube")
renderer = cube.AddComponent(MeshRenderer)
renderer.mesh = cubeMesh
renderer.mat = Material(Color(255, 0, 0), Texture2D("python.png"))
scene.Add(cube)
scene.Run()
```

1.2.2.4 Debugging

If you want to see what you've done already, then you can use a number of debugging methods. The first is to call `scene.List()`:

```
>>> scene.List()
/Main Camera
/Light
/Cube
```

This lists all the Gameobjects in the scene. Then, let's check the cube's components:

```
>>> cube.components
[<Transform position=Vector3(0, 0, 0) rotation=Quaternion(1, 0, 0, 0) scale=Vector3(1,
↪ 1, 1) path="/Cube">, <pyunity.core.MeshRenderer object at 0x0B170CA0>]
```

Finally, let's check the Main Camera's transform.

```
>>> scene.mainCamera.transform
<Transform position=Vector3(0, 3, -10) rotation=Quaternion(0.9914448613738104, 0.
↪13052619222005157, 0.0, 0.0) scale=Vector3(1, 1, 1) path="/Main Camera">
```

Next tutorial, we'll be covering scripts and Behaviours.

1.2.3 Tutorial 3: Scripts and Behaviours

Last tutorial we covered rendering meshes. In this tutorial we will be seeing how to make 2 GameObjects interact with each other.

1.2.3.1 Behaviours

A Behaviour is a Component that you can create yourself. To create a Behaviour, subclass from it:

```
>>> class MyBehaviour(Behaviour):
...     pass
```

In this case the Behaviour does nothing. To make it do something, use the Update function:

```
>>> class Rotator(Behaviour):
...     def Update(self, dt):
...         self.transform.localEulerAngles += Vector3(0, 90, 0) * dt
```

What this does is it rotates the GameObject that the Behaviour is on by 90 degrees each second around the y-axis. The `Update` function takes 1 argument, `dt`, which is how many seconds have passed since the last frame.

1.2.3.2 Behaviours vs Components

Look at the code for the Component class:

```
class Component:
    def __init__(self):
        self.gameObject = None
        self.transform = None
```

(continues on next page)

(continued from previous page)

```
    def GetComponent(self, component):
        return self.gameObject.GetComponent(component)

    def AddComponent(self, component):
        return self.gameObject.AddComponent(component)
```

A Component has 2 attributes: `gameObject` and `transform`. This is set whenever the Component is added to a GameObject. A Behaviour is subclassed from a Component and so has the same attributes. Each frame, the Scene will call the `Update` function on all Behaviours, passing the time since the last frame in seconds.

When you want to do something at the start of the Scene, use the `Start` function. That will be called right at the start of the scene, when `scene.Run()` is called.

```
>>> class MyBehaviour(Behaviour):
...     def Start(self):
...         self.a = 0
...     def Update(self, dt):
...         print(self.a)
...         self.a += dt
```

The example above will print in seconds how long it had been since the start of the Scene. Note that the order in which all Behaviours' `Start` functions will be the orders of the GameObjects.

With this, you can create all sorts of Components, and because Behaviour is subclassed from Component, you can add a Behaviour to a GameObject with `AddComponent`.

1.2.3.3 Examples

This creates a spinning cube:

```
>>> class Rotator(Behaviour):
...     def Update(self, dt):
...         self.transform.localEulerAngles += Vector3(0, 90, 135) * dt
...
>>> scene = SceneManager.AddScene("Scene")
>>> cube = GameObject("Cube")
>>> renderer = cube.AddComponent(MeshRenderer)
>>> renderer.mesh = Mesh.cube(2)
>>> renderer.mat = Material(Color(255, 0, 0))
>>> cube.AddComponent(Rotator)
>>> scene.Add(cube)
>>> scene.Run()
```

This is a debugging Behaviour, which prints out the change in position, rotation and scale each 10 frames:

```
class Debugger(Behaviour):
    lastPos = Vector3.zero()
    lastRot = Quaternion.identity()
    lastScl = Vector3.one()
    a = 0
    def Update(self, dt):
        self.a += 1
        if self.a == 10:
            print(self.transform.position - self.lastPos)
            print(self.transform.rotation.conjugate * self.lastRot)
```

(continues on next page)

(continued from previous page)

```
            print(self.transform.scale / self.lastScl)
            self.a = 0
```

Note that the printed output for non-moving things would be as so:

```
Vector3(0, 0, 0)
Quaternion(1, 0, 0, 0)
Vector3(1, 1, 1)
Vector3(0, 0, 0)
Quaternion(1, 0, 0, 0)
Vector3(1, 1, 1)
Vector3(0, 0, 0)
Quaternion(1, 0, 0, 0)
Vector3(1, 1, 1)
...
```

This means no rotation, position or scale change. It will break when you set the scale to `Vector3(0, 0, 0)`.

In the next tutorial we'll be looking at physics.

1.3 Links

Here are some links to websites about the PyUnity project:

https://github.com/pyunity/pyunity - GitHub repository

https://pypi.org/project/pyunity - PyPi page

https://discord.gg/zTn48BEbF9 - Discord server

1.4 License

1.5 pyunity package

1.5.1 Version 0.6.0 (in development)

PyUnity is a Python implementation of the Unity Engine, written in C++. This is just a fun project and many features have been taken out to make it as easy as possible to create a scene and run it.

1.5.1.1 Installing

To install PyUnity for Linux distributions based on Ubuntu or Debian, use:

