AssimpKit Documentation

Release 1.0

Deepak Surti

Sep 19, 2017

User Documentation

AssimpKit is an open source library hosted on Github that converts 30 3D file formats using Assimp to Scene Kit scenes.

The main documentation for this library is split into:

- *User Documentation*
- *Developer Documentation*
- *Dessert*

CHAPTER 1

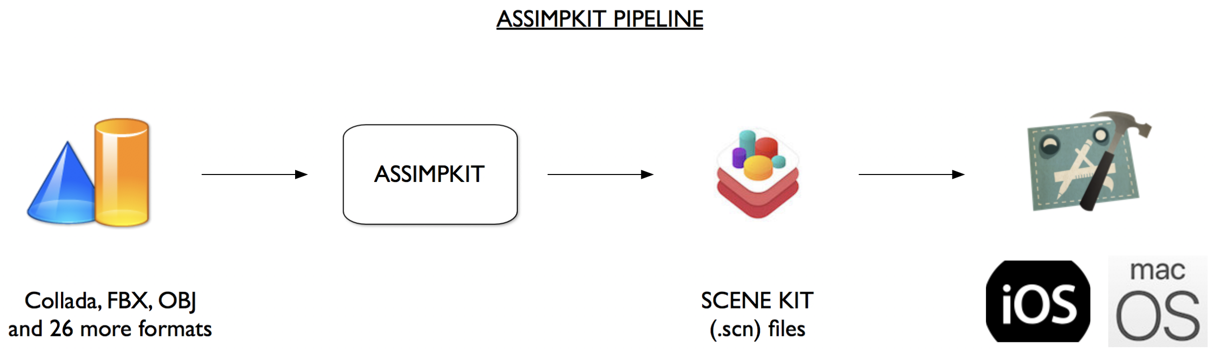
AssimpKit at a glance

Introduction

AssimpKit is a cross platform library (macOS, iOS) that coverts the files supported by Assimp to Scene Kit scenes.

Why AssimpKit

AssimpKit currently supports 29 file formats that allows you to use these files directly in SceneKit without having to convert these to any of the files that SceneKit or Model IO supports thereby saving an extra step in your asset pipeline.



File formats supported

Currently AssimpKit supports the following file formats:

3d, 3ds, ac, b3d, bvh, cob, dae, dxf, ifc, irr, md2, md5mesh, md5anim, m3sd, nff, obj, off, mesh.xml, ply, q3o, q3s, raw, smd, stl, wrl, xgl, zgl, fbx, md3

CHAPTER 2

Getting Started

Requirements

- Xcode 8.0 or later
- ObjC 2.0
- iOS 10.0 or later
- macOS 10.11 or later

Installation

AssimpKit is Carthage compatible.

To install with Carthage, follow the instructions on Carthage.

Your application Cartfile should have the following entry for AssimpKit:

```
github "dmsurti/AssimpKit"
```

After carthage update, add the appropriate platform framework (iOS, macOS) to your project. The frameworks are placed in iOS and Mac subdirectories under the `Carthage/Build` directory of your project.

Important Build Setting for iOS applications only

If you are developing an iOS application, set the `Enable Bitcode` under `Build Settings->Build Options` of your target to NO.

API Overview

Table below lists the important clasess in AssimpKit.

Class/Category	Description
SCNScene(AssimpImport)	The container for all SceneKit content, loaded with assimp.
SCNNode(AssimpImport)	The node category to add animation to a node.

You can use the `AssimpImport` category defined on `SCNScene` to load scenes. The post processing steps that the assimp library can apply to the imported data are listed at AssimpKitPostProcessSteps.

The imported SCNAssimpScene contains a model `SCNScene` which represents the 3D model and the skeleton if it contains one, in addition to the array of animations each represented by an `SCNScene` object. The SCNAssimpScene also contains the key names for the animations which can be used when adding, removing animations.

The `AssimpImport` category defined on SCNNode+AssimpImport also contain a method to add a skeltal animation.

For more information, refer to the *Tutorial*.

CHAPTER 3

Tutorial

Install the `AssimpKit.framework` following the *Installation* guide.

It is recommended to go through the *API Overview*, before working through the tutorial.

Load a 3D model

Load a Scene which is a part of your app bundle

You can load a scene which is a part of your app bundle, as in Listing I-1 below.

Listing I-1: Load a scene which is part of your app bundle:

```
#import <AssimpKit/PostProcessing.h>
#import <AssimpKit/SCNScene+AssimpImport.h>

NSString *spider = @"spider.obj";

// Start the import on the given file with some example postprocessing
// Usually - if speed is not the most important aspect for you - you'll
// probably request more postprocessing than we do in this example.
SCNAssimpScene* scene =
    [SCNScene sceneNamed:spider
        postProcessFlags:AssimpKit_Process_FlipUVs |
                         AssimpKit_Process_Triangulate]];

// retrieve the SCNView
SCNView *scnView = (SCNView *)self.view;

// set the model scene to the view
scnView.scene = scene.modelScene;
```

Load a scene by specifying a file URL

You can load a scene by specifying a file URL, as in Listing I-2 below.

Listing I-2: Load a scene with a file URL:

```
#import <AssimpKit/PostProcessing.h>
#import <AssimpKit/SCNScene+AssimpImport.h>

// The path to the file path must not be a relative path
NSString *soldierPath = @"/assets/apple/attack.dae";

// Start the import on the given file with some example postprocessing
// Usually - if speed is not the most important aspect for you - you'll
// probably request more postprocessing than we do in this example.
SCNAssimpScene *scene =
    [SCNScene assimpSceneWithURL:[NSURL URLWithString:soldierPath]
                postProcessFlags:AssimpKit_Process_FlipUVs |
                                 AssimpKit_Process_Triangulate]];

// retrieve the SCNView
SCNView *scnView = (SCNView *)self.view;

// set the model scene to the view
scnView.scene = scene.modelScene;
```

Load Skeletal Animations

AssimpKit builds on top of the skeletal animation support provided by SceneKit. For any scene that contains skeletal animation data, it creates a skinner and sets it to the node whose geometry the skinner deforms. The animated scene after importing will contain a set of animations each with a unique animation key. You only have to add the animation to the scene to play it.

AssimpKit supports skeletal animations irrespective of whether they are defined in one animation file or multiple animation files.

AssimpKit supports CAMediaTiming, animation attributes and animating scene kit content with an SCNAssimpAnimSettings class which you can (optionally) pass when adding an animation. You can set animation events and a delegate as well.

Load an animation which is defined in the same file

You can load an animation which is defined in the same file as the model you are animating, using the listing I-3 below.

Listing I-3: Load and play an animation which is defined in the same file:

```
#import <AssimpKit/PostProcessing.h>
#import <AssimpKit/SCNScene+AssimpImport.h>
#import <AssimpKit/SCNAssimpAnimSettings.h>

// The path to the file path must not be a relative path
NSString *boyPath = @"/of/assets/astroBoy_walk.dae";

// Start the import on the given file with some example postprocessing
// Usually - if speed is not the most important aspect for you - you'll
// probably request more postprocessing than we do in this example.
SCNAssimpScene *scene =
    [SCNScene assimpSceneWithURL:[NSURL URLWithString:boyPath];
                postProcessFlags:AssimpKit_Process_FlipUVs |
                                 AssimpKit_Process_Triangulate]];

// add the walk animation to the boy model scene
// add an animation event as well as a delegate
SCNAssimpAnimSettings *settings =
          [[SCNAssimpAnimSettings alloc] init];
settings.repeatCount = 3;

NSString *key = [scene.animationKeys objectAtIndex:0];
SCNAnimationEventBlock eventBlock =
    ^(CAAnimation *animation, id animatedObject,
      BOOL playingBackward) {
        NSLog(@" Animation Event triggered ");
        // You can remove the animation
        // [scene.rootNode removeAnimationSceneForKey:key];
    };
SCNAnimationEvent *animEvent =
    [SCNAnimationEvent animationEventWithKeyTime:0.9f
                                           block:eventBlock];
NSArray *animEvents =
    [[NSArray alloc] initWithObjects:animEvent, nil];
settings.animationEvents = animEvents;

settings.delegate = self;

// get the animation which is defined in the same file
SCNScene *animation = [animScene animationSceneForKey:key];
[scene.modelScene.rootNode addAnimationScene:animation
                                     forKey:key
                               withSettings:settings];

// retrieve the SCNView
SCNView *scnView = (SCNView *)self.view;

// set the model scene to the view
scnView.scene = scene.modelScene;
```

Load an animation which is defined in a separate file

You can load an animation which is defined in a separate file from the model you are animating, using the listing I-5 below.

