KITTY Documentation

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Contents:

Fig. 1: KITTY!

This is a Tiled importer for Unity.

KITTY differentiates itself from other Tiled importers through seamless basic integration, automatic object-to-prefab instantiation, and friction-free translation from Tiled custom properties to C# fields.

KITTY imports every graphic, object and setting you've defined in your Tiled tilemaps into Unity.

Unity's built-in tilemap editor is okay, but Tiled is *way* better. You can define stuff like text, warps, and pickups directly in Tiled. KITTY just imports and applies all that seamlessly.

KITTY can't make custom behaviours without coding those behaviours, though. You still need to write character controllers, enemy AI, interaction behaviours etc. yourself.

CHAPTER 1

Seamless basic integration

KITTY supports importing Tiled's `.tmx` and `.tsx` file formats natively in Unity.

The importers automatically reimport when you change a tilemap or tileset outside of Unity.

Advanced Tiled features like Collision Shapes, per-frame animation framerate and tile objects *just work*.

CHAPTER 2

Automatic object-to-prefab instantiation

KITTY aggressively instantiates prefabs from Tiled objects based on the **Type** property in Tiled.

The suggested workflow is to make a prefab (or prefab variant) for each generic object or tile object type, attach a bunch of components, and let the custom properties differentiate the specific object instances.

Alternatively, you can mix and match manually created Unity objects with automatically imported Tiled objects without losing your work.

CHAPTER 3

Friction-free translation from Tiled custom properties

KITTY takes care of full Tiled Custom Property integration in your game.

The preferred approach to making your game aware of Custom Properties is to decorate relevant fields with the `[TiledProperty]` attribute – this automatically assigns the value defined in Tiled to your C# field.

KITTY automatically figures out the mapping from Tiled to C# based on the name of the C# field. If you need direct control over the mapping, the `TiledProperty` attribute takes an optional `name` parameter for specifying the Tiled property name.

Listing 1: Sign.cs

```
public class Sign : MonoBehaviour {
        [TiledProperty] private string text;
        [TiledProperty("Text Speed")] private float speed;
}
```

3.1 Getting Started

Find or make some tileset images. You'll be using these to build your maps. Save them somewhere in the Unity `Assets` folder, preferably somewhere like `Assets/Maps/Tileset.png`.

In Tiled, make a few tilesets and tilemaps using those tileset images, and save them next to the tileset images. You can put the tilemaps in subfolders, like `Assets/Maps/World 1-1/Tilemap.tmx`, etc.

In Tiled, make every interactive part of your tilemaps (*Player*, *Sign*s, *NPC*s, *Coin*s, etc.) into a Tiled object, and give the objects separate Types based on their, well, type.

In Unity, make a prefab for each of the Types you used in Tiled. You can add as many built-in and custom components as you want.

Every time you reimport the tilesets or tilemaps, those prefabs get instantiated for each Typed object and tile.

You can use `[TiledProperty]` attributes to translate a Custom Property from Tiled into a regular field in your custom `MonoBehaviour`s.

3.2 Tilesets and Tilemaps

Tiled is a piece of software that allows you to define tilesets and tilemaps.

KITTY imports those tilesets and tilemaps into Unity, using the native ScriptedImporter class.

3.2.1 Tiles

Each tileset tile defines what form the tile will take in a tilemap in Unity.

For example, if the tile has an animation in a Tiled tileset, it'll be animated in Unity, too.

Collision Shapes defined in a Tiled tileset translate directly into the tilemap's `Collider`, as well.

Fig. 1: Composite collider

Additionally, if the tile has a defined **Type** in a Tiled tileset, a prefab named after that **Type** will be instantiated automatically at the tile's position. This is described in more detail in the *Prefab instantiation* section.

Note: When importing any tilemap, a tile is exactly one Unity unit wide – if the tilemap tiles are square, the tiles are one Unity unit tall, as well.

3.2.2 Files

A Tiled tileset is defined in a `.tsx`-file. For regular, grid-based tilesets, a `.tsx`-file has exactly one associated image. For image collection tilesets, every tile has a separate associated image.

Note: KITTY automatically adds a 1-pixel border to each grid-based tileset tile before using it. This keeps the tiles from bleeding into each other, even with weird camera angles or settings.

Tiled tilemaps are defined in `.tmx`-files, and reference one or multiple `.tsx`-files for the tiles in the tilemap.

For ease of import and use, I suggest creating images and their related tilesets and tilemaps in the same folder, somewhere inside your project's `Assets` folder.

Note: KITTY is entirely non-destructive, so keeping the source images, tilesets and tilemaps somewhere in the `Assets` folder is not a risk.

3.2.3 Automatic reloading

KITTY automatically loads any changed image, tileset or tilemap, and any asset depending on the changed file.

This means that when you edit images, configure tilesets or draw on tilemaps, Unity will apply the changes immediately.

Note: Tiled recommends avoiding a change in tileset width – ie. how many tiles are in a row. As such, you should add new tile rows to the bottom of the tileset image, if necessary.

3.3 Prefab instantiation

By setting the **Type** property of a tile or object in Tiled, KITTY will instantiate the most relevant prefab with a matching name from anywhere in the `Assets` folder.

Relevance is determined by how much of the prefab path matches the tilemap path.

3.3.1 Tile prefabs

For tileset tiles with a defined **Type** property in Tiled, a prefab is instantiated at every instance of that tile's position in a tilemap, unmodified except for rotation based on the tile's flipping, if any.

Note: When you change a prefab instantiated from a tileset, you need to reimport that tileset.

3.3.2 Object prefabs

Objects with a defined **Type** property in tiled will instantiate an instance of the most relevant prefab with the same name as the **Type** property's value.

The instantiated `GameObject`'s name is changed to match the name of the object in Tiled, if any.

For example, a Tiled object with the **Name** *Mega Man* and the **Type** *Player* will instantiate a prefab named *Player*, and change the instance's name to *Mega Man*, followed by an object ID.

Note: When you change a prefab instantiated from an object, you need to reimport the tilemap.

3.3.3 Tile object prefabs

A tile object is an object in Tiled based on a tileset tile. It inherits graphics and properties from its source tile, and the properties can be overwritten for each object instance.

If the tile object itself does not have an explicitly defined **Type**, it inherits the **Type** of its source tile. This way, the object still instantiates a prefab, just based on the tile's **Type** instead.

For tile objects, a child `SpriteRenderer` is automatically created to render the object's source tile graphic.

For all Collision Shapes on the source tile of a tile object, a child `PolygonCollider2D` is created as well.

If the source tile of a tile object is animated, an `Animator` with a preconfigured `AnimatorController` is also added to the *Renderer* `GameObject`. This is described in more detail in the *Animations* section.

3.3.4 Position and rotation

Prefabs are instantiated with their origin at the tile or object's bottom left corner. "Bottom left" is relative to the rotation and flipping, so prefabs have correct rotations and positions.

Prefabs retain their initial rotation when instantiated; the rotation and flipping defined in Tiled is compounded with the initial rotation.

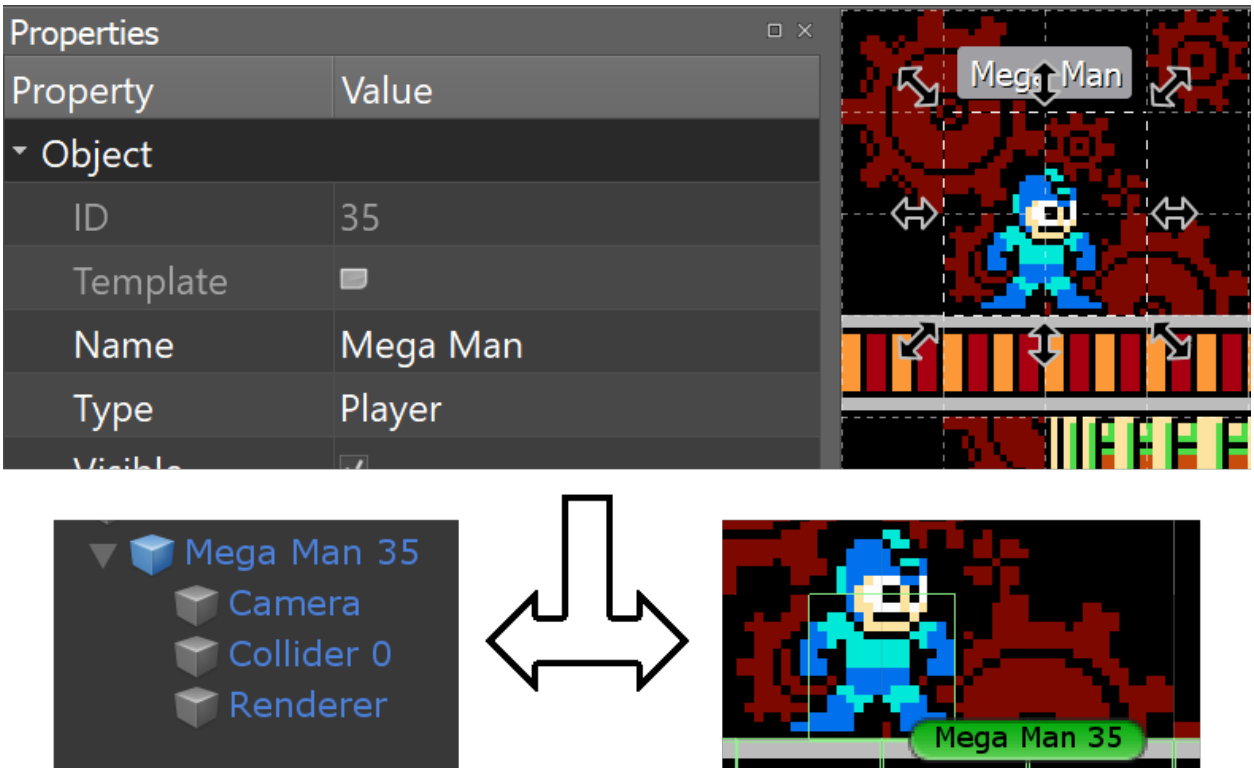


Fig. 2: Translation from a Tiled object to a Unity prefab

Fig. 3: Fun with initial prefab rotation of 60° around the X-axis.

