

## CSCI441 Library

v1.1

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# Chapter 1

## Main Page

This library is intended to be used with OpenGL for [CSCI441](#) at the Colorado School of Mines.

When building, the library must be compiled and linked against OpenGL and glm.

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Revision history

v1.1 - 21 Sep 2017

Added OpenGLUtils class to store commonly used helper functions

v1.0.1 - 19 Sep 2017

Added documentation

Added inline definition to functions to prevent duplicate linking errors

v1.0 - 01 Sep 2017

Initial release of all OpenGL 3D objects



## Chapter 2

# Namespace Index

### 2.1 Namespace List

Here is a list of all documented namespaces with brief descriptions:

<a href="#">CSCI441</a>	
<a href="#">CSCI441</a>	Helper Functions for OpenGL . . . . . 9





## Chapter 3

# Class Index

### 3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

<a href="#">CSCI441::OpenGLUtils</a>	
Static class containing OpenGL Utilities . . . . .	<a href="#">21</a>



## Chapter 4

# File Index

### 4.1 File List

Here is a list of all documented files with brief descriptions:

<a href="#">objects.hpp</a>	Helper functions to draw 3D OpenGL 2.1 objects . . . . .	23
<a href="#">OpenGLUtils.hpp</a>	Helper functions to work with OpenGL . . . . .	25
<a href="#">teapot.hpp</a>	Helper functions to draw teapot with OpenGL 2.1 . . . . .	26



## Chapter 5

# Namespace Documentation

### 5.1 CSCI441 Namespace Reference

CSCI441 Helper Functions for OpenGL.

#### Classes

- class [OpenGLUtils](#)  
*static class containing OpenGL Utilities*

#### Functions

- void [drawSolidCone](#) (GLdouble base, GLdouble height, GLint stacks, GLint slices)  
*Draws a solid cone.*
- void [drawWireCone](#) (GLdouble base, GLdouble height, GLint stacks, GLint slices)  
*Draws a wireframe cone.*
- void [drawSolidCube](#) (GLdouble sideLength)  
*Draws a solid cube.*
- void [drawWireCube](#) (GLdouble sideLength)  
*Draws a wireframe cube.*
- void [drawSolidCylinder](#) (GLdouble base, GLdouble top, GLdouble height, GLint stacks, GLint slices)  
*Draws a solid open ended cylinder.*
- void [drawWireCylinder](#) (GLdouble base, GLdouble top, GLdouble height, GLint stacks, GLint slices)  
*Draws a wireframe open ended cylinder.*
- void [drawSolidDisk](#) (GLdouble inner, GLdouble outer, GLint slices, GLint rings)  
*Draws a solid disk.*
- void [drawWireDisk](#) (GLdouble inner, GLdouble outer, GLint slices, GLint rings)  
*Draws a wireframe disk.*
- void [drawSolidPartialDisk](#) (GLdouble inner, GLdouble outer, GLint slices, GLint rings, GLdouble start, GLdouble sweep)  
*Draws part of a solid disk.*
- void [drawWirePartialDisk](#) (GLdouble inner, GLdouble outer, GLint slices, GLint rings, GLdouble start, GLdouble sweep)  
*Draws part of a wireframe disk.*

- void [drawSolidSphere](#) (GLdouble radius, GLint stacks, GLint slices)  
*Draws a solid sphere.*
- void [drawWireSphere](#) (GLdouble radius, GLint stacks, GLint slices)  
*Draws a wireframe sphere.*
- void [drawSolidTeapot](#) (GLdouble size)  
*Draws a solid teapot.*
- void [drawWireTeapot](#) (GLdouble size)  
*Draws a wireframe teapot.*
- void [drawSolidTorus](#) (GLdouble innerRadius, GLdouble outerRadius, GLint sides, GLint rings)  
*Draws a solid torus.*
- void [drawWireTorus](#) (GLdouble innerRadius, GLdouble outerRadius, GLint sides, GLint rings)  
*Draws a wireframe torus.*
- void [pushMatrix](#) (glm::mat4 mtx)  
*Multiplies current matrix by given matrix.*
- void [popMatrix](#) (glm::mat4 mtx)  
*Multiplies current matrix by inverse of given matrix.*

### 5.1.1 Detailed Description

[CSCI441](#) Helper Functions for OpenGL.