Listing I-4: Load and play an animation which is defined in a separate file:

```
#import <AssimpKit/PostProcessing.h>
#import <AssimpKit/SCNScene+AssimpImport.h>

// The path to the file path must not be a relative path
NSString *explorer = @"/assets/apple/explorer_skinned.dae";

// Start the import on the given file with some example postprocessing
// Usually - if speed is not the most important aspect for you - you'll
// probably request more postprocessing than we do in this example.
```

```
SCNAssimpScene *scene =
    [SCNScene assimpSceneWithURL:[NSURL URLWithString:explorer]
                postProcessFlags:AssimpKit_Process_FlipUVs |
                                 AssimpKit_Process_Triangulate];

// load an animation which is defined in a separate file
NSString *jumpAnim = @"/explorer/jump_start.dae"];
SCNAssimpScene *jumpStartScene =
    [SCNAssimpScene assimpSceneWithURL:[NSURL URLWithString:jumpAnim]
                      postProcessFlags:AssimpKit_Process_FlipUVs |
                                       AssimpKit_Process_Triangulate];

// get the aniamtion with animation key
NSString *jumpId = @"jump_start-1";
SCNScene *jumpStartAnim = [jumpStartScene animationSceneForKey:jumpId];

// add the jump animation to the explorer scene
// use the default settings, for custom settings see previous listing I-4
[scene.modelScene.rootNode addAnimation:jumpStartAnim
                                 forKey:jumpId
                           withSettings:nil];

// retrieve the SCNView
SCNView *scnView = (SCNView *)self.view;

// set the model scene to the view
scnView.scene = scene.modelScene;
```

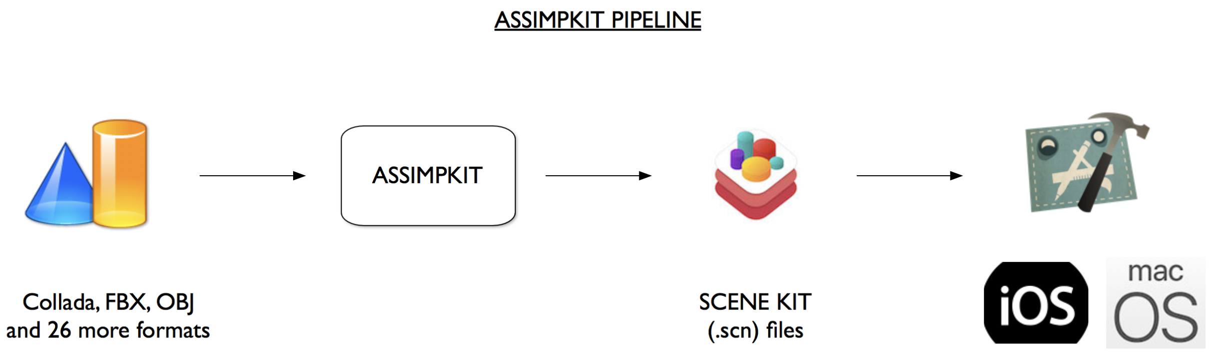
Managing Animations

The SCNNode+AssimpImport category simulates the SCNAnimatable protocol and provides methods to attach, remove, pause and resume animations.

Serialization and integrating with asset pipeline

You can serialize the model and animation scenes in SCNAssimpScene using the write defined in SCNScene to export to either *.scn* or *.dae* file. See the discussion section of write for more details.

By exporting using the above serialization method, you can both edit the exported assets in XCode's scene editor and also integrate the assets imported into your application's asset pipeline.



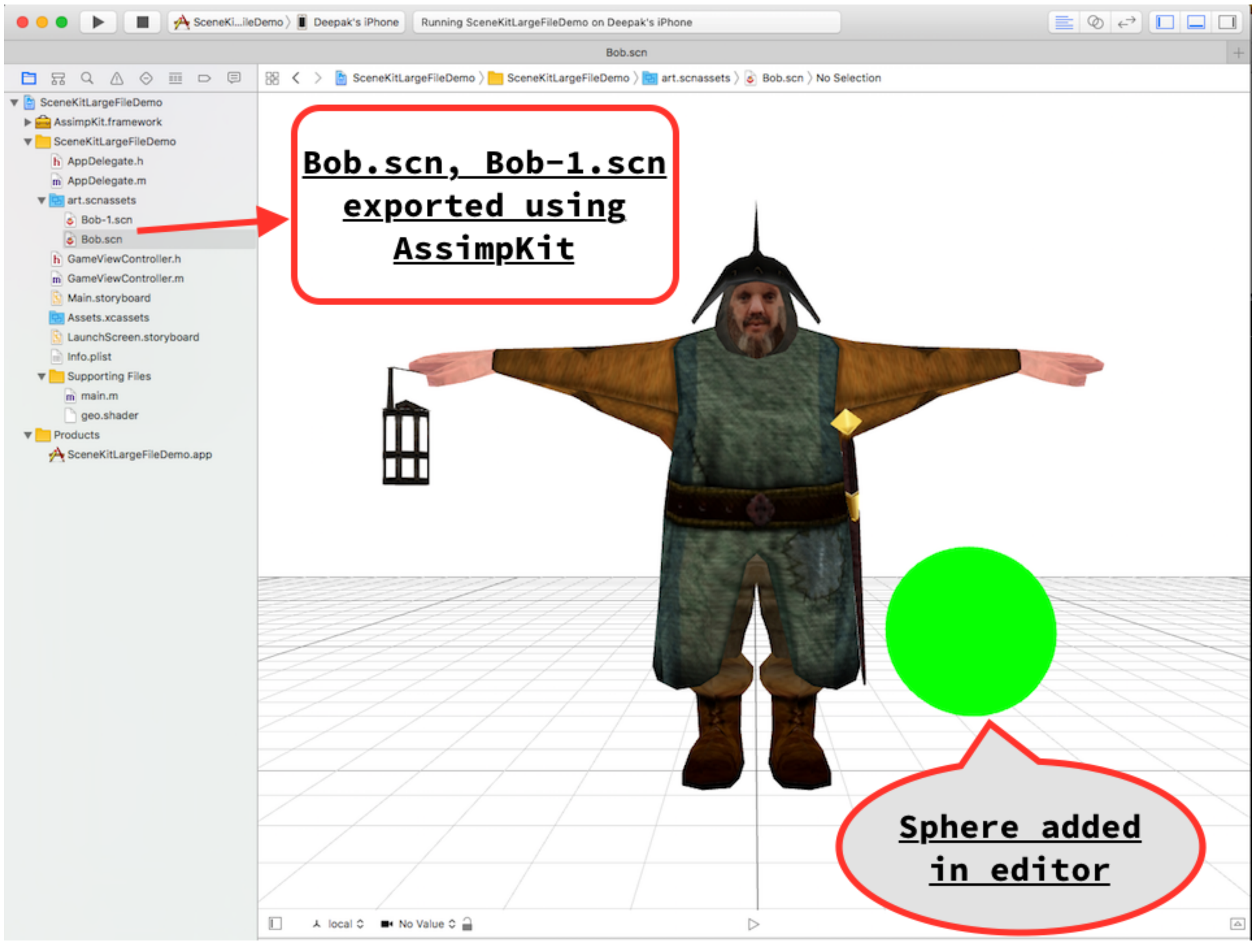
Using `.scn` archives exported from AssimpKit in your app

Assuming you have two files in the `Quake .md5` format, `Bob.md5mesh` which contains the 3D model data and `Bob.md5anim` which contains a skeletal animation. Using the API as explained above, you can load both the model `SCNScene` and animation `SCNScene` and then export these to the native `.scn` archive format.

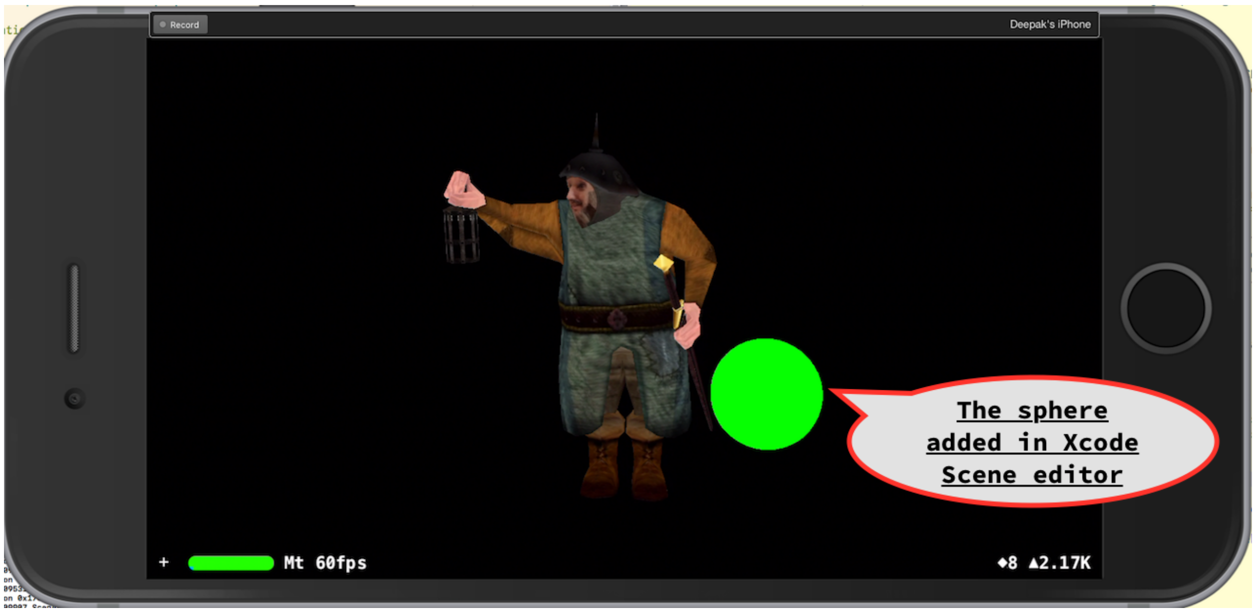
Assume `Bob.md5mesh` is exported to `Bob.scn` and `Bob.md5anim` is exported to `Bob-1.scn`, then in some `iOS/macOS` app, you can load these and play the animation as such.:

```
#import <AssimpKit/SCNScene+AssimpImport.h>
#import <AssimpKit/SCNAssimpAnimSettings.h>

SCNScene *scene = [SCNScene sceneNamed:@"art.scnassets/Bob.scn"];
SCNScene *animScene = [SCNScene sceneNamed:@"art.scnassets/Bob-1.scn"];

SCNAssimpAnimSettings * settings = [[SCNAssimpAnimSettings alloc] init];
settings.repeatCount = 3;
[scene.rootNode addAnimationScene:animScene
                          forKey:@"Bob-1"
                    withSettings:settings];
```

