

RocketRobot

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# Chapter 1

## Summary

### 1.1 Overview

RocketRobot is a multi-featured robot simulator. It simulates robots, targets, and obstacles in an environment, with the goal of robots seeking and finding their targets. When a robot finds its target, both disappear from the simulation. In addition, stimuli or light sources can be placed in the environment. There are several types of robots. Simple robots have sensors that only seek the target, and ignore obstacles. Complex robots have sensors for lights, robots, obstacles, and the target. Note that obstacle sensors include the wall as an 'obstacle', straight ahead of the sensor. For both robot types, the wheels speeds are controlled directly by the sensor readings. Complex robots can have each type of sensor scaled or connected in any pattern, this is controllable from the 'New complex robot settings' tab in the interface. Neural network robots use a feed-forward neural network for control. The network takes the target, robot, and obstacle settings as inputs, and outputs the wheel speeds. The network is loaded from a file, specified in the 'New neural network robot settings' tab in the interface.

#### 1.1.1 Installation

You can execute the 'gorobot' executable directly from the src or bin folder, but it is easier to directly install it. This allows you to run it as 'rocketrobot <optional filename>=>' from any folder. To install on a Linux computer, simply run the install script from the main folder. This soft-links a script to your ~/bin folder. This requires that you have a ~/bin folder on your path, if not you can create one and add it to your .bashrc or .cshrc. To uninstall, you can simply run the uninstall script.

#### 1.1.2 User Interface

The RocketRobot user interface is fairly simple. The control panel allows you to start, stop, pause, resume, and quit the simulation. The reset button reverts to the previous time it was started if the simulation was opened from a file, or randomly generates a new simulation if the current simulation is random. The 'Refresh settings' button reloads the configuration files (described later). The open/save tab also lets you open or save the current state. You can also provide a file to open as the command-line argument. There are several examples simulations for this in the examples folder.

The user interface is fairly straightforward for adding and removing objects. There are several control tabs from which the number of obstacles, robots, and lights can be controlled. Objects are added and removed in a FILO manner from the interface. Targets are always created with a robot, but not all robots need to have a target. Decreasing the number of robots through the control panel deletes the target paired with the removed robot.

For more information about an object (location, speed, orientation, radius), you can click on an object. You can also drag and drop objects to move them, or drag them off the screen to delete them. The radius of the selected object can be changed with the up and down arrow keys, the orientation with the left and right keys, and the speed with the + and - keys. You can also middle-click to paste a copy of the selected object. Note that copying a robot creates a new robot with the same target (if any.) You cannot copy targets.

## 1.2 Neural network optimization

A major portion of the project is the neural network-driven robot, and the associated optimization algorithms. To optimize the neural network robot, a separate simulation class, [OptimizeSimulation](#), was created. Optimization employs a genetic algorithm, in which a pool of possible networks is maintained, along with their performance. The performances are calculated by performing a large number of runs of (consistent) random simulations, and summing the total time for all robots to find all targets. In addition, several specific test cases are run for each network to test some interesting cases (e.g. navigating a simple maze, etc.) Pairs of networks are randomly selected from the pool (with one network from a better subset of the pool.) These are combined by taking half the weights from each and merging them into a new network, then making more random tweaks. This is then tested and added to the pool if it is better than the worst performance in the pool. The best performance in the pool is the optimal network.

To run the optimization, run `./optimize` from the scripts folder. The temporary and intermediate files get saved to `runtime/neuralnetwork`. This includes the optimization log, pool performances, optimal network, pool networks, and several others.

## 1.3 Implementation

The various objects are all subclasses of [PhysicalObject](#), which handles basic behaviors and attributes. This class is virtual, so that specific behaviors for collisions, etc are handled individually, and can optionally call back to the default handlers in [PhysicalObject](#). Each type of robot is a subclass of [Robot](#), which is also virtual, as it has virtual functions to get new wheel speeds given the sensor readings. Everything else, including reading from sensors and collision behavior, is handled directly by the robot class.

There is also an environment namespace with which all objects register, and are automatically removed when they are destructed. An iterator over all objects can be requested from the environment, and they can also be accessed by id. The environment also contains functions for detecting collisions between walls and objects. A util namespace provides an easy way of adding and removing objects, managing stacks so that objects are added and removed in FILO order. It also contains functionality to open and save the current state to and from files.

The [Simulation](#) class handles the user interface, providing a wrapper for the functions in util. It also acts as a driver, requesting updates and redraws from all objects.

### 1.3.1 Object motion

Object movement is handled by [PhysicalObject](#). It has an `updateMembers` function which advances all objects by a distance calculated from the speed, after calling the virtual update function. The robot class update sets the position and speed from the calculated wheel speeds. The `updateMembers` function is called for each object from `advance` in util, which in turn is called from `advance` in [Simulation](#) which is triggered by a glut timer function.

### 1.3.2 Graphics

A graphical display of the simulation is rendered by OpenGL. Most of the graphics functionality is in the artist namespace, which has simple functions for drawing circles and lines, which are used by more complex functions for different kinds of objects. There is a virtual function in [PhysicalObject](#) to render each object as a circle, and this is overridden by [Robot](#) and [LightSource](#). These are called by simulation similarly to `updatePosition`.

### 1.3.3 Configuration system

Most settings are loaded through the configuration system, see [configuration.h](#) for more details. This allows settings to be stored externally, and avoids needing to recompile often when making small changes. [Configuration](#) values can also be set from the command line.

## 1.4 Licence

This project has been developed by Lucas Kramer, Carl Bahn, Himawan Go, and Xi Zhang. It has been extended by Lucas Kramer to add neural network-controlled robots and made the interface more useable. Copyright (C) 2015 Lucas Kramer, Carl Bahn, Himawan Go, and Xi Zhang

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## Chapter 2

# Namespace Index

### 2.1 Namespace List

Here is a list of all namespaces with brief descriptions:

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## Chapter 3

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### 4.1 Class List

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<a href="#">ComplexRobot</a>	A complex robot with configurable feedback from all sensors . . . . .	35
<a href="#">Configuration</a>	. . . . .	37
<a href="#">configValue</a>	This struct holds a configuration value of any legal type . . . . .	39
<a href="#">LightSource</a>	<a href="#">LightSource</a> for the robot to seek . . . . .	40
<a href="#">Location</a>	Xy position on the screen, approximately in pixels x is horizontal from the left and y is vertical from the bottom . . . . .	43
<a href="#">NeuralNetwork</a>	A representation of a neural network . . . . .	43
<a href="#">NeuralNetworkRobot</a>	A robot controlled by a neural network with inputs from the sensors . . . . .	46
<a href="#">NoOpenLocationException</a>	An exception to be thrown when an open <a href="#">Location</a> cannot be found . . . . .	48
<a href="#">ObjectIterator</a>	<a href="#">ObjectIterator</a> class, a simple iterator for the object in environment . . . . .	48
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## Chapter 6

# Namespace Documentation

### 6.1 artist Namespace Reference

graphical commands

#### Functions

- void [drawObject](#) ([Location](#) loc, int radius, [Color](#) color)
- void [debugArrow](#) ([Location](#) loc, int orientation)
- void [drawLight](#) ([Location](#) loc, int radius, [Color](#) color)
- void [drawObstacle](#) ([Location](#) loc, int radius)
- void [drawSensor](#) ([Location](#) loc, int orientation, int angle, float intensity)
- void [drawRobot](#) ([Location](#) loc, int radius, int orientation, [Color](#) color, [Color](#) lineColor)

#### 6.1.1 Detailed Description

graphical commands

##### Author

Carl artist functions provide a contained way to display graphics without putting OpenGL graphics in each file

#### 6.1.2 Function Documentation

6.1.2.1 void artist::debugArrow ( [Location](#) *loc*, int *orientation* )

6.1.2.2 void artist::drawLight ( [Location](#) *loc*, int *radius*, [Color](#) *color* )

Draws a [LightSource](#)

##### Parameters

<i>loc</i>	absolute <a href="#">Location</a> to draw center of light
<i>radius</i>	radius of 'bulb' of light

6.1.2.3 void artist::drawObject ( [Location](#) *loc*, int *radius*, [Color](#) *color* )

**Author**

Lucas Kramer Draws the default Object, which is a circle

**Parameters**

<i>loc</i>	absolute <a href="#">Location</a> to draw center of circle
<i>radius</i>	radius of circle
<i>color</i>	the color of the circle

**6.1.2.4 void artist::drawObstacle ( [Location](#) *loc*, int *radius* )**

Draws an obstacle

**Parameters**

<i>loc</i>	absolute <a href="#">Location</a> to draw center of <a href="#">Obstacle</a>
<i>radius</i>	radius of <a href="#">Obstacle</a>

**6.1.2.5 void artist::drawRobot ( [Location](#) *loc*, int *radius*, int *orientation*, [Color](#) *color*, [Color](#) *lineColor* )**

Draws a [Robot](#)

**Parameters**

<i>loc</i>	absolute <a href="#">Location</a> of center of robot
<i>orientation</i>	absolute direction for robot to face
<i>color</i>	the color of the robot's body
<i>lineColor</i>	the color of the robot's direction line

**6.1.2.6 void artist::drawSensor ( [Location](#) *loc*, int *orientation*, int *angle*, float *intensity* )**

Draws a sensor

**Parameters**

<i>loc</i>	absolute <a href="#">Location</a> to draw center of <a href="#">Sensor</a>
<i>orientation</i>	absolute direction of sensor
<i>angle</i>	number of degrees that sensor senses in, with orientation in center
<i>intensity</i>	redness of sensor as value between 0 and 1, meant to indicate amount of light detected

## 6.2 environment Namespace Reference

environment namespace, handles all the objects as a group. Also manages object ids and collision detection

**Typedefs**

- typedef [ObjectIterator](#) [objectIterator](#)

**Functions**

- int [addObject](#) ([PhysicalObject](#) \*object)  
Adds an object to the environment.

- void `removeObject` (int id)  
*Removes an object from the environment.*
- void `clear` ()  
*Removes all objects from the environment and resets the id counter.*
- unsigned `getNumObjects` ()  
*Gets the number of objects in environment.*
- `PhysicalObject` \* `getObject` (int id)  
*Finds an object from the environment.*
- `objectIterator` `getObjectsBegin` ()  
*Gets an iterator to the beginning of the objects.*
- `objectIterator` `getObjectsEnd` ()  
*Gets an iterator to the end of the objects.*
- bool `isTouchingWall` (`Location` l, int r)
- bool `isTouchingWall` (int id)
- bool `isTouchingObject` (`Location` l, int r, int id)
- bool `isTouchingHitableObject` (`Location` l, int r, int id)
- bool `isTouchingObject` (`Location` l, int r)
- bool `isTouchingHitableObject` (`Location` l, int r)
- bool `isTouchingObject` (int id)
- bool `isTouchingHitableObject` (int id)
- bool `isColliding` (`Location` l, int r)
- bool `isColliding` (int id)
- bool `isCollidingWithHitable` (`Location` l, int r)
- bool `isCollidingWithHitable` (int id)
- int `getCollisionId` (`Location` l, int r, int id)
- int `getHitableCollisionId` (`Location` l, int r, int id)
- int `getCollisionId` (`Location` l, int r)
- int `getHitableCollisionId` (`Location` l, int r)
- int `getCollisionId` (int id)
- int `getHitableCollisionId` (int id)

### 6.2.1 Detailed Description

environment namespace, handles all the objects as a group. Also manages object ids and collision detection

### 6.2.2 Typedef Documentation

#### 6.2.2.1 typedef `ObjectIterator` `environment::objectIterator`

An object iterator

### 6.2.3 Function Documentation

#### 6.2.3.1 int `environment::addObject` ( `PhysicalObject` \* *object* )

Adds an object to the environment.

Parameters

---

<i>object</i>	The object to add
---------------	-------------------

**Returns**

The assigned id of the object

**6.2.3.2 void environment::clear ( )**

Removes all objects from the environment and resets the id counter.

**6.2.3.3 int environment::getCollisionId ( Location *l*, int *r*, int *id* )**

Determines what object is being hit by another object

**Parameters**

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object
<i>id</i>	The id of the object to exclude

**Returns**

The id of one object that is being hit, or -1 if it is hitting nothing or a wall

**See Also**

[isColliding](#)

**6.2.3.4 int environment::getCollisionId ( Location *l*, int *r* )**

Determines what object is being hit by another object

**Parameters**

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object

**Returns**

The id of one object that is being hit, or -1 if it is hitting nothing or a wall

**See Also**

[isColliding](#)

**6.2.3.5 int environment::getCollisionId ( int *id* )**

Determines what object is being hit by another object



## Parameters

<i>id</i>	The id of the object
-----------	----------------------

## Returns

The id of one object that is being hit, or -1 if it is hiting nothing or a wall

## See Also

[isColliding](#)

**6.2.3.6** `int environment::getHitableCollisionId ( Location l, int r, int id )`

Determines what hitable object is being hit by another object

## Parameters

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object
<i>id</i>	The id of the object to exclude

## Returns

The id of one hitable object that is being hit, or -1 if it is hiting nothing or a wall

## See Also

[isColliding](#)

**6.2.3.7** `int environment::getHitableCollisionId ( Location l, int r )`

Determines what hitable object is being hit by another object

## Parameters

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object

## Returns

The id of one hitable object that is being hit, or -1 if it is hiting nothing or a wall

## See Also

[isColliding](#)

**6.2.3.8** `int environment::getHitableCollisionId ( int id )`

Determines what hitable object is being hit by another object

## Parameters

<i>id</i>	The id of the object
-----------	----------------------

## Returns

The id of one hitable object that is being hit, or -1 if it is hiting nothing or a wall

## See Also

[isColliding](#)

**6.2.3.9 unsigned environment::getNumObjects ( )**

Gets the number of objects in environment.

## Returns

The number of objects

**6.2.3.10 PhysicalObject \* environment::getObject ( int *id* )**

Finds an object from the environment.

## Parameters

<i>id</i>	The id of the object to find
-----------	------------------------------

## Returns

The object that was looked iup

**6.2.3.11 objectIterator environment::getObjectsBegin ( )**

Gets an iterator to the beginning of the objects.

## Returns

The iterator

**6.2.3.12 objectIterator environment::getObjectsEnd ( )**

Gets an iterator to the end of the objects.

## Returns

The iterator

**6.2.3.13 bool environment::isColliding ( Location *l*, int *r* )**

Checks if the object specified by the given [Location](#) and radius is touching a wall or any other objects

## Parameters

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object

## Returns

true when the object is touching a wall or any other object

## See Also

[isTouchingWall](#), [isTouchingObject](#)

**6.2.3.14 bool environment::isColliding ( int *id* )**

Checks if the object specified by the given *id* is touching a wall or any other objects

## Parameters

<i>id</i>	The id of the object
-----------	----------------------

## Returns

true when the object is touching a wall or any other object

## See Also

[isTouchingWall](#), [isTouchingObject](#)

**6.2.3.15 bool environment::isCollidingWithHitable ( [Location](#) *l*, int *r* )**

Checks if the object specified by the given [Location](#) and radius is touching a wall or any other hitable objects

## Parameters

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object

## Returns

true when the object is touching a wall or any other hitable object

## See Also

[isTouchingWall](#), [isTouchingObject](#)

**6.2.3.16 bool environment::isCollidingWithHitable ( int *id* )**

Checks if the object specified by the given *id* is touching a wall or any other hitable objects

## Parameters

<i>id</i>	The id of the object
-----------	----------------------

## Returns

true when the object is touching a wall or any other hitable object

## See Also

[isTouchingWall](#), [isTouchingObject](#)

### 6.2.3.17 bool environment::isTouchingHitableObject ( Location *l*, int *r*, int *id* )

Same as [isTouchingObject\(Location \*l\*, int \*r\*\)](#), but ignores the object with the given id and non-hitable objects.

