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# **nTiled Documentation**

***Release 0.1***

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*nTiled* is an *OpenGL* viewer that implements tiled and clustered shading as well as a novel technique named hierarchical shading. It is written to evaluate the time and space complexity of said algorithms.

*nTiled* is written as part of my thesis in order to obtain my masters in computer science at KU Leuven.



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## How this document is organised

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Over time *nTiled* has grown significantly in size. In order to ensure the usefulness of this project, this documentation is organised in four sections:

- *Motivation* describes in depth the use case of this project as well as provide links to the data generated by this project and the actual text written.
- *Getting Started* describes how to get this project running.
- *Structure of the Project* provides a high level overview of the project as well as several class diagrams.
- *The nTiled API reference* section describes in depth the classes and functions of this project.

Furthermore the thesis text and additional data are housed at the following repositories:

- Thesis Text repository.
- Thesis Data repository.



## Motivation

*nTiled* is written as a tool to evaluate the performance of several light assignment algorithms.

## Light Assignment

### The Algorithms

Tiled Shading

Clustered Shading

Hierarchical Shading

Thesis and data sources

## Getting Started

### Installation

*nTiled* is developed as a visual studio project. In order to get it running on your machine you will need the latest visual studio as well as the following set of dependencies.

### Dependencies

*nTiled* requires the following dependencies:

- *openGL* in the form of *GLAD*

- *glfw* as a windows manager
- *glm* to manage mathematics
- *assimp* to read different 3d files
- *rapidjson* to read json files

### Step by step installation

1. Install Visual Studio with the installer obtained from [here](#).
2. Clone the *nTiled* repository

```
cd <desired parent directory>
git clone https://github.com/BeardedPlatypus/nTiled.git
```

3. Download dependencies and put them at their relative path

- (a) *openGL*: [glad](#)

Follow the instructions in the readme of glad to generate the appropriate c code and headers. Place these files at `<solution_directory>/nTiled/lib/</code>`

- (b) *glfw*

Download the files from the homepage and put these under `<solution_directory>/nTiled/lib/glfw/</code> If a different version than 3.1.2 is used this needs to be updated in the nTiled properties`

- (c) *glm*

Download the files and put these under `<solution_directory>/nTiled/lib/glm/</code>`

- (d) *assimp*

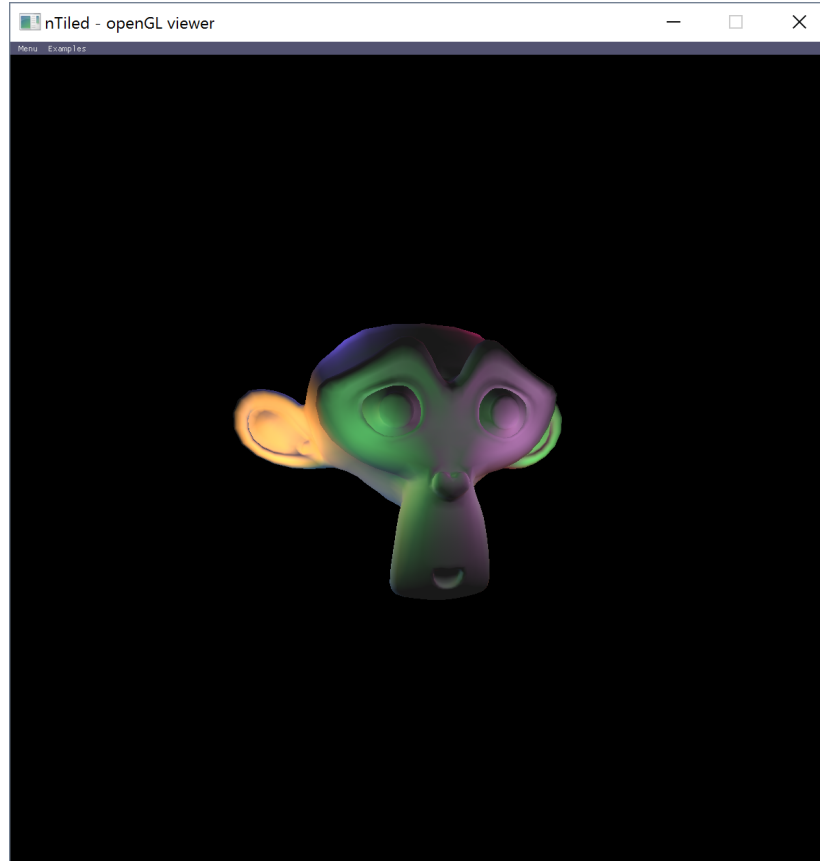
Download the files from the homepage and put these under `<solution_directory>/nTiled/lib/assimp/</code>`