You can see below the `Bob.scn` file edited in XCode Scene editor.



The edited `Bob.scn` with animation rendered.


Record
Deepak's iPhone
The sphere added in Xcode Scene editor
Mt 60fps
◆8 ▲2.17K

CHAPTER 4

Example Apps

The library source code on GitHub repo ships with two example apps, for iOS and macOS platforms, which demonstrate the use of this API.

Build Instructions for the example apps

- Checkout the source code from GitHub repo.
- Open the `iOS-Example.xcodeproj` for the iOS example app.
- Open the `OSX-Example.xcodeproj` for the macOS example app.
- Clean, Build in XCode.

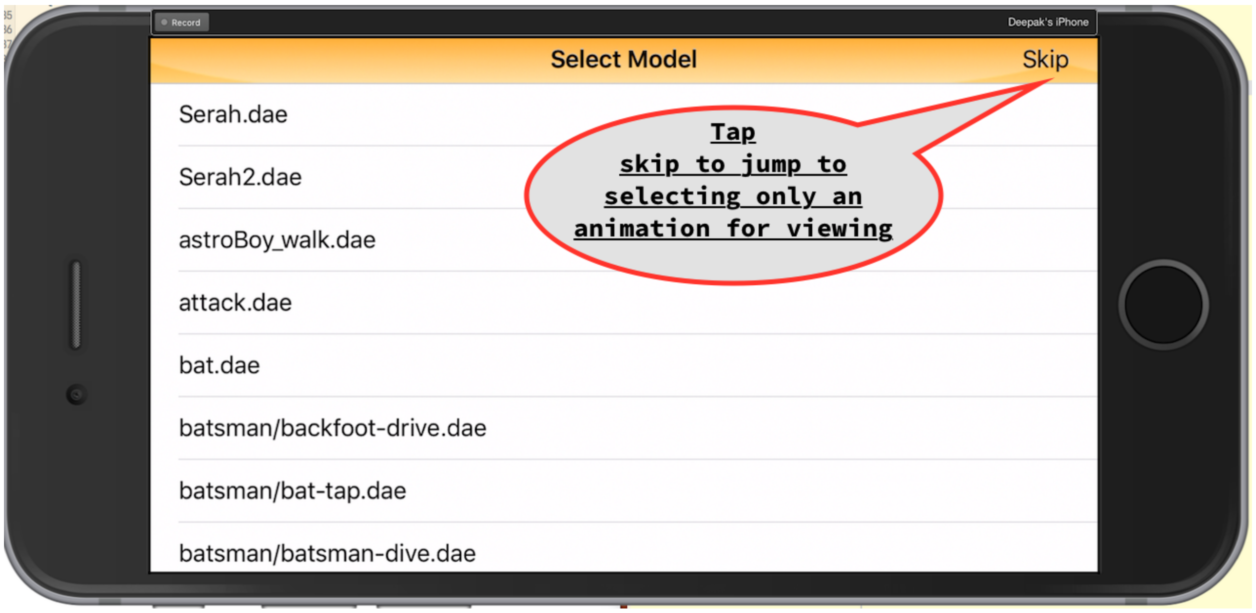
About the iOS example app

This example app has `Application supports iTunes file sharing` property enabled in it's `plist` file, which allows you to use iTunes to upload your 3D models to your device.

Once you have uploaded the 3D models, you can view the models as such.

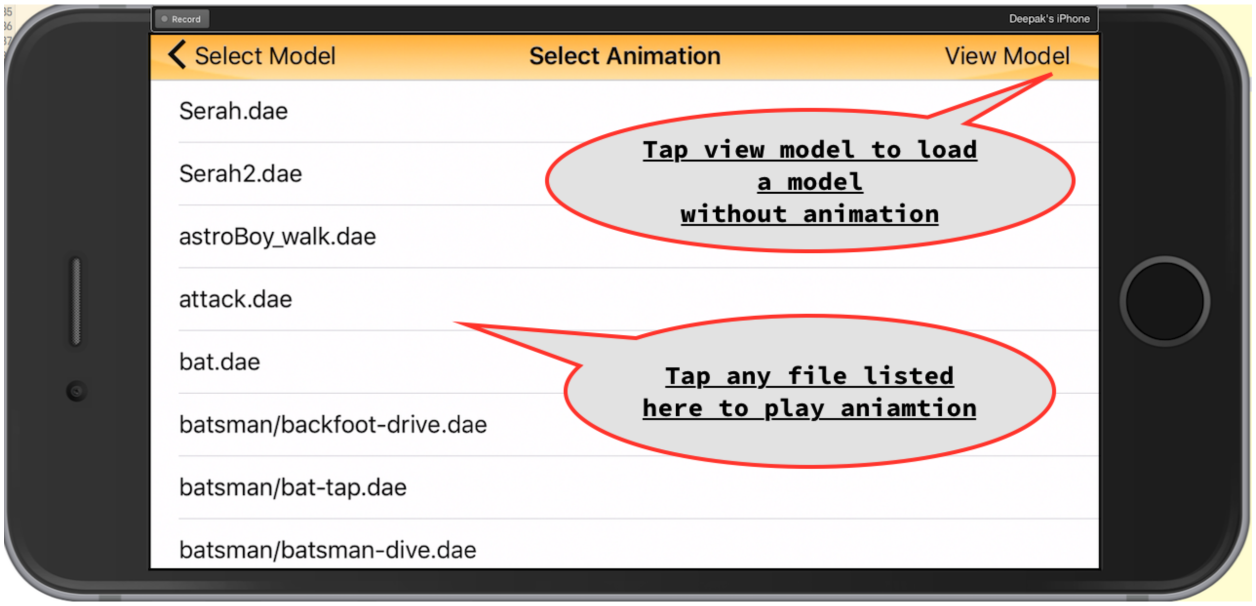
Step 1

You can pick the model to view. You can also skip picking a model and navigate to picking only a 3D skeletal animation.



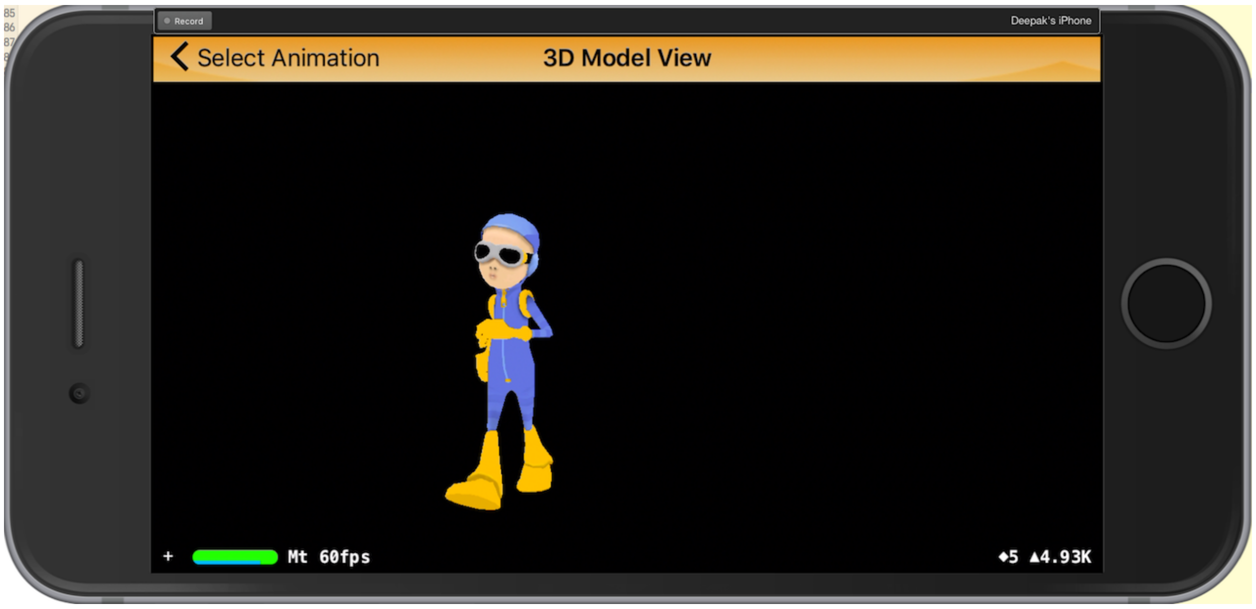
Step 2

You can pick a 3D animation in this step. You can skip this step if you just want to view the 3D model selected in step 1.