```
> pip3 install pyunity
```

To install PyUnity for other operating systems, use pip:

```
> pip install pyunity
```

Alternatively, you can clone the repository here to build the package from source. Then use `setup.py` to build. Note that it will install Cython to compile.

> python setup.py install

Its only dependencies are PyOpenGL, Pygame, GLFW, Pillow and PyGLM.

1.5.1.2 Importing

To start using pyunity, you must import it. A standard way to import is like so:

```
>>> from pyunity import *
```

Debug information is turned on by default. If you want to turn it off, set the PYUNITY_DEBUG_MODE environment variable to `"0"`. This is the output with debugging:

```
Loaded config
Trying GLFW as a window provider
GLFW doesn't work, trying Pygame
Using window provider Pygame
Loaded PyUnity version 0.6.0
```

If debugging is off, there is no output:

```
>>> import os
>>> os.environ["PYUNITY_DEBUG_MODE"] = "0"
>>> from pyunity import *
>>> # No output
```

1.5.1.3 Scenes

All PyUnity projects start with a scene. To add a scene, do this:

```
>>> scene = SceneManager.AddScene("Scene 1")
```

Then, let's move the camera backwards 10 units.

```
>>> scene.mainCamera.transform.position = Vector3(0, 0, -10)
```

Finally, add a cube at the origin:

```
>>> cube = GameObject("Cube")
>>> renderer = cube.AddComponent(MeshRenderer)
>>> renderer.mesh = Mesh.cube(2)
>>> renderer.mat = Material(Color(255, 0, 0))
>>> scene.Add(cube)
```

To see what you have added to the scene, call `scene.List()`:

```
>>> scene.List()
/Main Camera
/Light
/Cube
```

Finally, to run the scene, call `scene.Run()`. The window that is created is one of FreeGLUT, GLFW or Pygame. The window is selected on module initialization (see Windows subheading).

1.5.1.4 Behaviours

To create your own PyUnity script, create a class that inherits from Behaviour. Usually in Unity, you would put the class in its own file, but Python can't do something like that, so put all of your scripts in one file. Then, to add a script, just use `AddComponent()`. Do not put anything in the `__init__` function, instead put it in `Start()`. The `Update()` function receives one parameter, `dt`, which is the same as `Time.deltaTime`.

1.5.1.5 Windows

The window is provided by one of three providers: GLFW, Pygame and FreeGLUT. When you first import PyUnity, it checks to see if any of the three providers work. The testing order is as above, so Pygame is tested last.

To create your own provider, create a class that has the following methods:

- `__init__`: initiate your window and check to see if it works.
- `start`: start the main loop in your window. The first parameter is `update_func`, which is called when you want to do the OpenGL calls.

Check the source code of any of the window providers for an example. If you have a window provider, then please create a new pull request.

Examples

To run an example, import it like so:

```
>>> from pyunity.examples.example1 import main
Loaded config
Trying FreeGLUT as a window provider
FreeGLUT doesn't work, trying GLFW
GLFW doesn't work, trying Pygame
Using window provider Pygame
Loaded PyUnity version 0.6.0
>>> main()
```

Or from the command line:

```
> python -m pyunity 1
```

The `1` just means to load example 1, and there are 9 examples. To load all examples one by one, do not specify a number. If you want to contribute an example, then please create a new pull request.

1.5.2 Subpackages

1.5.2.1 pyunity.physics package

A basic 3D Physics engine that uses similar concepts to the Unity Engine itself. Only supports non-rotated colliders.

To create an immoveable object, use math.inf or the provided `infinity` variable. This will make the object not be able to move, unless you set an initial velocity. Then, the collider will either push everything it collides with, or bounces it back at twice the speed.

Example

```
>>> cube = GameObject("Cube")
>>> collider = cube.AddComponent(AABBoxCollider)
>>> collider.SetSize(-Vector3.one(), Vector3.one())
>>> collider.velocity = Vector3.right()
```

Configuration

If you want to change some configurations, import the config file like so:

```
>>> from pyunity.physics import config
```

Inside the config file there are some configurations:

- `gravity` is the gravity of the whole system. It only affects Rigidbodies that have `Rigidbody.gravity` set to True.

Submodules

pyunity.physics.config module

pyunity.physics.config.**gravity = Vector3(0, -9.81, 0)**
Gravitational constant (9.81 m/s^2)

pyunity.physics.core module

Core classes of the PyUnity physics engine.

class pyunity.physics.core.**AABBoxCollider**
Bases: *pyunity.physics.core.Collider*

An axis-aligned box collider that cannot be deformed.

min
The corner with the lowest coordinates.

Type Vector3

max
The corner with the highest coordinates.

Type Vector3

pos
The center of the AABBoxCollider

Type Vector3

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

CheckOverlap(*other*)
Checks to see if the bounding box of two colliders overlap.

Parameters **other** (Collider) – Other collider to check against

Returns Whether they are overlapping or not

Return type bool

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

SetSize(*min*, *max*)
Sets the size of the collider.

Parameters

- **min** (*Vector3*) – The corner with the lowest coordinates.
- **max** (*Vector3*) – The corner with the highest coordinates.

collidingWith(*other*)
Check to see if the collider is colliding with another collider.

Parameters **other** (Collider) – Other collider to check against

Returns Collision data

Return type *Manifold* or None

Notes

To check against another AABBoxCollider, the corners are checked to see if they are inside the other collider.

To check against a SphereCollider, the check is as follows:

1. The sphere's center is checked to see if it is inside the AABB.
2. If it is, then the two are colliding.
3. If it isn't, then a copy of the position is clamped to the AABB's bounds.

4. Finally, the distance between the clamped position and the original position is measured.
5. If the distance is bigger than the sphere's radius, then the two are colliding.
6. If not, then they aren't colliding.

class pyunity.physics.core.**CollManager**
Bases: object

Manages the collisions between all colliders.

rigidbodies
Dictionary of rigidbodies andthe colliders on the gameObject that the Rigidbody belongs to

Type dict

dummyRigidbody
A dummy rigidbody used when a GameObject has colliders but no rigidbody. It has infinite mass

Type *Rigidbody*

AddPhysicsInfo(*scene*)
Get all colliders and rigidbodies from a specified scene. This overwrites the collider and rigidbody lists, and so can be called whenever a new collider or rigidbody is added or removed.

Parameters **scene** (Scene) – Scene to search for physics info

Notes

This function will overwrite the pre-existing dictionary of rigidbodies. When there are colliders but no rigidbody is on the GameObject, then they are placed in the dictionary with a dummy Rigidbody that has infinite mass and a default physic material. Thus, they cannot move.

CheckCollisions()
Goes through every pair exactly once, then checks their collisions and resolves them.

GetRestitution(*a*, *b*)
Get the restitution needed for two rigidbodies, based on their combine function

Parameters

- **a** (Rigidbody) – Rigidbody 1
- **b** (Rigidbody) – Rigidbody 2

Returns Restitution

Return type float

Step(*dt*)
Steps through the simulation at a given delta time.

Parameters **dt** (*float*) – Delta time to step

Notes

The simulation is stepped 10 times, so that it is more precise.

class pyunity.physics.core.**Collider**
Bases: *pyunity.core.Component*

Collider base class.

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

class pyunity.physics.core.**Manifold**(*a*, *b*, *normal*, *penetration*)
Bases: object

Class to store collision data.

Parameters

- **a** (Collider) – The first collider
- **b** (Collider) – The second collider
- **normal** (*Vector3*) – The collision normal
- **penetration** (*float*) – How much the two colliders overlap

class pyunity.physics.core.**PhysicMaterial**(*restitution=0.75*, *friction=1*)
Bases: object

Class to store data on a collider's material.

Parameters

- **restitution** (*float*) – Bounciness of the material
- **friction** (*float*) – Friction of the material

restitution
Bounciness of the material

Type float

friction
Friction of the material

Type float

combine
Combining function. -1 means minimum, 0 means average, and 1 means maximum

Type int

class pyunity.physics.core.**Rigidbody**
Bases: *pyunity.core.Component*

Class to let a GameObject follow physics rules.

mass
Mass of the Rigidbody. Defaults to 100

Type int or float

velocity
Velocity of the Rigidbody

Type Vector3

physicMaterial
Physics material of the Rigidbody

Type *PhysicMaterial*

position
Position of the Rigidbody. It is assigned to its GameObject's position when the CollHandler is created

Type Vector3

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

AddForce(*force*)
Apply a force to the center of the Rigidbody.

Parameters **force** (*Vector3*) – Force to apply

Notes

A force is a gradual change in velocity, whereas an impulse is just a jump in velocity.

AddImpulse(*impulse*)
Apply an impulse to the center of the Rigidbody.

Parameters **impulse** (*Vector3*) – Impulse to apply

Notes

A force is a gradual change in velocity, whereas an impulse is just a jump in velocity.