## Parameters

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object
<i>id</i>	The id of the object to ignore

### 6.2.3.18 bool environment::isTouchingHitableObject ( Location *l*, int *r* )

Checks if the object specified by the given [Location](#) and radius is touching any other hitable objects

## Parameters

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object

## Returns

true when the object is touching any other hitable object

### 6.2.3.19 bool environment::isTouchingHitableObject ( int *id* )

Checks if the object specified by the given id is touching any other hitable objects

## Parameters

<i>id</i>	The id of the object
-----------	----------------------

## Returns

true when the object is touching any other hitable object

### 6.2.3.20 bool environment::isTouchingObject ( Location *l*, int *r*, int *id* )

Same as [isTouchingObject\(Location \*l\*, int \*r\*\)](#), but ignores the object with the given id.

## Parameters

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object
<i>id</i>	The id of the object to ignore

**6.2.3.21** bool environment::isTouchingObject ( [Location](#) *l*, int *r* )

Checks if the object specified by the given [Location](#) and radius is touching any other objects

## Parameters

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object

## Returns

true when the object is touching any other object

**6.2.3.22** bool environment::isTouchingObject ( int *id* )

Checks if the object specified by the given id is touching any other objects

## Parameters

<i>id</i>	The id of the object
-----------	----------------------

## Returns

true when the object is touching any other object

**6.2.3.23** bool environment::isTouchingWall ( [Location](#) *l*, int *r* )

Checks if an object is in the designated window

It returns true whenever the following conditions are met:

x position - radius  $\leq$  0

y position - radius  $\leq$  0

x position + radius  $\geq$  width

y position + radius  $\geq$  height

## Parameters

<i>l</i>	The <a href="#">Location</a> of the object
<i>r</i>	The radius of the object

## Returns

true when the object is touching a wall

**6.2.3.24** bool environment::isTouchingWall ( int *id* )

Checks if an object is in the designated window

It reads in the width, height, x and y position of the object, and then returns true whenever the following conditions are met:

x position - radius  $\leq$  0

y position - radius  $\leq$  0

x position + radius  $\geq$  width

y position + radius  $\geq$  height

#### Parameters

<i>id</i>	The id of the object
-----------	----------------------

#### Returns

true when the object is touching a wall

#### 6.2.3.25 void environment::removeObject ( int *id* )

Removes an object from the environment.

#### Parameters

<i>id</i>	The id of the object to remove
-----------	--------------------------------

## 6.3 util Namespace Reference

util namespace, contains helper functions to add and remove robots

### Functions

- void [reset](#) ()  
*Removes all objects and resets to the initial state.*
- void [display](#) ()  
*Function to render all the objects. This function is called repeatedly from the simulation, and iterates through the objects and calls their respective display functions.*
- void [advance](#) ()  
*Function to update the positions of all objects. This function is called repeatedly from the simulation, and iterates through the objects and calls their respective updatePosition functions.*
- [Color](#) [newColor](#) ()  
*Gets a new, unused color.*
- int [getNumRobotsTargets](#) ()  
*Gets the number of robots/target pairs.*
- int [getNumLights](#) ()  
*Gets the number of lights.*
- int [getNumObstacles](#) ()  
*Gets the number of obstacles.*
- bool [addRobotTarget](#) (int robotType, int lightSensorConnectionPattern, int robotSensorConnectionPattern, int obstacleSensorConnectionPattern, int targetSensorConnectionPattern, float lightSensorScale, float robotSensorScale, float obstacleSensorScale, float targetSensorScale, int initialSpeed, std::string neuralNetworkFile)  
*Adds a robot and paired target to the simulation.*

- bool `addRobot` (int robotType, int lightSensorConnectionPattern, int robotSensorConnectionPattern, int obstacleSensorConnectionPattern, int targetSensorConnectionPattern, float lightSensorScale, float robotSensorScale, float obstacleSensorScale, float targetSensorScale, int initialSpeed, std::string neuralNetworkFile)  
*Adds a robot to the simulation.*
- bool `addNeuralNetworkRobotTarget` (const `NeuralNetwork` &network)  
*Adds a neural network robot and a paired target to the simulation.*
- bool `addStationaryLightSource` ()  
*Adds a light to the simulation.*
- bool `addMovingLightSource` ()  
*Adds a light to the simulation.*
- bool `addObstacle` ()  
*Adds a obstacle to the simulation.*
- bool `copy` (int id, `Location` loc)  
*Copies an object to a new `Location`.*
- bool `removeRobotTarget` ()  
*Removes a robot from the simulation.*
- bool `removeLightSource` ()  
*Removes a light from the simulation.*
- bool `removeObstacle` ()  
*Removes a obstacle from the simulation.*
- void `removeAllRobotTarget` ()  
*Removes all robots.*
- void `removeAllLightSource` ()  
*Removes all lights.*
- void `removeAllObstacle` ()  
*Removes all obstacles.*
- bool `open` (std::string filename)  
*Loads a simulation from a file.*
- bool `save` (std::string filename)  
*Saves the current state to a file.*

### 6.3.1 Detailed Description

util namespace, contains helper functions to add and remove robots

### 6.3.2 Function Documentation

#### 6.3.2.1 bool util::addMovingLightSource ( )

Adds a light to the simulation.

#### Returns

true if successful

#### 6.3.2.2 bool util::addNeuralNetworkRobotTarget ( const `NeuralNetwork` & *network* )

Adds a neural network robot and a paired target to the simulation.

## Parameters

<i>network</i>	the network to control the robot
----------------	----------------------------------

## Returns

true if successful

## 6.3.2.3 bool util::addObstacle ( )

Adds a obstacle to the simulation.

## Returns

true if successful

6.3.2.4 bool util::addRobot ( int *robotType*, int *lightSensorConnectionPattern*, int *robotSensorConnectionPattern*, int *obstacleSensorConnectionPattern*, int *targetSensorConnectionPattern*, float *lightSensorScale*, float *robotSensorScale*, float *obstacleSensorScale*, float *targetSensorScale*, int *initialSpeed*, std::string *neuralNetworkFile* )

Adds a robot to the simulation.

## Parameters

<i>robotType</i>	The type of robot to add. 0 is <a href="#">SimpleRobot</a> , 1 is <a href="#">ComplexRobot</a> , and 2 is <a href="#">NeuralNetworkRobot</a>
<i>lightSensor-Connection-Pattern</i>	Settings for <a href="#">ComplexRobot</a> light sensor
<i>robotSensor-Connection-Pattern</i>	Settings for <a href="#">ComplexRobot</a> robot sensor
<i>obstacleSensor-Connection-Pattern</i>	Settings for <a href="#">ComplexRobot</a> obstacle sensor
<i>targetSensor-Connection-Pattern</i>	Settings for <a href="#">ComplexRobot</a> target sensor
<i>lightSensorScale</i>	Settings for <a href="#">ComplexRobot</a> light sensor
<i>robotSensorScale</i>	Settings for <a href="#">ComplexRobot</a> robot sensor
<i>obstacleSensorScale</i>	Settings for <a href="#">ComplexRobot</a> obstacle sensor
<i>targetSensorScale</i>	Settings for <a href="#">ComplexRobot</a> target sensor
<i>initalSpeed</i>	Default speed for <a href="#">ComplexRobot</a>
<i>neuralNetwork-File</i>	File in which neural network is stored

## Returns

true if successful

6.3.2.5 bool util::addRobotTarget ( int *robotType*, int *lightSensorConnectionPattern*, int *robotSensorConnectionPattern*, int *obstacleSensorConnectionPattern*, int *targetSensorConnectionPattern*, float *lightSensorScale*, float *robotSensorScale*, float *obstacleSensorScale*, float *targetSensorScale*, int *initialSpeed*, std::string *neuralNetworkFile* )

Adds a robot and paired target to the simulation.



## Parameters

<i>robotType</i>	The type of robot to add. 0 is <a href="#">SimpleRobot</a> , 1 is <a href="#">ComplexRobot</a> , and 2 is <a href="#">NeuralNetworkRobot</a>
<i>lightSensor-Connection-Pattern</i>	Settings for <a href="#">ComplexRobot</a> light sensor
<i>robotSensor-Connection-Pattern</i>	Settings for <a href="#">ComplexRobot</a> robot sensor
<i>obstacleSensor-Connection-Pattern</i>	Settings for <a href="#">ComplexRobot</a> obstacle sensor
<i>targetSensor-Connection-Pattern</i>	Settings for <a href="#">ComplexRobot</a> target sensor
<i>lightSensorScale</i>	Settings for <a href="#">ComplexRobot</a> light sensor
<i>robotSensorScale</i>	Settings for <a href="#">ComplexRobot</a> robot sensor
<i>obstacleSensorScale</i>	Settings for <a href="#">ComplexRobot</a> obstacle sensor
<i>targetSensorScale</i>	Settings for <a href="#">ComplexRobot</a> target sensor
<i>initalSpeed</i>	Default speed for <a href="#">ComplexRobot</a>
<i>neuralNetwork-File</i>	File in which neural network is stored

## Returns

true if successful

## 6.3.2.6 bool util::addStationaryLightSource ( )

Adds a light to the simulation.

## Returns

true if successful

## 6.3.2.7 void util::advance ( )

Function to update the positions of all objects. This function is called repeatedly from the simulation, and iterates through the objects and calls their respective updatePosition functions.

## 6.3.2.8 bool util::copy ( int id, Location loc )

Copies an object to a new [Location](#).

## Parameters

<i>id</i>	the id of the object to copy
<i>loc</i>	the destination

## Returns

true if successful

**6.3.2.9 void util::display ( )**

Function to render all the objects. This function is called repeatedly from the simulation, and iterates through the objects and calls their respective display functions.

**6.3.2.10 int util::getNumLights ( )**

Gets the number of lights.

**Returns**

The number of lights

**6.3.2.11 int util::getNumObstacles ( )**

Gets the number of obstacles.

**Returns**

The number of obstacles

**6.3.2.12 int util::getNumRobotsTargets ( )**

Gets the number of robots/target pairs.

**Returns**

The number of robots/target pairs

**6.3.2.13 Color util::newColor ( )**

Gets a new, unused color.

**Returns**

The new color

**6.3.2.14 bool util::open ( std::string *filename* )**

Loads a simulation from a file.

**6.3.2.15 void util::removeAllLightSource ( )**

Removes all lights.

**6.3.2.16 void util::removeAllObstacle ( )**

Removes all obstacles.

**6.3.2.17 void util::removeAllRobotTarget ( )**

Removes all robots.

**6.3.2.18 bool util::removeLightSource ( )**

Removes a light from the simulation.

**Returns**

true if successful

**6.3.2.19 bool util::removeObstacle ( )**

Removes a obstacle from the simulation.

**Returns**

true if successful

**6.3.2.20 bool util::removeRobotTarget ( )**

Removes a robot from the simulation.

**Returns**

true if successful

**6.3.2.21 void util::reset ( )**

Removes all objects and resets to the initial state.

**6.3.2.22 bool util::save ( std::string *filename* )**

Saves the current state to a file.



## Chapter 7

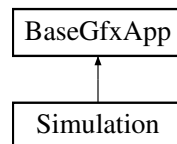
# Class Documentation

### 7.1 BaseGfxApp Class Reference

Graphics driver class.

```
#include <BaseGfxApp.h>
```

Inheritance diagram for BaseGfxApp:



#### Public Member Functions

- [BaseGfxApp](#) (int argc, char \*argv[], int [width](#), int [height](#), int x, int y, int glutFlags, bool createGLUIWin, int gluiWinX, int gluiWinY)
- virtual [~BaseGfxApp](#) ()
- void [setCaption](#) (const std::string &caption)
- void [runMainLoop](#) ()
- virtual void [display](#) ()
- virtual void [advance](#) ()
- virtual void [mouseMoved](#) (int x, int y)
- virtual void [mouseDragged](#) (int x, int y)
- virtual void [leftMouseDown](#) (int x, int y)
- virtual void [leftMouseUp](#) (int x, int y)
- virtual void [rightMouseDown](#) (int x, int y)
- virtual void [rightMouseUp](#) (int x, int y)
- virtual void [middleMouseDown](#) (int x, int y)
- virtual void [middleMouseUp](#) (int x, int y)
- virtual void [keyboard](#) (unsigned char c, int x, int y)
- virtual void [keyboardSpecial](#) (int key, int x, int y)
- virtual void [keyboardUp](#) (unsigned char c, int x, int y)
- virtual void [keyboardSpecialUp](#) (int key, int x, int y)
- virtual void [reshape](#) (int [width](#), int [height](#))
- virtual void [gluiControl](#) (int controlId)
- int [width](#) () const
- int [height](#) () const
- int [handle](#) ()
- GLUI \* [glui](#) ()

## Static Public Member Functions

- static void [graphicsBegin](#) (int v, int delay)

## Static Protected Member Functions

- static void [graphicsTimer](#) (int v)
- static void [s\\_reshape](#) (int [width](#), int [height](#))
- static void [s\\_keyboard](#) (unsigned char c, int x, int y)
- static void [s\\_keyboardspecial](#) (int key, int x, int y)
- static void [s\\_keyboardup](#) (unsigned char c, int x, int y)
- static void [s\\_keyboardspecialup](#) (int key, int x, int y)
- static void [s\\_mousemotion](#) (int x, int y)
- static void [s\\_mousebtn](#) (int b, int s, int x, int y)
- static void [s\\_draw](#) ()
- static void [s\\_glucallback](#) (int controlId)

## Protected Attributes

- int [m\\_glutWindowHandle](#)
- GLUT \* [m\\_glui](#)
- bool [m\\_drag](#)
- int [m\\_width](#)
- int [m\\_height](#)

## Static Protected Attributes

- static [BaseGfxApp](#) \* [s\\_currentApp](#) = NULL
- static bool [s\\_glutInitialized](#) = false

### 7.1.1 Detailed Description

Graphics driver class.

### 7.1.2 Constructor & Destructor Documentation

7.1.2.1 [BaseGfxApp::BaseGfxApp](#) ( int *argc*, char \* *argv*[], int *width*, int *height*, int *x*, int *y*, int *glutFlags*, bool *createGLUIWin*, int *gluiWinX*, int *gluiWinY* )

7.1.2.2 [BaseGfxApp::~~BaseGfxApp](#) ( ) [virtual]

### 7.1.3 Member Function Documentation

7.1.3.1 virtual void [BaseGfxApp::advance](#) ( ) [inline],[virtual]

Reimplemented in [Simulation](#).

7.1.3.2 virtual void [BaseGfxApp::display](#) ( ) [inline],[virtual]

Reimplemented in [Simulation](#).

7.1.3.3 `GLUI* BaseGfxApp::glui ( ) [inline]`

7.1.3.4 `virtual void BaseGfxApp::gluiControl ( int controlID ) [inline],[virtual]`

Reimplemented in [Simulation](#).

7.1.3.5 `void BaseGfxApp::graphicsBegin ( int v, int delay ) [static]`

This function starts the graphics after a delay.

7.1.3.6 `void BaseGfxApp::graphicsTimer ( int v ) [static],[protected]`

This function calls itself using `glutTimerFunc` once per frame.

7.1.3.7 `int BaseGfxApp::handle ( ) [inline]`

7.1.3.8 `int BaseGfxApp::height ( ) const`

7.1.3.9 `virtual void BaseGfxApp::keyboard ( unsigned char c, int x, int y ) [inline],[virtual]`

Reimplemented in [Simulation](#).

7.1.3.10 `virtual void BaseGfxApp::keyboardSpecial ( int key, int x, int y ) [inline],[virtual]`

Reimplemented in [Simulation](#).

7.1.3.11 `virtual void BaseGfxApp::keyboardSpecialUp ( int key, int x, int y ) [inline],[virtual]`

7.1.3.12 `virtual void BaseGfxApp::keyboardUp ( unsigned char c, int x, int y ) [inline],[virtual]`

7.1.3.13 `virtual void BaseGfxApp::leftMouseDown ( int x, int y ) [inline],[virtual]`

Reimplemented in [Simulation](#).

7.1.3.14 `virtual void BaseGfxApp::leftMouseUp ( int x, int y ) [inline],[virtual]`

Reimplemented in [Simulation](#).