Step 3

Based on your selection, you can view only the model, the skeletal animation or both.

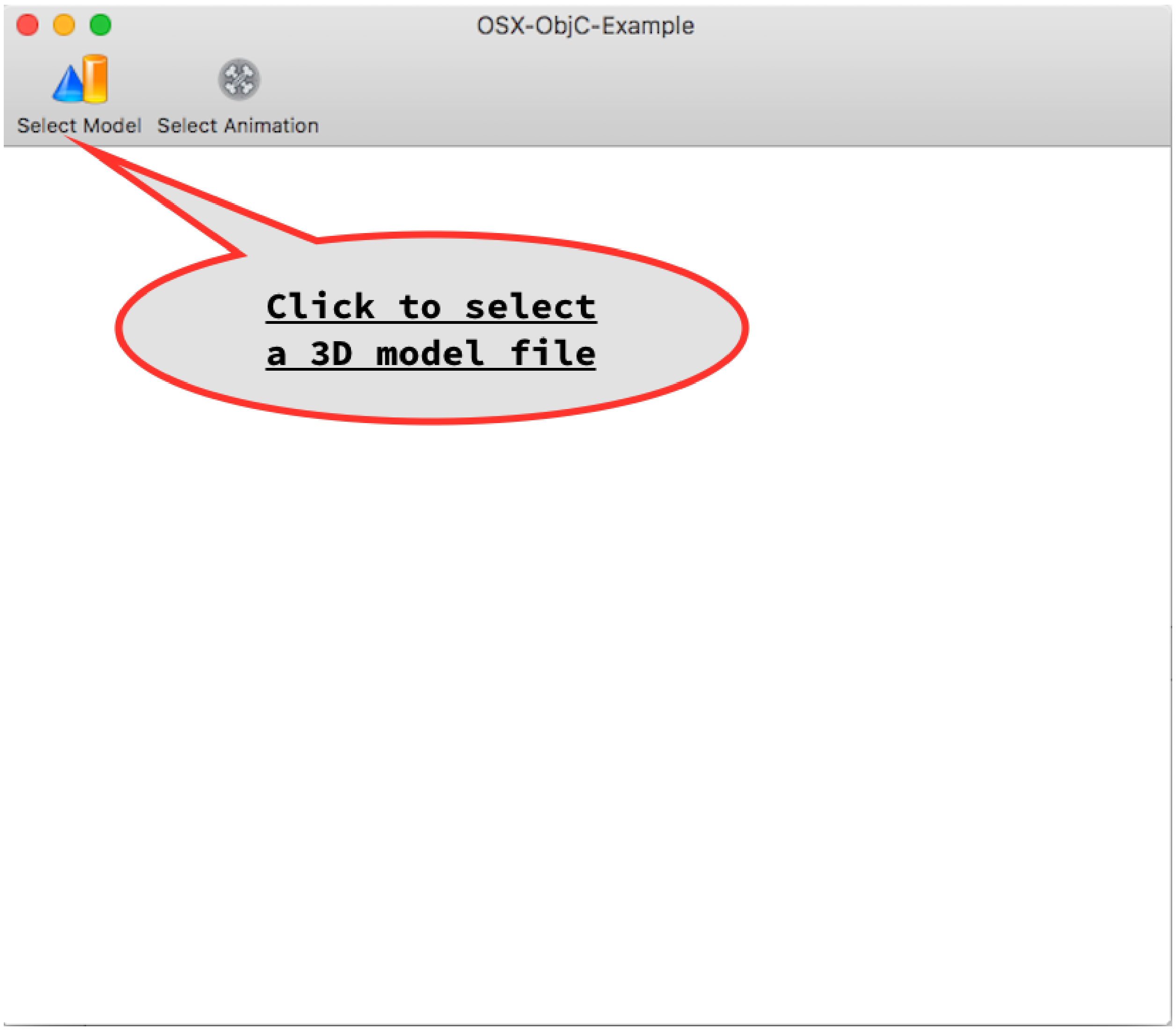


About the macOS example app

This example app allows you to select the 3D model and animation files using the file picker.

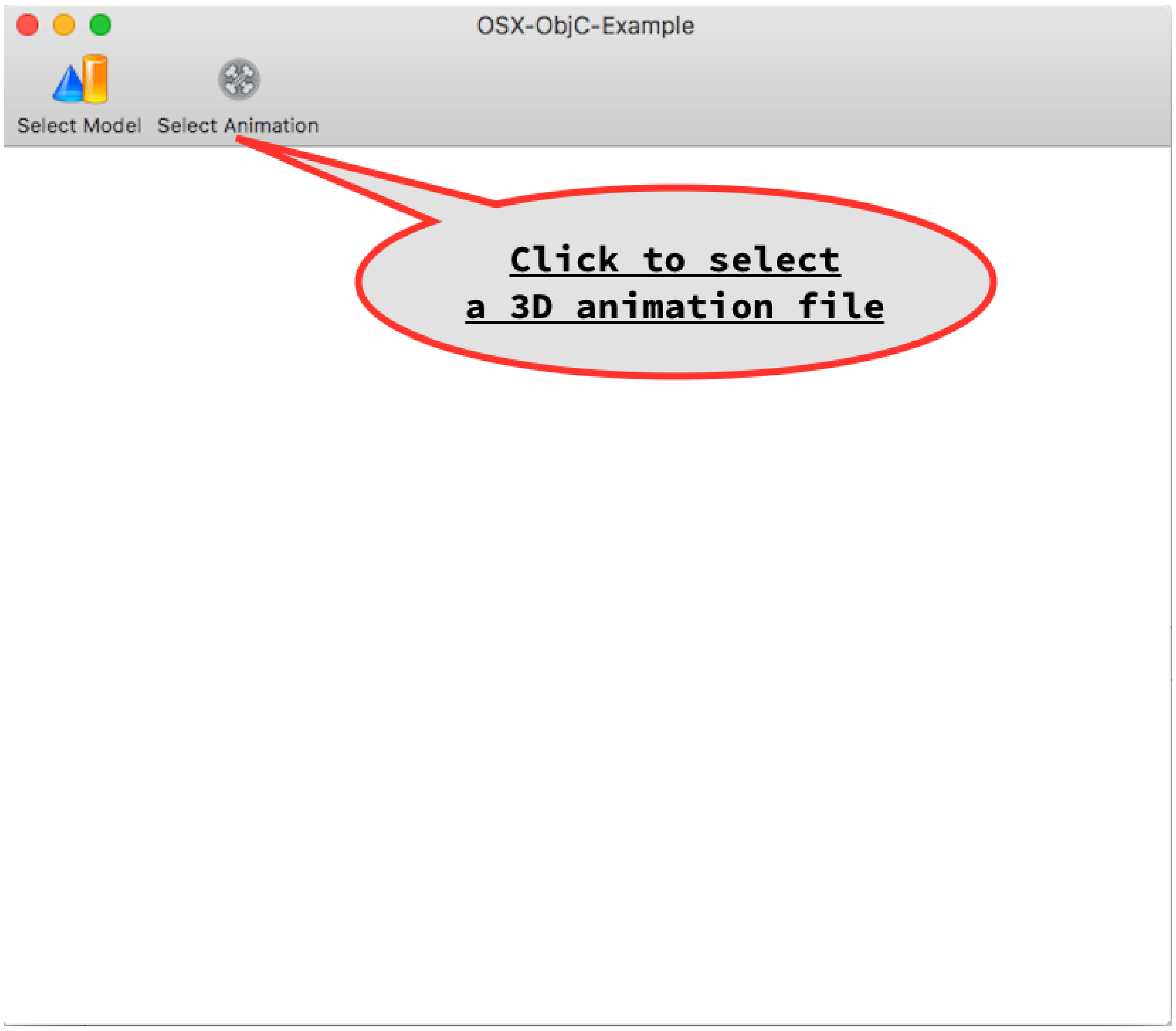
Step 1

You can pick the model to view. You can also skip picking a model and instead pick only a 3D skeletal animation.



