PyUnity

Release 0.1.0

Nov 09, 2020

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, use pip:

> pip install pyunity

Its dependencies are just OpenGL, Pygame and GLFW.

Alternatively, you can clone the repository here. Then run setup.py:

> python setup.py install

Sometimes on Linux machines, Pygame cannot be installed via pip: in that case, use the package manager. For example, on Ubuntu:

> sudo apt-get install python3-pygame

1.1 Releases

1.1.1 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

1.1.2 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

1.1.3 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

1.1.4 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 need 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 port 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 will belong to a GameObject. A GameObject is a named object that has lots of different things on it that will affect the GameObject and other GameObjects. Each GameObject has its own Components, which are like the hardware in a computer. These Components can do all sorts of things.

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 can also have a child. This child is also a GameObject's component. 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 0.1.0
```

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

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 `localEulerAngles` 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 3 pieces of data: the vertices (or points), the faces and the normals. Normals are just vectors saying which way the face is pointing.

For this, we don't want to have 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((255, 0, 0))
```

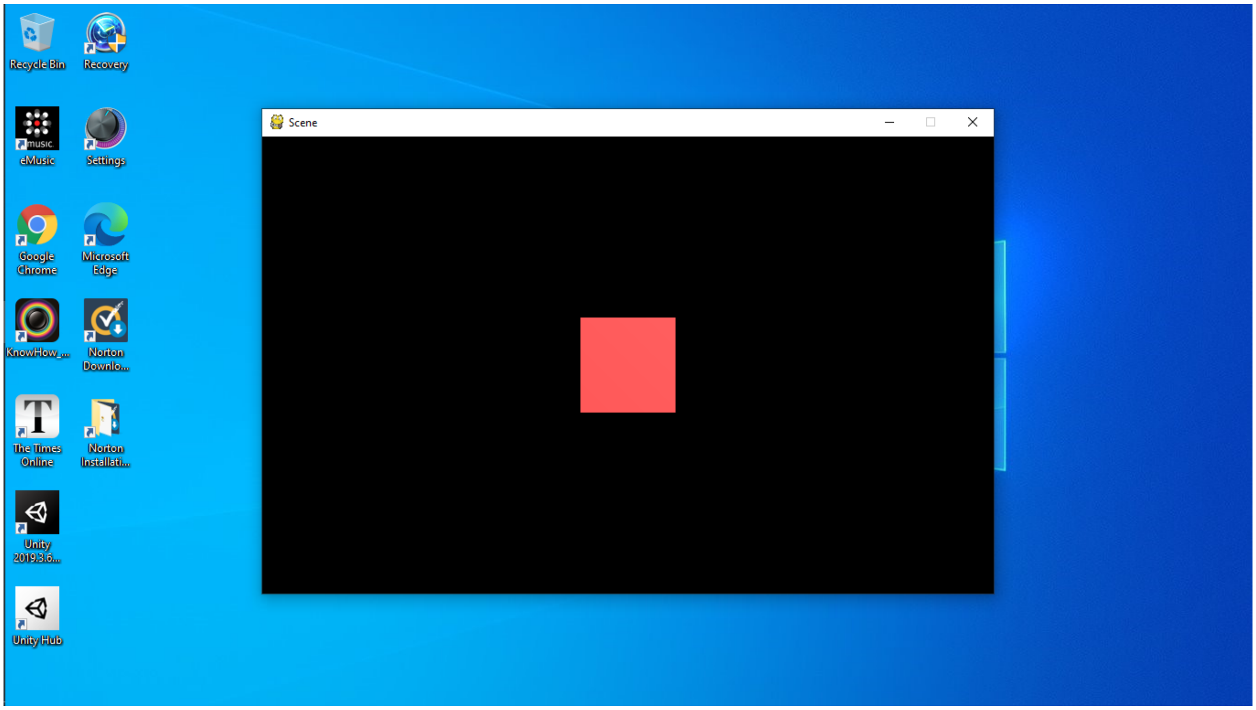
Here I used a red material. Finally we need to add the cube to our scene, otherwise we can't see it in the window:

```
>>> 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 0.1.0
>>> 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((255, 0, 0))
>>> scene.Add(cube)
```