3.3.5 Properties

If a field on a `MonoBehaviour` attached to the prefab (or any children) is decorated with the `[TiledProperty]` attribute, the value of that field is set based on a Tiled object or source tile's Custom Property of the same name – case-insensitive, and stripped for whitespace.

This is described in more detail in the *Custom properties* section.

3.4 Map and Layer prefabs

Like *Prefab instantiation* for tiles and objects, KITTY will instantiate the most relevant prefab named after a map or layer, if it exists.

Relevance is determined by how much of the prefab path matches the tilemap path.

3.4.1 Map components

A `Grid` component, static `Rigidbody2D` component, and a `CompositeCollider2D` component are always automatically added, so even with a custom map prefab, you don't need to add those components yourself.

Components on and children of a custom map prefab stay on the tilemap `GameObject` too, of course.

Tip: You can use a custom map prefab for multiple tilemaps by naming it something like *Map*, and making named prefab variants of this *Map* prefab original.

3.4.2 Layer components

For layers, `Tilemap`, `TilemapRenderer` and `TilemapCollider2D` components are always automatically added.

Components on and children of a custom layer prefab stay on the layer `GameObject` too, of course.

The same layer prefab can be used for a layer in multiple tilemaps if they have the same layer name.

Since the prefabs are loaded based on relevance, you can have separate prefabs for layers with the same name by just having each tilemap in a separate folder, along with that tilemap's layer prefabs.

3.5 Custom properties

Tiled allows you to define custom properties for nearly everything, from properties of entire maps and layers to objects and tileset tiles.

These custom properties have no effect by themselves. However, they can easily be put to good use with KITTY.

3.5.1 TiledProperty attribute

To make KITTY import a custom property to a specific field in a script, you simply decorate that field with the `[TiledProperty]` attribute; for example like this:

Listing 2: Enemy.cs

```
public class Enemy : MonoBehaviour {
        [TiledProperty] public int damage;
        [TiledProperty] public float speed;
}
```

This will read the **Damage** and **Speed** custom properties (case-insensitive, ignoring whitespace) from the tile, object, layer, or map, and assign the values defined in Tiled to the respective fields in the C# script.

The `[TiledProperty]` attribute can take an optional `name` parameter, in case the property defined in Tiled does not have (roughly) the same name as the corresponding field in C#:

Listing 3: Overriding the Tiled property name

```
[TiledProperty("Wait")] public float delay;
```

This will read the **Wait** custom property from the tile or object, and assign its value defined in Tiled to the `delay` field in the C# script.

3.5.2 Tile properties

Each tile with a defined **Type** will instantiate the most relevant prefab from anywhere in the `Assets` folder named after that type. This is described in more detail in the *Prefab instantiation* section.

If a field on a `MonoBehaviour` attached to that prefab (or any children) is decorated with the `[TiledProperty]` attribute, the value of that field is set based on the tile's Custom Property of the same name – case-insensitive, ignoring whitespace.

3.5.3 Object properties

Like tiles, objects with a defined **Type** will instantiate a prefab named after that type. Objects based on tileset tiles are called tile objects.

Unless a tile object explicitly defines a specific property, that property's value, if any, is inherited from the source tile's property of the same name.

3.5.4 Map and layer properties

For maps and layers, KITTY will instantiate prefabs based on map and layer names, as described in *Map and Layer prefabs*.

Fields declared with the `[TiledProperty]` attribute in `MonoBehaviours` attached to those prefabs (or any children) will have their values set based on the map or layer's Custom Property with the same name as that field – case-insensitive, ignoring whitespace.

3.6 Animations

Tile animations defined in Tiled tilesets work as expected, and support per-frame durations.

By default, objects defined in Tiled tilemaps based on animated tiles also work as expected, looping through each frame according to its duration.

3.6.1 Custom animation sequences

Sometimes, the frames of an animated tile aren't meant to be played fully in sequence; for example, a character sprite sheet tileset might have animations for idle, run, and jump, all defined in the same animation in Tiled.

The animation frames defined in tiled determine each frame's duration, as well. For more direct control over playback speed, the `Speed` parameter can be used as a playback speed factor. It defaults to `1.0f`.

By setting the `Start` and `End` parameters of an object's child Animator component, any subsequence can be played at any time.

For example, a `CharacterController` script with 4 idle frames followed by 6 walk frames might contain the following:

Listing 4: CharacterController.cs

```
void Update() {
        var animator = GetComponentInChildren<Animator>();
        if (walking) {
                animator.SetParameter("Start", 4);
                animator.SetParameter("End", 9);
        } else {
                animator.SetParameter("Start", 0);
                animator.SetParameter("End", 3);
        }
}
```

This code tells the `Animator` to cycle through frames 4 through 9 when walking. When not walking, frames 0 through 3 are cycled through instead.

Note: Frame indices start from 0.

Fig. 4: In the NES game DuckTales 2, Scrooge McDuck has 4 idle frames (3 unique) and 6 walk frames (5 unique)

3.7 Tutorial

Thank you for using KITTY!

This tutorial takes you through making a small top-down game from scratch, using Tiled to make your game. KITTY imports it into Unity, where you can add game-specific behaviours to tiles and objects from Tiled.

The end result is a grid-based, animated character controller able to interact with signs, NPCs, and doors which are all defined in Tiled. It plays like this:

Fig. 5: Tutorial teaser

Keep in mind that this is just an example project to get you started; KITTY can do much, much more than what this tutorial teaches.

Learning how to use Tiled is not part of this tutorial. Have a look at the Official Tiled Documentation for that.

3.7.1 TL;DR

- Make tilemaps in Tiled with typed and possibly animated objects
- Make prefabs in Unity with names that match Tiled objects' types
- Add built-in or custom components in Unity to your prefabs
- Import, change, and reimport your tilemaps in Unity as needed

3.7.2 Images, Tilesets and Tilemaps

To begin making a tile-based game, you need to make or find neat tileset images with the same tile size. These determine what tiles you can build your map with, and to some extent what objects you can make.

You also need some character spritesheets, which are effectively also a form of tileset, but since we'll be using them for objects rather than tiles, they don't have to have the same tile size as your tilesets.

I went with tilesets and spritesheets from Pokémon FireRed/LeafGreen, modified to fit into a grid. Of course, if you plan to distribute your game, you can't use tiles or sprites you don't have a license to.

Tileset Images

Place the tileset images somewhere in the Assets folder, like in `Assets/Maps/Tutorial`. Ideally, the Tiled tilesets and tilemaps you're going to create will end up here, as well. Keeping map-related images, tilesets, and tilemaps together makes it easier to maintain references and update the files as you make your game.

Make sure to change the Texture Type in the image import settings to **Sprite (2D and UI)** – this takes care of proper scaling, and is the most fitting texture type for tiles and sprites.

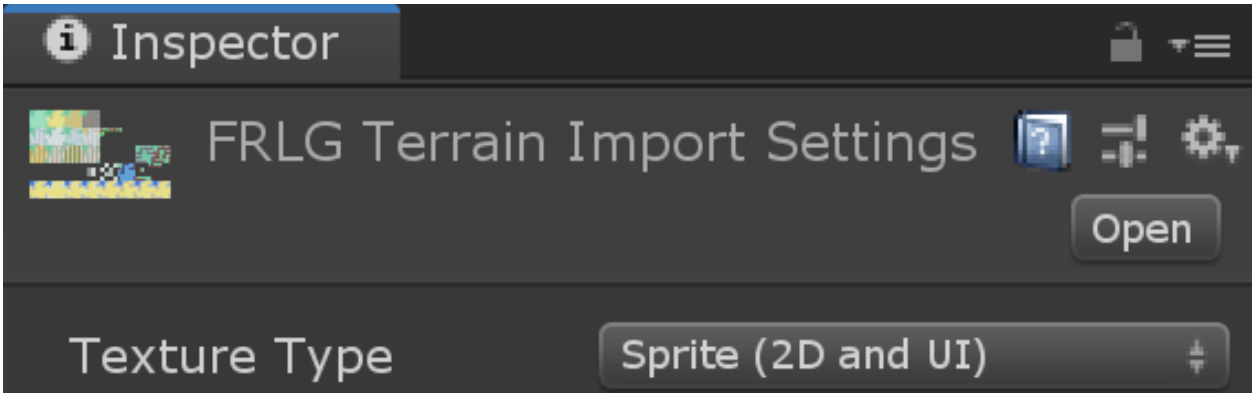


Fig. 6: Image import settings

If you're making a pixel art game, you also want to set the Filter Mode to **Point (no filter)**, and Compression to **None**. This keeps your pixels crisp.