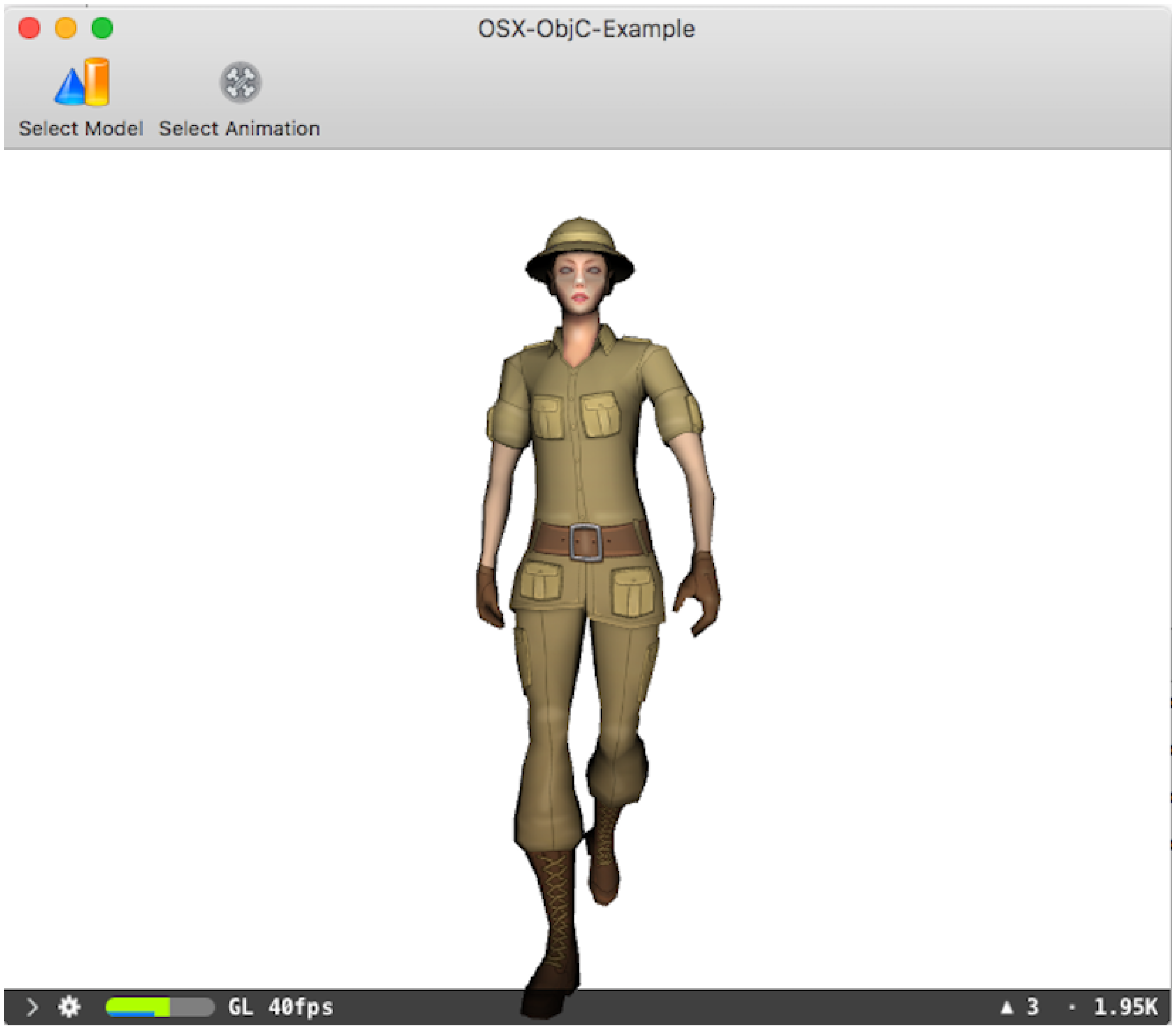
Step 2

You can pick a 3D animation in this step. You can skip this step if you just want to view the 3D model selected in step 1.



Step 3

Based on your selection, you can view only the model, the skeletal animation or both.


OSX-ObjC-Example
Select Model
Select Animation
GL 40fps
▲ 3
· 1.95K

CHAPTER 5

FAQ

1. Which are the file formats supported?
1. See *File formats supported*.
2. Why AssimpKit?
1. See *Why AssimpKit*.
3. What is the preferred use case for using AssimpKit?
1. The preferred use case is when you are using SceneKit and want to use files that are not supported by SceneKit or Model I/O. If your target app is a real time app such as a game, it is recommended that you export the scenes generated by AssimpKit into a native SceneKit archive and then use these archives. See *Using .scn archives exported from AssimpKit in your app*.
4. What are the known limitations?
1. As of released version 1.0, there is no light support at import time and while Assimp supports 40+ file formats, AssimpKit currently supports 30 file formats.

CHAPTER 6

Installation

This library has a simple 2 step installation process:

- Fork the repository.
- Clone your forked repository.

Assimp Dependency

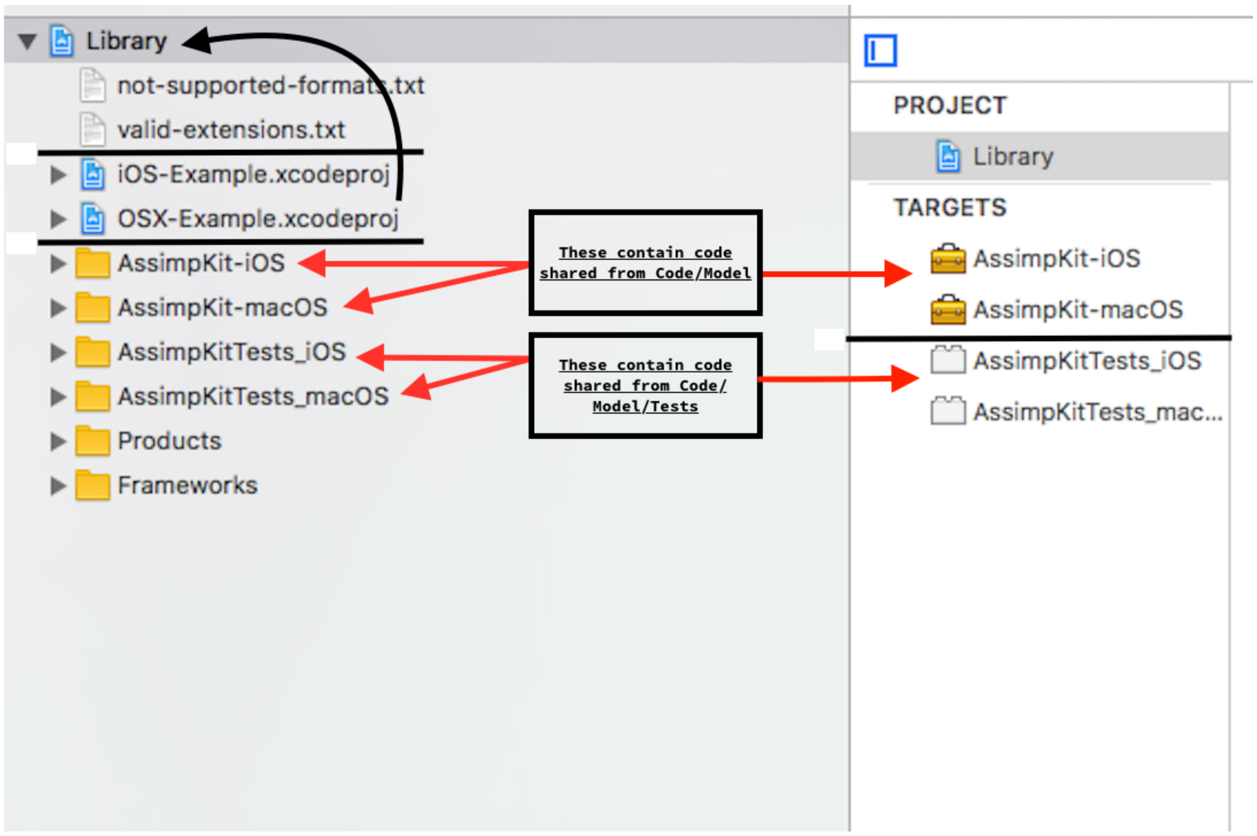
As AssimpKit depends on Assimp, AssimpKit ships with the static fat libraries for both iOS and macOS platform. The xcodeproj is also configured for Assimp dependency usage, so you only need to checkout and start editing!!!

The repository also contains `assets` which have their own licenses and are meant to be used only for testing. Please refer to the License and Licenses for more information.

CHAPTER 7

XCode Project Layout

The XCode project is laid out such that the common cross platform code related to reading using Assimp and transforming it to a Scene Kit scene graph is reused for both the iOS and macOS platforms. The testing code is similary reused for both the platforms.



