

# 深圳大学实验报告

实验课程名称: 几何建模与处理

实验项目名称: 实验一: 配置环境

学院: 建筑与城市规划学院 专业: 人工智能

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实验时间: 2022.9.30-2022.10.2

实验报告提交时间: 2022.10.2

## 一. 实验目的

课程所需环境配置，并且了解Eigen和libigl的一些基础用法

## 二. 实验内容

根据<https://github.com/alecjacobson/geometry-processing-introduction>根据链接内的说明自行配置好环境，编译代码，跑通程序。并将 src/edges.cpp 与 src/euler\_characteristic.cpp 两个文件的内容补全。 libigl库中已经实现了这两个函数，请在自己实现了代码后，使用libigl的函数验证结果。

## 三、实验步骤

实验环境说明:  
MacbookAir 2020 (M1)

```
Apple clang version 14.0.0 (clang-1400.0.29.102)
Target: arm64-apple-darwin21.6.0
Thread model: posix
InstalledDir: /Library/Developer/CommandLineTools/usr/
bin
cmake version 3.24.2
GNU Make 3.81
```

## 下载源码

```
[steven@stevendeMacBook-Air GP % git clone --recursive http://github.com/alecjacobson/geometry-processing-introduction.git
Cloning into 'geometry-processing-introduction'...
warning: redirecting to https://github.com/alecjacobson/geometry-processing-introduction.git/
remote: Enumerating objects: 201, done.
remote: Counting objects: 100% (77/77), done.
remote: Compressing objects: 100% (60/60), done.
remote: Total 201 (delta 35), reused 40 (delta 13), pack-reused 124
Receiving objects: 100% (201/201), 1.14 MiB | 3.05 MiB/s, done.
Resolving deltas: 100% (95/95), done.
steven@stevendeMacBook-Air GP % ]
```

