Ubisoft API documentation:

Installation:

BackBone:

The underlying system driving the api is a free, open source multimedia library SFML: https://www.sfml-dev.org/ the functions and classes created for the challenge are using it at lower level to handle 2d image/texture functionality, sound, input processing.

Project:

The API has been prepared in VS2015/Windows and proper *.sln files are inside the zip of the project. If used in this environment the installation should be as easy as unzip & run. If there are any problems in building the project, proper instructions on how to include sflm in VS, Linux, Code::Blocks can be accessed here:
https://www.sfml-dev.org/tutorials/2.5/start-vc.php
https://www.sfml-dev.org/tutorials/2.5/start-cb.php
https://www.sfml-dev.org/tutorials/2.5/start-linux.php
API itself should have no functionality that is counting on the environment being Windows, so if needed one should be able to convert it to Linux based project, with typical changes needed only in the main() loop.

Additional documentation of low level SFLM functionality can be seen here:
https://www.sfml-dev.org/documentation/2.5.0/
and in the header files of included SFLM libs.

GameEngine:

Basic structure:

On top of the low level SFLM code a basic GameEngine API and Game implementation has been provided. Participants are expected to modify a whole source base, engine included, to fit the needs that their game will create. Current version is kept basic purposefully and created in the same "hackaton" style as the challenge itself – Made in less than 30 labor hours, solving the problems that needed to be solved for our game implementation, while still keeping a proper robust structure that most of the games would need.

Enity:

At the core of our API concept lies an ENTITY. Entity is an object that exists in our game, has a position, size and a bunch of other common functionalities. Think of it that way – if it should be dynamically created/removed, it exists/moves in the gameWorld, it can be seen/affected by the user – Most probably it should be an Entity. The opposing side would be Managers/Helpers – structures that most

often exit in game as Singletons and are responsible for the “behind scenes” work that our game needs to work (f.i – TextureManager, InputManager, AnimationManager),

Component:

In our engine we opted for Component based design, since:
a) Most of the modern GameEngines implement that structure
b) And for good reason – since it makes the code quite robust and easy to work with, where functionalities are divided into manageable chunks and one can easily control what an Entity is supposed to be doing in our world.

Examples:
AnimationComponent – fully responsible for animating a sprite
SpriteRenderComponent – Bit of code that makes sure that the sprite is actually shown on the screen
CollidableComponent – Marker component that implements basic collision detection functionality

That way, if we want our player to be animating, moving with inputs, rendering on screen as a sprite, and colliding with stuff, we can do:

(…)

```
m_player = new Entity();
m_player->AddComponent<GameEngine::CollidablePhysicsComponent>();
m_player->AddComponent<GameEngine::SpriteRenderComponent>();
m_player->AddComponent<GameEngine::AnimationComponent>();
m_player->AddComponent<GameEngine::PlayerMovementComponent>();
```

(…)

And if we want to create an animated Obtacle, we use the same snippet, but drop the PlayerMovementComponent.

At its core – component should be responsible for singular functionality, and should be made robust enough to fit many different types of entities to perform the same function. More about components we implemented for you - later.

GameEngine Life Cycle:

The `void GameEngineMain::OnInitialised()` function is called after the SFLM window is initialised and our game should be ready to go. All local initis, new manager, should probably be handled there.

The `void GameEngineMain::Update()` is called EVERY frame and goes through the list of added entities to put them into Update que and Render que. This also makes sure that Entiy::Update and Component::Update functions are called.

An entity when added to the engine, will always be one frame delayed, before being ready. This is done to allow all static values and new components to be created inside the Entity constructor, and then used safely in a provided: `void Entity::OnAddToWorld()` / `void Component::OnAddToWorld()`.

Symetricaly, when the Entity is removed from game, before being fully deleted and cleared the proper OnRemoveFromWorld will be called, to allow cleanup dependant on the values that might still exist within components.

Entity::Entity()-> GameEngine::AddEntity-> 1 frame delay -> Entity::OnAddToWorld

GameEngine::RemoveEntity -> Entity::OnRemoveFromWorld -> 1 frame delay -> Entity::~Entity()

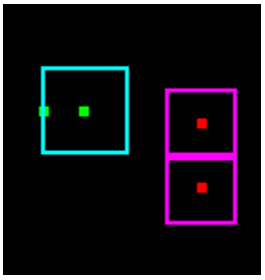
Implemented systems:

GameEngine API provides a few game systems and toys, that most of the implementations would probably find use of. They are implemented in a very basic way, and you are welcome to build on top of them, to fill your application needs.