### 5.1.2 Function Documentation

#### 5.1.2.1 drawSolidCone()

```
void CSCI441::drawSolidCone (
    GLdouble base,
    GLdouble height,
    GLint stacks,
    GLint slices ) [inline]
```

Draws a solid cone.

Cone is oriented along the y-axis with the origin along the base of the cone

#### Parameters

<i>GLdouble</i>	base - radius of the base of the cone
<i>GLdouble</i>	height - height of the cone from the base to the tip
<i>GLint</i>	stacks - resolution of the number of steps rotated around the central axis of the cone
<i>GLint</i>	slices - resolution of the number of steps to take along the height

#### Precondition

base must be greater than zero  
height must be greater than zero

stacks must be greater than zero  
slices must be greater than two

### 5.1.2.2 drawSolidCube()

```
void CSCI441::drawSolidCube (
    GLdouble sideLength ) [inline]
```

Draws a solid cube.

The origin is at the cube's center of mass. Cube is oriented with our XYZ axes

#### Parameters

<i>GLdouble</i>	sideLength - length of the edge of the cube
-----------------	---

#### Precondition

sideLength must be greater than zero

### 5.1.2.3 drawSolidCylinder()

```
void CSCI441::drawSolidCylinder (
    GLdouble base,
    GLdouble top,
    GLdouble height,
    GLint stacks,
    GLint slices ) [inline]
```

Draws a solid open ended cylinder.

Cylinder is oriented along the y-axis with the origin along the base

#### Parameters

<i>GLdouble</i>	base - radius of the base of the cylinder
<i>GLdouble</i>	top - radius of the top of the cylinder
<i>GLdouble</i>	height - height of the cylinder from the base to the top
<i>GLint</i>	stacks - resolution of the number of steps rotated around the central axis of the cylinder
<i>GLint</i>	slices - resolution of the number of steps to take along the height

#### Precondition

either: (1) base is greater than zero and top is greater than or equal to zero or (2) base is greater than or equal to zero and top is greater than zero

height must be greater than zero  
stacks must be greater than zero  
slices must be greater than two

#### 5.1.2.4 drawSolidDisk()

```
void CSCI441::drawSolidDisk (
    GLdouble inner,
    GLdouble outer,
    GLint slices,
    GLint rings ) [inline]
```

Draws a solid disk.

Disk is drawn in the XY plane with the origin at its center

##### Parameters

<i>GLdouble</i>	inner - equivalent to the width of the disk
<i>GLdouble</i>	outer - radius from the center of the disk to the center of the ring
<i>GLint</i>	slices - resolution of the number of steps rotated along the disk
<i>GLint</i>	rings - resolution of the number of steps to take along the disk width

##### Precondition

inner is greater than zero  
outer is greater than zero  
outer is greater than inner  
slices is greater than two  
rings is greater than zero

#### 5.1.2.5 drawSolidPartialDisk()

```
void CSCI441::drawSolidPartialDisk (
    GLdouble inner,
    GLdouble outer,
    GLint slices,
    GLint rings,
    GLdouble start,
    GLdouble sweep ) [inline]
```

Draws part of a solid disk.

Disk is drawn in the XY plane with the origin at its center



**Parameters**

<i>GLdouble</i>	inner - equivalent to the width of the disk
<i>GLdouble</i>	outer - radius from the center of the disk to the center of the ring
<i>GLint</i>	stacks - resolution of the number of steps rotated along the disk
<i>GLint</i>	rings - resolution of the number of steps to take along the disk width
<i>GLdouble</i>	start - angle in degrees to start the disk at
<i>GLdouble</i>	sweep - distance in degrees to rotate through

**Precondition**

inner is greater than zero  
 outer is greater than zero  
 outer is greater than inner  
 slices is greater than two  
 rings is greater than zero  
 start is between [0, 360]  
 sweep is between [0, 360]

**5.1.2.6 drawSolidSphere()**

```
void CSCI441::drawSolidSphere (
    GLdouble radius,
    GLint stacks,
    GLint slices ) [inline]
```

Draws a solid sphere.

Origin is at the center of the sphere

**Parameters**

<i>GLdouble</i>	radius - radius of the sphere
<i>GLint</i>	stacks - resolution of the number of steps to take along theta (rotate around Y-axis)
<i>GLint</i>	slices - resolution of the number of steps to take along phi (rotate around X- or Z-axis)

**Precondition**

radius must be greater than 0  
 stacks must be greater than 2  
 slices must be greater than 2

**5.1.2.7 drawSolidTeapot()**

```
void CSCI441::drawSolidTeapot (
    GLdouble size ) [inline]
```

Draws a solid teapot.