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

Move(*dt*)
Moves all colliders on the GameObject by the Rigidbody's velocity times the delta time.

Parameters **dt** (*float*) – Time to simulate movement by

MovePos(*offset*)
Moves the rigidbody and its colliders by an offset.

Parameters **offset** (*Vector3*) – Offset to move

class pyunity.physics.core.**SphereCollider**
Bases: *pyunity.physics.core.Collider*

A spherical collider that cannot be deformed.

min
The corner with the lowest coordinates.

Type Vector3

max
The corner with the highest coordinates.

Type Vector3

pos
The center of the SphereCollider

Type Vector3

radius
The radius of the SphereCollider

Type Vector3

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

CheckOverlap(*other*)
Checks to see if the bounding box of two colliders overlap.

Parameters **other** (Collider) – Other collider to check against

Returns Whether they are overlapping or not

Return type bool

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

SetSize(*radius*, *offset*)
Sets the size of the collider.

Parameters

- **radius** (*float*) – The radius of the collider.
- **offset** (*Vector3*) – Offset of the collider.

collidingWith(*other*)
Check to see if the collider is colliding with another collider.

Parameters **other** (Collider) – Other collider to check against

Returns Collision data

Return type *Manifold* or None

Notes

To check against another SphereCollider, the distance and the sum of the radii is checked.

To check against an AABBoxColider, the check is as follows:

1. The sphere's center is checked to see if it is inside the AABB.
2. If it is, then the two are colliding.
3. If it isn't, then a copy of the position is clamped to the AABB's bounds.
4. Finally, the distance between the clamped position and the original position is measured.
5. If the distance is bigger than the sphere's radius, then the two are colliding.
6. If not, then they aren't colliding.

pyunity.physics.core.**infinity = inf**
A representation of infinity

1.5.2.2 pyunity.scenes package

Module to create and load Scenes.

Submodules

pyunity.scenes.scene module

Class to load, render and manage GameObjects and their various components.

You should never use the `Scene` class directly, instead, only use the SceneManager class.

class pyunity.scenes.scene.**Scene**(*name*)
Bases: `object`

Class to hold all of the GameObjects, and to run the whole scene.

Parameters **name** (*str*) – Name of the scene

Notes

Create a scene using the SceneManager, and don't create a scene directly using this class.

Add(*gameObject*)
Add a GameObject to the scene.

Parameters **gameObject** (GameObject) – The GameObject to add.

FindGameObjectsByName(*name*)
Finds all GameObjects matching the specified name.

Parameters **name** (*str*) – Name of the GameObject

Returns List of the matching GameObjects

Return type list

FindGameObjectsByTagName(*name*)
Finds all GameObjects with the specified tag name.

Parameters **name** (*str*) – Name of the tag

Returns List of matching GameObjects

Return type list

Raises GameObjectException – When there is no tag named *name*

FindGameObjectsByTagNumber(*num*)
Gets all GameObjects with a tag of tag *num*.

Parameters **num** (*int*) – Index of the tag

Returns List of matching GameObjects

Return type list

Raises GameObjectException – If there is no tag with specified index.

List()
Lists all the GameObjects currently in the scene.

Remove(*gameObject*)
Remove a GameObject from the scene.

Parameters **gameObject** (GameObject) – GameObject to remove.

Raises PyUnityException – If the specified GameObject is the Main Camera, or if the specified GameObject is not part of the Scene.

Start()
Start the internal parts of the Scene.

inside_frustrum(*renderer*)
Check if the renderer's mesh can be seen by the main camera.

Parameters **renderer** (MeshRenderer) – Renderer to test

Returns If the mesh can be seen

Return type bool

start_scripts()
Start the scripts in the Scene.

update()
Updating function to pass to the window provider.

update_scripts()
Updates all scripts in the scene.

pyunity.scenes.sceneManager module

Module that manages creation and deletion of Scenes.

pyunity.scenes.sceneManager.**AddScene**(*sceneName*)
Add a scene to the SceneManager. Pass in a scene name to create a scene.

Parameters **sceneName** (*str*) – Name of the scene

Returns Newly created scene

Return type *Scene*

Raises PyUnityException – If there already exists a scene called *sceneName*

pyunity.scenes.sceneManager.**CurrentScene**()
Gets the current scene being run

pyunity.scenes.sceneManager.**GetSceneByIndex**(*index*)
Get a scene by its index.

Parameters **index** (*int*) – Index of the scene

Returns Specified scene at index *index*

Return type *Scene*

Raises IndexError – If there is no scene at the specified index

pyunity.scenes.sceneManager.**GetSceneByName**(*name*)
Get a scene by its name.

Parameters **name** (*str*) – Name of the scene

Returns Specified scene with name of *name*

Return type *Scene*

Raises `KeyError` – If there is no scene called *name*

`pyunity.scenes.sceneManager.`**`LoadScene`**`(`*`scene`*`)`
Load a scene by a reference.

Parameters **`scene`** (`Scene`) – Scene to be loaded

Raises