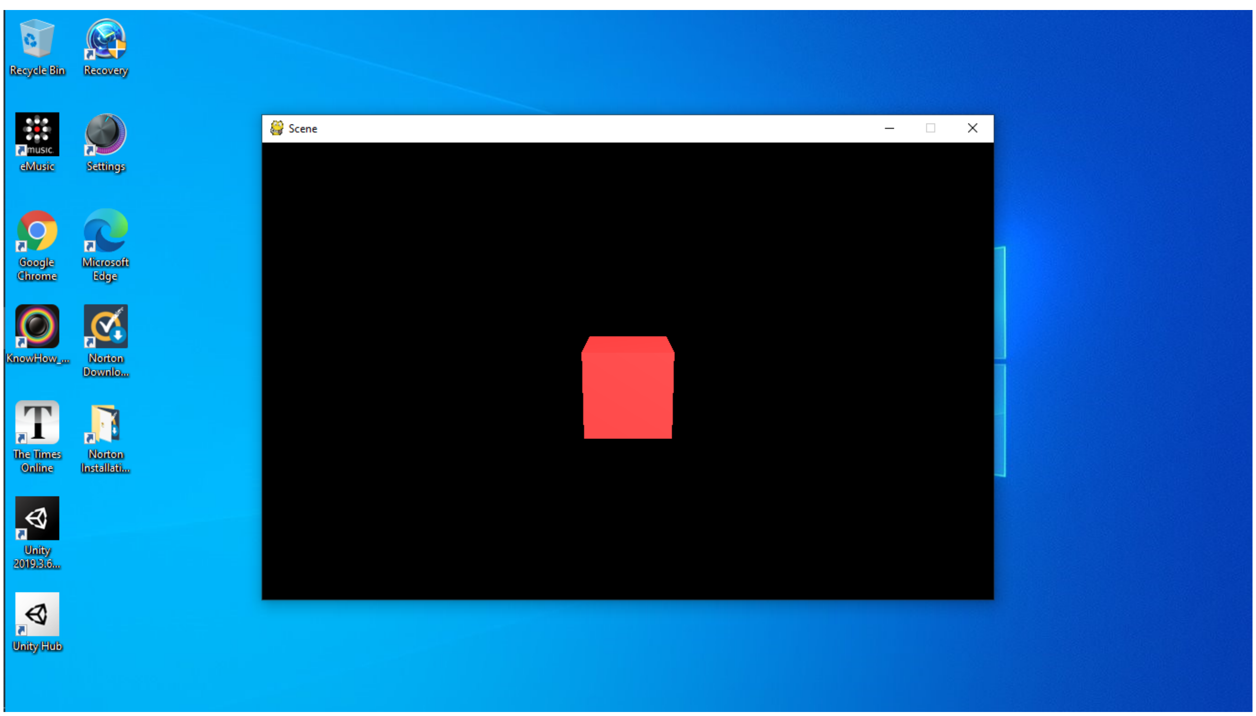
Then, to run our scene, we use `scene.Run()`. And now we have a cube:



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:



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 has passed since 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
```

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```
    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((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)
```

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```
            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 License

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1.4 API reference

1.4.1 PyUnity package

1.4.1.1 Version 0.1.0 (in development)

A Python implementation of the Unity Engine that supports different types of windows. Still in development.

Importing

The first step in using PyUnity is always importing 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 FreeGLUT as a window provider FreeGLUT doesn't work, trying GLFW GLFW doesn't work, trying Pygame Using window provider Pygame Loaded PyUnity version 0.1.0

If debugging is off, there is no output:

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

Scenes

All PyUnity projects start with a scene. There is no way to change between scenes yet.

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((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).

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`.

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 0.1.0
>>> main()
```

Or from the command line:

> > python -m pyunity 1

The `1` just means to load example 1, and there are 6 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.

`pyunity.`**`timer`**(*func*)
: Use this decorator to print how long a function takes.

1.4.1.2 Subpackages

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 *gravity* set to True.

Submodules

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*

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

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.

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*

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.

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*

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

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

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 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.

pyunity.window.**LoadWindowProvider**()
Loads 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 pyunity.window.glfwWindow.**Window**(*size*, *name*)
Bases: object

A window provider that uses GLFW.

Raises pyunityException – If the window creation fails

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

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

pyunity.window.glutWindow module

class pyunity.window.glutWindow.**Window**(*size*, *name*)
Bases: object

A window provider that uses FreeGLUT.

display()
Function to render in the scene.

schedule_update(*t*)
Starts the window refreshing.

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

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

pyunity.window.pygameWindow module

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

A window provider that uses PyGame.

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

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

1.4.1.3 Submodules

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 0.1.0
>>> mat = Material((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
>>> 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(2, 2, 2) path="/Root/Child1">, <pyunity.core.MeshRenderer object at␣
↪0x0B14FCB8>]
>>> child2.transform.children # List child2's children
[<Transform position=Vector3(0, 5, 0) rotation=Quaternion(1, 0, 0, 0) scale=Vector3(3,
↪ 3, 3) path="/Root/Child2/Grandchild">]
```

class pyunity.core.**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*

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.