- (e) *rapidjson*

Follow the installation instructions on the README of rapidjson

4. You should now be able to start the solution from inside visual studio and it should compile.

## Basic Usage



*nTiled* can be run by running the produced executable followed by the path to a run configuration file.

```
nTiled <path_to_conf_file.json>
```

An example run configuration file can be found in the example folder. This is the same file that will be run when no path is specified.

For other example files see [the data repository](#). For a complete overview of the configuration options see :ref: conf\_spec

## Structure of the Project

### The nTiled API reference

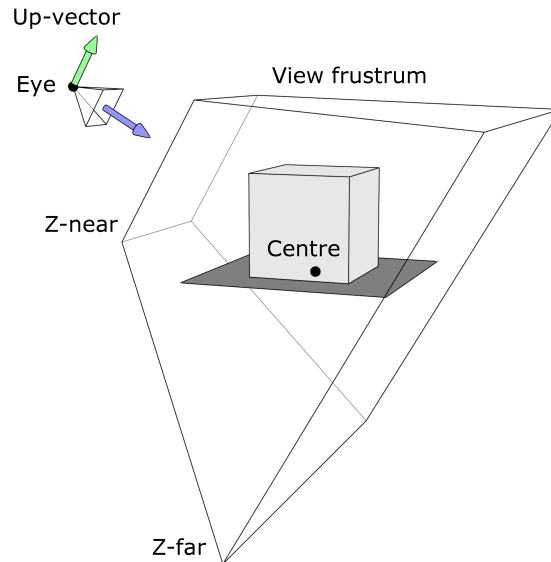
The *nTiled* api is divided into modules.

#### Camera

The camera module contains all classes and functions related to the Camera in *nTiled*. The *Camera* class acts as a facade, facilitating interactions between the rest of the program and the camera module. The control scheme of the *Camera* is controlled by the CameraControl class.

## Camera Model

In order to ensure no errors in communication are made, the following naming conventions were adopted within the *camera* module:



The location of the camera is specified by Eye vector. The look at point is defined by the centre, finally the local y-direction is controlled by the Up-vector.

Furthermore each camera has a limited space it will display. This space is controlled by the z-near and z-far values. These in combination with the field of view and aspect ratio values determine the view frustum.

The field of view values are all specified in degrees. The eye, centre and z-depth values are all defined in world coordinates.

## Camera Input

In order to control the Camera the following classes are implemented: \* *TURNTABLE*: allows a direct user controlled input similar to the controls in blender

- *PATH*: Loads a file containing the lookat matrices per frame. It will render these sequentially.