Basic Rendering:

Implemented through RenderComponent – basic rendering allows us to use sflm::draw methods to show basic shapes in our game. Every entity registered in game engine that HAS the RenderComponent will end up on Render que, be properly sorted in Z 2d space (meaning things in a background will be drawn prior to things in the foreground) and then the Render method with proper rendering target (in our case – the Window that the user sees) will be called.

```
void RenderComponent::Render(sf::RenderTarget* target)
{
	//Debug draw of entity pos
	sf::RectangleShape shape(sf::Vector2f(5.f, 5.f));
	sf::Vector2f pos = GetEntity()->GetPos();
	pos -= shape.getSize() / 2.f;
	shape.setFillColor(m_fillColor);
	shape.setPosition(pos);
	target->draw(shape);
}
```



Sprite Rendering:

For us to be able to draw a sprite on screen, we have to be able to load and parse a *.png file as an sflm::texture. This is done in TextureManager class implemented with Singleton pattern.

To add a new texture to load, you can simply edit static texture enums in that file, and provide the filename to an image that should be the texture:

```
namespace eTexture
{
	enum type
	{
		None = -1,
		Player = 0,
		Tileset,
		BG,
		Particles,
		Count,
	};
}

inline const char* GetPath(eTexture::type texture)
{
	switch (texture)
	{
	case eTexture::Player:    return "player.png";
	case eTexture::Tileset:   return "tileset.png";
	case eTexture::BG:           return "bg.png";
	case eTexture::Particles: return "particles.png";
	default:       return "UnknownTexType";
	}
}
```

Once that part is done, we should be able to access that texture anywhere in the code with:

```
sf::Texture* texture = TextureManager::GetInstance()->GetTexture(eTexture::Player);
```

Textures usually hold a whole set of pictures to be used in the game, as dividing images into many files can be resource heavy. That is why, we have defined a texture TILE size, which you can modify here:

```
static sf::Vector2f GetTextureTileSize(GameEngine::eTexture::type texture)
{
	switch (texture)
	{
	case  GameEngine::eTexture::Player:  return sf::Vector2f(32.f, 32.f);
	case  GameEngine::eTexture::Tileset: return sf::Vector2f(32.f, 32.f);
	case  GameEngine::eTexture::BG:         return sf::Vector2f(500.f, 500.f);
	case  GameEngine::eTexture::Particles: return sf::Vector2f(31.f, 32.f);
	default:                                return sf::Vector2f(-1.f, -1.f);
	}
}
```

Tile defines a single “sprite image” that renders on the screen

Player.Png – Full texture

Single tile from that texture.

The SpriteRenderComponent (extending RenderComponent) is responsible for figuring out which part of texture we want to render in our game

```
void SpriteRenderComponent::UpdateSpriteParams()
{
	if (m_texture == eTexture::None)
		return;

	sf::Texture* texture = TextureManager::GetInstance()->GetTexture(m_texture);
	m_sprite.setTexture(*texture);

	//Set origin to centre
	sf::Vector2f textureSize = sf::Vector2f(texture->getSize());
	if (TextureHelper::GetTextureTileSize(m_texture).x > 0.f)
	{
		textureSize = TextureHelper::GetTextureTileSize(m_texture);
	}

	sf::IntRect textureRect((int)textureSize.x * m_tileIndex.x, (int)textureSize.y *
m_tileIndex.y, (int)textureSize.x, (int)textureSize.y);
	m_sprite.setTextureRect(textureRect);

	m_sprite.setOrigin(sf::Vector2f(textureSize.x / 2.f, textureSize.y / 2.f));
	//If we have specified size, rescale to fit:
	if (GetEntity()->GetSize().x > 0.f && GetEntity()->GetSize().y > 0.f)
	{
		float scaleX = GetEntity()->GetSize().x / textureSize.x;
		float scaleY = GetEntity()->GetSize().y / textureSize.y;

		m_sprite.setScale(sf::Vector2f(scaleX, scaleY));
	}
}
```

And we control, which tile, by setting the m_tileIndex to what we want to show:

```
entity->GetComponent< SpriteRenderComponent >().SetTileIndex(0,0)
```

```
entity->GetComponent< SpriteRenderComponent >().SetTileIndex(3,0)
```

Animation:

As you can probably see from previous example, the SetTileIndex function of SpireRenderComponent can and is used for animation handling. If we switch the tiles after certain amount of time, we render