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

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

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

parent
Parent GameObject, if GameObject has one

Type *GameObject* or None

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.Component*

Component to hold data about the light in a scene.

class pyunity.core.**Material**(*color*)
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.Component*

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*

render()
Render the mesh that the MeshRenderer has.

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

static AddTag(*self*, *name*)
Add a new tag to the tag list.

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

Returns The tag index

Return type int

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

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

FullPath()
Gets the full path of the Transform.

Returns The full path of the Transform.

Return type str

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.

pyunity.core.**tags = ['Default']**
List of current tags

pyunity.errors module

Module for all exceptions related to PyUnity.

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

Class for PyUnity exceptions relating to components.

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

Class for PyUnity exceptions relating to GameObjects.

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

Base class for PyUnity exceptions.

pyunity.loader module

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

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

capsule = <pyunity.meshes.Mesh object>

cube = <pyunity.meshes.Mesh object>

cylinder = <pyunity.meshes.Mesh object>

double_quad = <pyunity.meshes.Mesh object>

quad = <pyunity.meshes.Mesh object>

sphere = <pyunity.meshes.Mesh object>

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.

pyunity.meshes module

Module for prebuilt meshes.

class pyunity.meshes.**Mesh**(*verts*, *triangles*, *normals*)

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 vertexes. Each int is the index of a vertex above.
- **normals** (*list*) – List of Vector3's containing the normal of each triangle. Unlike Unity, PyUnity uses normals per triangle.

verts

List of Vector3's containing each vertex

Type list

triangles

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

Type list

normals

List of Vector3's containing the normal of each triangle. Unlike Unity, PyUnity uses normals per triangle.

Type list

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* facing in the direction of the negative z axis.

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*

pyunity.scene module

class pyunity.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** (*GameObejct*) – 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.

Run()
Run the scene and create a window for it.

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

no_interactive()

render()
Renders all GameObjects with MeshRenderers.

start_scripts()
Start the scripts in the Scene.

transform(*transform*)
Transform the matrix by a specified transform.

Parameters **transform** (Transform) – Transform to move

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

update_scripts()
Updates all scripts in the scene.

pyunity.scene.**SceneManager = <pyunity.scene.SceneManager object>**
Manages all scene additions and changes

pyunity.vector3 module

A class to store x, y and z values, with a lot of utility functions.

class pyunity.vector3.**Vector3**(*x_or_list=None*, *y=None*, *z=None*)
Bases: object

static back()
Vector3 pointing in the negative z axis

clamp(*min*, *max*)
Clamps a vector between two other vectors, resulting in the vector being as close to the edge of a bounding box created as possible.

Parameters

- **min** (Vector3) – Min vector

- **max** (Vector3) – Max vector

copy()
Makes a copy of the Vector3

Returns A shallow copy of the vector

Return type *Vector3*

cross(*other*)
Cross product of two vectors

Parameters **other** (Vector3) – Other vector

Returns Cross product of the two vectors

Return type *Vector3*

dot(*other*)
Dot product of two vectors.

Parameters **other** (Vector3) – Other vector

Returns Dot product of the two vectors

Return type float

static down()
Vector3 pointing in the negative y axis

static forward()
Vector3 pointing in the positive z axis

get_dist_sqrd(*other*)
The distance between this vector and the other vector, squared. It is more efficient to call this than to call *get_distance* and square it.

Returns The squared distance

Return type float

get_distance(*other*)
The distance between this vector and the other vector

Returns The distance

Return type float

get_length_sqrd()
Gets the length of the vector squared. This is much faster than finding the length.

Returns The length of the vector squared

Return type float

int_tuple
Return the x, y and z values of this vector as ints

static left()
Vector3 pointing in the negative x axis

length
Gets or sets the magnitude of the vector

normalize_return_length()
Normalize the vector and return its length before the normalization

Returns The length before the normalization

Return type float

normalized()
Get a normalized copy of the vector, or Vector3(0, 0, 0) if the length is 0.

Returns A normalized vector

Return type *Vector3*

static one()
A vector of ones

static right()
Vector3 pointing in the postive x axis

rounded
Return the x, y and z values of this vector rounded to the nearest integer

static up()
Vector3 pointing in the postive y axis

static zero()
A vector of zero length

pyunity.vector3.**clamp**(*x*, *_min*, *_max*)
Clamp a value between a minimum and a maximum

pyunity.quaternion module

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*

CHAPTER 2

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Python Module Index

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