Tilesets

Create a new tileset in Tiled for each of your tileset images, and save them in `Assets/Maps/Tutorial` as well. Tilesets get the extension `.tmx`, so don't worry about naming them differently from the source image's filename.

Make sure to set the **Tile width** and **Tile height** to match the tileset images' tile size. If your tileset's tiles have borders around them, you can set the margin and spacing accordingly.

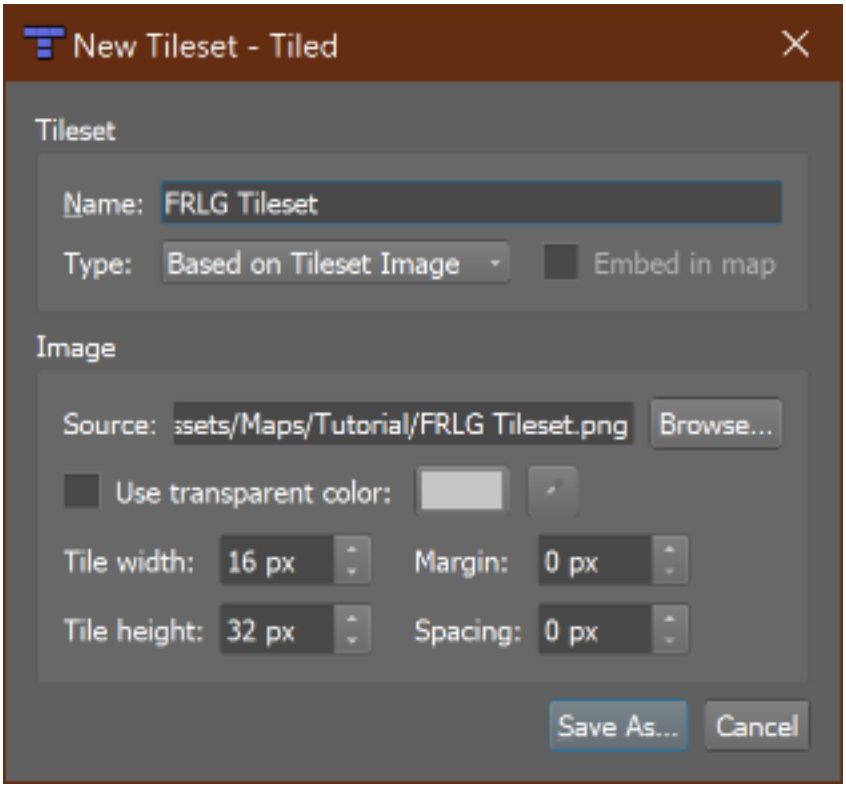


Fig. 7: New tileset settings

If you haven't worked with Tiled before, I recommend looking into Using the Terrain Brush in the official documentation, but don't sweat it.

Feel free to define animations for any animated tiles in your tileset, as well. These will carry over to Unity with no extra setup.

Tilemaps

Now that you have some tilesets, it's time to make a tilemap!

Anything goes, really. You don't have to worry about interactable stuff like signs or NPCs just yet – we'll get to those a bit further down. Feel free to add more Tile Layers if you need them.

Fig. 8: Modified Pewter City

I made a slightly changed Pewter City from Pokémon FireRed/LeafGreen.

Note that I didn't bother adding signs yet, and I left out some doors. I will add those to an object layer later – that way I can directly define the sign texts and door destinations, respectively.

Like the tileset, you want to save your tilemap in `Assets/Maps/Tutorial`.

3.7.3 Initial Unity Import

Go ahead and drop the entire KITTY Unity Package into the root of your Assets folder.

If you saved your tilesets and tilemaps next to your tileset images, the folder contents should now look a bit like this:

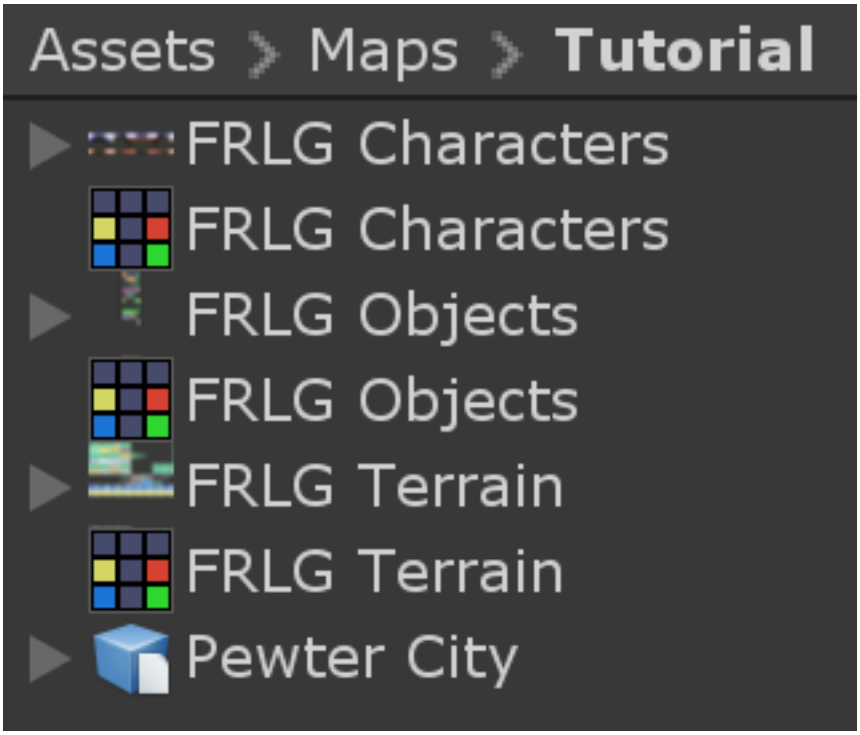


Fig. 9: The colourful Tiled icons are tilesets, and the tilemap has been made into a prefab.

You can drop the tilemap prefab directly into the **Hierarchy** to see your work in the **Scene** view.

Note: Whenever you update your tilesets or tilemaps, or edit your tileset images, they automatically get reimported.

If you go into **Play Mode** now, any animated tiles will animate, but nothing else really happens. We're going to change that!

3.7.4 Player Object

Of course, there are no objects yet – not even a *Player*. Let's add a small character from a spritesheet, ideally with a few walking animation frames for each of the four directions. I went with *Leaf* from *Pokémon FireRed/LeafGreen*.

Character and object spritesheets don't need to have the same tile size as the tilemap, as they're not part of the grid. *Leaf*'s spritesheet, for example, uses 16×32 pixel sprites for each animation frame.

Note: You can make Tiled snap objects and other things to the tile grid by toggling it in **View -> Snapping -> Snap to Grid**.

We can insert sprites of any size anywhere in the map as objects by adding an Object Layer. I called my layer *Characters*, added a Tile Object of *Leaf* from the character spritesheet, and set the object's name to *Leaf*. You don't have to give your objects names, but since they carry over to Unity, it will be easier to tell them apart if you do.

So far, so good. When you switch to Unity now, you'll see your character gets created as a `GameObject` with the name you specified, followed by an object ID. A `SpriteRenderer` child has automatically been added, and the `GameObject` even a small name label.