Common Code

The common code, including both sources and tests, is placed under Code/Model. This common code is then used in 4 targets, 2 of which ship the iOS and macOS frameworks while the other two are testing targets.

Targets

The project contains the following 4 targets.

AssimpKit-iOS

This target builds the `AssimpKit.framework` for the iOS platform using the common code.

AssimpKit-macOS

This target builds the `AssimpKit.framework` for the macOS platform using the common code.

AssimpKitTests_iOS

This target tests the common code using the test assets for the iOS platform.

AssimpKitTests_macOS

This target tests the common code using the test assets for the macOS platform.

Example Apps

The library also contains 2 example apps iOS-Example.xcodeproj and OSX-Example.xcodeproj which are configured for the `AssimpKit.framework` depedency. You can read more about the *Example Apps*.

Changing Code

Any code change either for fixing a bug or adding a new feature, should ideally result in updates to the test code as well as example apps.

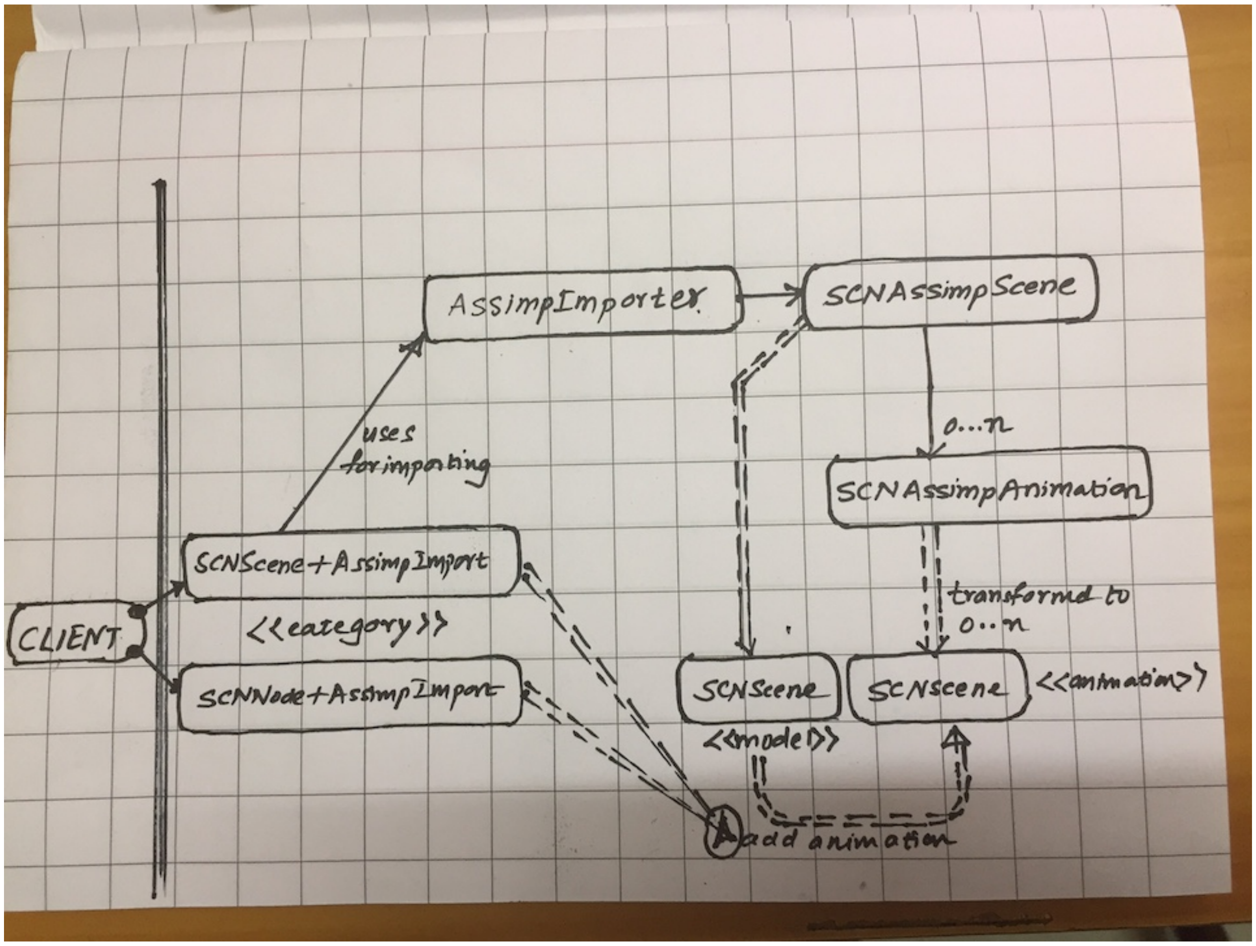
CHAPTER 8

Design

The design of this library is based on the transformation of the Assimp scene graph to a Scene Kit scene graph.

Classes

The class diagram for the code in Code/Model is shown below.



AssimpImporter is the most important class which transforms the assimp scene graph to the scene kit scene graph. It does the transformation by doing a depth first traversal of the assimp scene graph and for each assimp node visited, it generates a scene kit node.

SCNAssimpScene contains all the transformed data, excluding the animation data, for which SCNAssimpAnimation is the container. The SCNAssimpScene generates the model SCNScene and animation SCNScene instances. The SCNNode+AssimpImport category contains method to add the animation.

Generating the scene kit scene graph

The scene kit scene graph is generated in a 3 pass process:

- Pass 1: Generate the scene graph with geometry, materials and camera. In this pass, we also collect the bone names if the aiMesh has bones.
- Pass 2: This pass is executed only if the file has skeletal animation data, in which case, we infer all the skeleton info so that we can make a SCNSkinner and then generate the animation data using CAAnimation objects.
- Pass 3: Finally we transform the generated scene graph to a SCNScene and each animation generated in pass 2 to SCNScene. This transformation is important as it makes it easy to both serialize to native `.scn` format and integrate into asset pipelines and/or applications.

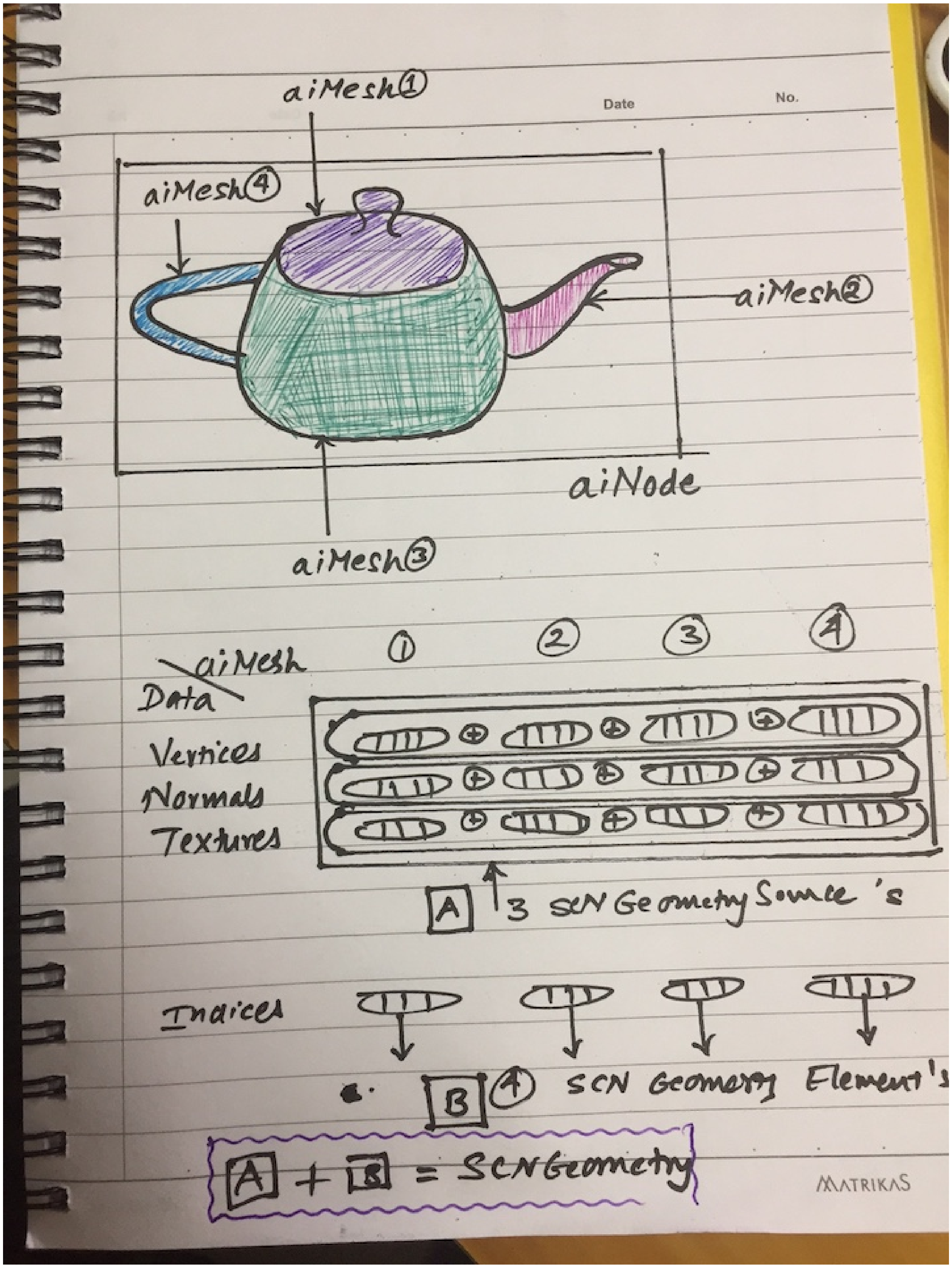
Each pass is further described in detail next.