7.1.3.15 `virtual void BaseGfxApp::middleMouseDown ( int x, int y ) [inline],[virtual]`

Reimplemented in [Simulation](#).

7.1.3.16 `virtual void BaseGfxApp::middleMouseUp ( int x, int y ) [inline],[virtual]`

7.1.3.17 `virtual void BaseGfxApp::mouseDragged ( int x, int y ) [inline],[virtual]`

Reimplemented in [Simulation](#).

- 7.1.3.18 `virtual void BaseGfxApp::mouseMoved ( int x, int y )` `[inline], [virtual]`
- 7.1.3.19 `void BaseGfxApp::reshape ( int width, int height )` `[virtual]`
- 7.1.3.20 `virtual void BaseGfxApp::rightMouseDown ( int x, int y )` `[inline], [virtual]`
- 7.1.3.21 `virtual void BaseGfxApp::rightMouseUp ( int x, int y )` `[inline], [virtual]`
- 7.1.3.22 `void BaseGfxApp::runMainLoop ( )`
- 7.1.3.23 `void BaseGfxApp::s_draw ( )` `[static], [protected]`
- 7.1.3.24 `void BaseGfxApp::s_glucallback ( int controlID )` `[static], [protected]`
- 7.1.3.25 `void BaseGfxApp::s_keyboard ( unsigned char c, int x, int y )` `[static], [protected]`
- 7.1.3.26 `void BaseGfxApp::s_keyboardspecial ( int key, int x, int y )` `[static], [protected]`
- 7.1.3.27 `void BaseGfxApp::s_keyboardspecialup ( int key, int x, int y )` `[static], [protected]`
- 7.1.3.28 `void BaseGfxApp::s_keyboardup ( unsigned char c, int x, int y )` `[static], [protected]`
- 7.1.3.29 `void BaseGfxApp::s_mousebtn ( int b, int s, int x, int y )` `[static], [protected]`
- 7.1.3.30 `void BaseGfxApp::s_mousemotion ( int x, int y )` `[static], [protected]`
- 7.1.3.31 `void BaseGfxApp::s_reshape ( int width, int height )` `[static], [protected]`
- 7.1.3.32 `void BaseGfxApp::setCaption ( const std::string & caption )`
- 7.1.3.33 `int BaseGfxApp::width ( ) const`

#### 7.1.4 Member Data Documentation

- 7.1.4.1 `bool BaseGfxApp::m_drag` `[protected]`
- 7.1.4.2 `GLUI* BaseGfxApp::m_glui` `[protected]`
- 7.1.4.3 `int BaseGfxApp::m_glutWindowHandle` `[protected]`

Underlying glut window handle

- 7.1.4.4 `int BaseGfxApp::m_height` `[protected]`
- 7.1.4.5 `int BaseGfxApp::m_width` `[protected]`
- 7.1.4.6 `BaseGfxApp * BaseGfxApp::s_currentApp = NULL` `[static], [protected]`

GLUT and GLUI event callbacks are sent to the current window/app. Right now, there is only one window anyway (not counting the GLUI UI window.. in the future could be extended to support more windows. In any case, some structure like this is always needed when using glut with C++, since the glut callbacks must be either global or static functions.



7.1.4.7 `bool BaseGfxApp::s_glutInitialized = false` `[static], [protected]`

Has glutInit been called? (only allowed once per program)

The documentation for this class was generated from the following files:

- [BaseGfxApp.h](#)
- [BaseGfxApp.cpp](#)

## 7.2 Color Struct Reference

This struct holds the representation of a color.

```
#include <Color.h>
```

### Public Member Functions

- [Color](#) ()
- [Color](#) (float r, float g, float b)
- [Color](#) (char c)  
*Creates a RGB color from its char color name The following is the list of allowed colors:*
- [Color](#) (int c)  
*Creates an RGB color from a hex value The color is stored as the last 3 bytes, as 0x<unused (set to 0)><red><green><blue>  
Each byte is interpreted as an integer holding an RGB value from 0-255. These are then converted to floats between 0 and 1 by dividing by 255. Note that this requires at least 3 byte integers.*
- bool [isSimilar](#) ([Color](#) c1)  
*Checks if two colors are similar.*
- std::ostream & [operator<<](#) (std::ostream &out)
- bool [operator==](#) ([Color](#) c1)  
*Checks if two colors are equal.*
- bool [operator!=](#) ([Color](#) c1)  
*Checks if two colors are not equal.*

### Public Attributes

- float [red](#)
- float [green](#)
- float [blue](#)

#### 7.2.1 Detailed Description

This struct holds the representation of a color.

Each field is a float value that should be between 0 and 1. This allows a direct translation from hex colors, with each field being the hex RGB value / 255.

#### 7.2.2 Constructor & Destructor Documentation

7.2.2.1 `Color::Color ( )` `[inline]`

7.2.2.2 `Color::Color ( float r, float g, float b )` `[inline]`

### 7.2.2.3 Color::Color ( char c )

Creates a RGB color from its char color name The following is the list of allowed colors:

Author

Lucas Kramer

Color char	Color name	RGB floating-point value
'R'	Red	(1, 0, 0)
'O'	Orange	(1, 0.4, 0)
'Y'	Yellow	(1, 1, 0)
'G'	Green	(0, 1, 0)
'B'	Blue	(0, 0, 1)
'V'	Violet	(0.5, 0, 0.5)
'W'	White	(1, 1, 1)
default	Black	(0, 0, 0)

### 7.2.2.4 Color::Color ( int c )

Creates an RGB color from a hex value The color is stored as the last 3 bytes, as 0x<unused>(set to 0)><red><green><blue>

Each byte is interpreted as an integer holding an RGB value from 0-255. These are then converted to floats between 0 and 1 by dividing by 255. Note that this requires at least 3 byte integers.

Author

Carl Bahn Lucas Kramer

## 7.2.3 Member Function Documentation

### 7.2.3.1 bool Color::isSimilar ( Color c1 )

Checks if two colors are similar.

Author

Lucas Kramer

Parameters

<i>c1</i>	the color to compare
-----------	----------------------

Returns

true if the colors are similar

### 7.2.3.2 bool Color::operator!=( Color c1 )

Checks if two colors are not equal.

Author

Lucas Kramer

## Parameters

<i>c1</i>	the color to check
-----------	--------------------

## Returns

true if the colors are not equal

7.2.3.3 `std::ostream& Color::operator<< ( std::ostream & out )` `[inline]`

7.2.3.4 `bool Color::operator== ( Color c1 )`

Checks if two colors are equal.

## Author

Lucas Kramer

## Parameters

<i>c1</i>	the color to check
-----------	--------------------

## Returns

true if the colors are equal

## 7.2.4 Member Data Documentation

7.2.4.1 `float Color::blue`

7.2.4.2 `float Color::green`

7.2.4.3 `float Color::red`

The documentation for this struct was generated from the following files:

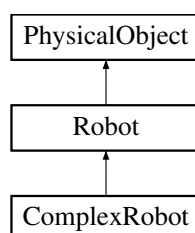
- [Color.h](#)
- [Color.cpp](#)

## 7.3 ComplexRobot Class Reference

A complex robot with configurable feedback from all sensors.

```
#include <ComplexRobot.h>
```

Inheritance diagram for ComplexRobot:



## Public Member Functions

- [ComplexRobot](#) ()
- [ComplexRobot](#) (int radius, [Color](#) color, [Color](#) lineColor, bool [enableLightSensors](#), bool [enableRobotSensors](#), bool [enableObstacleSensors](#), bool [enableTargetSensors](#), bool [lightSensorsCrossed](#), bool [robotSensorsCrossed](#), bool [obstacleSensorsCrossed](#), bool [targetSensorsCrossed](#), float [lightSensorScale](#), float [robotSensorScale](#), float [obstacleSensorScale](#), float [targetSensorScale](#), int [defaultSpeed](#), int targetId=-1)
- [ComplexRobot](#) (int radius, [Location](#) loc, [Color](#) color, [Color](#) lineColor, bool [enableLightSensors](#), bool [enableRobotSensors](#), bool [enableObstacleSensors](#), bool [enableTargetSensors](#), bool [lightSensorsCrossed](#), bool [robotSensorsCrossed](#), bool [obstacleSensorsCrossed](#), bool [targetSensorsCrossed](#), float [lightSensorScale](#), float [robotSensorScale](#), float [obstacleSensorScale](#), float [targetSensorScale](#), int [defaultSpeed](#), int targetId=-1)
- [~ComplexRobot](#) ()
- float [getLeftSpeed](#) (float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal)
- float [getRightSpeed](#) (float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal)

## Public Attributes

- const bool [enableLightSensors](#)
- const bool [enableRobotSensors](#)
- const bool [enableObstacleSensors](#)
- const bool [enableTargetSensors](#)
- const bool [lightSensorsCrossed](#)
- const bool [robotSensorsCrossed](#)
- const bool [obstacleSensorsCrossed](#)
- const bool [targetSensorsCrossed](#)
- const float [lightSensorScale](#)
- const float [robotSensorScale](#)
- const float [obstacleSensorScale](#)
- const float [targetSensorScale](#)
- const int [defaultSpeed](#)

## Additional Inherited Members

### 7.3.1 Detailed Description

A complex robot with configurable feedback from all sensors.

### 7.3.2 Constructor & Destructor Documentation

#### 7.3.2.1 [ComplexRobot::ComplexRobot](#) ( )

**7.3.2.2** [ComplexRobot::ComplexRobot](#) ( int radius, [Color](#) color, [Color](#) lineColor, bool [enableLightSensors](#), bool [enableRobotSensors](#), bool [enableObstacleSensors](#), bool [enableTargetSensors](#), bool [lightSensorsCrossed](#), bool [robotSensorsCrossed](#), bool [obstacleSensorsCrossed](#), bool [targetSensorsCrossed](#), float [lightSensorScale](#), float [robotSensorScale](#), float [obstacleSensorScale](#), float [targetSensorScale](#), int [defaultSpeed](#), int targetId = -1 )

**7.3.2.3** [ComplexRobot::ComplexRobot](#) ( int radius, [Location](#) loc, [Color](#) color, [Color](#) lineColor, bool [enableLightSensors](#), bool [enableRobotSensors](#), bool [enableObstacleSensors](#), bool [enableTargetSensors](#), bool [lightSensorsCrossed](#), bool [robotSensorsCrossed](#), bool [obstacleSensorsCrossed](#), bool [targetSensorsCrossed](#), float [lightSensorScale](#), float [robotSensorScale](#), float [obstacleSensorScale](#), float [targetSensorScale](#), int [defaultSpeed](#), int targetId = -1 )

7.3.2.4 `ComplexRobot::~~ComplexRobot ( )`

### 7.3.3 Member Function Documentation

7.3.3.1 `float ComplexRobot::getLeftSpeed ( float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal )` [virtual]

Implements [Robot](#).

7.3.3.2 `float ComplexRobot::getRightSpeed ( float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal )` [virtual]

Implements [Robot](#).

### 7.3.4 Member Data Documentation

7.3.4.1 `const int ComplexRobot::defaultSpeed`

7.3.4.2 `const bool ComplexRobot::enableLightSensors`

7.3.4.3 `const bool ComplexRobot::enableObstacleSensors`

7.3.4.4 `const bool ComplexRobot::enableRobotSensors`

7.3.4.5 `const bool ComplexRobot::enableTargetSensors`

7.3.4.6 `const float ComplexRobot::lightSensorScale`

7.3.4.7 `const bool ComplexRobot::lightSensorsCrossed`

7.3.4.8 `const float ComplexRobot::obstacleSensorScale`

7.3.4.9 `const bool ComplexRobot::obstacleSensorsCrossed`

7.3.4.10 `const float ComplexRobot::robotSensorScale`

7.3.4.11 `const bool ComplexRobot::robotSensorsCrossed`

7.3.4.12 `const float ComplexRobot::targetSensorScale`

7.3.4.13 `const bool ComplexRobot::targetSensorsCrossed`

The documentation for this class was generated from the following files:

- [ComplexRobot.h](#)
- [ComplexRobot.cpp](#)

## 7.4 Configuration Class Reference

```
#include <configuration.h>
```

## Public Member Functions

- int [getIntConfig](#) (const std::string &name)  
*Looks up an int.*
- float [getFloatConfig](#) (const std::string &name)  
*Looks up a float.*
- bool [getBoolConfig](#) (const std::string &name)  
*Looks up a boolean.*
- char [getCharConfig](#) (const std::string &name)  
*Looks up a character.*
- std::string [getStringConfig](#) (const std::string &name)  
*Looks up a string.*

## Static Public Member Functions

- static void [initConfig](#) (const std::string &filename)
- static void [initConfig](#) (int argc, char \*argv[], const std::string &defaultFilename)
- static [Configuration](#) \* [get](#) ()
- static void [refresh](#) ()

### 7.4.1 Member Function Documentation

#### 7.4.1.1 [Configuration](#) \* [Configuration::get](#) ( ) [static]

#### 7.4.1.2 bool [Configuration::getBoolConfig](#) ( const std::string & name )

Looks up a boolean.

##### Parameters

<i>table</i>	The table from which to look up the value
<i>name</i>	The name of the value

##### Returns

The value

#### 7.4.1.3 char [Configuration::getCharConfig](#) ( const std::string & name )

Looks up a character.

##### Parameters

<i>table</i>	The table from which to look up the value
<i>name</i>	The name of the value

##### Returns

The value

#### 7.4.1.4 float [Configuration::getFloatConfig](#) ( const std::string & name )

Looks up a float.

## Parameters

<i>table</i>	The table from which to look up the value
<i>name</i>	The name of the value

## Returns

The value

#### 7.4.1.5 int Configuration::getIntConfig ( const std::string & *name* )

Looks up an int.

## Parameters

<i>table</i>	The table from which to look up the value
<i>name</i>	The name of the value

## Returns

The value

#### 7.4.1.6 string Configuration::getStringConfig ( const std::string & *name* )

Looks up a string.

## Parameters

<i>table</i>	The table from which to look up the value
<i>name</i>	The name of the value

## Returns

The value

#### 7.4.1.7 static void Configuration::initConfig ( const std::string & *filename* ) [static]

#### 7.4.1.8 static void Configuration::initConfig ( int *argc*, char \* *argv*[], const std::string & *defaultFilename* ) [static]

#### 7.4.1.9 void Configuration::refresh ( ) [static]

The documentation for this class was generated from the following files:

- [configuration.h](#)
- [configuration.cpp](#)

## 7.5 configValue Struct Reference

This struct holds a configuration value of any legal type.

```
#include <configuration.h>
```

## Public Attributes

- `std::string type`
- `union {`
  - `int intVal`
  - `float floatVal`
  - `char charVal`
  - `bool boolVal`
  - `const char * stringVal``};`

### 7.5.1 Detailed Description

This struct holds a configuration value of any legal type.

Note that `stringVal` is stored as a `const char *` in the union due to restrictions in C++ not allowing complex types in unions. The string is converted to a `char *` after it is parsed, and is converted back in `getStringVal`.

### 7.5.2 Member Data Documentation

#### 7.5.2.1 `union { ... }`

An anonymous union of all possible types that can be stored.

#### 7.5.2.2 `bool configValue::boolVal`

#### 7.5.2.3 `char configValue::charVal`

#### 7.5.2.4 `float configValue::floatVal`

#### 7.5.2.5 `int configValue::intVal`

#### 7.5.2.6 `const char* configValue::stringVal`

#### 7.5.2.7 `std::string configValue::type`

The name of the type that is stored ("int", "float", "char", "bool", or "string") or an error code from parsing ("invalid type name" or "invalid syntax").