Oriented with spout and handle running along X-axis, cap and bottom along Y-axis. Origin is at the center of the teapot

#### Parameters

<i>GLdouble</i>	size - scale of the teapot
-----------------	----------------------------

#### Precondition

size must be greater than zero

#### 5.1.2.8 drawSolidTorus()

```
void CSCI441::drawSolidTorus (
    GLdouble innerRadius,
    GLdouble outerRadius,
    GLint sides,
    GLint rings ) [inline]
```

Draws a solid torus.

Torus is oriented in the XY-plane with the origin at its center

#### Parameters

<i>innerRadius</i>	- equivalent to the width of the torus ring
<i>outerRadius</i>	- radius from the center of the torus to the center of the ring
<i>sides</i>	- resolution of steps to take around the band of the ring
<i>rings</i>	- resolution of steps to take around the torus

#### Precondition

innerRadius must be greater than zero  
 outerRadius must be greater than zero  
 sides must be greater than two  
 rings must be greater than two

#### 5.1.2.9 drawWireCone()

```
void CSCI441::drawWireCone (
    GLdouble base,
    GLdouble height,
    GLint stacks,
    GLint slices ) [inline]
```

Draws a wireframe cone.

Cone is oriented along the y-axis with the origin along the base of the cone

**Parameters**

<i>GLdouble</i>	base - radius of the base of the cone
<i>GLdouble</i>	height - height of the cone from the base to the tip
<i>GLint</i>	stacks - resolution of the number of steps rotated around the central axis of the cone
<i>GLint</i>	slices - resolution of the number of steps to take along the height

**Precondition**

base must be greater than zero  
 height must be greater than zero  
 stacks must be greater than zero  
 slices must be greater than two

**5.1.2.10 drawWireCube()**

```
void CSCI441::drawWireCube (
    GLdouble sideLength ) [inline]
```

Draws a wireframe cube.

The origin is at the cube's center of mass. Cube is oriented with our XYZ axes

**Parameters**

<i>GLdouble</i>	sideLength - length of the edge of the cube
-----------------	---

**Precondition**

sideLength must be greater than zero

**5.1.2.11 drawWireCylinder()**

```
void CSCI441::drawWireCylinder (
    GLdouble base,
    GLdouble top,
    GLdouble height,
    GLint stacks,
    GLint slices ) [inline]
```

Draws a wireframe open ended cylinder.

Cylinder is oriented along the y-axis with the origin along the base

**Parameters**

<i>GLdouble</i>	base - radius of the base of the cylinder
<i>GLdouble</i>	top - radius of the top of the cylinder
<i>GLdouble</i>	height - height of the cylinder from the base to the top
<i>GLint</i>	stacks - resolution of the number of steps rotated around the central axis of the cylinder
<i>GLint</i>	slices - resolution of the number of steps to take along the height

**Precondition**

either: (1) base is greater than zero and top is greater than or equal to zero or (2) base is greater than or equal to zero and top is greater than zero  
height must be greater than zero  
stacks must be greater than zero  
slices must be greater than two

**5.1.2.12 drawWireDisk()**

```
void CSCI441::drawWireDisk (
    GLdouble inner,
    GLdouble outer,
    GLint slices,
    GLint rings ) [inline]
```

Draws a wireframe disk.

Disk is drawn in the XY plane with the origin at its center

**Parameters**

<i>GLdouble</i>	inner - equivalent to the width of the disk
<i>GLdouble</i>	outer - radius from the center of the disk to the center of the ring
<i>GLint</i>	slices - resolution of the number of steps rotated along the disk
<i>GLint</i>	rings - resolution of the number of steps to take along the disk width

**Precondition**

inner is greater than zero  
outer is greater than zero  
outer is greater than inner  
slices is greater than two  
rings is greater than zero

**5.1.2.13 drawWirePartialDisk()**

```
void CSCI441::drawWirePartialDisk (
    GLdouble inner,
```

```

    GLdouble outer,
    GLint slices,
    GLint rings,
    GLdouble start,
    GLdouble sweep ) [inline]

```

Draws part of a wireframe disk.