- `TypeError` – When the scene is not of type *Scene*
- `PyUnityException` – When the scene is not part of the SceneManager. This is checked because the SceneManager has to make some checks before the scene can be run.

`pyunity.scenes.sceneManager.`**`LoadSceneByIndex`**`(`*`index`*`)`
Loads a scene by its index of when it was added to the SceneManager.

Parameters **`index`** (*`int`*) – Index of the scene

Raises

- `TypeError` – When the provided index is not an integer
- `PyUnityException` – When there is no scene at index `index`

`pyunity.scenes.sceneManager.`**`LoadSceneByName`**`(`*`name`*`)`
Loads a scene by its name.

Parameters **`name`** (*`str`*) – Name of the scene

Raises

- `TypeError` – When the provided name is not a string
- `PyUnityException` – When there is no scene named `name`

`pyunity.scenes.sceneManager.`**`RemoveScene`**`(`*`scene`*`)`
Removes a scene from the SceneManager.

Parameters **`scene`** (`Scene`) – Scene to remove

Raises

- `TypeError` – If the provided scene is not type Scene
- `PyUnityException` – If the scene is not part of the SceneManager

1.5.2.3 pyunity.window package

pyunity.window

A module used to load the window providers.

Windows

The window is provided by one of three providers: GLFW, Pygame and FreeGLUT. When you first import PyUnity, it checks to see if any of the three providers work. The testing order is as above, so FreeGLUT is tested last.

To create your own provider, create a class that has the following methods:

- **__init__: initiate your window and** check to see if it works.
- **start: start the main loop in your** window. The first parameter is `update_func`, which is called when you want to do the OpenGL calls.

Check the source code of any of the window providers for an example. If you have a window provider, then please create a new pull request.

`pyunity.window.`**`GetWindowProvider`**`()`
Gets an appropriate window provider to use

`pyunity.window.`**`glfwCheck`**`()`
Checks to see if GLFW works

`pyunity.window.`**`glutCheck`**`()`
Checks to see if FreeGLUT works

`pyunity.window.`**`pygameCheck`**`()`
Checks to see if Pygame works

Submodules

pyunity.window.glfwWindow module

Class to create a window using GLFW.

class `pyunity.window.glfwWindow.`**`Window`**(*config*, *name*, *resize*)
Bases: `object`

A window provider that uses GLFW.

Raises `PyUnityException` – If the window creation fails

`start`(*update_func*)
Start the main loop of the window.

Parameters **`update_func`** (*`function`*) – The function that calls the OpenGL calls.

pyunity.window.glutWindow module

Class to create a window using FreeGLUT.

class `pyunity.window.glutWindow.`**`Window`**(*config*, *name*, *resize*)
Bases: `object`

A window provider that uses FreeGLUT.

`display`()
Function to render in the scene.

`schedule_update`(*t*)
Starts the window refreshing.

`start`(*update_func*)
Start the main loop of the window.

Parameters **`update_func`** (*`function`*) – The function that calls the OpenGL calls.

pyunity.window.pygameWindow module

Class to create a window using Pygame.

class pyunity.window.pygameWindow.**Window**(*config*, *name*, *resize*)
Bases: object

A window provider that uses PyGame.

start(*update_func*)
Start the main loop of the window.

Parameters **update_func** (*function*) – The function that calls the OpenGL calls.

1.5.3 Submodules

1.5.3.1 pyunity.audio module

Classes to manage the playback of audio. It uses the pygame.mixer library, and if it cannot be initialized, then dummy classes are made to prevent stop of program. A variable in the config module called audio will be set to False if this happens.

class pyunity.audio.**AudioClip**(*file*)
Bases: object

Class to store information about an audio file.

file
Name of the file

Type str

sound
Sound file that can be played with a pygame.mixer.Channel. Only set when the AudioClip is in an AudioSource n a running scene.

Type pygame.mixer.Sound

SetSound(*file*)
Changes the audio file.

Parameters **file** (*str*) – Name of the audio file Must be a .ogg file, which can work on any platform.

Raises

- PyUnityException – If the provided file is not an OGG audio file
- TypeError – If the provided file is not of type str

class pyunity.audio.**AudioSource**
Bases: *pyunity.core.Component*

Manages playback on an AudioSource.

clip
Clip to play. Best way to set the clip is to use the SetClip function.

Type *AudioClip*

PlayOnStart
Whether it plays on start or not.

Type bool

Loop
Whether it loops or not. This is not fully supported.

Type bool

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

Pause()
Pauses the current clip.

Play()
Plays the current clip.

SetClip(*clip*)
Sets the clip to play.

Parameters **clip** (AudioClip) – Clip to set

Raises TypeError – If the provided clip is not of type AudioClip

Stop()
Stop the current clip.

UnPause()
Unpauses the current clip.

1.5.3.2 pyunity.core module

Core classes for the PyUnity library.

This module has some key classes used throughout PyUnity, and have to be in the same file due to references both ways. Usually when you create a scene, you should never create Components directly, instead add them with AddComponent.

Example

To create a GameObject with 2 children, one of which has its own child, and all have MeshRenderers:

```
>>> from pyunity import * # Import
Loaded config
Trying GLFW as a window provider
GLFW doesn't work, trying Pygame
Trying Pygame as a window provider
Using window provider Pygame
Loaded PyUnity version 0.6.0
>>> mat = Material(Color(255, 0, 0)) # Create a default material
>>> root = GameObject("Root") # Create a root GameObjects
>>> child1 = GameObject("Child1", root) # Create a child
>>> child1.transform.localPosition = Vector3(-2, 0, 0) # Move the child
>>> renderer = child1.AddComponent(MeshRenderer) # Add a renderer
```

(continues on next page)

(continued from previous page)

```
>>> renderer.mat = mat # Add a material
>>> renderer.mesh = Mesh.cube(2) # Add a mesh
>>> child2 = GameObject("Child2", root) # Create another child
>>> renderer = child2.AddComponent(MeshRenderer) # Add a renderer
>>> renderer.mat = mat # Add a material
>>> renderer.mesh = Mesh.quad(1) # Add a mesh
>>> grandchild = GameObject("Grandchild", child2) # Add a grandchild
>>> grandchild.transform.localPosition = Vector3(0, 5, 0) # Move the grandchild
>>> renderer = grandchild.AddComponent(MeshRenderer) # Add a renderer
>>> renderer.mat = mat # Add a material
>>> renderer.mesh = Mesh.cube(3) # Add a mesh
>>> root.transform.List() # List all GameObjects
/Root
/Root/Child1
/Root/Child2
/Root/Child2/Grandchild
>>> child1.components # List child1's components
[<Transform position=Vector3(-2, 0, 0) rotation=Quaternion(1, 0, 0, 0)␣
↪scale=Vector3(1, 1, 1) path="/Root/Child1">, <pyunity.core.MeshRenderer object at␣
↪0x0A929460>]
>>> child2.transform.children # List child2's children
[<Transform position=Vector3(0, 5, 0) rotation=Quaternion(1, 0, 0, 0) scale=Vector3(1,
↪ 1, 1) path="/Root/Child2/Grandchild">]
```

class pyunity.core.**Component**

Bases: object

Base class for built-in components.

gameObject

GameObject that the component belongs to.

Type *GameObject*

transform

Transform that the component belongs to.

Type *Transform*

AddComponent(*component*)

Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

GetComponent(*component*)

Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

class pyunity.core.**GameObject**(*name='GameObject'*, *parent=None*)

Bases: object

Class to create a GameObject, which is an object with components.

Parameters

- **name** (*str, optional*) – Name of GameObject
- **parent** (GameObject *or None*) – Parent of GameObject

name
Name of the GameObject

Type str

components
List of components

Type list

tag
Tag that the GameObject has (defaults to tag 0 or Default)

Type *Tag*

transform
Transform that belongs to the GameObject

Type *Transform*

AddComponent(*componentClass*)
Adds a component to the GameObject. If it is a transform, set GameObject's transform to it.

Parameters **componentClass** (Component) – Component to add. Must inherit from Component

GetComponent(*componentClass*)
Gets a component from the GameObject. Will return first match. For all matches, do a manual loop.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

class pyunity.core.**Light**
Bases: *pyunity.core.SingleComponent*

Component to hold data about the light in a scene.

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

class pyunity.core.**Material**(*color*, *texture=None*)
Bases: object

Class to hold data on a material.

color
A list or tuple of 4 floats that make up a RGBA color.

Type list or tuple

class pyunity.core.**MeshRenderer**
Bases: *pyunity.core.SingleComponent*

Component to render a mesh at the position of a transform.

mesh
Mesh that the MeshRenderer will render.

Type *Mesh*

mat
Material to use for the mesh

Type *Material*

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

Render()
Render the mesh that the MeshRenderer has.

class pyunity.core.**SingleComponent**
Bases: *pyunity.core.Component*

Represents a component that can be added only once.

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

class pyunity.core.**Tag**(*tagNumOrName*)
Bases: object

Class to group GameObjects together without referencing the tags.

Parameters **tagNumOrName** (*str or int*) – Name or index of the tag

Raises

- ValueError – If there is no tag name
- IndexError – If there is no tag at the provided index
- TypeError – If the argument is not a str or int

tagName
Tag name

Type str

tag
Tag index of the list of tags

Type int

classmethod AddTag(*name*)
Add a new tag to the tag list.

Parameters **name** (*str*) – Name of the tag

Returns The tag index

Return type int

tags = ['Default']
List of current tags

class pyunity.core.**Transform**
Bases: *pyunity.core.SingleComponent*

Class to hold data about a GameObject's transformation.

gameObject
GameObject that the component belongs to.

Type *GameObject*

localPosition
Position of the Transform in local space.

Type Vector3

localRotation
Rotation of the Transform in local space.

Type *Quaternion*

localScale
Scale of the Transform in local space.

Type Vector3

parent
Parent of the Transform. The hierarchical tree is actually formed by the Transform, not the GameObject.

Type *Transform* or None

children
List of children

Type list

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

FullPath()
Gets the full path of the Transform.

Returns The full path of the Transform.

Return type str

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

List()
Prints the Transform's full path from the root, then lists the children in alphabetical order. This results in a nice list of all GameObjects.

ReparentTo(*parent*)
Reparent a Transform.

Parameters **parent** (Transform) – The parent to reparent to.

eulerAngles
Rotation of the Transform in world space. It is measured in degrees around x, y, and z.

localEulerAngles
Rotation of the Transform in local space. It is measured in degrees around x, y, and z.

position
Position of the Transform in world space.

rotation
Rotation of the Transform in world space.

scale
Scale of the Transform in world space.

1.5.3.3 pyunity.errors module

Module for all exceptions and warnings related to PyUnity.