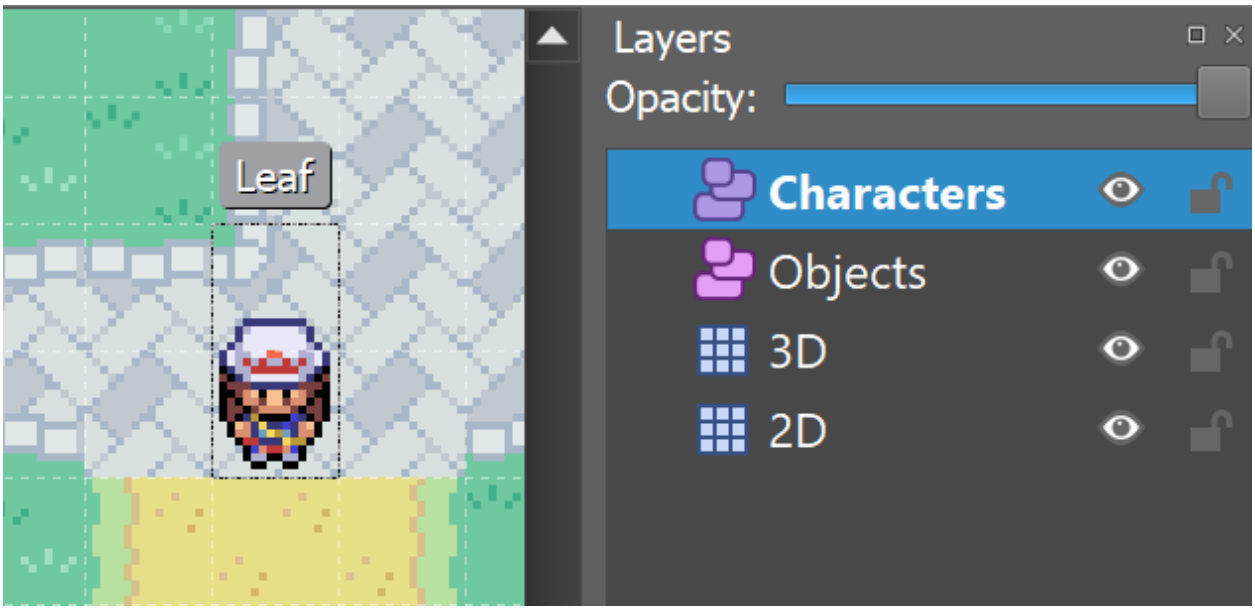


Fig. 10: Player object in Tiled

Fig. 11: Player object in Unity

That's all well and good, but the player doesn't do anything, and adding components manually to every object that needs any will get tedious quickly.

Player Prefab

KITTY automatically generates a `SpriteRenderer` for us, and if your character sprite already has an animation defined, the *Renderer* child will have a fully configured `Animator` component as well. You could even go so far as to add collision shapes to your character sprite, which would generate a `PolygonCollider2D` for each shape, but you won't need to do that for your character in this tutorial.

The ability to control how Tiled objects are translated to `GameObject`s is the primary feature of KITTY, however!

Let's have the `Camera` component on the *Player* `GameObject` instead of at the root of the scene.

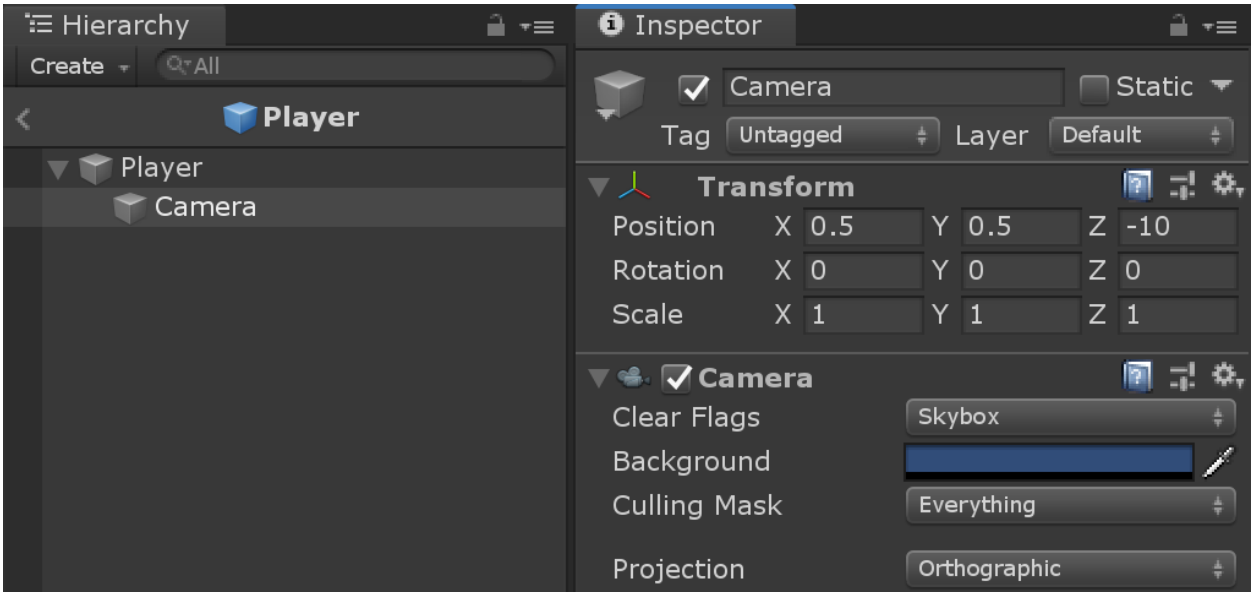
Start by removing the *Main Camera* `GameObject` from the scene. This will make the **Game** view complain about a missing `Camera`.

Add an empty `GameObject` to the scene; this will become our *Player* prefab. Drag it from the scene **Hierarchy** to the **Project** view to save it as a prefab asset – anywhere in the `Assets` folder is fine, but let's drag it into `Assets/Maps/Tutorial` for now. It's important to name it *Player* or something similar, because KITTY uses prefab names to translate from Tiled objects to `GameObject`s.

Now that you have your empty *Player* prefab in your `Assets` folder, go ahead and delete the *Player* instance from the scene, then double click the prefab to enter **Prefab Edit Mode**.

Add an empty child `GameObject` named *Camera* to the prefab, and set its position to `(0.5, 0.5, -10)`; every tile and object imported from Tiled is created at its bottom left position, so to center the *Camera* child on the *Player* character, it needs to be offset by half the width of a "tile" in your spritesheet. The `-10` Z-position is just to make sure the `Camera` doesn't clip the tilemap and all its objects.

Finally for now, add a `Camera` component to the new *Camera* child, and set its Projection to **Orthographic**.

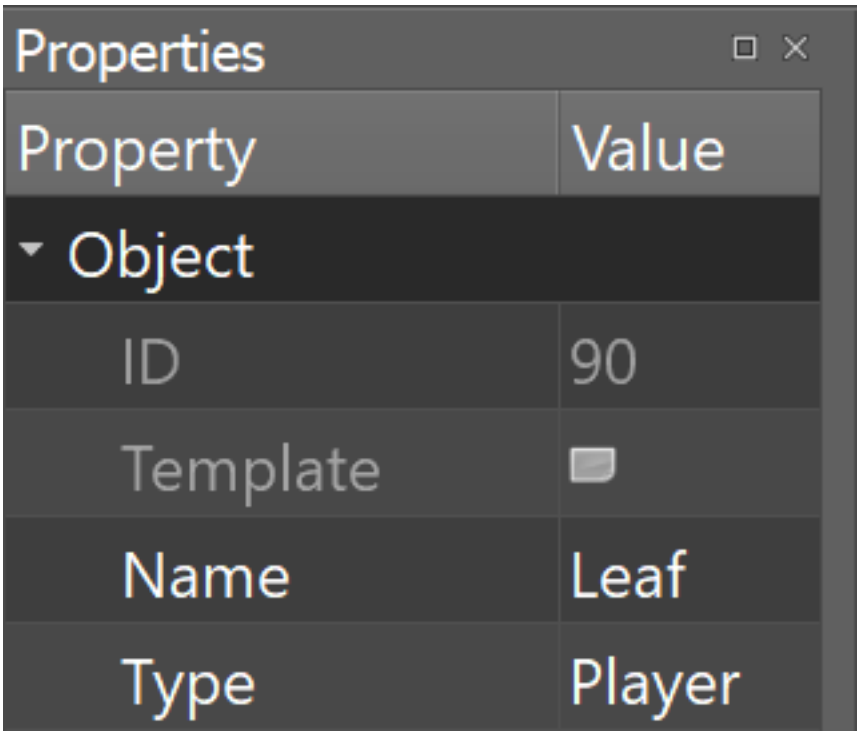


We'll return to the *Player* prefab to add more functionality later!

Note: If you want objects based on your new prefab to still have a label, you can choose a label in the icon dropdown of your root *Player* `GameObject` in the top left corner of the inspector.

Typed Objects

To let KITTY know that the character you added to the *Characters* object layer in Tiled should use your new Player prefab for instantiation, all you need to do is set the **Type** property of the object in Tiled.



Switching back to Unity, your **Game** view now shows the "game" with your character in the center.

Note: This approach – creating a named prefab (or prefab variant) and setting the "Type" property of an object or even a tile in Tiled – is the core way of defining the specific behaviours of your game.

3.7.5 Movement Script

Now we actually get to add game-specific behaviour to our game. First up is *Player* movement.

Adding Behaviours to Objects

Whenever a tile or object in Tiled has the **Type** *Player*, KITTY loads your *Player* prefab in its place. This holds true for any typed Tiled object/Unity prefab combination with matching names.

To define behaviours for objects, you simply add the components and child `GameObjects` you need to the prefab that matches the object **Type** you want to define behaviours for.