The documentation for this struct was generated from the following file:

- [configuration.h](#)

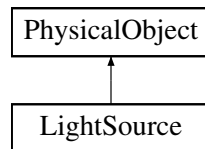
## 7.6 LightSource Class Reference

[LightSource](#) for the robot to seek.

```
#include <LightSource.h>
```

Inheritance diagram for `LightSource`:





## Public Member Functions

- [LightSource](#) (int radius, [Color](#) color)
- [LightSource](#) (int maxRadius, int minRadius, [Color](#) color)
- [LightSource](#) (int radius, [Location](#) loc, [Color](#) color)
- bool [handleCollision](#) (int otherId, bool wasHit)
- [~LightSource](#) ()
- void [display](#) ()

## Additional Inherited Members

### 7.6.1 Detailed Description

[LightSource](#) for the robot to seek.

### 7.6.2 Constructor & Destructor Documentation

#### 7.6.2.1 [LightSource::LightSource](#) ( int *radius*, [Color](#) *color* )

This constructor requires two parameters: radius and color)

##### Parameters

<i>radius</i>	the radius in pixels
<i>color</i>	a struct of float value 0 to 1 representing a hexadecimal color

##### Initialization

[LightSource](#) is initialized with the following values:

Orientation: random

Speed: 0

Position: (loc.x, loc.y)

#### 7.6.2.2 [LightSource::LightSource](#) ( int *maxRadius*, int *minRadius*, [Color](#) *color* )

This constructor creates a light with a random radius

##### Parameters

<i>minRadius</i>	the minimum possible radius in pixels
<i>maxRadius</i>	the maximum possible radius in pixels
<i>color</i>	a struct representing color

##### Initialization

[LightSource](#) is initialized with the following values:

Orientation: random

Speed: 0

Position: (loc.x, loc.y)

#### 7.6.2.3 `LightSource::LightSource ( int radius, Location loc, Color color )`

This constructor requires four parameters: radius, color, start [Location](#) and ConfigTable value)

##### Parameters

<i>radius</i>	the radius in pixels
<i>color</i>	a struct of float value 0 to 1 representing a hexadecimal color
<i>loc</i>	a struct of the x,y start <a href="#">Location</a> in pixels
<i>config</i>	a configuration table

##### Initialization

[LightSource](#) is initialized with the following values:

Orientation: 0

Speed: 0

Position: (loc.x, loc.y)

#### 7.6.2.4 `LightSource::~~LightSource ( )`

This is the class destructor.

### 7.6.3 Member Function Documentation

#### 7.6.3.1 `void LightSource::display ( ) [virtual]`

This function displays the [LightSource](#) in the graphics.

Reimplemented from [PhysicalObject](#).

#### 7.6.3.2 `bool LightSource::handleCollision ( int otherId, bool wasHit ) [virtual]`

##### Author

Lucas Kramer This function gives [LightSource](#) an appropriate reaction when a collision occurs.

##### Parameters

<i>otherId</i>	id of the object that it collides with
<i>wasHit</i>	tells if the object was hit previously

Implements [PhysicalObject](#).

The documentation for this class was generated from the following files:

- [LightSource.h](#)
- [LightSource.cpp](#)

## 7.7 Location Struct Reference

an xy position on the screen, approximately in pixels x is horizontal from the left and y is vertical from the bottom

```
#include <Location.h>
```

### Public Member Functions

- [Location](#) ()
- [Location](#) (float x, float y)
- bool [operator==](#) ([Location](#) other)

### Public Attributes

- float [x](#)
- float [y](#)

#### 7.7.1 Detailed Description

an xy position on the screen, approximately in pixels x is horizontal from the left and y is vertical from the bottom

#### 7.7.2 Constructor & Destructor Documentation

7.7.2.1 [Location::Location](#) ( ) `[inline]`

7.7.2.2 [Location::Location](#) ( float x, float y ) `[inline]`

#### 7.7.3 Member Function Documentation

7.7.3.1 bool [Location::operator==](#) ( [Location](#) *other* ) `[inline]`

#### 7.7.4 Member Data Documentation

7.7.4.1 float [Location::x](#)

7.7.4.2 float [Location::y](#)

The documentation for this struct was generated from the following file:

- [Location.h](#)

## 7.8 NeuralNetwork Class Reference

A representation of a neural network.

```
#include <NeuralNetwork.h>
```

### Public Member Functions

- [NeuralNetwork](#) (const [NeuralNetwork](#) &other)
- [NeuralNetwork](#) (const std::string &filename)
- std::vector< float > [compute](#) (const std::vector< float > &inputs)

- [NeuralNetwork mutate](#) (int numChanged, float amount)
- [NeuralNetwork combine](#) (const [NeuralNetwork](#) &other)
- void [write](#) (const std::string &filename)

## Static Public Member Functions

- static [NeuralNetwork load](#) (const std::string &filename)

### 7.8.1 Detailed Description

A representation of a neural network.

### 7.8.2 Constructor & Destructor Documentation

#### 7.8.2.1 NeuralNetwork::NeuralNetwork ( const NeuralNetwork & *other* )

The copy constructor

Parameters

<i>other</i>	the network to copy
--------------	---------------------

#### 7.8.2.2 NeuralNetwork::NeuralNetwork ( const std::string & *filename* )

Constructs a network from a file description

Parameters

<i>filename</i>	the description filename
-----------------	--------------------------

### 7.8.3 Member Function Documentation

#### 7.8.3.1 NeuralNetwork NeuralNetwork::combine ( const NeuralNetwork & *other* )

Combines the network with another network by constructing a new network with half the connection strengths from each. Throws an exception if the networks have incompatible structures

Returns

the new network

#### 7.8.3.2 vector< float > NeuralNetwork::compute ( const std::vector< float > & *inputs* )

Computes the output values of a network for a vector of inputs. Throws an exception if an incorrect number of inputs is provided

Parameters

<i>inputs</i>	a vector containing the inputs
---------------	--------------------------------

Returns

a vector containing the outputs

### 7.8.3.3 NeuralNetwork NeuralNetwork::load ( const std::string & *filename* ) [static]

Loads a network from a file

## Parameters

<i>filename</i>	the filename to load
-----------------	----------------------

## Returns

the new network

#### 7.8.3.4 NeuralNetwork NeuralNetwork::mutate ( int *numChanged*, float *amount* )

Mutates the network by changing numChanged connection strengths by a random number between -amount and amount

## Parameters

<i>numChanged</i>	the number of connections to mutate
<i>amount</i>	the maximum amount to change the connections

## Returns

the new network

#### 7.8.3.5 void NeuralNetwork::write ( const std::string & *filename* )

Writes the network to a file

## Parameters

<i>filename</i>	the file to write
-----------------	-------------------

The documentation for this class was generated from the following files:

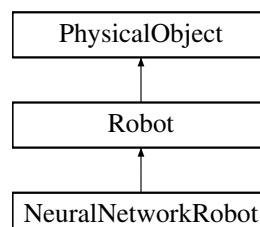
- [NeuralNetwork.h](#)
- [NeuralNetwork.cpp](#)

## 7.9 NeuralNetworkRobot Class Reference

A robot controlled by a neural network with inputs from the sensors.

```
#include <NeuralNetworkRobot.h>
```

Inheritance diagram for NeuralNetworkRobot:



## Public Member Functions

- [NeuralNetworkRobot](#) (int radius, [Color](#) color, [Color](#) lineColor, [NeuralNetwork](#) network, int targetId=-1, std::string filename=GET\_STRING("DEFAULT\_NEURAL\_NETWORK\_FILE"))

- [NeuralNetworkRobot](#) (int radius, [Location](#) loc, [Color](#) color, [Color](#) lineColor, [NeuralNetwork](#) network, int targetId=-1, std::string filename=GET\_STRING("DEFAULT\_NEURAL\_NETWORK\_FILE"))
- [~NeuralNetworkRobot](#) ()
- float [getLeftSpeed](#) (float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal)
- float [getRightSpeed](#) (float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal)

## Public Attributes

- const std::string [filename](#)

## Additional Inherited Members

### 7.9.1 Detailed Description

A robot controlled by a neural network with inputs from the sensors.

### 7.9.2 Constructor & Destructor Documentation

**7.9.2.1** `NeuralNetworkRobot::NeuralNetworkRobot ( int radius, Color color, Color lineColor, NeuralNetwork network, int targetId = -1, std::string filename = GET_STRING ( "DEFAULT_NEURAL_NETWORK_FILE" ) )`

**7.9.2.2** `NeuralNetworkRobot::NeuralNetworkRobot ( int radius, Location loc, Color color, Color lineColor, NeuralNetwork network, int targetId = -1, std::string filename = GET_STRING ( "DEFAULT_NEURAL_NETWORK_FILE" ) )`

**7.9.2.3** `NeuralNetworkRobot::~~NeuralNetworkRobot ( )`

### 7.9.3 Member Function Documentation

**7.9.3.1** `float NeuralNetworkRobot::getLeftSpeed ( float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal ) [virtual]`

Implements [Robot](#).

**7.9.3.2** `float NeuralNetworkRobot::getRightSpeed ( float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal ) [virtual]`

Implements [Robot](#).

### 7.9.4 Member Data Documentation

**7.9.4.1** `const std::string NeuralNetworkRobot::filename`

The documentation for this class was generated from the following files:

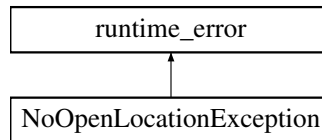
- [NeuralNetworkRobot.h](#)
- [NeuralNetworkRobot.cpp](#)

## 7.10 NoOpenLocationException Class Reference

An exception to be thrown when an open [Location](#) cannot be found.

```
#include <environment.h>
```

Inheritance diagram for NoOpenLocationException:



### Public Member Functions

- [NoOpenLocationException](#) ()

#### 7.10.1 Detailed Description

An exception to be thrown when an open [Location](#) cannot be found.

#### 7.10.2 Constructor & Destructor Documentation

##### 7.10.2.1 NoOpenLocationException::NoOpenLocationException ( ) [inline]

The documentation for this class was generated from the following file:

- [environment.h](#)

## 7.11 ObjectIterator Class Reference

[ObjectIterator](#) class, a simple iterator for the object in environment.

```
#include <environment.h>
```

### Public Member Functions

- [ObjectIterator](#) ()  
*The default constructor, the iterated objects are allways the iterObjects vector in environment.*
- [ObjectIterator](#) (const [ObjectIterator](#) &other)  
*The copy constructor, the iterated objects are allways the iterObjects vector in environment.*
- [~ObjectIterator](#) ()  
*The destructor, does nothing.*
- void [operator++](#) ()
- void [operator++](#) (int)
- [PhysicalObject](#) \* [operator\\*](#) ()
- bool [operator>](#) (const [ObjectIterator](#) &other)
- bool [operator<](#) (const [ObjectIterator](#) &other)
- bool [operator==](#) (const [ObjectIterator](#) &other)
- bool [operator!=](#) (const [ObjectIterator](#) &other)



## Friends

- [environment::objectIterator environment::getObjectsBegin \( \)](#)
- [environment::objectIterator environment::getObjectsEnd \( \)](#)

### 7.11.1 Detailed Description

[ObjectIterator](#) class, a simple iterator for the object in environment.

### 7.11.2 Constructor & Destructor Documentation

#### 7.11.2.1 ObjectIterator::ObjectIterator ( )

The default constructor, the iterated objects are allways the iterObjects vector in environment.

#### 7.11.2.2 ObjectIterator::ObjectIterator ( const ObjectIterator & other )

The copy constructor, the iterated objects are allways the iterObjects vector in environment.

Parameters

<i>other</i>	The <a href="#">ObjectIterator</a> to copy
--------------	--

#### 7.11.2.3 ObjectIterator::~~ObjectIterator ( )

The destructor, does nothing.

### 7.11.3 Member Function Documentation

#### 7.11.3.1 bool ObjectIterator::operator!= ( const ObjectIterator & other )

#### 7.11.3.2 PhysicalObject \* ObjectIterator::operator\* ( )

#### 7.11.3.3 void ObjectIterator::operator++ ( )

#### 7.11.3.4 void ObjectIterator::operator++ ( int )

#### 7.11.3.5 bool ObjectIterator::operator< ( const ObjectIterator & other )

#### 7.11.3.6 bool ObjectIterator::operator== ( const ObjectIterator & other )

#### 7.11.3.7 bool ObjectIterator::operator> ( const ObjectIterator & other )

### 7.11.4 Friends And Related Function Documentation

#### 7.11.4.1 environment::objectIterator environment::getObjectsBegin ( ) [friend]

#### 7.11.4.2 environment::objectIterator environment::getObjectsEnd ( ) [friend]

The documentation for this class was generated from the following files:

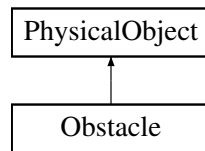
- [environment.h](#)
- [environment.cpp](#)

## 7.12 Obstacle Class Reference

[Obstacle](#) for the robot to hit/avoid.

```
#include <Obstacle.h>
```

Inheritance diagram for Obstacle:



### Public Member Functions

- [Obstacle](#) (int radius, [Color](#) color)
- [Obstacle](#) (int maxRadius, int minRadius, [Color](#) color)
- [Obstacle](#) (int radius, [Location](#) loc, [Color](#) color)
- bool [handleCollision](#) (int otherId, bool wasHit)
- [~Obstacle](#) ()

### Additional Inherited Members

#### 7.12.1 Detailed Description

[Obstacle](#) for the robot to hit/avoid.

#### 7.12.2 Constructor & Destructor Documentation

##### 7.12.2.1 Obstacle::Obstacle ( int *radius*, [Color](#) *color* )

###### Parameters

<i>radius</i>	the radius in pixels
<i>color</i>	a struct of float value 0 to 1 representing a hexadecimal color
<i>config</i>	a configuration table

###### Initialization

[Obstacle](#) is initialized with the following values:

Radius: DEFAULT\_RADIUS as specified in ../config/default

Orientation: random

Speed: 0

Position: (loc.x, loc.y)

##### 7.12.2.2 Obstacle::Obstacle ( int *maxRadius*, int *minRadius*, [Color](#) *color* )

## Parameters

<i>minRadius</i>	the minimum radius in pixels
<i>maxRadius</i>	the maximum radius in pixels
<i>color</i>	a struct of float value 0 to 1 representing a hexadecimal color

## Initialization

[Obstacle](#) is initialized with the following values:

Orientation: random

Speed: 0

Position: (loc.x, loc.y)

7.12.2.3 Obstacle::Obstacle ( int *radius*, Location *loc*, Color *color* )

## Parameters

<i>radius</i>	the radius in pixels
<i>color</i>	a struct of float value 0 to 1 representing a hexadecimal color
<i>loc</i>	a struct of the x,y start <a href="#">Location</a> in pixels

## Initialization

[Obstacle](#) is initialized with the following values:

Orientation: 0

Speed: 0

Position: (loc.x, loc.y)

## 7.12.2.4 Obstacle::~~Obstacle ( )

This is the class destructor.

## 7.12.3 Member Function Documentation

7.12.3.1 bool Obstacle::handleCollision ( int *otherId*, bool *wasHit* ) [virtual]

## Author

Lucas Kramer This function gives [Obstacle](#) an appropriate reaction when a collision occurs. Does nothing for now

## Parameters

<i>otherId</i>	id of the object that it collides with
<i>wasHit</i>	tells if the object was hit previously

Implements [PhysicalObject](#).

The documentation for this class was generated from the following files:

- [Obstacle.h](#)
- [Obstacle.cpp](#)

## 7.13 OptimizeSimulation Class Reference

[OptimizeSimulation](#) class, sets up environments and robots.

```
#include <OptimizeSimulation.h>
```

### Public Member Functions

- [OptimizeSimulation](#) (int argc, char \*argv[])  
The constructor for the [Simulation](#) class.
- virtual [~OptimizeSimulation](#) ()
- void [runMainLoop](#) ()
- int [getPerformance](#) (const [NeuralNetwork](#) &network)
- int [getPerformanceRandomRepeated](#) (const [NeuralNetwork](#) &network)
- int [getPerformanceMaze](#) (const [NeuralNetwork](#) &network)
- int [getPerformanceObstacles](#) (const [NeuralNetwork](#) &network)

### 7.13.1 Detailed Description

[OptimizeSimulation](#) class, sets up environments and robots.