exception pyunity.errors.**ComponentException**
Bases: *pyunity.errors.PyUnityException*

Class for PyUnity exceptions relating to components.

with_traceback()
Exception.with_traceback(tb) – set self.__traceback__ to tb and return self.

exception pyunity.errors.**GameObjectException**
Bases: *pyunity.errors.PyUnityException*

Class for PyUnity exceptions relating to GameObjects.

with_traceback()
Exception.with_traceback(tb) – set self.__traceback__ to tb and return self.

exception pyunity.errors.**PyUnityException**
Bases: Exception

Base class for PyUnity exceptions.

with_traceback()
Exception.with_traceback(tb) – set self.__traceback__ to tb and return self.

1.5.3.4 pyunity.files module

Module to represent files.

class pyunity.files.**Texture2D**(*path*)
Bases: object

Class to represent a texture.

load()
Loads the texture and sets up an OpenGL texture name.

use()
Binds the texture for usage. The texture is reloaded if it hasn't already been.

1.5.3.5 pyunity.input module

Module to manage getting input from window providers.

This will be imported as `pyunity.Input`.

class pyunity.input.**Code**(*vals*)
Bases: object

Represents a key on a keyboard. Do not instantiate this class.

pyunity.input.**GetKey**(*keycode*)
Check if key has been pressed.

Parameters **keycode** (KeyCode) – Key to query

Returns 1 if pressed and 0 if not pressed.

Return type int

pyunity.input.**GetKeyDown**(*keycode*)
Check if key was pressed down this frame.

Parameters **keycode** (KeyCode) – Key to query

Returns 1 if pressed and 0 if not pressed.

Return type int

pyunity.input.**GetKeyUp**(*keycode*)
Check if key was released this frame.

Parameters **keycode** (KeyCode) – Key to query

Returns 1 if released and 0 if not released.

Return type int

class pyunity.input.**KeyCode**
Bases: object

KeyCodes to reference each key on the keyboard. Do not instantiate this class.

1.5.3.6 pyunity.loader module

Utility functions related to loading and saving PyUnity meshes and scenes.

This will be imported as `pyunity.Loader`.

pyunity.loader.**LoadMesh**(*filename*)
Loads a .mesh file generated by *SaveMesh*. It is optimized for faster loading.

Parameters **filename** (*str*) – Name of file relative to the cwd

Returns Generated mesh

Return type *Mesh*

pyunity.loader.**LoadObj**(*filename*)
Loads a .obj file to a PyUnity mesh.

Parameters **filename** (*str*) – Name of file

Returns A mesh of the object file

Return type *Mesh*

pyunity.loader.**LoadScene**(*sceneName*, *filePath=None*)
Load a scene from a file. Uses pickle.

Parameters **sceneName** (*str*) – Name of the scene, without the .scene extension

Returns Loaded scene

Return type *Scene*

Notes

If there already is a scene called *sceneName*, then no scene will be added.

class pyunity.loader.**Primitives**
Bases: object

Primitive preloaded meshes. Do not instantiate this class.

pyunity.loader.**SaveMesh**(*mesh*, *name*, *filePath=None*)
Saves a mesh to a .mesh file for faster loading.

Parameters

- **mesh** (Mesh) – Mesh to save
- **name** (*str*) – Name of the mesh
- **filePath** (*str, optional*) – Pass in *__file__* to save in directory of script, otherwise pass in the path of where you want to save the file. For example, if you want to save in C:Downloads, then give "C:Downloadsmesh.mesh". If not specified, then the mesh is saved in the cwd.

pyunity.loader.**SaveScene**(*scene*, *filePath=None*)
Save a scene to a file. Uses pickle.

Parameters

- **scene** (Scene) – Scene to save
- **filePath** (*str, optional*) – Pass in *__file__* to save in directory of script, otherwise pass in a directory. If not specified, then the scene is saved in the cwd.

1.5.3.7 pyunity.logger module

Utility functions to log output of PyUnity.

This will be imported as pyunity.Logger.

class pyunity.logger.**Level**(*abbr*, *name*)
Bases: object

Represents a level or severity to log. You should never instantiate this directly, instead use one of *Logging.OUTPUT*, *Logging.INFO*, *Logging.DEBUG*, *Logging.ERROR* or *Logging.WARN*.

pyunity.logger.**Log**(**message*)
Logs a message with level OUTPUT.

pyunity.logger.**LogException**(*e*)
Log an exception.

Parameters **e** (*Exception*) – Exception to log

pyunity.logger.**LogLine**(*level*, **message*)
Logs a line in *latest.log* found in these two locations: Windows: `%appdata%\PyUnity\Logs\latest.log` Other: `/tmp/pyunity/logs/latest.log`

Parameters **level** (Level) – Level or severity of log.

pyunity.logger.**LogSpecial**(*level*, *type*)
Log a line of level *level* with a special line that is generated at runtime.

Parameters

- **level** (Level) – Level of log
- **type** (Special) – The special line to log

pyunity.logger.**Save**()
Saves a new log file with a timestamp of initializing PyUnity for the first time.

class pyunity.logger.**Special**(*func*)
Bases: object

Class to represent a special line to log. You should never instantiate this class, instead use one of *Logger.RUNNING_TIME*.

1.5.3.8 pyunity.meshes module

Module for meshes created at runtime.

class pyunity.meshes.**Mesh**(*verts*, *triangles*, *normals*, *texcoords=None*)
Bases: object

Class to create a mesh for rendering with a MeshRenderer

Parameters

- **verts** (*list*) – List of Vector3's containing each vertex
- **triangles** (*list*) – List of ints containing triangles joining up the vertices. Each int is the index of a vertex above.
- **normals** (*list*) – List of Vector3's containing the normal of each vertex.

verts
List of Vector3's containing each vertex

Type list

triangles
List of ints containing triangles joining up the vertices. Each int is the index of a vertex above.

Type list

normals
List of Vector3's containing the normal of each vertex.

Type list

texcoords
List of lists containing the texture coordinate of each vertex.

Type list

Notes

When a mesh is created, you cannot edit any of the attributes to update the mesh while a scene is running. Instead you will have to instantiate a new mesh:

```
>>> mesh = Mesh.cube(2)
>>> mesh2 = Mesh(mesh.verts, mesh.triangles, mesh.normals, mesh.texcoords)
>>> # Or this:
>>> mesh2 = mesh.copy()
```

copy()
Create a copy of the current Mesh.

Returns Copy of the mesh

Return type *Mesh*

static cube(*size*)
Creates a cube mesh.

Parameters **size** (*float*) – Side length of cube

Returns A cube centered at Vector3(0, 0, 0) that has a side length of `size`

Return type *Mesh*

static double_quad(*size*)
Creates a two-sided quadrilateral mesh.

Parameters **size** (*float*) – Side length of quad

Returns A double-sided quad centered at Vector3(0, 0) with side length of `size`.

Return type *Mesh*

static quad(*size*)
Creates a quadrilateral mesh.

Parameters **size** (*float*) – Side length of quad

Returns A quad centered at Vector3(0, 0) with side length of `size` facing in the direction of the negative z axis.

Return type *Mesh*

1.5.3.9 pyunity.quaternion module

Class to represent a rotation in 3D space.

class pyunity.quaternion.**Quaternion**(*w*, *x*, *y*, *z*)
Bases: `object`

Class to represent a 4D Quaternion.

Parameters

- **w** (*float*) – Real value of Quaternion
- **x** (*float*) – x coordinate of Quaternion
- **y** (*float*) – y coordinate of Quaternion
- **z** (*float*) – z coordinate of Quaternion

static Euler(*vector*)
Create a quaternion using Euler rotations.

Parameters **vector** (*Vector3*) – Euler rotations

Returns Generated quaternion

Return type *Quaternion*

static FromAxis(*angle*, *a*)
Create a quaternion from an angle and an axis.

Parameters

- **angle** (*float*) – Angle to rotate
- **a** (*Vector3*) – Axis to rotate about

RotateVector(*vector*)
Rotate a vector by the quaternion

angleAxisPair
Gets or sets the angle and axis pair.

Notes

When getting, it returns a tuple in the form of `(angle, x, y, z)`. When setting, assign like `q.eulerAngles = (angle, vector)`.

conjugate
The conjugate of a unit quaternion

copy()
Deep copy of the Quaternion.

Returns A deep copy

Return type *Quaternion*

eulerAngles
Gets or sets the Euler Angles of the quaternion

static identity()
Identity quaternion representing no rotation

normalized()
A normalized Quaternion, for rotations. If the length is 0, then the identity quaternion is returned.

Returns A unit quaternion

Return type *Quaternion*

1.5.3.10 pyunity.render module

Classes to aid in rendering in a Scene.

class pyunity.render.**Camera**
Bases: *pyunity.core.SingleComponent*

Component to hold data about the camera in a scene.

fov
Fov in degrees measured horizontally. Defaults to 90.

Type int

near
Distance of the near plane in the camera frustrum. Defaults to 0.05.

Type float

far
Distance of the far plane in the camera frustrum. Defaults to 100.

Type float

clearColor
Tuple of 4 floats of the clear color of the camera. Defaults to (.1, .1, .1, 1). Color mode is RGBA.

Type tuple

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

Resize(*width*, *height*)
Resizes the viewport on screen size change.

Parameters

- **width** (*int*) – Width of new window
- **height** (*int*) – Height of new window

pyunity.render.**convert**(*type*, *list*)
Converts a Python array to a C type from ctypes.

Parameters

- **type** (*_ctypes.PyCSimpleType*) – Type to cast to.
- **list** (*list*) – List to cast

Returns A C array

Return type Any

pyunity.render.**gen_array**()
Generate a vertex array object.

Returns

A vertex buffer object of floats. Has 3 elements:

vertex # normal # texcoord x, y, z, a, b, c, u, v

Return type Any

pyunity.render.**gen_buffers**(*mesh*)
Create buffers for a mesh.

Parameters **mesh** (Mesh) – Mesh to create buffers for

Returns Tuple containing a vertex buffer object and an index buffer object.

Return type tuple

1.5.3.11 pyunity.script module

Module to manage loading scripts from files.

class pyunity.script.**Behaviour**
Bases: *pyunity.core.Component*

Base class for behaviours that can be scripted.

gameObject
GameObject that the component belongs to.

Type *GameObject*

transform
Transform that the component belongs to.

Type *Transform*

AddComponent(*component*)
Calls *AddComponent* on the component's GameObject.

Parameters **component** (Component) – Component to add. Must inherit from Component

GetComponent(*component*)
Calls *GetComponent* on the component's GameObject.

Parameters **componentClass** (Component) – Component to get. Must inherit from Component

Start()
Called every time a scene is loaded up.

Update(*dt*)
Called every frame.

Parameters **dt** (*float*) – Time since last frame, sent by the scene that the Behaviour is in.

pyunity.script.**CheckScript**(*text*)
Check if text is a valid script for PyUnity.

Parameters **text** (*list*) – List of lines

Returns If script is valid or not.

Return type bool

Notes

This function checks each line to see if it matches at least one of these criteria:

1. The line is an import statement
2. The line is just whitespace or blank
3. The line is just a comment preceded by whitespace or nothing
4. The line is a class definition
5. The line has an indentation at the beginning

These checks are essential to ensure no malicious code is run to break the PyUnity engine.

pyunity.script.**LoadScripts**(*path*)
Loads all scripts found in path.

Parameters **path** (*Pathlike*) – A path to a folder containing all the scripts

Returns A module that contains all the imported scripts

Return type ModuleType

Notes

This function will add a module to sys.modules that is called PyUnityScripts, and can be imported like any other module. The module will also have a variable called __pyunity__ which shows that it is from PyUnity and not a real module. If an existing module named PyUnityScripts is present and does not have the __pyunity__ variable set, then a warning will be issued and it will be replaced.

1.5.3.12 pyunity.vector3 module

A class to represent a 3D point in space, with a lot of utility functions.

CHAPTER 2

Indices and tables

- genindex
- modindex
- search

Python Module Index

p

Index

D

E

F

G

I

K

L

M

N

P

Q

R

S

T

U

V

W