Grid Movement

Let's make the *Player* able to move by pressing the arrow keys (or any other directional input, like WASD or a joypad). For this tutorial, the player can move either horisontally or vertically, but not both at the same time.

Create a new C# script called `GridController` somewhere in your `Assets` folder with the following contents:

Listing 5: GridController.cs

```
using UnityEngine;

public class GridController : MonoBehaviour {
        void Update() {
                var input = new Vector2(Input.GetAxisRaw("Horizontal"), Input.
↪GetAxisRaw("Vertical"));

                // Move one tile in an input direction, if any, preferring horizontal␣
↪movement.
                if (input.x != 0f) {
                        transform.position += new Vector3(input.x, 0).normalized;
                } else if (input.y != 0f) {
                        transform.position += new Vector3(0, input.y).normalized;
                }
        }
}
```

Note: I'm using `Input.GetAxisRaw` to get the raw input data between `-1` and `1`, and normalizing it to get a direction vector.

Now just add this new `GridController` component to your *Player* prefab by double-clicking the prefab asset, and dragging or adding the component to the prefab's root `GameObject` (called *Player*). Reimport your tilemap to make Unity apply the changes to your *Player* prefab.

Fig. 12: Moving one tile per frame

Tile widths in KITTY are always exactly one Unity unit wide, so moving one unit in any direction corresponds exactly to moving one tile in that direction. Because we're always adding integers, the character position doesn't suffer from floating point inaccuracies.

Note: When you change a prefab, you need to reimport any tilemaps or tilesets that use that prefab.

If you reimport your tilemap and go into **Play Mode**, the character moves when you give it directional input, and it also stays exactly on the tile positions – but it's way too fast, potentially moving one tile per frame!

Continuous Movement

When receiving directional input, we want the character to move a little bit every frame until it reaches the next tile. There are many ways to make things happen over time, but this is a KITTY tutorial, not a C# or Unity tutorial.

Let's just add a small `Walk` method in our `GridController` class that does everything we want; it moves the character a little bit each frame until it reaches the next tile.

We'll be using an `IEnumerator` to call the method as a coroutine, so you need to add `using System.Collections` to the top of the file, as well.

Listing 6: GridController.cs

```
using UnityEngine;
using System.Collections;

public class GridController : MonoBehaviour {
        ///<summary>Walk to tile in `direction`.</summary>
        IEnumerator Walk(Vector3 direction) {
                // Disable the Update method until we're done walking one tile.
                enabled = false;

                // Move towards target, 1/16th tile per frame
                var target = transform.position + direction;
                while (transform.position != target) {
                        transform.position = Vector3.MoveTowards(transform.position,␣
↪target, 1f / 16f);
                        yield return null; // Wait for one frame before continuing.
                }

                // Enable the Update method after we're done walking one tile.
                enabled = true;
        }
// ...
}
```

Note: Moving by 1/16th unit won't introduce floating point inaccuracies, because it's a negative power of two.

We need to update the `Update` method to call our new `Walk` method as a coroutine, as well:

Listing 7: GridController.cs

```
// ...
if (input.x != 0f) {
        StartCoroutine(Walk(new Vector3(input.x, 0).normalized));
} else if (input.y != 0f) {
        StartCoroutine(Walk(new Vector3(0, input.y).normalized));
}
// ...
```

Calling `Walk` as a coroutine makes it able to stop for a bit and continue on the next frame, instead of running all the code immediately.

Fig. 13: Moving one pixel per frame

This is very useful to us, since we want to move a little bit, wait for the next frame, and then move a little bit more – until we reach the target tile.

3.7.6 Colliders and Collision

The *Player* is currently unstoppable; there's nothing to collide against, and no collisions ever happen.

Colliders

KITTY natively understands Collision Shapes defined in Tiled tilesets, and turns them into Sprite Physics Shapes – sprite/tile `Colliders`. The entire tilemap has a `CompositeCollider` component that composes all the individual tile layer colliders into one, for performance reasons.

This also means you can't query *what* tile an object collided with, as Unity sees them all as the same, full-map composite collider. That's fine for simple non-interactive collision shapes, though.

Since we're making a grid-based topdown game, square collision shapes will suffice.

Open one of your tilesets in Tiled, switch to Tile Collision Editor mode in the top middle, and start drawing full-tile collision shapes for all the tiles that should be collidable.

Fig. 14: Adding tile Collision Shapes in the tileset

By defining the collisions in the tileset rather than the tilemap, the Collision Shapes are reused; you only need to define them once for each tile in the tileset, instead of having to make sure every collidable tile in your tilemap has a collider defined.

This is the reason KITTY imports tile Collision Shapes, but not object shapes, as colliders.

Back in Unity, the tilemap now has a `Collider` with all the Collision Shapes you defined.

Collision

Your entire tilemap automatically got a full-map `Collider` in Unity by just defining a few tile Collision Shapes in your Tiled tileset. Neat.

The `Collider` doesn't stop the *Player* yet, though. One way of making `GameObjects` interact with `Colliders` in Unity is to add a `Collider2D` and a `Rigidbody2D` component, but since we don't need physics, just collisions, we can instead add a simple collision check around the `Walk` method's movement loop in our `GridController` class.

Listing 8: GridController.cs

```
// ...
// BoxCast from the character's center, in the desired direction, to check for␣
↪collisions.
var origin = transform.position + new Vector3(0.5f, 0.5f);
var size = Vector2.one / 2f; // Half box size to avoid false positives.
var hit = Physics2D.BoxCast(origin, size, angle: 0f, direction, distance: 1f);
if (hit) {
        // Nothing to do, don't move.
} else {
        // Move towards target, 1/16th tile per frame
        var target = transform.position + direction;
        while (transform.position != target) {
                transform.position = Vector3.MoveTowards(transform.position, target,␣
↪1f / 16f);
                yield return null; // Wait for one frame before continuing.
        }
}
// ...
```

This code addition simply makes sure we only run the movement loop if the *Player* won't collide with anything at the target position.

Fig. 15: I lowered the tilemap opacity to make the `Collider` more visible in the **Scene** view.

Fig. 16: Collisions limit *Player* movement

If you enter **Play Mode** now, the *Player* character is no longer able to pass through the tiles you defined Collision Shapes for in your tilesets.

3.7.7 Occlusion with Tile Masks

A non-essential improvement we can make is to let the *Player* walk behind/under things like roofs and treetops – since my *Characters* layer is on top of all other layers, the *Player* character currently renders on top of everything.

You *could* add another Tile Layer above the *Characters* layer, and make sure everything that should occlude the *Player* character is placed in that layer, and not its original layer.

I find non-semantic layers like that tedious, repetitious, and error-prone, though.

Let's define occluding tiles directly in the tileset, instead; we'll use a prefab with a `SpriteMask` component, and a small script that synchronises the `SpriteMask`'s `Sprite` with the tile's `Sprite`.

Create a script called `TileMask`:

Listing 9: TileMask.cs

```
using UnityEngine;
using UnityEngine.Tilemaps;

[RequireComponent(typeof(SpriteMask))]
public class TileMask : MonoBehaviour {
        void Start() {
                var tilemap = GetComponentInParent<Tilemap>();
                var position = Vector3Int.FloorToInt(transform.localPosition);
                var sprite = tilemap.GetSprite(position);
                GetComponent<SpriteMask>().sprite = sprite;
                transform.localPosition += (Vector3)(sprite.pivot / sprite.
↪pixelsPerUnit);
        }
}
```

Since the `Sprite`'s pivot will be read as centered, the `Transform`'s `localPosition` is aligned to the center of the tile.

Now create a new prefab called *Mask*, and add your new `TileMask` component to it. A `SpriteMask` component will automatically be added as well, because of the `RequireComponent` class attribute.

Finally, in your tileset in Tiled, select all tiles that should occlude objects, and set their **Type** to *Mask*. This will make KITTY instantiate your new *Mask* prefab at every one of those tiles' positions in your tilemap.

Fig. 17: The *Player* is masked by the *Mask* tiles.

This approach of defining the occlusion directly in the tileset means you avoid repeating the occlusion definition, don't have to wrestle with multiple layers, and can't forget to make a tile in the tilemap occlude the *Player*.

Note: If you make changes to a prefab for tileset tiles, you need to reimport the tileset, which will automatically reimport the tilemap as well.

3.7.8 Interactions

We have a working prototype for a playable game, now! There's no way for the *Player* to interact with the world, though. Let's add signs the *Player* can read.

Custom Properties

Tiled allows you to add Custom Properties to almost everything, from maps and layers to tiles and objects.

KITTY allows you to assign the value of a Custom Property to a field in one or more of your classes, through the `[TiledProperty]` attribute. We'll use that to define the text on the signs.

Simple Sign

Create a new prefab called *Sign*, add a child with a `Canvas` component, and add a child with a `Text` component to the *Canvas* child. Configure the text to be visible even when there's a few lines in the `Text` component, then disable the *Canvas* child `GameObject` so it doesn't start visible.