### 7.13.2 Constructor & Destructor Documentation

#### 7.13.2.1 [OptimizeSimulation::OptimizeSimulation](#) ( int argc, char \* argv[] )

The constructor for the [Simulation](#) class.

Parameters

<i>argc</i>	The number of command-line arguments
<i>argv</i>	The command-line arguments

#### 7.13.2.2 [OptimizeSimulation::~~OptimizeSimulation](#) ( ) [virtual]

### 7.13.3 Member Function Documentation

#### 7.13.3.1 [int OptimizeSimulation::getPerformance](#) ( const [NeuralNetwork](#) & network )

#### 7.13.3.2 [int OptimizeSimulation::getPerformanceMaze](#) ( const [NeuralNetwork](#) & network )

#### 7.13.3.3 [int OptimizeSimulation::getPerformanceObstacles](#) ( const [NeuralNetwork](#) & network )

#### 7.13.3.4 [int OptimizeSimulation::getPerformanceRandomRepeated](#) ( const [NeuralNetwork](#) & network )

#### 7.13.3.5 [void OptimizeSimulation::runMainLoop](#) ( )

The documentation for this class was generated from the following files:

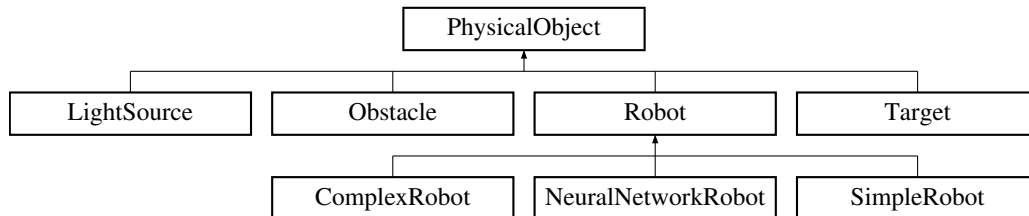
- [OptimizeSimulation.h](#)
- [OptimizeSimulation.cpp](#)

## 7.14 PhysicalObject Class Reference

This is a common superclass for all objects.

```
#include <PhysicalObject.h>
```

Inheritance diagram for PhysicalObject:



### Public Member Functions

- [PhysicalObject](#) ([ObjectType](#) objectType, int radius=[GET\\_INT](#)("DEFAULT\_RADIUS"), [Color](#) color=[Color](#)('?'), bool isHitable=true)
- [PhysicalObject](#) ([ObjectType](#) objectType, int maxRadius, int minRadius, [Color](#) color=[Color](#)('?'), bool isHitable=true)
- [PhysicalObject](#) ([ObjectType](#) objectType, int radius, [Location](#) loc, [Color](#) color=[Color](#)('?'), bool isHitable=true)
- virtual [~PhysicalObject](#) ()
- int [getId](#) () const
- void [setPosition](#) (float x, float y)
- void [forceSetPosition](#) (float x, float y)
- void [setLocation](#) ([Location](#) loc)
- void [reorient](#) (int angle, float distance)
- bool [translate](#) (float distance)
- void [forceTranslate](#) (float distance)
- void [setOrientation](#) (int degrees)
- void [setSpeed](#) (int pps)
- void [setRadius](#) (int radius)
- void [setColor](#) ([Color](#) color)
- float [getXPosition](#) () const
- float [getYPosition](#) () const
- [Location](#) [getLocation](#) () const
- int [getOrientation](#) () const
- int [getSpeed](#) () const
- int [getRadius](#) () const
- [Color](#) [getColor](#) () const
- void [pointTo](#) (const [PhysicalObject](#) &other)
- void [rotate](#) (int degrees)
- bool [hasEqualPosition](#) (const [PhysicalObject](#) &other) const
- bool [updatePosition](#) ()
- virtual void [update](#) ()
- virtual void [updateMembers](#) ()
- virtual void [display](#) ()
- virtual bool [handleCollision](#) (int otherId, bool wasHit)=0

### Public Attributes

- const [ObjectType](#) objectType
- const bool isHitable

## Static Protected Member Functions

- static [Location](#) [findOpenLocation](#) (int radius)

### 7.14.1 Detailed Description

This is a common superclass for all objects.

### 7.14.2 Constructor & Destructor Documentation

7.14.2.1 **PhysicalObject::PhysicalObject** ( **ObjectType** *objectType*, int *radius* = **GET\_INT** ( "DEFAULT\_RADIUS" ), **Color** *color* = **Color** ( ' ? ' ), bool *isHitable* = **true** )

7.14.2.2 **PhysicalObject::PhysicalObject** ( **ObjectType** *objectType*, int *maxRadius*, int *minRadius*, **Color** *color* = **Color** ( ' ? ' ), bool *isHitable* = **true** )

7.14.2.3 **PhysicalObject::PhysicalObject** ( **ObjectType** *objectType*, int *radius*, **Location** *loc*, **Color** *color* = **Color** ( ' ? ' ), bool *isHitable* = **true** )

7.14.2.4 **PhysicalObject::~~PhysicalObject** ( ) [virtual]

This is the class destructor, it is implemented by all subclasses.

### 7.14.3 Member Function Documentation

7.14.3.1 **void PhysicalObject::display** ( ) [virtual]

This is implemented by each class, normally just calls [displayAsCircle](#).

See Also

[displayAsCircle\(\)](#)

Reimplemented in [Robot](#), and [LightSource](#).

7.14.3.2 **Location PhysicalObject::findOpenLocation** ( int *radius* ) [static], [protected]

This function finds an open [Location](#) to place the object

Parameters

<i>radius</i>	The radius of the object
---------------	--------------------------

7.14.3.3 **void PhysicalObject::forceSetPosition** ( float *x*, float *y* )

Sets the position for the object. It does not throw an exception on invalid input.

Parameters

<i>x</i>	position in pixels
<i>y</i>	position in pixels

#### 7.14.3.4 void PhysicalObject::forceTranslate ( float *distance* )

Translates without calling handleCollision. This may cause objects to overlap

## Parameters

<i>distance</i>	Distance to move in pixels
-----------------	----------------------------

**7.14.3.5 Color** `PhysicalObject::getColor ( ) const`

Returns the color of the object

## Returns

color

**7.14.3.6 int** `PhysicalObject::getId ( ) const`

Getter function for the object's id.

## Returns

The object's id

**7.14.3.7 Location** `PhysicalObject::getLocation ( ) const`

Returns the x and y [Location](#) of the object in pixels in a struct

## See Also

[Location](#)

**7.14.3.8 int** `PhysicalObject::getOrientation ( ) const`

Returns the orientation of the object in degrees

## Returns

orientation in degrees

**7.14.3.9 int** `PhysicalObject::getRadius ( ) const`

Returns the radius of the object

## Returns

radius

**7.14.3.10 int** `PhysicalObject::getSpeed ( ) const`

Returns the speed of the object

## Returns

speed in pixels per second



#### 7.14.3.11 float PhysicalObject::getXPosition ( ) const

Returns the x position in pixels of the object

##### Returns

x position, horizontal from left

#### 7.14.3.12 float PhysicalObject::getYPosition ( ) const

Returns the y position in pixels of the object

##### Returns

y position, vertical from bottom

#### 7.14.3.13 virtual bool PhysicalObject::handleCollision ( int *otherId*, bool *wasHit* ) [pure virtual]

This is implemented by each class. It controls the objects behavior on collision during translate, normally just calls reorient.

##### Parameters

<i>otherId</i>	The id of the object it hit, or -1 for a wall
<i>wasHit</i>	true if the object hit something, false if hit by something (see translate)

##### Returns

true if objects were added or removed

##### See Also

[reorient\(\)](#)

Implemented in [Robot](#), [LightSource](#), [Obstacle](#), and [Target](#).

#### 7.14.3.14 bool PhysicalObject::hasEqualPosition ( const PhysicalObject & *other* ) const

This member function checks when two objects are at the same [Location](#), it has one parameter

##### Parameters

<i>other</i>	The object to compare
--------------	-----------------------

##### Returns

A boolean value that is true when objects are overlapping

#### 7.14.3.15 void PhysicalObject::pointTo ( const PhysicalObject & *other* )

Calculates the direction of the object is facing towards the target object based on position of the two objects using the math function atan2

## Parameters

<i>other</i>	A <a href="#">PhysicalObject</a> class pointer
--------------	--

7.14.3.16 void PhysicalObject::reorient ( int *angle*, float *distance* )

This function can be called by subclasses when handling a collision. This causes the robot to rotate by the specified amount, and then translate if that is enabled in the configuration. Since translating could cause another collision, this could call back to reorient, causing infinite recursion in some cases. To prevent this, the function omits the translate if it is more than MAX\_REORIENT\_RETRIES deep in recursive calls, set in the configuration

## Parameters

<i>angle</i>	Angle to rotate in degrees
<i>distance</i>	Distance to move in pixels

7.14.3.17 void PhysicalObject::rotate ( int *degrees* )

This function increments the object's orientation

## Parameters

<i>degrees</i>	Angle to be incremented clockwise.
----------------	------------------------------------

## Exceptions

<i>Input</i>	must be within (-360,360)
--------------	---------------------------

7.14.3.18 void PhysicalObject::setColor ( [Color](#) *color* )

Set a new color for the object.

## Parameters

<i>color</i>	
--------------	--

## See Also

[Color](#)

7.14.3.19 void PhysicalObject::setLocation ( [Location](#) *loc* )

Sets the position for the object for the object

## Parameters

<i>loc</i>	A struct of the x,y <a href="#">Location</a> in pixels
------------	--

## See Also

[setPosition](#)

7.14.3.20 void PhysicalObject::setOrientation ( int *degrees* )

Sets the absolute orientation for an object

## Parameters

<i>degrees</i>	New angle for the object in degrees clockwise of North.
----------------	---

7.14.3.21 void PhysicalObject::setPosition ( float *x*, float *y* )

Sets the position for the object

## Parameters

<i>x</i>	x position in pixels
<i>y</i>	y position in pixels

7.14.3.22 void PhysicalObject::setRadius ( int *radius* )

Set the radius of the object

## Parameters

<i>radius</i>	the new radius in pixels
---------------	--------------------------

7.14.3.23 void PhysicalObject::setSpeed ( int *pps* )

Sets the speed of an object

## Parameters

<i>pps</i>	The new speed in pixels per second
------------	------------------------------------

7.14.3.24 bool PhysicalObject::translate ( float *distance* )

Translates in the current direction, and calls handleCollision where needed

## Parameters

<i>distance</i>	Distance to move in pixels
-----------------	----------------------------

## Returns

true if objects were added or removed when any collisions were handled. This is to allow the position update function to break out of the loop when objects are removed, to prevent trying to update objects that no longer exist

## 7.14.3.25 void PhysicalObject::update ( ) [virtual]

This is implemented by each class, and performs random updates, e.g. point toward target

Reimplemented in [Robot](#).

## 7.14.3.26 void PhysicalObject::updateMembers ( ) [virtual]

This is implemented by each class, and performs updates such as setting the position of sub-objects

Reimplemented in [Robot](#).

#### 7.14.3.27 bool PhysicalObject::updatePosition ( )

This member function uses the speed and time to update the [Location](#)

#### Returns

true if objects were added or removed

### 7.14.4 Member Data Documentation

#### 7.14.4.1 const bool PhysicalObject::isHitable

#### 7.14.4.2 const ObjectType PhysicalObject::objectType

The documentation for this class was generated from the following files:

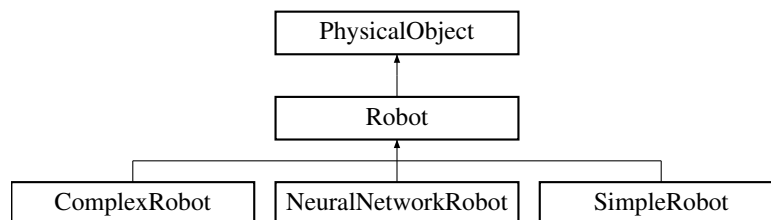
- [PhysicalObject.h](#)
- [PhysicalObject.cpp](#)

## 7.15 Robot Class Reference

[Robot](#) that moves around the window and bumps into obstacles.

```
#include <Robot.h>
```

Inheritance diagram for Robot:



### Public Member Functions

- [Robot](#) ([RobotType](#) robotType, int radius, [Color](#) color, [Color](#) lineColor, int targetId=-1)
- [Robot](#) ([RobotType](#) robotType, int radius, [Location](#) loc, [Color](#) color, [Color](#) lineColor, int targetId=-1)
- [~Robot](#) ()
- int [getTarget](#) () const
- void [setTarget](#) (int id)
- bool [handleCollision](#) (int otherId, bool wasHit)
- void [update](#) ()
- void [updateMembers](#) ()
- void [display](#) ()
- void [setLineColor](#) ([Color](#) lineColor)
- [Color](#) [getLineColor](#) ()

### Public Attributes

- const [RobotType](#) robotType

## Protected Member Functions

- virtual float [getLeftSpeed](#) (float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal)=0
- virtual float [getRightSpeed](#) (float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal)=0

## Additional Inherited Members

### 7.15.1 Detailed Description

[Robot](#) that moves around the window and bumps into obstacles.

### 7.15.2 Constructor & Destructor Documentation

#### 7.15.2.1 Robot::Robot ( RobotType robotType, int radius, Color color, Color lineColor, int targetId = -1 )

##### Parameters

<i>robotType</i>	the robot type
<i>radius</i>	the radius in pixels
<i>color</i>	color of the robot itself, a struct of float value 0 to 1 representing a hexadecimal color
<i>lineColor</i>	color of the line, a struct of float value 0 to 1 representing a hexadecimal color

##### Initialization

[Robot](#) is initialized with the following values:

Orientation: 0

Speed: 0

Position: (loc.x, loc.y)

#### 7.15.2.2 Robot::Robot ( RobotType robotType, int radius, Location loc, Color color, Color lineColor, int targetId = -1 )

##### Parameters

<i>robotType</i>	the robot type
<i>radius</i>	the radius in pixels
<i>color</i>	a struct of float value 0 to 1 representing a hexadecimal color
<i>linecolor</i>	color of the line, a struct of float value 0 to 1 representing a hexadecimal color
<i>loc</i>	start <a href="#">Location</a> of the robot

##### Initialization

[Robot](#) is initialized with the following values:

Orientation: random

Speed: 0

Position: (loc.x, loc.y)

#### 7.15.2.3 Robot::~~Robot ( )

This is the class destructor.

### 7.15.3 Member Function Documentation

#### 7.15.3.1 void Robot::display ( ) [virtual]

##### Author

Lucas Kramer This function displays the [Robot](#) in the graphics

Reimplemented from [PhysicalObject](#).

#### 7.15.3.2 virtual float Robot::getLeftSpeed ( float *leftLightSensorVal*, float *rightLightSensorVal*, float *leftRobotSensorVal*, float *rightRobotSensorVal*, float *leftObstacleSensorVal*, float *rightObstacleSensorVal*, float *leftTargetSensorVal*, float *rightTargetSensorVal* ) [protected],[pure virtual]

Implemented in [ComplexRobot](#), [NeuralNetworkRobot](#), and [SimpleRobot](#).

#### 7.15.3.3 Color Robot::getLineColor ( )

#### 7.15.3.4 virtual float Robot::getRightSpeed ( float *leftLightSensorVal*, float *rightLightSensorVal*, float *leftRobotSensorVal*, float *rightRobotSensorVal*, float *leftObstacleSensorVal*, float *rightObstacleSensorVal*, float *leftTargetSensorVal*, float *rightTargetSensorVal* ) [protected],[pure virtual]

Implemented in [ComplexRobot](#), [NeuralNetworkRobot](#), and [SimpleRobot](#).

#### 7.15.3.5 int Robot::getTarget ( ) const

##### Author

Lucas Kramer This function gets the id of the target for the robot to seek.