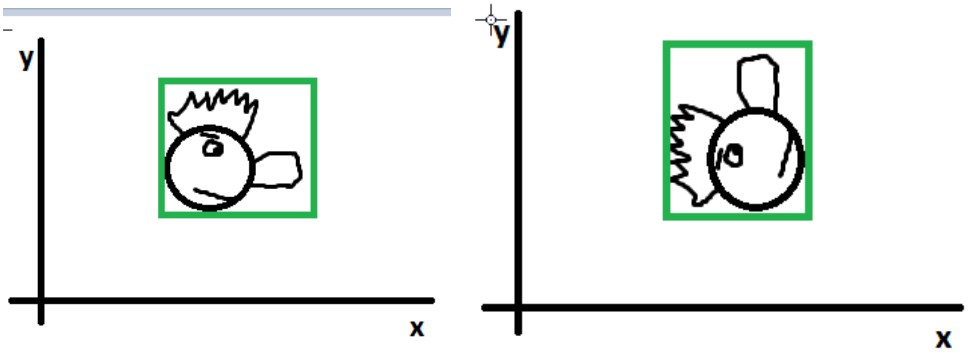
the next frame of animation, making our bird move. Animation parameters and clips are defined in AnimationManager

```
void AnimationManager::InitStaticGameAnimations()
{
	m_animDefinitions.push_back
	(
		SAnimationDefinition(
			EAnimationId::BirdIdle,
			eTexture::Player,
			sf::Vector2i(0, 0),
			10,
			3)
	);

	m_animDefinitions.push_back
	(
		SAnimationDefinition(
			EAnimationId::BirdFly,
			eTexture::Player,
			sf::Vector2i(0, 1),
			10,
			15)
	);

	m_animDefinitions.push_back
	(
		SAnimationDefinition(
			EAnimationId::Smoke,
			eTexture::Particles,
			sf::Vector2i(0, 0),
			10,
			15)
	);
}
```

Where SAnimationDefinition is a structure filled with: **AnimationId** to be used later in the code, **Texture** that the animation uses, **Index** of first tile of the animation, **Length** of animation in frames, **Frames** per second. This animation definition is later used in AnimationComponent, that modifies the tile index of SpriteRenderComponent according to animation logic, making out characters animate on the screen:

Collision System:

We implemented a very basic AABB (Axis Alligned Bounding Box) collision system for you to build on. The AABB box is always aligned towards x/y axises on 2d space, which is less than ideal for complicated physics, but works well in simple examples and is very easy to implement.



The box and the Entity ability to collide is implemented in `CollidableComponent`

Every entity with that compoent is gathered in CollisionManager and used for further collision handling. CollidableComponent on it's own does not really do anything – just defines that this is an object that we can collide WITH. In order to have our character actually stop and react to collision properly, a separate `CollidablePhysicsComponent` is used, and a simple code modifies the position of an Entity according to collision data:

```
void CollidablePhysicsComponent::Update()
{
	//For the time being just a simple intersection check that moves the entity out of all potential intersect boxes
	std::vector<CollidableComponent*>& collidables = CollisionManager::GetInstance()->GetCollidables();

	for (int a = 0; a < collidables.size(); ++a)
	{
		CollidableComponent* colComponent = collidables[a];
		if (colComponent == this)
			continue;

		AABBRect intersection;
		AABBRect myBox = GetWorldAABB();
		AABBRect colideBox = colComponent->GetWorldAABB();
		if (myBox.intersects(colideBox, intersection))
		{
			sf::Vector2f pos = GetEntity()->GetPos();
			if (intersection.width < intersection.height)
			{
				if (myBox.left < colideBox.left)
					pos.x -= intersection.width;
				else
					pos.x += intersection.width;
			}
			else
			{
				if (myBox.top < colideBox.top)
					pos.y -= intersection.height;
				else
					pos.y += intersection.height;
			}

			GetEntity()->SetPos(pos);
		}
```

```
	}
}
```

Particle emitter:

Huge word, for something so simple, but our basic implementation of particle emitters is as simple as creating a component that allows us to dynamically spawn new entities in fixed time increments, that also can automatically delete themselves after their specified “lifetime”.

```
void ParticleEmitterComponent::Update()
{
	float dt = GameEngine::GameEngineMain::GetInstance()->GetTimeDelta();
	m_toEmitTimer -= dt;

	if (m_toEmitTimer <= 0.f)
	{
		EmitParticle();

		m_toEmitTimer = RandomFloatRange(m_minTimeToEmit, m_maxTimeToEmit);
	}
}


void ParticleComponent::Update()
{
	float dt = GameEngine::GameEngineMain::GetInstance()->GetTimeDelta();

	m_lifeTimer -= dt;

	if (m_lifeTimer <= 0.f)
	{
		GameEngine::GameEngineMain::GetInstance()->RemoveEntity(GetEntity());
	}
}
```

Expanding this functionality with emission velocity (to randomise the particle directions and have paricles move on screen), further emit randomisation would definetly improve detail aspect of your games.