## Camera API

```
class nTiled::camera::Camera
```

**Warning:** doxygenclass: Cannot find class “nTiled::camera::Camera” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::camera::CameraControl

**Warning:** doxygenclass: Cannot find class “nTiled::camera::CameraControl” in doxygen xml output for project “nTiled” from directory: doxyxml/

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**Warning:** doxygenclass: Cannot find class “nTiled::camera::TurnTableCameraControl” in doxygen xml output for project “nTiled” from directory: doxyxml/

---

**Warning:** doxygenclass: Cannot find class “nTiled::camera::PathCameraControl” in doxygen xml output for project “nTiled” from directory: doxyxml/

---

**struct** nTiled::camera::CameraConstructionData

**Warning:** doxygenstruct: Cannot find class “nTiled::camera::CameraConstructionData” in doxygen xml output for project “nTiled” from directory: doxyxml/

---

**struct** nTiled::camera::CameraData

**Warning:** doxygenstruct: Cannot find class “nTiled::camera::CameraData” in doxygen xml output for project “nTiled” from directory: doxyxml/

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## GUI

The gui module is written with the dear, imgui library, (available [here](#)) It determines whether user input is meant for the interface, or should be forwarded to the Camera of nTiled.

### GUI API

**class** nTiled::gui::GuiManager

**Warning:** doxygenclass: Cannot find class “nTiled::gui::GuiManager” in doxygen xml output for project “nTiled” from directory: doxyxml/

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**enum class** nTiled::gui::GuiFocus

**Warning:** doxygenenum: Cannot find enum “nTiled::gui::GuiFocus” in doxygen xml output for project “nTiled” from directory: doxyxml/

## Logging

The logging module provides the functionality to track the execution time of functions.

### Logging API

**class** nTiled::logged::ExecutionTimeLogger

**Warning:** doxygenclass: Cannot find class “nTiled::logged::ExecutionTimeLogger” in doxygen xml output for project “nTiled” from directory: doxyxml/

## Main

Main contains the definitions of the classes and functions related to executing nTiled.

### Main API

**class** nTiled::Clock

**Warning:** doxygenclass: Cannot find class “nTiled::Clock” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::Controller

**Warning:** doxygenclass: Cannot find class “nTiled::Controller” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::DrawMethod

**Warning:** doxygenclass: Cannot find class “nTiled::DrawMethod” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::DrawToMemory

**Warning:** doxygenclass: Cannot find class “nTiled::DrawToMemory” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::DrawToView

**Warning:** doxygenclass: Cannot find class “nTiled::DrawToView” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::FrameEvent

**Warning:** doxygenclass: Cannot find class “nTiled::FrameEvent” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::FrameEventCompare

**Warning:** doxygenclass: Cannot find class “nTiled::FrameEventCompare” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::SetDrawMethodEvent

**Warning:** doxygenclass: Cannot find class “nTiled::SetDrawMethodEvent” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::ToggleLoggingDataEvent

**Warning:** doxygenclass: Cannot find class “nTiled::ToggleLoggingDataEvent” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::ExportLoggingDataEvent

**Warning:** doxygenclass: Cannot find class “nTiled::ExportLoggingDataEvent” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::ExitEvent

**Warning:** doxygenclass: Cannot find class “nTiled::ExitEvent” in doxygen xml output for project “nTiled” from directory: doxygenxml/

## Math

The *Math* module contains all custom math functions used in *nTiled*.

## Math API

### Functions

**Warning:** doxygenfunction: Cannot find function “nTiled::math::to\_radians” in doxygen xml output for project “nTiled” from directory: doxyxml/

**Warning:** doxygenfunction: Cannot find function “nTiled::math::to\_degrees” in doxygen xml output for project “nTiled” from directory: doxyxml/

**Warning:** doxygenfunction: Cannot find function “nTiled::math::getNextPow2” in doxygen xml output for project “nTiled” from directory: doxyxml/

### Constants

**Warning:** doxygenvariable: Cannot find variable “nTiled::math::kPi” in doxygen xml output for project “nTiled” from directory: doxyxml/

## Pipeline

The Pipeline module is the heart of *nTiled*, it contains all rendering functionality, including both Tiled and Clustered shading.

Because the module itself is as big as it is, it has been subdivided in the following sections

### Interfaces of the Pipeline

This section contains links to all the interfaces used in the Pipeline module.