Pass 1: Generating the graph with geometry

Generating Geometry

The assimp node can contain mulitiple meshes where each mesh maps to the SCNGeometryElement. The importer generates a single SCNGeometrySource for each of vertex, normal and texture data for all the meshes in the nodes. Next it generates separate SCNGeometryElement for each mesh in the data, ensuring the vertex indices are offset correctly for the combined geometry source.

A visual representation of this transformation is as shown.


aiMesh①
Date
No.
aiMesh④
aiMesh②
aiNode
aiMesh③
aiMesh
Data
① ② ③ ④
Vertices
Normals
Textures
A 3 SCN Geometry Source 's
Indices
B ④ SCN Geometry Element's
A + B = SCNGeometry
MATRIKAS

Generating Materials

As seen in the visual for geometry transformation, the importer now generates a material for each mesh in the node. The material in assimp maps to SCNMaterial in scene kit. The importer generates a image object for a texture or a color object for a color if available for the following material properties: diffuse, specular, ambient, reflective, opacity, normals, height, displacement and light map. Both embedded and external textures are supported. The material property in assimp maps to SCNMaterialProperty.

Generating Cameras

The camera in assimp maps to SCNCamera in scene kit. For an assimp node with a camera, the importer generates a node with a camera which has `xFov, zNear, zFar` configured.

Generating Lights

As of now the generation of lights has been disabled, due to a problem in serialization of light nodes in scene kit. See Issue #46.

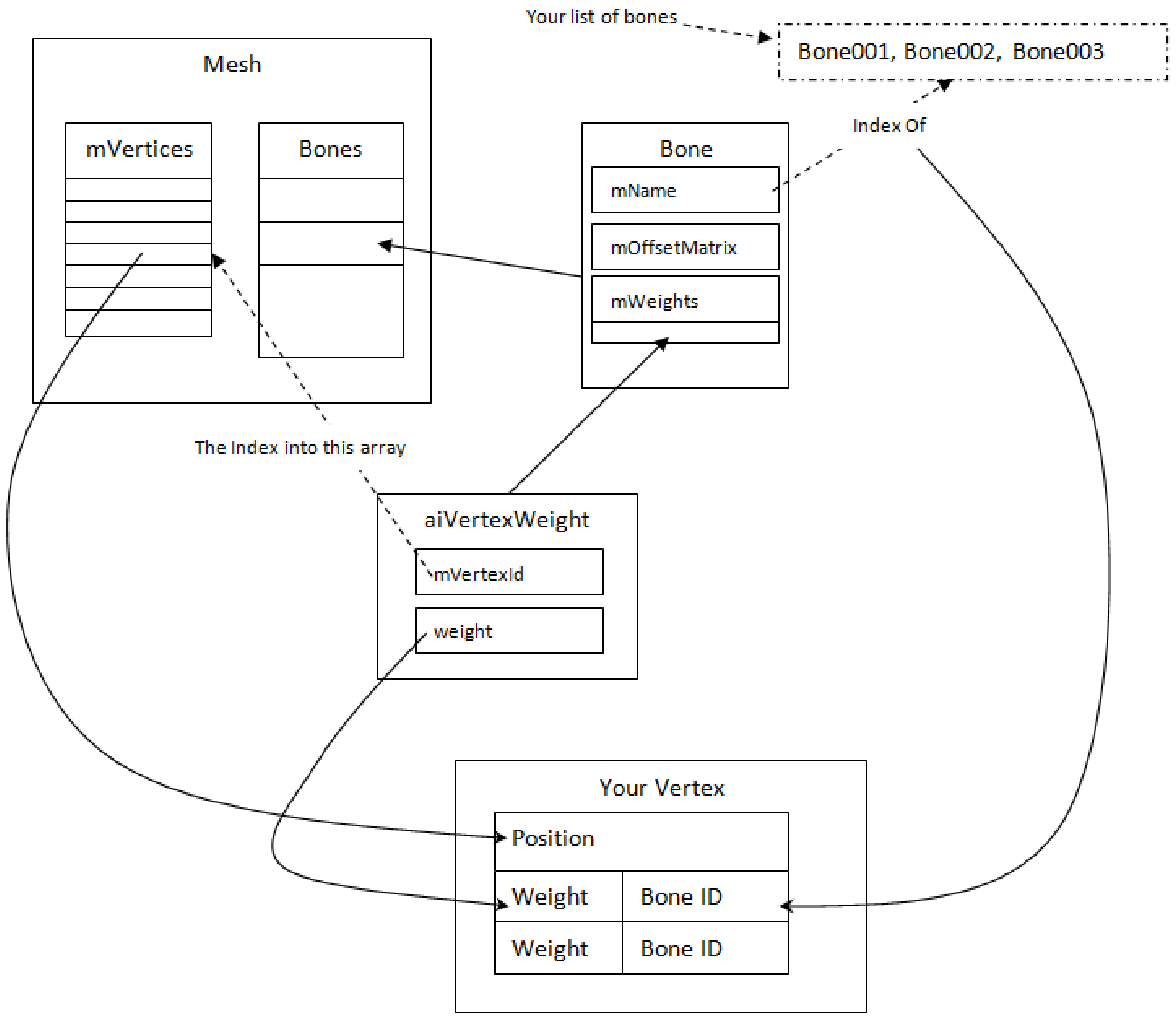
Pass 2: Generating Skeletal Animations

The skeletal animation data is generated in a 3 step process which consists of:

- Making a skeleton database
- Making a scene kit skinner
- Making the core animation objects

Making a skeleton database

The assimp scene graph does not contain a unique list of bones or the root of the skeleton which have to be inferred from the assimp data structures.