##### Parameters

<i>id</i>	the id of the target
-----------	----------------------

#### 7.15.3.6 bool Robot::handleCollision ( int *otherId*, bool *wasHit* ) [virtual]

##### Author

Lucas Kramer This function gives [Robot](#) an appropriate reaction when a collision occurs

##### Parameters

<i>otherId</i>	id of the object that it collides with
<i>wasHit</i>	tells if the object was hit previously

Implements [PhysicalObject](#).

#### 7.15.3.7 void Robot::setLineColor ( Color *lineColor* )

##### Author

Lucas Kramer This function sets a new color for the robot's direction line.

## Parameters

<i>lineColor</i>	color of the line, a struct of float value 0 to 1 representing a hexadecimal color
------------------	--

## 7.15.3.8 void Robot::setTarget ( int id )

## Author

Lucas Kramer This function sets the id of the target for the robot to seek.

## Returns

the target id

## 7.15.3.9 void Robot::update ( ) [virtual]

## Author

Lucas Kramer This function updates the [Robot's](#) wheel speeds from the sensors

Reimplemented from [PhysicalObject](#).

## 7.15.3.10 void Robot::updateMembers ( ) [virtual]

## Author

Lucas Kramer This function updates the position of the robot's sub-objects

Reimplemented from [PhysicalObject](#).

## 7.15.4 Member Data Documentation

## 7.15.4.1 const RobotType Robot::robotType

The documentation for this class was generated from the following files:

- [Robot.h](#)
- [Robot.cpp](#)

## 7.16 Sensor Class Reference

```
#include <Sensor.h>
```

## Public Member Functions

- [Sensor](#) ([Location](#) loc, int orientation, [ObjectType](#) typeDetected)
- [Sensor](#) ([Location](#) loc, int orientation, int viewAngle, [ObjectType](#) typeDetected)
- void [setPosition](#) (float x, float y)
- void [setPosition](#) ([Location](#) loc)
- [Location](#) [getPosition](#) ()
- float [getXPosition](#) ()
- float [getYPosition](#) ()

- void [setOrientation](#) (int orientation)
- int [getOrientation](#) ()
- void [setViewAngle](#) (int degrees)
- int [getViewAngle](#) ()
- void [setTypeDetected](#) ([ObjectType](#) type)
- [ObjectType](#) [getTypeDetected](#) ()
- void [updatePosition](#) ([Location](#) robotLoc, int robotAngle)
- void [display](#) ()
- float [sense](#) ()

### 7.16.1 Constructor & Destructor Documentation

#### 7.16.1.1 [Sensor](#)::[Sensor](#) ( [Location](#) *loc*, int *orientation*, [ObjectType](#) *typeDetected* )

[Sensor](#) constructor with default angle

Parameters

<i>loc</i>	<a href="#">Location</a> of the sensor in x and y
<i>orientation</i>	orientation of the sensor
<i>typeDetected</i>	type that sensor will detect

#### 7.16.1.2 [Sensor](#)::[Sensor](#) ( [Location](#) *loc*, int *orientation*, int *viewAngle*, [ObjectType](#) *typeDetected* )

[Sensor](#) constructor

Parameters

<i>loc</i>	<a href="#">Location</a> of the sensor in x and y
<i>orientation</i>	orientation of the sensor
<i>viewAngle</i>	view angle of the sensor in degrees
<i>typeDetected</i>	type that sensor will detect

### 7.16.2 Member Function Documentation

#### 7.16.2.1 void [Sensor](#)::[display](#) ( )

Displays the sensor

Author

Carl

#### 7.16.2.2 int [Sensor](#)::[getOrientation](#) ( )

Returns the orientation of the sensor

Returns

orientation in degrees



#### 7.16.2.3 Location Sensor::getPosition ( )

Returns a [Location](#) struct of x and y position in pixels of the sensor

Returns

A [Location](#) struct of x and y position

#### 7.16.2.4 ObjectType Sensor::getTypeDetected ( )

Returns the type that sensor detects

Author

Himawan

Returns

type the sensor detects

#### 7.16.2.5 int Sensor::getViewAngle ( )

Returns the view angle of the sensor

Returns

view angle in degrees

#### 7.16.2.6 float Sensor::getXPosition ( )

Returns the x position in pixels of the sensor

Returns

x position

#### 7.16.2.7 float Sensor::getYPosition ( )

Returns the y position in pixels of the sensor

Returns

y position

#### 7.16.2.8 float Sensor::sense ( )

Returns some strength by sensing the environment

Author

Carl & Himawan

Returns

the strength of sensor reading of [0..1]

#### 7.16.2.9 void Sensor::setOrientation ( int *orientation* )

Sets the orientation for the sensor

## Parameters

<i>orientation</i>	The orientation of the object in degrees
--------------------	--

## 7.16.2.10 void Sensor::setPosition ( float x, float y )

Sets the position for the sensor

## Parameters

<i>x</i>	x position in pixels
<i>y</i>	y position in pixels

## 7.16.2.11 void Sensor::setPosition ( Location loc )

Sets the position for the sensor

## Parameters

<i>loc</i>	A struct of the x and y <a href="#">Location</a> in pixels
------------	--

## 7.16.2.12 void Sensor::setTypeDetected ( ObjectType type )

Sets the object type that the sensor detects

## Author

Himawan

## Parameters

<i>type</i>	object type to detect
-------------	-----------------------

## 7.16.2.13 void Sensor::setViewAngle ( int degrees )

Sets the view angle of the sensor

## Parameters

<i>degrees</i>	The view angle of the sensor in degrees
----------------	---

## 7.16.2.14 void Sensor::updatePosition ( Location robotLoc, int robotAngle )

Called to update the position of the sensor match the updated position of the robot

## Author

Carl

The documentation for this class was generated from the following files:

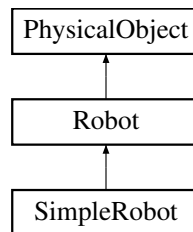
- [Sensor.h](#)
- [Sensor.cpp](#)

## 7.17 SimpleRobot Class Reference

A simple robot with uncrossed feedback.

```
#include <SimpleRobot.h>
```

Inheritance diagram for SimpleRobot:



### Public Member Functions

- [SimpleRobot](#) (int radius, [Color](#) color, [Color](#) lineColor, int targetId=-1)
- [SimpleRobot](#) (int radius, [Location](#) loc, [Color](#) color, [Color](#) lineColor, int targetId=-1)
- [~SimpleRobot](#) ()
- float [getLeftSpeed](#) (float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal)
- float [getRightSpeed](#) (float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal)

### Additional Inherited Members

#### 7.17.1 Detailed Description

A simple robot with uncrossed feedback.

#### 7.17.2 Constructor & Destructor Documentation

7.17.2.1 `SimpleRobot::SimpleRobot ( int radius, Color color, Color lineColor, int targetId = -1 )`

7.17.2.2 `SimpleRobot::SimpleRobot ( int radius, Location loc, Color color, Color lineColor, int targetId = -1 )`

7.17.2.3 `SimpleRobot::~~SimpleRobot ( )`

#### 7.17.3 Member Function Documentation

7.17.3.1 `float SimpleRobot::getLeftSpeed ( float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal ) [virtual]`

Implements [Robot](#).

7.17.3.2 `float SimpleRobot::getRightSpeed ( float leftLightSensorVal, float rightLightSensorVal, float leftRobotSensorVal, float rightRobotSensorVal, float leftObstacleSensorVal, float rightObstacleSensorVal, float leftTargetSensorVal, float rightTargetSensorVal ) [virtual]`

Implements [Robot](#).

The documentation for this class was generated from the following files:

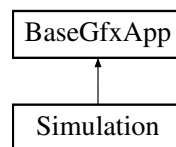
- [SimpleRobot.h](#)
- [SimpleRobot.cpp](#)

## 7.18 Simulation Class Reference

[Simulation](#) class, sets up the GUI and the drawing environment.

```
#include <Simulation.h>
```

Inheritance diagram for [Simulation](#):



### Public Member Functions

- [Simulation](#) (int argc, char \*argv[])  
*The constructor for the [Simulation](#) class.*
- virtual `~Simulation` ()
- void [initObjects](#) ()  
*Adds objects according to configuration.*
- void [tryAddRobotTarget](#) ()  
*Adds a robot and target to the simulation, or raises an error on failure.*
- void [tryAddRobot](#) ()  
*Adds a robot to the simulation, or raises an error on failure.*
- void [tryAddStationaryLightSource](#) ()  
*Adds a stationary light to the simulation, or raises an error on failure.*
- void [tryAddMovingLightSource](#) ()  
*Adds a moving light to the simulation, or raises an error on failure.*
- void [tryAddObstacle](#) ()  
*Adds an obstacle to the simulation, or raises an error on failure.*
- void [tryRemoveRobotTarget](#) ()  
*Removes a robot and target from the simulation, or raises an error on failure.*
- void [tryRemoveLightSource](#) ()  
*Removes a light from the simulation, or raises an error on failure.*
- void [tryRemoveObstacle](#) ()  
*Removes an obstacle from the simulation, or raises an error on failure.*
- void [tryOpen](#) ()  
*Loads a simulation, or raises an error on failure.*
- void [trySave](#) ()  
*Saves a simulation, or raises an error on failure.*
- void [display](#) ()

Call-back function to render all the objects. This function is called repeatedly from glut, and iterates through the objects and calls their respective display functions.

- void [advance](#) ()

Call-back function to update the positions of all objects. This function is called repeatedly from glut, and iterates through the objects and calls their respective updatePosition functions.

- void [gluiControl](#) (int controlId)

Call-back function for user input.

- void [leftMouseDown](#) (int x, int y)

Call-back function for mouse click.

- void [leftMouseUp](#) (int x, int y)

Call-back function for mouse click.

- void [middleMouseDown](#) (int x, int y)

Call-back function for mouse click.

- void [mouseDragged](#) (int x, int y)

Call-back function for mouse drag.

- void [keyboard](#) (unsigned char key, int x, int y)

Call-back function keyboard press.

- void [keyboardSpecial](#) (int key, int x, int y)

Call-back function for special keyboard press.

- void [start](#) (int)

- void [pause](#) (int)

- void [resume](#) (int)

- void [reset](#) (int)

- void [clear](#) (int)

- void [random](#) (int)

## Static Public Member Functions

- static void [s\\_start](#) (int)
- static void [s\\_pause](#) (int)
- static void [s\\_resume](#) (int)
- static void [s\\_reset](#) (int)
- static void [s\\_clear](#) (int)
- static void [s\\_random](#) (int)
- static void [s\\_addRobotTarget](#) (int)
- static void [s\\_addRobot](#) (int)
- static void [s\\_addStationaryLightSource](#) (int)
- static void [s\\_addMovingLightSource](#) (int)
- static void [s\\_addObstacle](#) (int)
- static void [s\\_removeRobotTarget](#) (int)
- static void [s\\_removeLightSource](#) (int)
- static void [s\\_removeObstacle](#) (int)
- static void [s\\_removeAllRobotTarget](#) (int)
- static void [s\\_removeAllLightSource](#) (int)
- static void [s\\_removeAllObstacle](#) (int)
- static void [s\\_refreshConfiguration](#) (int)
- static void [s\\_open](#) (int)
- static void [s\\_save](#) (int)
- static void [s\\_neuralNetworkFileChanged](#) (int)

## Additional Inherited Members

### 7.18.1 Detailed Description

[Simulation](#) class, sets up the GUI and the drawing environment.

### 7.18.2 Constructor & Destructor Documentation

#### 7.18.2.1 `Simulation::Simulation ( int argc, char * argv[] )`

The constructor for the [Simulation](#) class.

Parameters

<i>argc</i>	The number of command-line arguments
<i>argv</i>	The command-line arguments

#### 7.18.2.2 `Simulation::~Simulation ( )` [virtual]

### 7.18.3 Member Function Documentation

#### 7.18.3.1 `void Simulation::advance ( )` [virtual]

Call-back function to update the positions of all objects. This function is called repeatedly from glut, and iterates through the objects and calls their respective `updatePosition` functions.

Reimplemented from [BaseGfxApp](#).

#### 7.18.3.2 `void Simulation::clear ( int )`

#### 7.18.3.3 `void Simulation::display ( )` [virtual]

Call-back function to render all the objects. This function is called repeatedly from glut, and iterates through the objects and calls their respective `display` functions.

Reimplemented from [BaseGfxApp](#).

#### 7.18.3.4 `void Simulation::gluiControl ( int controlId )` [virtual]

Call-back function for user input.

Reimplemented from [BaseGfxApp](#).

#### 7.18.3.5 `void Simulation::initObjects ( )`

Adds objects according to configuration.

#### 7.18.3.6 `void Simulation::keyboard ( unsigned char key, int x, int y )` [virtual]

Call-back function keyboard press.

Reimplemented from [BaseGfxApp](#).

7.18.3.7 `void Simulation::keyboardSpecial ( int key, int x, int y ) [virtual]`

Call-back function for special keyboard press.

Reimplemented from [BaseGfxApp](#).

7.18.3.8 `void Simulation::leftMouseDown ( int x, int y ) [virtual]`

Call-back function for mouse click.

Reimplemented from [BaseGfxApp](#).

7.18.3.9 `void Simulation::leftMouseUp ( int x, int y ) [virtual]`

Call-back function for mouse click.

Reimplemented from [BaseGfxApp](#).

7.18.3.10 `void Simulation::middleMouseDown ( int x, int y ) [virtual]`

Call-back function for mouse click.

Reimplemented from [BaseGfxApp](#).

7.18.3.11 `void Simulation::mouseDragged ( int x, int y ) [virtual]`

Call-back function for mouse drag.

Reimplemented from [BaseGfxApp](#).

7.18.3.12 `void Simulation::pause ( int )`

7.18.3.13 `void Simulation::random ( int )`

7.18.3.14 `void Simulation::reset ( int )`

7.18.3.15 `void Simulation::resume ( int )`

7.18.3.16 `void Simulation::s_addMovingLightSource ( int a ) [static]`

7.18.3.17 `void Simulation::s_addObstacle ( int a ) [static]`

7.18.3.18 `void Simulation::s_addRobot ( int a ) [static]`

7.18.3.19 `void Simulation::s_addRobotTarget ( int a ) [static]`

7.18.3.20 `void Simulation::s_addStationaryLightSource ( int a ) [static]`

7.18.3.21 `void Simulation::s_clear ( int a ) [static]`

7.18.3.22 `void Simulation::s_neuralNetworkFileChanged ( int a ) [static]`

7.18.3.23 `void Simulation::s_open ( int a ) [static]`

7.18.3.24 `void Simulation::s_pause ( int a ) [static]`



- 7.18.3.25 `void Simulation::s_random ( int a ) [static]`
- 7.18.3.26 `void Simulation::s_refreshConfiguration ( int a ) [static]`
- 7.18.3.27 `void Simulation::s_removeAllLightSource ( int a ) [static]`
- 7.18.3.28 `void Simulation::s_removeAllObstacle ( int a ) [static]`
- 7.18.3.29 `void Simulation::s_removeAllRobotTarget ( int a ) [static]`
- 7.18.3.30 `void Simulation::s_removeLightSource ( int a ) [static]`
- 7.18.3.31 `void Simulation::s_removeObstacle ( int a ) [static]`
- 7.18.3.32 `void Simulation::s_removeRobotTarget ( int a ) [static]`
- 7.18.3.33 `void Simulation::s_reset ( int a ) [static]`
- 7.18.3.34 `void Simulation::s_resume ( int a ) [static]`
- 7.18.3.35 `void Simulation::s_save ( int a ) [static]`
- 7.18.3.36 `void Simulation::s_start ( int a ) [static]`
- 7.18.3.37 `void Simulation::start ( int )`
- 7.18.3.38 `void Simulation::tryAddMovingLightSource ( )`

Adds a moving light to the simulation, or raises an error on failure.

- 7.18.3.39 `void Simulation::tryAddObstacle ( )`

Adds a obstacle to the simulation, or raises an error on failure.

- 7.18.3.40 `void Simulation::tryAddRobot ( )`

Adds a robot to the simulation, or raises an error on failure.