### Interfaces API

**class** nTiled::pipeline::Pipeline

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::Pipeline” in doxygen xml output for project “nTiled” from directory: doxyxml/

\_nTiled-pipeline-PipelineType:

**enum class** nTiled::pipeline::PipelineType

**Warning:** doxygenenum: Cannot find enum “nTiled::pipeline::PipelineType” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::pipeline::Shader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::Shader” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**struct** nTiled::pipeline::ShaderKey

**Warning:** doxygenstruct: Cannot find class “nTiled::pipeline::ShaderKey” in doxygen xml output for project “nTiled” from directory: doxygenxml/

## Forward Pipeline

Forward Pipeline module is part of the Pipeline module and provides all functionality related to the Forward Pipeline, including the ForwardPipeline definitions, and the ForwardShader definitions.

## Forward API

**class** nTiled::pipeline::ForwardPipeline

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ForwardPipeline” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::pipeline::ForwardPipelineLogged

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ForwardPipelineLogged” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::pipeline::DepthBuffer

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::DepthBuffer” in doxygen xml output for project “nTiled” from directory: doxygenxml/

**class** nTiled::pipeline::ForwardShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ForwardShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

\_nTiled-pipeline-ForwardShaderId:

**enum class** nTiled::pipeline::ForwardShaderId

**Warning:** doxygenenum: Cannot find enum “nTiled::pipeline::ForwardShaderId” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::ForwardAttenuatedShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ForwardAttenuatedShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::ForwardTiledShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ForwardTiledShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::ForwardClusteredShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ForwardClusteredShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::ForwardAttenuatedShaderLogged

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ForwardAttenuatedShaderLogged” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::ForwardTiledShaderLogged

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ForwardTiledShaderLogged” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::ForwardClusteredShaderLogged

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ForwardClusteredShaderLogged” in doxygen xml output for project “nTiled” from directory: doxyxml/

## Deferred Pipeline

Deferred Pipeline module is part of the Pipeline module and provides all functionality related to the Deferred Pipeline, including the DeferredPipeline definitions, and the DeferredShader definitions.

### Deferred API

**class** nTiled::pipeline::DeferredPipeline

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::DeferredPipeline” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::DeferredPipelineLogged

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::DeferredPipelineLogged” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::GBuffer

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::GBuffer” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::DeferredShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::DeferredShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

\_nTiled-pipeline-DeferredShaderId:

**enum class** nTiled::pipeline::DeferredShaderId

**Warning:** doxygenenum: Cannot find enum “nTiled::pipeline::DeferredShaderId” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::DeferredAttenuatedShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::DeferredAttenuatedShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::DeferredTiledShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::DeferredTiledShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::DeferredClusteredShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::DeferredClusteredShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::DeferredAttenuatedShaderLogged

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::DeferredAttenuatedShaderLogged” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::DeferredTiledShaderLogged

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::DeferredTiledShaderLogged” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::DeferredClusteredShaderLogged

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::DeferredClusteredShaderLogged” in doxygen xml output for project “nTiled” from directory: doxyxml/

## Light Management

The Light Management module contains all functionality related to the light assignment algorithms. Currently it supports both Tiled as well as Clustered shading.

## LightManagement API

**class** nTiled::pipeline::TiledLightManager

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::TiledLightManager” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::TiledLightManagerBuilder

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::TiledLightManagerBuilder” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::TiledLightManagerLogged

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::TiledLightManagerLogged” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::TiledLightManagerLoggedBuilder

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::TiledLightManagerLoggedBuilder” in doxygen xml output for project “nTiled” from directory: doxyxml/

\_nTiled-pipeline-LightProjector:

**enum class** nTiled::pipeline::LightProjector

**Warning:** doxygenenum: Cannot find enum “nTiled::pipeline::LightProjector” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::BoxProjector

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::BoxProjector” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::LightGrid