Disk is drawn in the XY plane with the origin at its center

#### Parameters

<i>GLdouble</i>	inner - equivalent to the width of the disk
<i>GLdouble</i>	outer - radius from the center of the disk to the center of the ring
<i>GLint</i>	stacks - resolution of the number of steps rotated along the disk
<i>GLint</i>	rings - resolution of the number of steps to take along the disk width
<i>GLdouble</i>	start - angle in degrees to start the disk at
<i>GLdouble</i>	sweep - distance in degrees to rotate through

#### Precondition

inner is greater than zero  
 outer is greater than zero  
 outer is greater than inner  
 slices is greater than two  
 rings is greater than zero  
 start is between [0, 360]  
 sweep is between [0, 360]

#### 5.1.2.14 drawWireSphere()

```

void CSCI441::drawWireSphere (
    GLdouble radius,
    GLint stacks,
    GLint slices ) [inline]

```

Draws a wireframe sphere.

Origin is at the center of the sphere

#### Parameters

<i>GLdouble</i>	radius - radius of the sphere
<i>GLint</i>	stacks - resolution of the number of steps to take along theta (rotate around Y-axis)
<i>GLint</i>	slices - resolution of the number of steps to take along phi (rotate around X- or Z-axis)

**Precondition**

radius must be greater than 0  
stacks must be greater than 2  
slices must be greater than 2

**5.1.2.15 drawWireTeapot()**

```
void CSCI441::drawWireTeapot (
    GLdouble size ) [inline]
```

Draws a wireframe teapot.

Oriented with spout and handle running along X-axis, cap and bottom along Y-axis. Origin is at the center of the teapot

**Parameters**

<i>GLdouble</i>	size - scale of the teapot
-----------------	----------------------------

**Precondition**

size must be greater than zero

**5.1.2.16 drawWireTorus()**

```
void CSCI441::drawWireTorus (
    GLdouble innerRadius,
    GLdouble outerRadius,
    GLint sides,
    GLint rings ) [inline]
```

Draws a wireframe torus.

Torus is oriented in the XY-plane with the origin at its center

**Parameters**

<i>innerRadius</i>	- equivalent to the width of the torus ring
<i>outerRadius</i>	- radius from the center of the torus to the center of the ring
<i>sides</i>	- resolution of steps to take around the band of the ring
<i>rings</i>	- resolution of steps to take around the torus

**Precondition**

innerRadius must be greater than zero  
outerRadius must be greater than zero  
sides must be greater than two  
rings must be greater than two

**5.1.2.17 popMatrix()**

```
void CSCI441::popMatrix (
    glm::mat4 mtx ) [inline]
```

Multiplies current matrix by inverse of given matrix.

**Parameters**

<i>glm::mat4</i>	mtx - matrix to multiply the current matrix by the inverse of
------------------	---

**5.1.2.18 pushMatrix()**

```
void CSCI441::pushMatrix (
    glm::mat4 mtx ) [inline]
```

Multiplies current matrix by given matrix.

**Parameters**

<i>glm::mat4</i>	mtx - matrix to multiply the current matrix by
------------------	--



## Chapter 6

# Class Documentation

### 6.1 CSCI441::OpenGLUtils Class Reference

static class containing OpenGL Utilities

```
#include <OpenGLUtils.hpp>
```

#### Static Public Member Functions

- static void [printOpenGLInfo](#) ()  
*Prints information about our OpenGL context.*

#### 6.1.1 Detailed Description

static class containing OpenGL Utilities

#### 6.1.2 Member Function Documentation

##### 6.1.2.1 [printOpenGLInfo\(\)](#)

```
void CSCI441::OpenGLUtils::printOpenGLInfo ( ) [inline], [static]
```

Prints information about our OpenGL context.

