MTAT.03.015 Computer Graphics (Fall 2013)
Exercise session XIV: OGRE

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In this exercise session we will have a look at high-level graphics engine called OGRE[1]. We will see how the concepts we know about are included into the OGRE engine, making our life easier: lighting, materials, shadows, environmental mapping and other techniques are made accessible by adding few lines of code, without the need to implement all annoying details on our own.

The solutions will have to be submitted as a zipped project directory. Please keep Windows libraries even if you work on Linux or Mac.

You can always seek for additional information and help in official tutorials `http://www.ogre3d.org/tikiwiki/tiki-index.php?page=Tutorials`: Basic Tutorials section.

1 Structure of the application

We start by comparing the structure of the application to the familiar structure we've been using so far. Please open `1_OgreTriangle` project and read through the code in the `triangle.cpp` file. Compare it to the GLUT-based applications we have seen before.

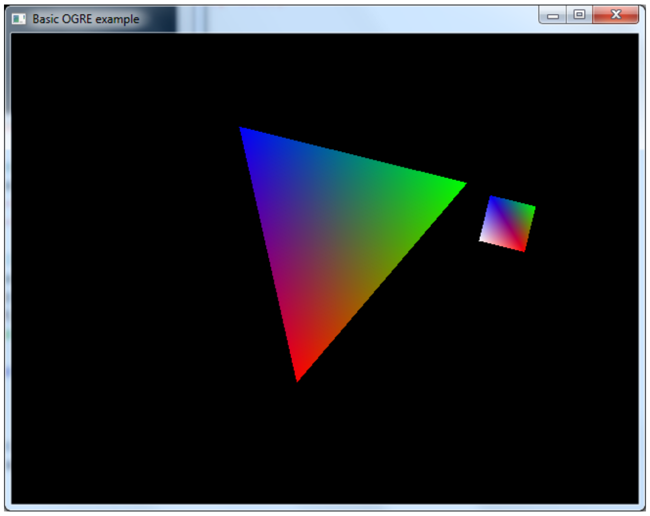
Exercise 1 (0.5pt). Add a small square which will fly around the triangle and rotate around it's own center. For that you will need to

1. Create new `Ogre::ManualObject` object using `createManualObject()` method of the scene manager.
2. Describe vertices of your square. Look up in the documentation of the `Ogre::RenderOperation` class[2] which operation type you should use. Note that in OGRE we first create the vertex itself and then describe it's attributes.
3. Create `Ogre::SceneNode` and attach the new object to it.

[1] `http://www.ogre3d.org/`
[2] `http://www.ogre3d.org/docs/api/html/classOgre_1_1RenderOperation.html`

4. Use this `SceneNode` to animate our object (update it's potision) in the `frameRenderingQueued()` method, which is an analog of `idleFunc()` in GLUT.

The existing code for the triangle will serve you as example. The result should look something like this:



2 High-levelness

Open project `2_OgreLighting`. The structure is same as before. Have a look at `createLitSphereScene()`, here we create a sphere, add materials to it and enable lighting. See how it is done. Now pay attention to these lines in the middle of `run()` function:

```
Ogre::ResourceGroupManager::getSingleton().
                        addResourceLocation("../data", "FileSystem");
Ogre::ResourceGroupManager::getSingleton().
                        initialiseAllResourceGroups();
```

Instead of writing material properties into the code, materials (and some other things) can be described in special *script* files. First line tells OGRE where to look for resources: various data files (textures, meshes, etc.) and scripts. Second line instructs it to read in resource descriptions and initialise *resource groups*.

Have a look at the `Examples.material` file in the `data` folder and try to apply some of materials described there to our sphere:

```
sphere->setMaterialName("Examples/WaterStream");
```

If you would like to try other examples you should download Ogre SDK[3] and add the resources needed for each particular example to our `data` folder.

Exercise 2 (0.5pt). Create new file `data/Sphere.material`. Here we will describe material for our sphere. Use `data/Examples.material` and `http://www.ogre3d.org/docs/manual/manual_16.html` to create a material script, which exactly reproduces material parameters we have specified in the code. The result should look exactly the same: red sphere with white specular spot on it. Note that you can use `WASD` keys to move the camera and mouse to look around.

Exercise 3 (0.5pt). In practice session #9, which was about different types of shadows, we implemented three different shadow techniques. You might remember that for implementing stencil shadows you first needed to create shadow volume objects and after that implement the logic by carefully playing with stencil, color and depth buffers. OGRE allows you to enable stencil shadows with literally one line of code[4]:

```
scene->setShadowTechnique(Ogre::SHADOWTYPE_STENCIL_ADDITIVE);
```

Create a plane (`Ogre::SceneManager::PT_PLANE`) below the sphere and enable shadows. Note that you can enable or disable whether specific object casts a shadow using `setCastShadows()` method of `Ogre::Entity` object.

Exercise 4 (0.5pt). Next let's see how we can map textures on our objects. The best way to do that is, again, by using `.material` scripts. Check out `data/Examples.material` for examples. Note that you can create animated textures just by adding one line (for example see `Examples/WaterStream`). Find your favourite picture in the internet and use it as texture for the plane.

Another popular use of texture is environmental mapping or cube mapping. Have a look at the tutorial[5] and add SkyBox or SkyDome to our scene.

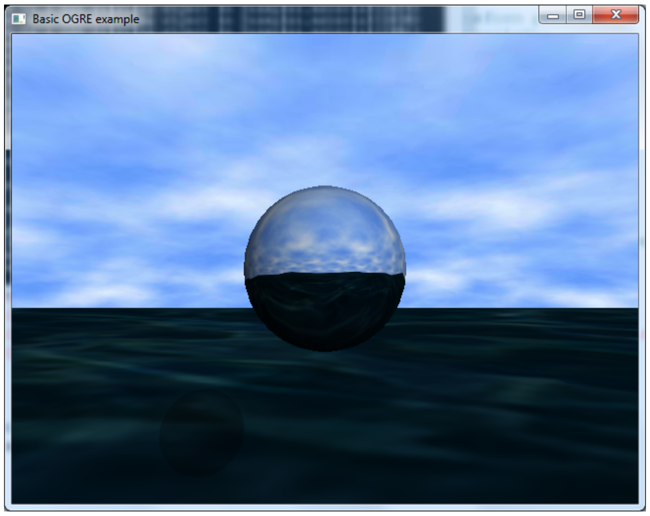
Exercise 5* (0.5pt). Look at the scene now. You might feel the urge to make sphere reflective. Study the code in `examples/CubeMapping/include/CubeMapping.h`. Here is an approximate description of the steps you need to do:

1. Make our `Application` class inherit `Ogre::RenderTargetListener`
2. Make use of `preRenderTargetUpdate()` method
3. Add some global variables
4. Create cube map texture in the same way as it is done in `createCubeMap()`

[3]`http://www.ogre3d.org/download/sdk`
[4]See more `http://www.ogre3d.org/tikiwiki/tiki-index.php?page=Basic+Tutorial+2`
[5]`http://www.ogre3d.org/tikiwiki/tiki-index.php?page=Basic+Tutorial+3`

5. Use `Examples/DynamicCubeMap` to create a new material in our `Sphere.material` script
6. Enable this material using `setMaterialName()` method

After completing exercises 3, 4 and 5 your scene will be something like this:



Now let us move to the next project and see how OGRE works with meshes. Open project `3_OgreMesh` and

3 Plugins

Open project `4_OgrePlugins`. You can switch scenes, look how it's done.

Exercise 6 (0.5pt). Do ??? with particle system

Exercise 6* (1pt). Add some other plugin (or any other display of creativity?)