Feel free to make it look fancy; I added a background panel and a custom font.

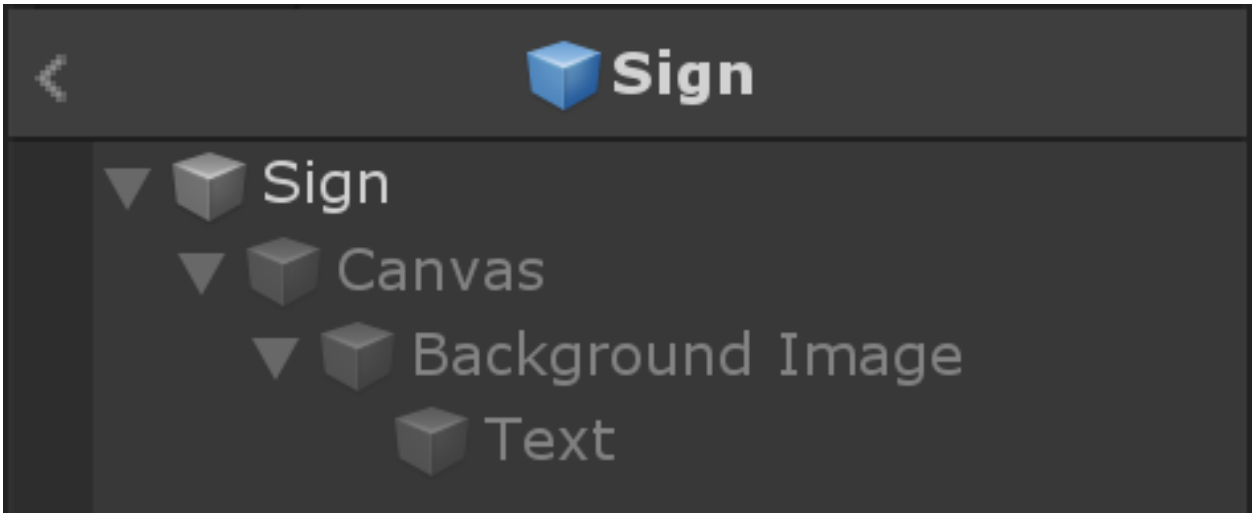


Fig. 18: My *Sign* prefab

Create a new `Sign` C# script, and add this component to the root of the *Sign* prefab:

Listing 10: Sign.cs

```
using System.Collections;
using KITTY;
using UnityEngine;
using UnityEngine.UI;

public class Sign : MonoBehaviour {
        public GameObject canvas;
        [TiledProperty] public string text;

        public IEnumerator Interact() {
                // Enable the text canvas, and wait for the player to press the "Fire1
↪" button.
```

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```
                canvas.SetActive(true);
                GetComponentInChildren<Text>().text = text;
                while (!Input.GetButtonDown("Fire1")) {
                        yield return null;
                }
                canvas.SetActive(false);
        }
}
```

Remember to add a reference to your *Canvas* `GameObject` in the `Sign` component's inspector.

The `[TiledProperty]` attribute lets us assign the value of any Custom Property named **Text** (case-insensitive, ignoring whitespace) directly from an object or tile in Tiled directly to our `public string text` property. *Nice*.

We're returning an `IEnumerator` again, because we want the `GridController` to wait for the "Fire1" button to be pressed before enabling its `Update` method again.

Note: The default "Fire1" buttons are Ctrl, left mouse button, and joypad button 1.

We need to add a few lines of code to the `GridController` class as well. It needs to wait for the `Interact` coroutine to finish when there *is* a BoxCast hit, *and* the collider that was hit also has a `Sign` component.

Listing 11: GridController.cs

```
// ...
if (hit) {
        // Interact with a Sign, if any.
        var interaction = hit.collider.GetComponentInParent<Sign>()?.Interact();
        if (interaction != null) {
                yield return StartCoroutine(interaction);
        }
} else {
// ...
```

Coroutines can start other coroutines, and even wait for them; the `GridController`'s `Walk` method will now wait for the `Sign`'s `Interact` method to complete before enabling the `GridController`'s `Update` method again with `enabled = true;`

We fetch the `Sign` component through `collider.GetComponentInParent<Sign>()` because KITTY automatically adds one or more child `Colliders` – based on a tile's Collision Shapes – to instantiated prefabs.

Back to Tiled; we need to make sure that in our tileset, our sign tile has the **Type** *Sign*, and has a full-tile Collision Shape. You can add a default `string` Custom Property named **Text**, as well; its value will be used as sign text if you don't give a sign a specific text.

If you have several different sign tiles you want to use, just repeat the process for all of them.

Now, add as many Tile Object Signs as you want to your tilemap, and add or change their **Text** Custom Property individually.

Switch back to Unity, enter **Play Mode**, and walk into a sign; with a few lines of code and a single Custom Property, you're now able to interact with the game world!

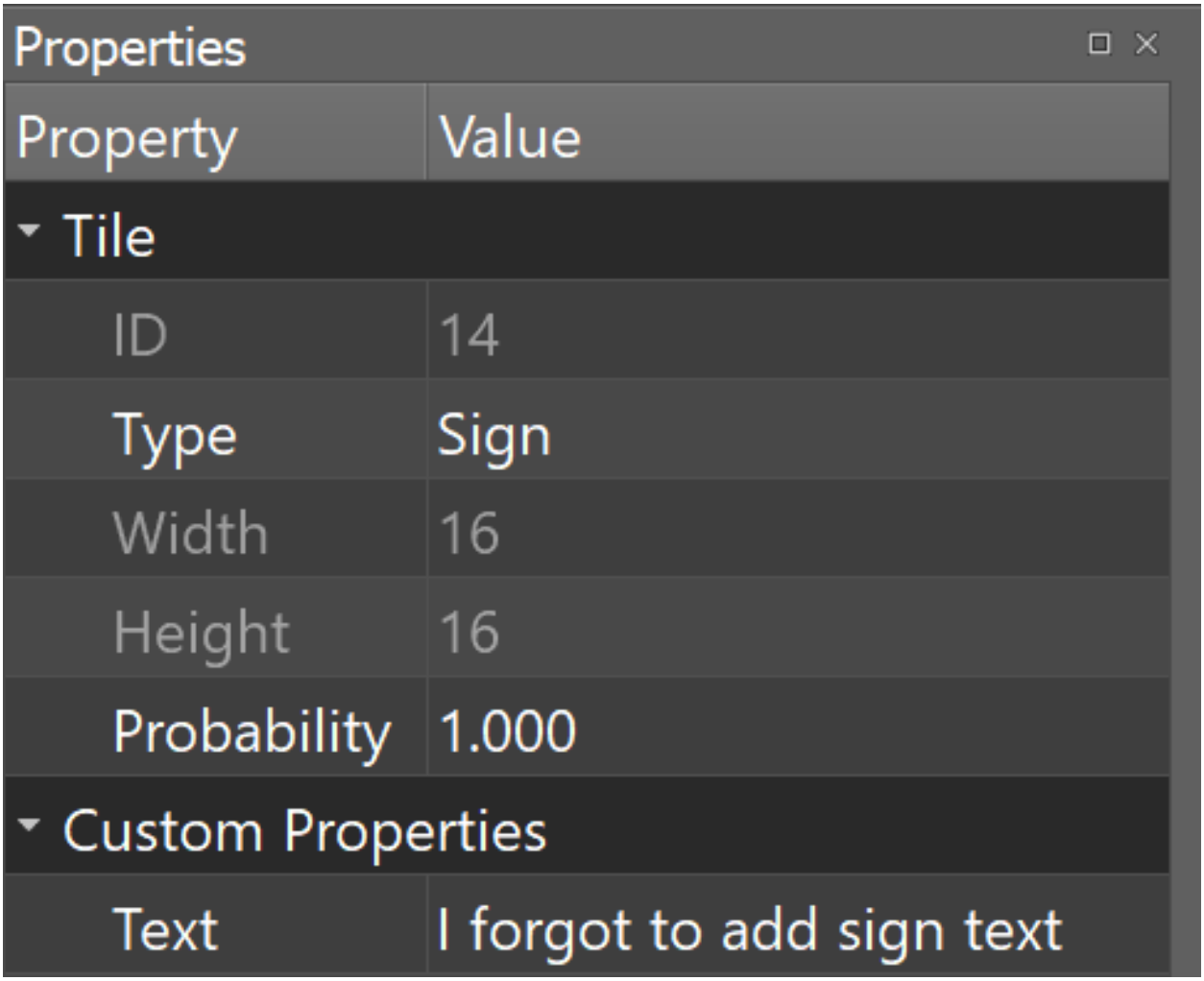

Fig. 19: Properties for *Sign* tile

Fig. 20: Signs showing a text box and waiting for input

Directional "Sign"

Before we start animating the *Player*, let's improve our `Sign` component a bit; depending on how you look at it, a stationary NPC that faces the *Player* when speaking is really just a *Directional "Sign"*. For my NPC, I went with four directional sprites of *May* from *Pokémon FireRed/LeafGreen*.

Instead of having separate classes and prefabs for *Sign*s and stationary NPCs, we can just make our `Sign` component face the *Player* if it has different frames for the four directions.

Listing 12: Sign.cs