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

- [OpenGLUtils.hpp](#)



# Chapter 7

## File Documentation

### 7.1 objects.hpp File Reference

Helper functions to draw 3D OpenGL 2.1 objects.

```
#include <GL/gl.h>
#include <assert.h>
#include <math.h>
#include <CSCI441/teapot.hpp>
```

#### Namespaces

- [CSCI441](#)  
*CSCI441 Helper Functions for OpenGL.*

#### Functions

- void [CSCI441::drawSolidCone](#) (GLdouble base, GLdouble height, GLint stacks, GLint slices)  
*Draws a solid cone.*
- void [CSCI441::drawWireCone](#) (GLdouble base, GLdouble height, GLint stacks, GLint slices)  
*Draws a wireframe cone.*
- void [CSCI441::drawSolidCube](#) (GLdouble sideLength)  
*Draws a solid cube.*
- void [CSCI441::drawWireCube](#) (GLdouble sideLength)  
*Draws a wireframe cube.*
- void [CSCI441::drawSolidCylinder](#) (GLdouble base, GLdouble top, GLdouble height, GLint stacks, GLint slices)  
*Draws a solid open ended cylinder.*
- void [CSCI441::drawWireCylinder](#) (GLdouble base, GLdouble top, GLdouble height, GLint stacks, GLint slices)  
*Draws a wireframe open ended cylinder.*
- void [CSCI441::drawSolidDisk](#) (GLdouble inner, GLdouble outer, GLint slices, GLint rings)  
*Draws a solid disk.*
- void [CSCI441::drawWireDisk](#) (GLdouble inner, GLdouble outer, GLint slices, GLint rings)  
*Draws a wireframe disk.*

- void [CSCI441::drawSolidPartialDisk](#) (GLdouble inner, GLdouble outer, GLint slices, GLint rings, GLdouble start, GLdouble sweep)  
*Draws part of a solid disk.*
- void [CSCI441::drawWirePartialDisk](#) (GLdouble inner, GLdouble outer, GLint slices, GLint rings, GLdouble start, GLdouble sweep)  
*Draws part of a wireframe disk.*
- void [CSCI441::drawSolidSphere](#) (GLdouble radius, GLint stacks, GLint slices)  
*Draws a solid sphere.*
- void [CSCI441::drawWireSphere](#) (GLdouble radius, GLint stacks, GLint slices)  
*Draws a wireframe sphere.*
- void [CSCI441::drawSolidTeapot](#) (GLdouble size)  
*Draws a solid teapot.*
- void [CSCI441::drawWireTeapot](#) (GLdouble size)  
*Draws a wireframe teapot.*
- void [CSCI441::drawSolidTorus](#) (GLdouble innerRadius, GLdouble outerRadius, GLint sides, GLint rings)  
*Draws a solid torus.*
- void [CSCI441::drawWireTorus](#) (GLdouble innerRadius, GLdouble outerRadius, GLint sides, GLint rings)  
*Draws a wireframe torus.*

### 7.1.1 Detailed Description

Helper functions to draw 3D OpenGL 2.1 objects.

#### Author

Dr. Jeffrey Paone

#### Date

Last Edit: 19 Sep 2017

#### Version

1.0.1

#### Copyright

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These functions draw solid (or wireframe) 3D closed OpenGL objects. All objects are constructed using triangles that have normals and texture coordinates properly set.

#### Warning

NOTE: This header file will only work with OpenGL 2.1

## 7.2 OpenGLUtils.hpp File Reference

Helper functions to work with OpenGL.

```
#include <GL/gl.h>
#include <glm/glm.hpp>
#include <stdio.h>
```

### Classes

- class [CSCI441::OpenGLUtils](#)  
*static class containing OpenGL Utilities*

### Namespaces

- [CSCI441](#)  
*CSCI441 Helper Functions for OpenGL.*

### Functions

- void [CSCI441::pushMatrix](#) (glm::mat4 mtx)  
*Multiplies current matrix by given matrix.*
- void [CSCI441::popMatrix](#) (glm::mat4 mtx)  
*Multiplies current matrix by inverse of given matrix.*

### 7.2.1 Detailed Description

Helper functions to work with OpenGL.

#### Author

Dr. Jeffrey Paone

#### Date

Last Edit: 21 Sep 2017

#### Version

1.1

#### Copyright

MIT License Copyright (c) 2017 Dr. Jeffrey Paone

These functions

#### Warning

NOTE: This header file will depends upon glm

## 7.3 teapot.hpp File Reference

Helper functions to draw teapot with OpenGL 2.1.

```
#include <GL/gl.h>
```

### 7.3.1 Detailed Description

Helper functions to draw teapot with OpenGL 2.1.

#### Date

Last Edit: 19 Sep 2017

#### Warning

NOTE: This header file will only work with OpenGL 2.1

Modified by Dr. Jeffrey Paone to work in Colorado School of Mines [CSCI441](#) course context.

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