- 7.18.3.41 `void Simulation::tryAddRobotTarget ( )`

Adds a robot and target to the simulation, or raises an error on failure.

- 7.18.3.42 `void Simulation::tryAddStationaryLightSource ( )`

Adds a stationary light to the simulation, or raises an error on failure.

- 7.18.3.43 `void Simulation::tryOpen ( )`

Loads a simulation, or raises an error on failure.

- 7.18.3.44 `void Simulation::tryRemoveLightSource ( )`

Removes a light from the simulation, or raises an error on failure.

#### 7.18.3.45 void Simulation::tryRemoveObstacle ( )

Removes a obstacle from the simulation, or raises an error on failure.

#### 7.18.3.46 void Simulation::tryRemoveRobotTarget ( )

Removes a robot and target from the simulation, or raises an error on failure.

#### 7.18.3.47 void Simulation::trySave ( )

Saves a simulation, or raises an error on failure.

The documentation for this class was generated from the following files:

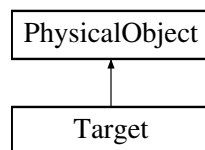
- [Simulation.h](#)
- [Simulation.cpp](#)

## 7.19 Target Class Reference

[Target](#) for the robot to seek.

```
#include <Target.h>
```

Inheritance diagram for Target:



### Public Member Functions

- [Target](#) ( )
- [Target](#) (int radius, [Color](#) color, int targetNum=[TARGET](#))
- [Target](#) (int maxRadius, int minRadius, [Color](#) color, int targetNum=[TARGET](#))
- [Target](#) (int radius, [Location](#) loc, [Color](#) color, int targetNum=[TARGET](#))
- bool [handleCollision](#) (int otherId, bool wasHit)
- [~Target](#) ( )

### Additional Inherited Members

#### 7.19.1 Detailed Description

[Target](#) for the robot to seek.

#### 7.19.2 Constructor & Destructor Documentation

##### 7.19.2.1 Target::Target ( )

##### 7.19.2.2 Target::Target ( int radius, [Color](#) color, int targetNum = [TARGET](#) )

7.19.2.3 `Target::Target ( int maxRadius, int minRadius, Color color, int targetNum = TARGET )`

7.19.2.4 `Target::Target ( int radius, Location loc, Color color, int targetNum = TARGET )`

7.19.2.5 `Target::~~Target ( )`

This is the class destructor.

### 7.19.3 Member Function Documentation

7.19.3.1 `bool Target::handleCollision ( int otherId, bool wasHit ) [virtual]`

#### Author

Lucas Kramer This function gives [Target](#) an appropriate reaction when a collision occurs.

#### Parameters

<i>otherId</i>	id of the object that it collides with
<i>wasHit</i>	tells if the object was hit previously

Implements [PhysicalObject](#).

The documentation for this class was generated from the following files:

- [Target.h](#)
- [Target.cpp](#)



## Chapter 8

# File Documentation

### 8.1 artist.cpp File Reference

```
#include "Color.h"
#include "artist.h"
#include "configuration.h"
#include <GL/glut.h>
#include <GL/glu.h>
#include <math.h>
```

#### Namespaces

- [artist](#)  
*graphical commands*

#### Macros

- [#define \\_USE\\_MATH\\_DEFINES](#)

#### Functions

- void [artist::drawObject](#) ([Location](#) loc, int radius, [Color](#) color)
- void [artist::debugArrow](#) ([Location](#) loc, int orientation)
- void [artist::drawLight](#) ([Location](#) loc, int radius, [Color](#) color)
- void [artist::drawObstacle](#) ([Location](#) loc, int radius)
- void [artist::drawSensor](#) ([Location](#) loc, int orientation, int angle, float intensity)
- void [artist::drawRobot](#) ([Location](#) loc, int radius, int orientation, [Color](#) color, [Color](#) lineColor)

#### 8.1.1 Macro Definition Documentation

##### 8.1.1.1 [#define \\_USE\\_MATH\\_DEFINES](#)

### 8.2 artist.h File Reference

A namespace for OpenGL graphical functions.

```
#include "Color.h"
#include "Location.h"
```

## Namespaces

- [artist](#)  
*graphical commands*

## Functions

- void [artist::debugArrow](#) ([Location](#) loc, int orientation)
- void [artist::drawObject](#) ([Location](#) loc, int radius, [Color](#) color)
- void [artist::drawLight](#) ([Location](#) loc, int radius, [Color](#) color)
- void [artist::drawObstacle](#) ([Location](#) loc, int radius)
- void [artist::drawSensor](#) ([Location](#) loc, int orientation, int angle, float intensity)
- void [artist::drawRobot](#) ([Location](#) loc, int radius, int orientation, [Color](#) color, [Color](#) lineColor)

### 8.2.1 Detailed Description

A namespace for OpenGL graphical functions.

#### Author

Carl Bahn Lucas Kramer

## 8.3 BaseGfxApp.cpp File Reference

Implementation of [BaseGfxApp](#).

```
#include "BaseGfxApp.h"
```

### 8.3.1 Detailed Description

Implementation of [BaseGfxApp](#).

#### Author

CSci3081 Guru Carl Bahn, Lucas Kramer

## 8.4 BaseGfxApp.h File Reference

The basic application class for CSci-3081 project. Uses GLUT and GLUI and wraps them in a nice C++ interface.

```
#include <string>
#include <iostream>
#include <assert.h>
#include <GL/glui.h>
```

## Classes

- class [BaseGfxApp](#)  
*Graphics driver class.*

### 8.4.1 Detailed Description

The basic application class for CSci-3081 project. Uses GLUT and GLUI and wraps them in a nice C++ interface.

#### Author

CSci3081 Guru Carl Bahn, Lucas Kramer

## 8.5 Color.cpp File Reference

Utility functions for handling color.

```
#include "Color.h"
#include "configuration.h"
#include <iostream>
#include <cstdlib>
#include <math.h>
```

### 8.5.1 Detailed Description

Utility functions for handling color.

#### Author

Carl Bahn Lucas Kramer

## 8.6 Color.h File Reference

Definintions for representing any hexadecimal color.

```
#include <iostream>
```

## Classes

- struct [Color](#)  
*This struct holds the representation of a color.*

## Macros

- #define [GET\\_COLOR](#)(COLOR\_VAR)

## Typedefs

- typedef struct [Color](#) [Color](#)  
*This struct holds the representation of a color.*

### 8.6.1 Detailed Description

Definitions for representing any hexadecimal color.

Author

Lucas Kramer

### 8.6.2 Macro Definition Documentation

#### 8.6.2.1 #define GET\_COLOR( COLOR\_VAR )

Value:

```
(GET_BOOL("USE_HEX_COLORS") ?
  Color(GET_INT(COLOR_VAR "_HEX")) :
  Color(GET_CHAR(COLOR_VAR)))
```

### 8.6.3 Typedef Documentation

#### 8.6.3.1 typedef struct Color Color

This struct holds the representation of a color.

Each field is a float value that should be between 0 and 1. This allows a direct translation from hex colors, with each field being the hex RGB value / 255.

## 8.7 ComplexRobot.cpp File Reference

The representation of a robot within the simulation.

```
#include <GL/glu.h>
#include <GL/glut.h>
#include <stdexcept>
#include "environment.h"
#include "Robot.h"
#include "ComplexRobot.h"
#include "configuration.h"
```

### 8.7.1 Detailed Description

The representation of a robot within the simulation.

Author

Lucas Kramer

## 8.8 ComplexRobot.h File Reference

The representation of a robot within the simulation.



```
#include "PhysicalObject.h"
#include "Robot.h"
#include "Sensor.h"
#include "configuration.h"
```

## Classes

- class [ComplexRobot](#)  
*A complex robot with configurable feedback from all sensors.*

### 8.8.1 Detailed Description

The representation of a robot within the simulation.

#### Author

Lucas Kramer

## 8.9 configuration.cpp File Reference

Implementation for configuration file loader.

```
#include <vector>
#include <iostream>
#include <fstream>
#include <sstream>
#include <string>
#include <string.h>
#include <boost/regex.hpp>
#include <boost/algorithm/string.hpp>
#include <boost/algorithm/string/regex.hpp>
#include "configuration.h"
```

## Typedefs

- typedef unordered\_map< string,  
[configValue](#) > [ConfigTable](#)  
*A type alias for an unordered map containing strings mapped to configValues.*

## Functions

- bool [isAllWhitespace](#) (const string &line)  
*A helper function for loadConfig that tests if the line is valid input.*
- [configValue](#) [parseValue](#) (const string &type, const string &valueText)
- [ConfigTable](#) [mergeConfigTables](#) ([ConfigTable](#) c1, [ConfigTable](#) c2)
- [ConfigTable](#) [loadConfig](#) (const string &filename)
- string [expandVar](#) (const smatch &match)

### 8.9.1 Detailed Description

Implementation for configuration file loader.

#### Author

Lucas Kramer Carl Bahn

See config.h for more information.

### 8.9.2 Typedef Documentation

#### 8.9.2.1 `typedef unordered_map<string, configValue> ConfigTable`

A type alias for an unordered map containing strings mapped to configValues.

### 8.9.3 Function Documentation

#### 8.9.3.1 `string expandVar ( const smatch & match )`

#### 8.9.3.2 `bool isAllWhitespace ( const string & line )`

A helper function for loadConfig that tests if the line is valid input.

#### 8.9.3.3 `ConfigTable loadConfig ( const string & filename )`

#### 8.9.3.4 `ConfigTable mergeConfigTables ( ConfigTable c1, ConfigTable c2 )`

#### 8.9.3.5 `configValue parseValue ( const string & type, const string & valueText )`

## 8.10 configuration.h File Reference

Interface definitions for configuration file loader.

```
#include <string>
#include <unordered_map>
```

### Classes

- struct [configValue](#)  
*This struct holds a configuration value of any legal type.*
- class [Configuration](#)

### Macros

- #define [GET\\_INT](#)(NAME) [Configuration::get\(\)](#)->getIntConfig(NAME)
- #define [GET\\_FLOAT](#)(NAME) [Configuration::get\(\)](#)->getFloatConfig(NAME)
- #define [GET\\_BOOL](#)(NAME) [Configuration::get\(\)](#)->getBoolConfig(NAME)
- #define [GET\\_CHAR](#)(NAME) [Configuration::get\(\)](#)->getCharConfig(NAME)
- #define [GET\\_STRING](#)(NAME) [Configuration::get\(\)](#)->getStringConfig(NAME)

### 8.10.1 Detailed Description

Interface definitions for configuration file loader.

#### Author

Lucas Kramer

The format of the config file is a series of lines with the format

```
<type> <name> = <value>
```

Blank lines are allowed, and comments # can occur at the end of a line.

Valid types are int, hex, octal, float, bool/boolean, char, and string. Note that int, hex, and octal all create a variable with type int, and only affect how the value is parsed.

Names can be [A-Za-z][A-Za-z0-9\_-]\*, but the recommended usage is all upper case, seperated by underscores.

The following is a list of valid value formats:

Type name	Format	Examples	Notes
int	[0-9]+	42	
hex	(0x)?[0-9A-Fa-f]+	0x3AF4, 0x3af4, 3AF4	It is recommended to use the 0x prefix and upper case A-F
hex	[0-7]+	0123, 123	It is recommended to use the 0 prefix
float	[0-9]+([0-9]+)?	3, 3.14	
bool/boolean	true false	true, false	It is recommended to use the bool type name
string	"[^\\n]*"	"Hello, World! ", "", "\$OTHER"	\$ followed by a variable is expanded to that variable. An actual \$ must be escaped
char	'([\\n\\r\\t] \\n \\r \\t)'	'a', 'A', '4', '\\n', '\\t'	

In addition to variable settings, it is possible to load other configuration files. This has the syntax:

```
use <filename>
```

where filename is a string. The path to <filename> is with respect to the directory containing the current file - absolute paths are not permitted. When an included file contains a variable with the same name as a value that is already defined, the current behavior is to overwrite the old value. Any value re-definition causes a warning.

### 8.10.2 Macro Definition Documentation

8.10.2.1 `#define GET_BOOL( NAME ) Configuration::get()->getBoolConfig(NAME)`

8.10.2.2 `#define GET_CHAR( NAME ) Configuration::get()->getCharConfig(NAME)`

8.10.2.3 `#define GET_FLOAT( NAME ) Configuration::get()->getFloatConfig(NAME)`

8.10.2.4 `#define GET_INT( NAME ) Configuration::get()->getIntConfig(NAME)`

8.10.2.5 `#define GET_STRING( NAME ) Configuration::get()->getStringConfig(NAME)`

## 8.11 environment.cpp File Reference

```
#include "PhysicalObject.h"
#include "environment.h"
#include "configuration.h"
#include <iostream>
#include <math.h>
```

### Functions

- bool [isTouching](#) ([Location](#) l1, int r1, [Location](#) l2, int r2)

### 8.11.1 Function Documentation

#### 8.11.1.1 bool isTouching ( [Location](#) l1, int r1, [Location](#) l2, int r2 )

Checks if two objects specified by their Locations and radii

#### Returns

a boolean value that is true when objects are overlapping

## 8.12 environment.h File Reference

```
#include "Location.h"
#include "configuration.h"
#include <unordered_map>
#include <vector>
#include <mutex>
#include <stdexcept>
```

### Classes

- class [ObjectIterator](#)  
*[ObjectIterator](#) class, a simple iterator for the object in environment.*
- class [NoOpenLocationException](#)  
*An exception to be thrown when an open [Location](#) cannot be found.*

### Namespaces

- [environment](#)  
*environment namespace, handles all the objects as a group. Also manages object ids and collision detection*

### Typedefs

- typedef [ObjectIterator](#) [environment::objectIterator](#)

## Functions

- int `environment::addObject` (`PhysicalObject` \*object)  
*Adds an object to the environment.*
- void `environment::removeObject` (int id)  
*Removes an object from the environment.*
- void `environment::clear` ()  
*Removes all objects from the environment and resets the id counter.*
- unsigned `environment::getNumObjects` ()  
*Gets the number of objects in environment.*
- `PhysicalObject` \* `environment::getObject` (int id)  
*Finds an object from the environment.*
- `objectIterator` `environment::getObjectsBegin` ()  
*Gets an iterator to the beginning of the objects.*
- `objectIterator` `environment::getObjectsEnd` ()  
*Gets an iterator to the end of the objects.*
- bool `environment::isTouchingWall` (`Location` l, int r)
- bool `environment::isTouchingWall` (int id)
- bool `environment::isTouchingObject` (`Location` l, int r, int id)
- bool `environment::isTouchingHitableObject` (`Location` l, int r, int id)
- bool `environment::isTouchingObject` (`Location` l, int r)
- bool `environment::isTouchingHitableObject` (`Location` l, int r)
- bool `environment::isTouchingObject` (int id)
- bool `environment::isTouchingHitableObject` (int id)
- bool `environment::isColliding` (`Location` l, int r)
- bool `environment::isColliding` (int id)
- bool `environment::isCollidingWithHitable` (`Location` l, int r)
- bool `environment::isCollidingWithHitable` (int id)
- int `environment::getCollisionId` (`Location` l, int r, int id)
- int `environment::getHitableCollisionId` (`Location` l, int r, int id)
- int `environment::getCollisionId` (`Location` l, int r)
- int `environment::getHitableCollisionId` (`Location` l, int r)
- int `environment::getCollisionId` (int id)
- int `environment::getHitableCollisionId` (int id)

## 8.13 LightSource.cpp File Reference

The representation of a target in the simulation.

```
#include <stdlib.h>
#include <math.h>
#include "artist.h"
#include "environment.h"
#include "LightSource.h"
#include "configuration.h"
```

### 8.13.1 Detailed Description

The representation of a target in the simulation.

#### Author

Himawan Go Lucas Kramer

## 8.14 LightSource.h File Reference

The representation of an obstacle in the simulation.

```
#include "PhysicalObject.h"
#include "configuration.h"
```

### Classes

- class [LightSource](#)  
*[LightSource](#) for the robot to seek.*

### 8.14.1 Detailed Description

The representation of an obstacle in the simulation.