```
// ...
public IEnumerator Interact(Transform actor) {
        // Display a specific direction frame to face the player.
        var animator = GetComponentInChildren<Animator>();
        var direction = actor.position - transform.position;
        var frame = 0;
        if      (direction == Vector3.down)  { frame = 0; }
        else if (direction == Vector3.left)  { frame = 1; }
        else if (direction == Vector3.up)    { frame = 2; }
        else if (direction == Vector3.right) { frame = 3; }
        animator?.SetInteger("Start", frame);
        animator?.SetInteger("End", frame);

        // Enable the text canvas, and wait for the player to press the "Fire1"␣
↪button.
        // ...
}
// ...
```

To determine the direction the *"Sign"* should face, we need to know what `Transform` is interacting with it; so, a `Transform` parameter has been added to the `Interact` method.

Depending on the direction, we select one of the four directional frames for our NPC *"Sign"*.

KITTY automatically adds a preconfigured `Animator` component to the automatically created *Renderer* `GameObject` of every Tiled tile object that's based on an animated tile.

We can set a subsequence of frames for this `Animator` at any time by specifying its `Start` and `End` properties. By setting both to the same value, the "animation" effectively turns into a single frame – the directional frame we want.

The `GridController` needs to pass in its `Transform` when calling `Interact`, too.

Listing 13: GridController.cs

```
var interaction = hit.collider.GetComponentInParent<Sign>()?.Interact(transform);
```

The only thing you need to do in Tiled is to define a short animation for your NPC *"Sign"*, with one frame for each of the four directions. Make sure the main tile has the **Type** *Sign*, and a defined collision shape.

Fig. 21: Four animation frames; one for each direction

Place a few NPC *"Sign"*s, add a `string` Custom Property named **Text** with whatever text you want, and they will turn to face the *Player* when interacted with in Unity's **Play Mode**.

Fig. 22: NPC *"Sign"* in action

She spins! By default, objects based on animated tiles will play out their full sequence of frames in a loop. If you want to have the *"Sign"* start facing one direction, just set the `Start` and `End` parameters of the `Animator` to the same frame number in a `Start` method.

Remember to check whether the `GameObject` *has* an `Animator` component, first.

Tip: Using `animator?.SetParameter` will not call `SetParameter` if `animator == null`.

3.7.9 Animating the Player

We'll use the same approach as the directional *"Sign"* for animating the *Player*; setting the `Start` and `End` parameters of the automatically created child `Animator` component to select animation sequences.

Fig. 23: *Player* sprite animation

Leaf from *Pokémon FireRed/LeafGreen* has three walking frames for each of the four directions, but her actual animation uses the middle frame twice.

Facing

Since *Leaf* has four walking frames per direction in her defined tile animation, the frame indices for each direction have a stride of four instead of one. In our `GridController`'s `Walk` method:

Listing 14: GridController.cs

```
// ...
enabled = false;

// Animation frame sequence depends on directions.
var animator = GetComponentInChildren<Animator>();
var frame = 0;
if      (direction == Vector3.down)  { frame =  0; }
else if (direction == Vector3.left)  { frame =  4; }
else if (direction == Vector3.up)    { frame =  8; }
else if (direction == Vector3.right) { frame = 12; }
// ...
```

Now that we have a frame offset for the direction, we can set a static frame facing that direction if the *Player* collides with anything:

Listing 15: GridController.cs

```
// ...
if (hit) {
        // Set static frame facing the collider.
        animator?.SetInteger("Start", frame + 1);
        animator?.SetInteger("End", frame + 1);
// ...
```

I add `1` to the frame offset because Leaf's animation frames are *left-foot*, *center*, *right-foot*, *center*, and I want her static frame to be a center frame.

It's important to set the `Animator` parameters *before* a potential `Interact` coroutine is started; that way, the *Player* will face a *Sign*, an NPC, or any other interactable object while waiting for the `Interact` coroutine to finish.

Animation

Animating your character's movement is done in the same way as setting a static frame, except the `Start` and `End` parameters are different from each other.

To animate Leaf with her four frames of animation, I simply define the subsequence of directional frames I want to play while she moves, wait for her to finish moving, and reset to a directional static frame:

Listing 16: GridController.cs

```
// ...
} else {
        // Set walking animation frame sequence.
        animator?.SetInteger("Start", frame);
        animator?.SetInteger("End", frame + 3);

        // Move towards target, 1/16th tile per frame
        // ...

        // Reset to idle.
        animator?.SetInteger("Start", frame + 1);
        animator?.SetInteger("End", frame + 1);
}
// ...
```

Now we've defined both an idle animation and a walking animation, for all four directions, in six lines of code. Wonderful!

Fig. 24: Walking animation plays when the *Player* moves

Note: Leaf, like May, initially plays her entire animation sequence in a loop. If you want to have your character face a specific direction from the start instead, just set both the `Start` and `End` parameters to the frame index you want in a `Start` method.

3.7.10 Recap

That concludes this tutorial in using Tiled and KITTY to make a small top-down game with Unity.

Let's go through what we've made.

Files

We don't really have that many files, despite having a small functioning game.

The contents of my `Assets/Maps/Tutorial` folder looks like this. Yours should be roughly similar, though probably with a different number of tilesets and images.

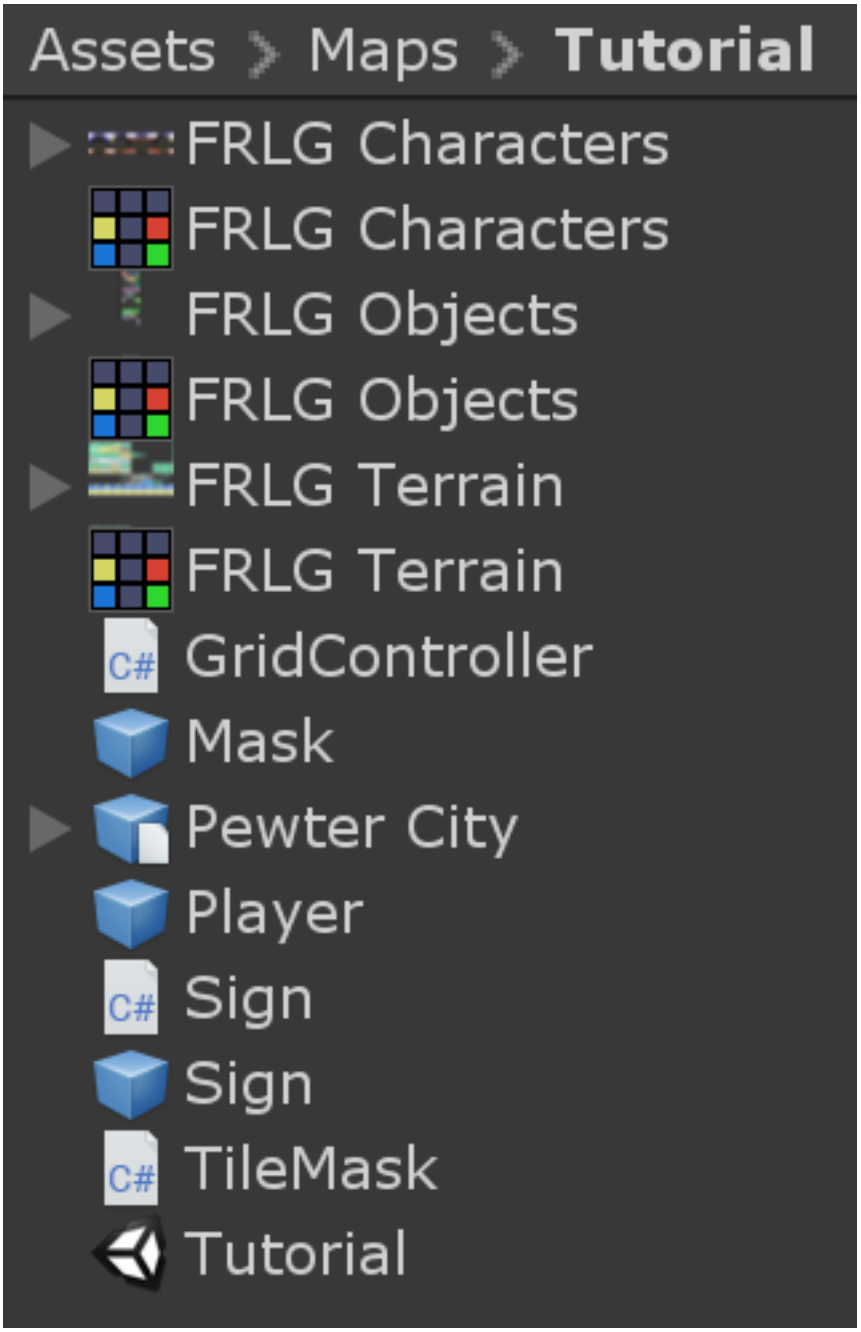

Fig. 25: **Project** folder contents

Scene Hierarchy

The scene **Hierarchy** just contains the tilemap prefab, and nothing else.

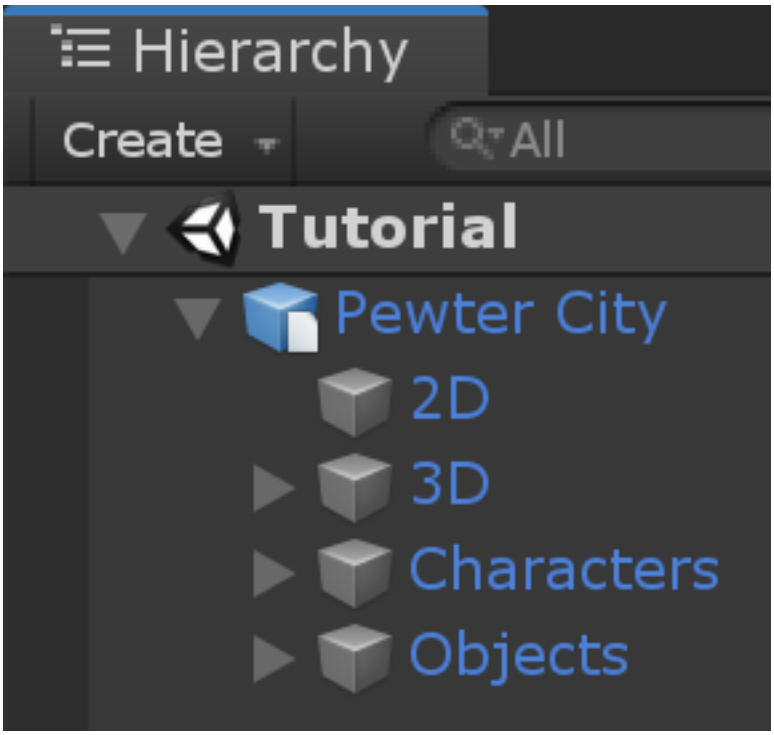

Fig. 26: Final scene **Hierarchy**

As you can see, there are no floating `GameObjects` to keep track of. I recommend making one fully self-contained scene per tilemap – that way, you can change mechanics as you see fit from one map to the next.

Code

Finally, we ended up with just three scripts to describe all the behaviour in our game.

Listing 17: GridController.cs