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::LightGrid” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::ClusteredLightManager

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ClusteredLightManager” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::ClusteredLightManagerBuilder

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ClusteredLightManagerBuilder” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::ClusteredLightManagerLogged

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ClusteredLightManagerLogged” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::ClusteredLightManagerLoggedBuilder

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::ClusteredLightManagerLoggedBuilder” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::clustered::LightClustering

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::clustered::LightClustering” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::clustered::ComputeShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::clustered::ComputeShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::pipeline::clustered::KeyComputeShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::clustered::KeyComputeShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

***class*** nTiled::pipeline::clustered::KeySortAndCompactShader

**Warning:** doxygenclass: Cannot find class “nTiled::pipeline::clustered::KeySortAndCompactShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

## Pipeline Utility functionality

This section contains all supporting functions and classes for the Pipeline module. This includes the methods with which OpenGL programs are loaded and compiled, as well as the classes used internally to represent objects and lights.

### PipelineUtil API

***struct*** nTiled::pipeline::PipelineLight

**Warning:** doxygenstruct: Cannot find class “nTiled::pipeline::PipelineLight” in doxygen xml output for project “nTiled” from directory: doxyxml/

***struct*** nTiled::pipeline::PipelineObject

**Warning:** doxygenstruct: Cannot find class “nTiled::pipeline::PipelineObject” in doxygen xml output for project “nTiled” from directory: doxyxml/

***PipelineObject\**** nTiled::pipeline::constructQuad()

**Warning:** doxygenfunction: Cannot find function “nTiled::pipeline::constructQuad” in doxygen xml output for project “nTiled” from directory: doxyxml/

***std::stringstream*** nTiled::pipeline::readShader()

**Warning:** doxygenfunction: Cannot find function “nTiled::pipeline::readShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

***std::stringstream*** nTiled::pipeline::readShaderWithLights()

**Warning:** doxygenfunction: Cannot find function “nTiled::pipeline::readShaderWithLights” in doxygen xml output for project “nTiled” from directory: doxyxml/

**GLuint** nTiled::pipeline::compileShader()

**Warning:** doxygenfunction: Cannot find function “nTiled::pipeline::compileShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

**GLuint** nTiled::pipeline::createProgram()

**Warning:** doxygenfunction: Cannot find function “nTiled::pipeline::createProgram” in doxygen xml output for project “nTiled” from directory: doxyxml/

**GLuint** nTiled::pipeline::loadAndCompileShader()

**Warning:** doxygenfunction: Cannot find function “nTiled::pipeline::loadAndCompileShader” in doxygen xml output for project “nTiled” from directory: doxyxml/

**GLuint** nTiled::pipeline::createVertexFragmentProgram()

**Warning:** doxygenfunction: Cannot find function “nTiled::pipeline::createVertexFragmentProgram” in doxygen xml output for project “nTiled” from directory: doxyxml/

**GLuint** nTiled::pipeline::createComputeProgram()

**Warning:** doxygenfunction: Cannot find function “nTiled::pipeline::createComputeProgram” in doxygen xml output for project “nTiled” from directory: doxyxml/

**GLuint** nTiled::pipeline::loadTexturePNG()

**Warning:** doxygenfunction: Cannot find function “nTiled::pipeline::loadTexturePNG” in doxygen xml output for project “nTiled” from directory: doxyxml/

## Debug Pipeline

Debug Pipeline module is part of the Pipeline module and provides the functionality to display a variety of PostProcessing effects in order to visualise the different algorithms used in Pipeline.

## Debug API

Interfaces contains the Interfaces from which Forward and Deferred inherit. Forward contains all functionality relating to the Forward Pipeline, and deferred contains all the functionality relating to the Deferred Pipeline. LightManagement

contains all functionality related to Tiled, Clustered and Hierarchical shading. Finally Debug contains the Debug functionality used to display additional information on top of the rendered scene.