#### Author

Himawan Go Lucas Kramer

## 8.15 Location.h File Reference

### Classes

- struct [Location](#)  
*an xy position on the screen, approximately in pixels x is horizontal from the left and y is vertical from the bottom*

### Typedefs

- typedef struct [Location](#) [Location](#)  
*an xy position on the screen, approximately in pixels x is horizontal from the left and y is vertical from the bottom*

### 8.15.1 Typedef Documentation

#### 8.15.1.1 typedef struct Location Location

an xy position on the screen, approximately in pixels x is horizontal from the left and y is vertical from the bottom

## 8.16 main.cpp File Reference

The main function to execute the simulation program.

```
#include <stdlib.h>
#include <time.h>
#include "OptimizeSimulation.h"
#include "Simulation.h"
#include "configuration.h"
```

## Macros

- `#define` `DEFAULT_CONFIG` `"../config/default"`

## Functions

- `int` `main` (`int` `argc`, `char` `*argv[]`)

### 8.16.1 Detailed Description

The main function to execute the simulation program.

#### Author

Lucas Kramer  
Carl Bahn  
Himawan Go

### 8.16.2 Macro Definition Documentation

#### 8.16.2.1 `#define` `DEFAULT_CONFIG` `"../config/default"`

### 8.16.3 Function Documentation

#### 8.16.3.1 `int` `main` ( `int` `argc`, `char` `* argv[]` )

Main function to execute the simulation

## 8.17 `mainpage.h` File Reference

## 8.18 `NeuralNetwork.cpp` File Reference

A feed-forward neural network class.

```
#include <stdlib.h>
#include <iostream>
#include <vector>
#include <mutex>
#include <fstream>
#include <sstream>
#include <string>
#include <string.h>
#include <boost/regex.hpp>
#include <boost/algorithm/string.hpp>
#include <boost/algorithm/string/regex.hpp>
#include "NeuralNetwork.h"
```

### 8.18.1 Detailed Description

A feed-forward neural network class.

**Author**

Lucas Kramer

## 8.19 NeuralNetwork.h File Reference

A feed-forward neural network class.

```
#include <vector>
#include <mutex>
```

### Classes

- class [NeuralNetwork](#)  
*A representation of a neural network.*

### 8.19.1 Detailed Description

A feed-forward neural network class.

**Author**

Lucas Kramer

## 8.20 NeuralNetworkRobot.cpp File Reference

The representation of a neural network robot within the simulation.

```
#include <GL/glu.h>
#include <GL/glut.h>
#include <stdexcept>
#include "environment.h"
#include "Robot.h"
#include "NeuralNetworkRobot.h"
#include "NeuralNetwork.h"
#include "configuration.h"
```

### 8.20.1 Detailed Description

The representation of a neural network robot within the simulation.

**Author**

Lucas Kramer

## 8.21 NeuralNetworkRobot.h File Reference

The representation of a neural network robot.



```
#include "PhysicalObject.h"
#include "Robot.h"
#include "Sensor.h"
#include "NeuralNetwork.h"
#include "configuration.h"
```

## Classes

- class [NeuralNetworkRobot](#)

*A robot controlled by a neural network with inputs from the sensors.*

### 8.21.1 Detailed Description

The representation of a neural network robot.

#### Author

Lucas Kramer

## 8.22 `Obstacle.cpp` File Reference

The representation of an obstacle in the simulation.

```
#include <stdlib.h>
#include <math.h>
#include "environment.h"
#include "Obstacle.h"
#include "configuration.h"
#include "artist.h"
```

### 8.22.1 Detailed Description

The representation of an obstacle in the simulation.

#### Author

Himawan Go Lucas Kramer

## 8.23 `Obstacle.h` File Reference

The representation of an obstacle in the simulation.

```
#include "PhysicalObject.h"
#include "configuration.h"
```

## Classes

- class [Obstacle](#)

*[Obstacle](#) for the robot to hit/avoid.*

### 8.23.1 Detailed Description

The representation of an obstacle in the simulation.

#### Author

Himawan Go Lucas Kramer

## 8.24 OptimizeSimulation.cpp File Reference

```
#include <unistd.h>
#include <stdlib.h>
#include <signal.h>
#include <algorithm>
#include <vector>
#include <mutex>
#include <stdexcept>
#include <sstream>
#include <fstream>
#include <iostream>
#include <climits>
#include <sys/stat.h>
#include <boost/interprocess/sync/named_upgradable_mutex.hpp>
#include "Robot.h"
#include "SimpleRobot.h"
#include "ComplexRobot.h"
#include "NeuralNetworkRobot.h"
#include "NeuralNetwork.h"
#include "Target.h"
#include "Obstacle.h"
#include "LightSource.h"
#include "Location.h"
#include "configuration.h"
#include "environment.h"
#include "util.h"
#include "OptimizeSimulation.h"
```

## 8.25 OptimizeSimulation.h File Reference

[Robot](#) simultaion for optimizing the [NeuralNetworkRobot](#).

```
#include <vector>
#include <boost/interprocess/sync/named_upgradable_mutex.hpp>
#include "Color.h"
#include "Location.h"
#include "configuration.h"
#include "environment.h"
#include "util.h"
#include "PhysicalObject.h"
#include "NeuralNetwork.h"
```

### Classes

- class [OptimizeSimulation](#)

*OptimizeSimulation* class, sets up environments and robots.

### 8.25.1 Detailed Description

[Robot](#) simultaion for optimizing the [NeuralNetworkRobot](#).

#### Author

Lucas Kramer

## 8.26 PhysicalObject.cpp File Reference

The representation of any object within the simulation.

```
#include <stdlib.h>
#include <iostream>
#include <math.h>
#include <assert.h>
#include <unistd.h>
#include <stdexcept>
#include "artist.h"
#include "PhysicalObject.h"
#include "environment.h"
#include "configuration.h"
```

#### Macros

- `#define \_USE\_MATH\_DEFINES`

### 8.26.1 Detailed Description

The representation of any object within the simulation.

#### Author

Lucas Kramer Himawan Go, Carl Bahn

### 8.26.2 Macro Definition Documentation

#### 8.26.2.1 `#define \_USE\_MATH\_DEFINES`

## 8.27 PhysicalObject.h File Reference

The representation of any object within the simulation.

```
#include "Color.h"
#include "configuration.h"
#include "Location.h"
```

## Classes

- class [PhysicalObject](#)

*This is a common superclass for all objects.*

## Enumerations

- enum [ObjectType](#) {  
    [ROBOT](#), [TARGET](#), [OBSTACLE](#), [LIGHT](#),  
    [LAST](#) = [LIGHT](#) }

### 8.27.1 Detailed Description

The representation of any object within the simulation.

#### Author

Lucas Kramer Himawan Go, Carl Bahn

### 8.27.2 Enumeration Type Documentation

#### 8.27.2.1 enum [ObjectType](#)

##### Enumerator

***ROBOT***

***TARGET***

***OBSTACLE***

***LIGHT***

***LAST***

## 8.28 Robot.cpp File Reference

The representation of robot within the simulation.

```
#include <stdexcept>
#include <math.h>
#include "artist.h"
#include "environment.h"
#include "Robot.h"
#include "configuration.h"
```

### 8.28.1 Detailed Description

The representation of robot within the simulation.

#### Author

Lucas Kramer Himawan Go, Carl Bahn

## 8.29 Robot.h File Reference

The representation of robot within the simulation.

```
#include "PhysicalObject.h"
#include "Sensor.h"
#include "configuration.h"
```

### Classes

- class [Robot](#)  
*[Robot](#) that moves around the window and bumps into obstacles.*

### Enumerations

- enum [RobotType](#) { [SIMPLE](#), [COMPLEX](#), [NEURAL\\_NETWORK](#) }

#### 8.29.1 Detailed Description

The representation of robot within the simulation.

##### Author

Himawan Go Lucas Kramer

#### 8.29.2 Enumeration Type Documentation

##### 8.29.2.1 enum RobotType

##### Enumerator

***SIMPLE***

***COMPLEX***

***NEURAL\_NETWORK***

## 8.30 Sensor.cpp File Reference

A sensor that detects certain objects in the environment.

```
#include "artist.h"
#include "Sensor.h"
#include "environment.h"
#include "configuration.h"
#include "PhysicalObject.h"
#include <iostream>
#include <math.h>
#include <stdexcept>
```

### Macros

- #define [\\_USE\\_MATH\\_DEFINES](#)

### 8.30.1 Detailed Description

A sensor that detects certain objects in the environment.

#### Author

Himawan Go Carl Bahn Lucas Kramer

### 8.30.2 Macro Definition Documentation

#### 8.30.2.1 `#define _USE_MATH_DEFINES`

## 8.31 Sensor.h File Reference

A sensor that detects certain objects in the environment.

```
#include "Color.h"
#include "Location.h"
#include "configuration.h"
#include "PhysicalObject.h"
```

### Classes

- class [Sensor](#)

### 8.31.1 Detailed Description

A sensor that detects certain objects in the environment.

#### Author

Himawan Go  
Carl Bahn

## 8.32 SimpleRobot.cpp File Reference

The representation of robot within the simulation.

```
#include <GL/glu.h>
#include <GL/glut.h>
#include <stdexcept>
#include "environment.h"
#include "Robot.h"
#include "SimpleRobot.h"
#include "configuration.h"
```

### 8.32.1 Detailed Description

The representation of robot within the simulation.

#### Author

Lucas Kramer

## 8.33 SimpleRobot.h File Reference

The representation of a simple robot.

```
#include "PhysicalObject.h"
#include "Robot.h"
#include "Sensor.h"
#include "configuration.h"
```

### Classes

- class [SimpleRobot](#)  
*A simple robot with uncrossed feedback.*

#### 8.33.1 Detailed Description

The representation of a simple robot.

#### Author

Lucas Kramer

## 8.34 Simulation.cpp File Reference

Implementation for the main application class of the robot simulation.

```
#include <unistd.h>
#include <limits.h>
#include <deque>
#include <mutex>
#include <stdexcept>
#include <sstream>
#include <iostream>
#include <fstream>
#include <dirent.h>
#include <sys/stat.h>
#include "PhysicalObject.h"
#include "Robot.h"
#include "SimpleRobot.h"
#include "ComplexRobot.h"
#include "NeuralNetworkRobot.h"
#include "Target.h"
#include "Obstacle.h"
#include "LightSource.h"
#include "Location.h"
#include "configuration.h"
#include "environment.h"
#include "util.h"
#include "Simulation.h"
```

### Functions

- string [ftos](#) (float f)

### 8.34.1 Detailed Description

Implementation for the main application class of the robot simulation.

#### Author

Lucas Kramer  
Lucas Kramer Xi Zhang, Carl Bahn

### 8.34.2 Function Documentation

#### 8.34.2.1 `string ftos ( float f )`

## 8.35 Simulation.h File Reference

Main application class for the robot simulation.

```
#include "Color.h"  
#include "Location.h"  
#include "configuration.h"  
#include "environment.h"  
#include "util.h"  
#include "BaseGfxApp.h"  
#include "PhysicalObject.h"
```

### Classes

- class [Simulation](#)  
*[Simulation](#) class, sets up the GUI and the drawing environment.*

### 8.35.1 Detailed Description

Main application class for the robot simulation.

#### Author

Lucas Kramer Xi Zhang, Carl Bahn

## 8.36 Target.cpp File Reference

The representation of a target in the simulation.

```
#include <stdlib.h>  
#include <math.h>  
#include "environment.h"  
#include "Target.h"  
#include "configuration.h"
```

### 8.36.1 Detailed Description

The representation of a target in the simulation.



**Author**

Himawan Go Lucas Kramer

## 8.37 Target.h File Reference

The representation of an obstacle in the simulation.

```
#include "PhysicalObject.h"
```

**Classes**

- class [Target](#)  
*Target for the robot to seek.*

### 8.37.1 Detailed Description

The representation of an obstacle in the simulation.

**Author**

Himawan Go Lucas Kramer

## 8.38 util.cpp File Reference

Implmentation of functions for the simulation.

```
#include <unistd.h>
#include <stack>
#include <queue>
#include <mutex>
#include <stdexcept>
#include <sstream>
#include <iostream>
#include <fstream>
#include <GL/glui.h>
#include <assert.h>
#include "Robot.h"
#include "SimpleRobot.h"
#include "ComplexRobot.h"
#include "NeuralNetwork.h"
#include "NeuralNetworkRobot.h"
#include "Target.h"
#include "Obstacle.h"
#include "LightSource.h"
#include "Location.h"
#include "configuration.h"
#include "environment.h"
#include "util.h"
```

**Variables**

- std::mutex [objectsMutex](#)

- `stack< int > robots`
- `stack< int > targets`
- `stack< int > lights`
- `stack< int > obstacles`
- `int colorNum = 0`

### 8.38.1 Detailed Description

Implementation of functions for the simulation.

Author

Lucas Kramer

### 8.38.2 Variable Documentation

8.38.2.1 `int colorNum = 0`

8.38.2.2 `stack<int> lights`

8.38.2.3 `std::mutex objectsMutex`

8.38.2.4 `stack<int> obstacles`

8.38.2.5 `stack<int> robots`

8.38.2.6 `stack<int> targets`

## 8.39 util.h File Reference

Helper functions for the simulation.

```
#include "NeuralNetwork.h"
```

### Namespaces

- `util`  
*util namespace, contains helper functions to add and remove robots*

### Functions

- `void util::reset ()`  
*Removes all objects and resets to the initial state.*
- `void util::display ()`  
*Function to render all the objects. This function is called repeatedly from the simulation, and iterates through the objects and calls their respective display functions.*
- `void util::advance ()`  
*Function to update the positions of all objects. This function is called repeatedly from the simulation, and iterates through the objects and calls their respective updatePosition functions.*
- `Color util::newColor ()`  
*Gets a new, unused color.*
- `int util::getNumRobotsTargets ()`

- Gets the number of robots/target pairs.*

  - int `util::getNumLights ()`

*Gets the number of lights.*
- int `util::getNumObstacles ()`

*Gets the number of obstacles.*
- bool `util::addRobotTarget` (int robotType, int lightSensorConnectionPattern, int robotSensorConnectionPattern, int obstacleSensorConnectionPattern, int targetSensorConnectionPattern, float lightSensorScale, float robotSensorScale, float obstacleSensorScale, float targetSensorScale, int initialSpeed, std::string neuralNetworkFile)

*Adds a robot and paired target to the simulation.*
- bool `util::addRobot` (int robotType, int lightSensorConnectionPattern, int robotSensorConnectionPattern, int obstacleSensorConnectionPattern, int targetSensorConnectionPattern, float lightSensorScale, float robotSensorScale, float obstacleSensorScale, float targetSensorScale, int initialSpeed, std::string neuralNetworkFile)

*Adds a robot to the simulation.*
- bool `util::addNeuralNetworkRobotTarget` (const `NeuralNetwork` &network)

*Adds a neural network robot and a paired target to the simulation.*
- bool `util::addStationaryLightSource ()`

*Adds a light to the simulation.*
- bool `util::addMovingLightSource ()`

*Adds a light to the simulation.*
- bool `util::addObstacle ()`

*Adds a obstacle to the simulation.*
- bool `util::copy` (int id, `Location` loc)

*Copies an object to a new `Location`.*
- bool `util::removeRobotTarget ()`

*Removes a robot from the simulation.*
- bool `util::removeLightSource ()`

*Removes a light from the simulation.*
- bool `util::removeObstacle ()`

*Removes a obstacle from the simulation.*
- void `util::removeAllRobotTarget ()`

*Removes all robots.*
- void `util::removeAllLightSource ()`

*Removes all lights.*
- void `util::removeAllObstacle ()`

*Removes all obstacles.*
- bool `util::open` (std::string filename)

*Loads a simulation from a file.*
- bool `util::save` (std::string filename)

*Saves the current state to a file.*

### 8.39.1 Detailed Description

Helper functions for the simulation.

Author

Lucas Kramer

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