```
using System.Collections;
using UnityEngine;

public class GridController : MonoBehaviour {
        ///<summary>Walk to tile in `direction`.</summary>
        IEnumerator Walk(Vector3 direction) {
                // Disable the Update method until we're done walking one tile.
                enabled = false;

                // Animation frame sequence depends on directions.
                var animator = GetComponentInChildren<Animator>();
                var frame = 0;
                if      (direction == Vector3.down)  { frame =  0; }
                else if (direction == Vector3.left)  { frame =  4; }
                else if (direction == Vector3.up)    { frame =  8; }
```

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```
                else if (direction == Vector3.right) { frame = 12; }

                // BoxCast from the character's center, in the desired direction, to␣
↪check for collisions.
                var origin = transform.position + new Vector3(0.5f, 0.5f);
                var size = Vector2.one / 2f; // Half box size to avoid false␣
↪positives.
                var hit = Physics2D.BoxCast(origin, size, angle: 0f, direction,␣
↪distance: 1f);
                if (hit) {
                        // Set static frame facing the collider.
                        animator?.SetInteger("Start", frame + 1);
                        animator?.SetInteger("End", frame + 1);

                        // Interact with a Sign, if any.
                        var interaction = hit.collider.GetComponentInParent<Sign>()?.
↪Interact(transform);
                        if (interaction != null) {
                                yield return StartCoroutine(interaction);
                        }
                } else {
                        // Set walking animation frame sequence.
                        animator?.SetInteger("Start", frame);
                        animator?.SetInteger("End", frame + 3);

                        // Move towards target, 1/16th tile per frame
                        var target = transform.position + direction;
                        while (transform.position != target) {
                                transform.position = Vector3.MoveTowards(transform.
↪position, target, 1f / 16f);
                                yield return null; // Wait for one frame before␣
↪continuing.
                        }

                        // Reset to idle.
                        animator?.SetInteger("Start", frame + 1);
                        animator?.SetInteger("End", frame + 1);
                }

                // Enable the Update method after we're done walking one tile.
                enabled = true;
        }

        void Update() {
                var input = new Vector2(Input.GetAxisRaw("Horizontal"), Input.
↪GetAxisRaw("Vertical"));

                // Move one tile in an input direction, if any, preferring horizontal␣
↪movement.
                if (input.x != 0f) {
                        StartCoroutine(Walk(new Vector3(input.x, 0).normalized));
                } else if (input.y != 0f) {
                        StartCoroutine(Walk(new Vector3(0, input.y).normalized));
                }
        }
}
```

Listing 18: TileMask.cs

```
using UnityEngine;
using UnityEngine.Tilemaps;

[RequireComponent(typeof(SpriteMask))]
public class TileMask : MonoBehaviour {
        void Start() {
                var tilemap = GetComponentInParent<Tilemap>();
                var position = Vector3Int.FloorToInt(transform.localPosition);
                var sprite = tilemap.GetSprite(position);
                GetComponent<SpriteMask>().sprite = sprite;
                transform.localPosition += (Vector3)(sprite.pivot / sprite.
↪pixelsPerUnit);
        }
}
```

Listing 19: Sign.cs

```
using System.Collections;
using KITTY;
using UnityEngine;
using UnityEngine.UI;

public class Sign : MonoBehaviour {
        public GameObject canvas;
        [TiledProperty] public string text;

        public IEnumerator Interact(Transform actor) {
                // Display a specific direction frame to face the player.
                var animator = GetComponentInChildren<Animator>();
                var direction = actor.position - transform.position;
                var frame = 0;
                if      (direction == Vector3.down)  { frame = 0; }
                else if (direction == Vector3.left)  { frame = 1; }
                else if (direction == Vector3.up)    { frame = 2; }
                else if (direction == Vector3.right) { frame = 3; }
                animator?.SetInteger("Start", frame);
                animator?.SetInteger("End", frame);

                // Enable the text canvas, and wait for the player to press the "Fire1
↪" button.
                canvas.SetActive(true);
                GetComponentInChildren<Text>().text = text;
                while (!Input.GetButtonDown("Fire1")) {
                        yield return null;
                }
                canvas.SetActive(false);
        }
}
```

3.7.11 Going Forward with KITTY

KITTY can do much more than just top-down orthogonal grid-based games.

With what you've learned in this tutorial, you can go on to make platformers with complex collision shapes, turn-based

strategy games with building mechanics, 3D tile-based first person games, or even improve upon KITTY itself.

Good luck!

This Tutorial

You should be able to build on what you've made with this tutorial.

For your next step, I have a few suggestions:

- Make *Door*s "warp" the *Player* to different maps by loading entire scenes by their name
- Expand the text boxes used for *Sign*s to support multiple pages, prompts, variables, and so on
- Add *NPC*s that walk around randomly

KITTY Examples

We currently only have one published game made with KITTY.

It's called PiRATS, it got second place in Mini Jam 28, and it's made by Fmlad and myself.

The game is short but kinda neat, we'd be happy if you would check it out~

3.7.12 Thank you again for using KITTY!

KITTY is just a hobby project I've been working on for a while.

It means a lot to me that you got through this tutorial, so thank you.

If you spot anything weird or wrong in this tutorial, or you find a bug or missing feature in KITTY, you're welcome to contact me.

3.8 Known issues

KITTY is a work in progress. It has missing features, known issues, and a few known bugs.

If you find an issue or a bug not listed here, you can contact me.

3.8.1 Isometric and hexagonal tilemap objects are misplaced

KITTY's initial focus is on orthogonal tilemaps. While isometric and hexagonal tilemaps import and display just fine, any objects defined within will be offset immensely.

3.8.2 Visible property in Tiled does nothing

Ideally, toggling the **Visible** property on a Tiled object should still create a `SpriteRenderer`, but disable it by default.

3.8.3 Non-power-of-two tileset texture misalignment

KITTY doesn't take into account any difference between a tileset's defined width and height, and a non-power-of-two texture's Unity-rescaled width and height.

A quick fix is to change the tileset image's import settings to not rescale non-power-of-two textures.

3.8.4 Private `[TiledProperty]` fields aren't serialized

While it doesn't make sense to import a property value to an unserialized field (it'll just be lost), the `[TiledProperty]` attribute doesn't automatically force field serialization.

A quick fix is to add the `[SerializeField]` attribute as well.

3.8.5 Tile collision shape types are ignored

Typed tile collision shapes should probably instantiate a prefab per shape. They currently don't.

3.8.6 Template objects don't work

Templates are not yet implemented in KITTY.