## State

The *State* module holds all classes and structs related to the state of a single run of *nTiled*.

The state itself does not contain any functions and merely serves as a datastructure on which each component of *nTiled* act.

It has been separated in several sections in order to decrease coupling within *nTiled*.

### State API

**struct** nTiled::state::State

**Warning:** doxygenstruct: Cannot find class “nTiled::state::State” in doxygen xml output for project “nTiled” from directory: doxyxml/

**struct** nTiled::state::Log

**Warning:** doxygenstruct: Cannot find class “nTiled::state::Log” in doxygen xml output for project “nTiled” from directory: doxyxml/

**struct** nTiled::state::Shading

**Warning:** doxygenstruct: Cannot find class “nTiled::state::Shading” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::state::TextureCatalog

**Warning:** doxygenstruct: Cannot find class “nTiled::state::TextureCatalog” in doxygen xml output for project “nTiled” from directory: doxyxml/

**struct** nTiled::state::View

**Warning:** doxygenstruct: Cannot find class “nTiled::state::View” in doxygen xml output for project “nTiled” from directory: doxyxml/

**struct** nTiled::state::ViewOutput

**Warning:** doxygenstruct: Cannot find class “nTiled::state::ViewOutput” in doxygen xml output for project “nTiled” from directory: doxyxml/

\_nTiled-state-OutputType:

**enum class** nTiled::state::OutputType

**Warning:** doxygenenum: Cannot find enum “nTiled::state::OutputType” in doxygen xml output for project “nTiled” from directory: doxyxml/

**State\*** nTiled::state::constructStateFromJson ()

**Warning:** doxygenfunction: Cannot find function “nTiled::state::constructStateFromJson” in doxygen xml output for project “nTiled” from directory: doxyxml/

**void** nTiled::state::parseLights ()

**Warning:** doxygenfunction: Cannot find function “nTiled::state::parseLights” in doxygen xml output for project “nTiled” from directory: doxyxml/

**void** nTiled::state::parseGeometry ()

**Warning:** doxygenfunction: Cannot find function “nTiled::state::parseGeometry” in doxygen xml output for project “nTiled” from directory: doxyxml/

**std::vector<glm::mat4>** nTiled::state::readCameraFrames ()

**Warning:** doxygenfunction: Cannot find function “nTiled::state::readCameraFrames” in doxygen xml output for project “nTiled” from directory: doxyxml/

## World

The *World* holds all data related to internal representation of the world within a *nTiled* execution. The meshes, objects, textures and lights can all be found within the world. as

### World API

**struct** nTiled::world::Mesh

**Warning:** doxygenstruct: Cannot find class “nTiled::world::Mesh” in doxygen xml output for project “nTiled” from directory: doxyxml/

**struct** nTiled::world::Object

**Warning:** doxygenstruct: Cannot find class “nTiled::world::Object” in doxygen xml output for project “nTiled” from directory: doxyxml/

**struct** nTiled::world::PointLight

**Warning:** doxygenstruct: Cannot find class “nTiled::world::PointLight” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::world::LightConstructor

**Warning:** doxygenclass: Cannot find class “nTiled::world::LightConstructor” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::world::PointLightConstructor

**Warning:** doxygenclass: Cannot find class “nTiled::world::PointLightConstructor” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::world::PrimitiveConstructor

**Warning:** doxygenclass: Cannot find class “nTiled::world::PrimitiveConstructor” in doxygen xml output for project “nTiled” from directory: doxyxml/

**class** nTiled::world::AssImpConstructor

**Warning:** doxygenclass: Cannot find class “nTiled::world::AssImpConstructor” in doxygen xml output for project “nTiled” from directory: doxyxml/

***class*** nTiled::world::World

**Warning:** doxygenclass: Cannot find class “nTiled::world::World” in doxygen xml output for project “nTiled” from directory: doxyxml/

## Search

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## CHAPTER 3

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### Indices and tables

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