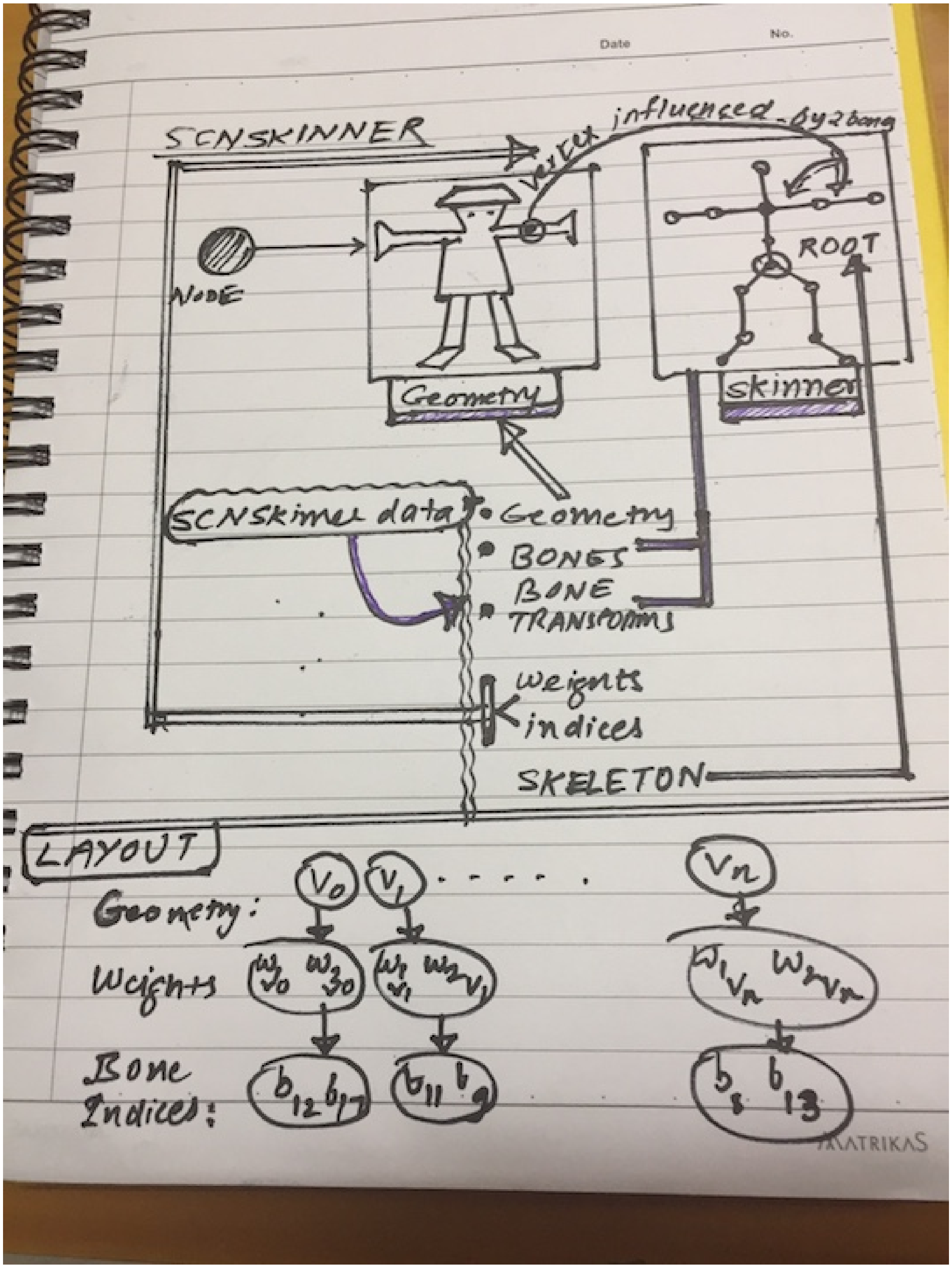


We parse the data structures above, so that we have a list of unique bone names, bone nodes and the bone inverse transforms. Once the unique bone nodes is known, the importer determines the root of the skeleton as that node which has the lowest depth from the parent!

Making a skinner

In order to make a skinner, we also need the vertex weights data in addition to the bone nodes and their inverse bind transforms which are available from *Making a skeleton database*.

Assuming each vertex is influenced by 2 weights, the scene kit skinner data layout is as such.



The importer first finds the number of vertices at the node and the maximum weights. As a node may contain multiple meshes, the weights information is generated for the combined meshes at that node and if a given node has less weights than the maximum weights, zero weights are added for the remaining weights.

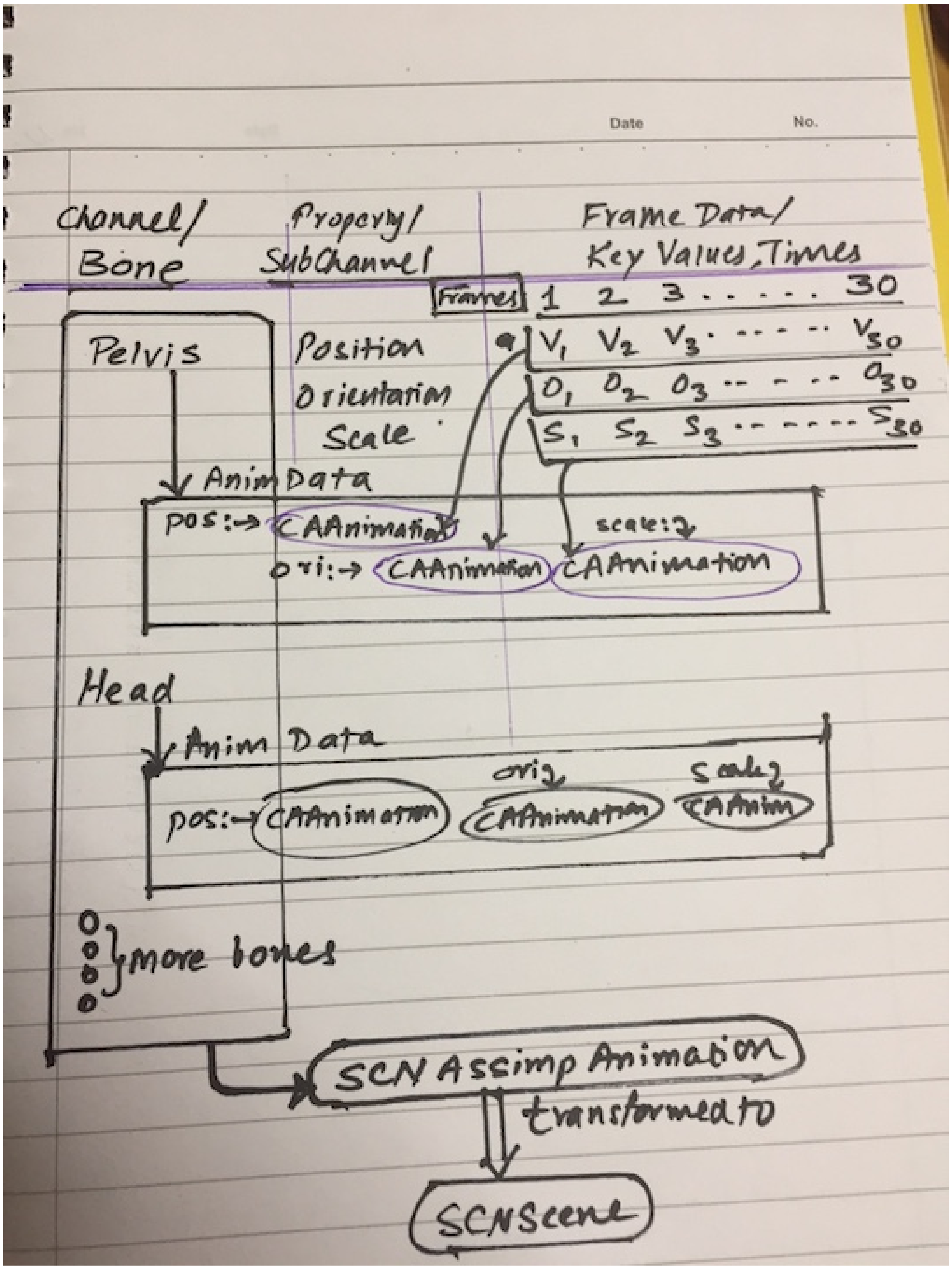
In assimp, each mesh's bones have vertex weights from which we have to calculate the inverse data of which vertices are influenced by which bones.

When calculating the bone indices for the corresponding bone weights, we pass the unique array of bone names which we will use when constructing the skinner so that the bone indices are as per skinner's bone indices layout. Again here, we translate from the assimp bone name to the index in the array of bone names generated when making the skeleton database.

If you combine the visuals of the assimp data structures and map them to the SCNSkinner, and understand the skeletal animation concept of vertex deformation using bone weights, then the above will be easier to understand.

Making the animations

The animation data is stored in aiAnimation as shown.



Each channel represents a bone and contains the keys for position, orientation and scale. The position, orientation and scale keys are then converted into a CAAnimation object. Each position and scale key value is represented by a SCNVector3 while the orientation is represented by a SCNVector4 which is a quaternion. These core animation objects are stored in a dictionary keyed by `position, orientation, scale`, along with a generated animation name, gives us a SCNAssimpAnimation object.

If we have multiple animations in a file, we end up with multiple SCNAssimpAnimation instances.

At the end of pass 2, we end up with SCNAssimpScene instance with SCNAssimpAnimation objects if animation data exists.

Pass 3: Generating native SCNScene instances

The SCNAssimpScene instance is now transformed into a SCNScene instance. Each SCNAssimpAnimation instance is transformed into a SCNScene instance. By transforming these to SCNScene instances, both serialization and integration into existing asset pipelines and/or applications becomes trivial.

Loading Animations

The SCNNode+AssimpImport category defines a method to add the animation. As all the animation data is just CAAnimation objects, the animation SCNScene graph is traversed and the core animation objects are added to the corresponding bone node in the target scene or target nodes' subtree.

Testing

The common test code place in Code/Library/Tests tests all the models in the assets directory filtered by all the *File formats supported*.

Each model is tested in AssimpImporterTests for:

- Structure where each node in the scene kit graph has the same data as the corresponding node in the assimp scene graph.
- The model and animation *SCNScene*'s generated by SCNAssimpScene are serializable to the native `.scn` format without any errors. The serialized files are generated in a temporary test directory, which is deleted after the test run.

There also exists a test SCNSceneTests for testing the file formats supported.

CHAPTER 9

Contributing

To contribute to AssimpKit:

- Please open an issue describing the bug, enhancement or any other improvement.
- If valid, please supply the sample model file that can help demonstrate the issue.
- If the design involves a larger refactor, please open a issue to dicuss the refactor.
- After discussion on the issue, you can submit a Pull Request by forking this project.
- Please accompany your Pull Request with updates to test code and example apps, the latter may not be required for every change.
- Please ensure you format the code using clang-format, there exists a .clang-format config for this project.

CHAPTER 10

API

You can find the API Docs here.

CHAPTER 11

Release Notes

Version 1.1

- Adds CAMediaTiming, animation attributes and SCNAnimatable like support.

Version 1.0

- Supports: geometry, materials, cameras and skeletal animations.
- Supports: serialization to native .scn format.
- Production Ready.