## 文件结构查看

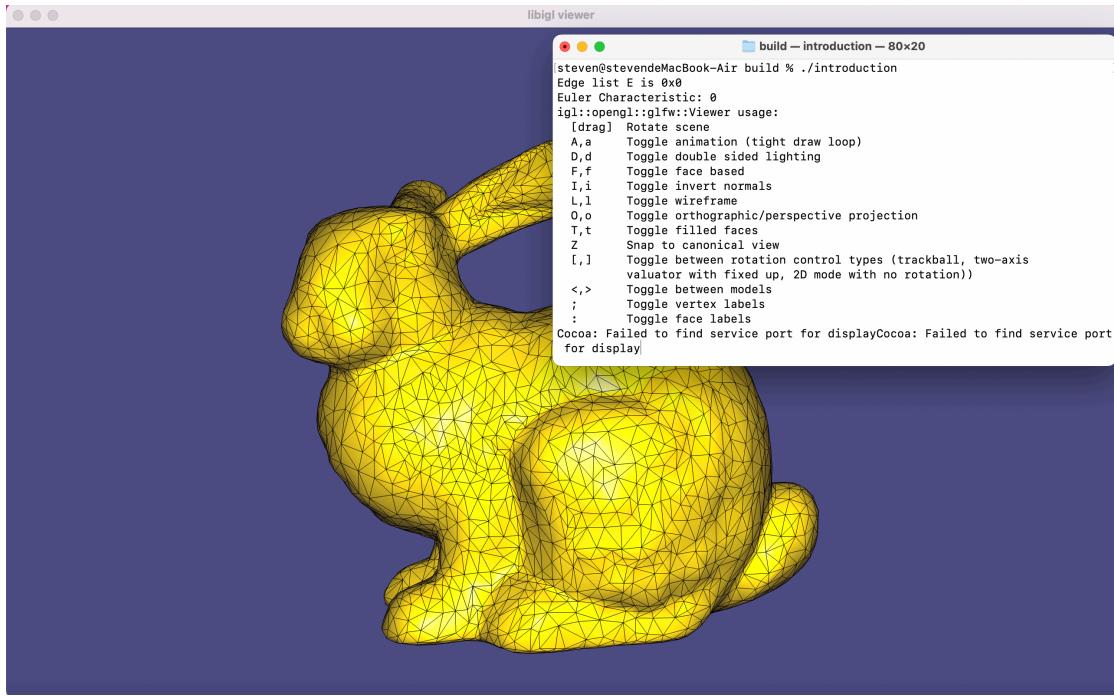
```
[steven@stevendeMacBook-Air GP % tree
.
└── geometry-processing-introduction
    ├── CMakeLists.txt
    ├── LICENSE
    ├── README.md
    ├── cmake
    │   └── libigl.cmake
    ├── data
    │   ├── beetle.off
    │   ├── bunny.off
    │   └── tiny-torus.obj
    ├── images
    │   ├── bunny-screenshot.jpg
    │   ├── half-edges.jpg
    │   ├── half-edges.pdf
    │   ├── right-hand-rule.jpg
    │   └── right-hand-rule.pdf
    ├── include
    │   ├── edges.h
    │   └── euler_characteristic.h
    ├── main.cpp
    ├── src
    │   ├── edges.cpp
    │   └── euler_characteristic.cpp
    └── tex
        ├── 2ad9d098b937e46f9f58968551adac57.svg
        ├── 3e18a4a28fdee1744e5e3f79d13b9ff6.svg
        ├── 4716870f3f422e3e30698c2aa13917a6.svg
        ├── 4bdc8d9bcfb35e1c9fb51fc69687dfc.svg
        ├── 5f44d895386d2bb0121dc78eb7e09862.svg
        ├── 6f1489510ace7328313aebec5fc3c626.svg
        ├── 87181ad2b235919e0785dee664166921.svg
        ├── 92991de2a74552da6902a11d444ace8a.svg
        ├── a9a3a4a202d80326bda413b5562d5cd1.svg
        ├── b8bc815b5e9d5177af01fd4d3d3c2f10.svg
        ├── d03c1e146df015e061405cc425738d83.svg
        └── e1cba67bdff5655799960c665b6aa02b.svg

7 directories, 29 files
steven@stevendeMacBook-Air GP % ]
```

## 编译

```
build -- zsh -- 80x41
[steven@stevendeMacBook-Air geometry-processing-introduction % ls
CMakeLists.txt README.md data include src
LICENSE cmake images main.cpp tex
[steven@stevendeMacBook-Air geometry-processing-introduction % mkdir build
[steven@stevendeMacBook-Air geometry-processing-introduction % cd build
[steven@stevendeMacBook-Air build % cmake ..
-- The C compiler identification is AppleClang 14.0.0.14000029
-- The CXX compiler identification is AppleClang 14.0.0.14000029
-- Detecting C compiler ABI info
-- Detecting C compiler ABI info - done
-- Check for working C compiler: /Library/Developer/CommandLineTools/usr/bin/cc
-- skipped
-- Detecting C compile features
-- Detecting C compile features - done
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler ABI info - done
-- Check for working CXX compiler: /Library/Developer/CommandLineTools/usr/bin/c++
-- skipped
-- Detecting CXX compile features
-- Detecting CXX compile features - done
-- Finding/Downloading libigl...
-- Creating target: igl::core (igl_core)
-- Third-party: creating target 'Eigen3::Eigen'
-- Performing Test CMAKE_HAVE_LIBC_PTHREAD
-- Performing Test CMAKE_HAVE_LIBC_PTHREAD - Success
-- Found Threads: TRUE
-- Creating target: igl::glfw (igl_glfw)
-- Third-party: creating target 'glfw::glfw'
-- Using Cocoa for window creation
-- Forcing include of libigl module: opengl
-- Creating target: igl::opengl (igl_opengl)
-- Third-party: creating target 'glad::glad'
-- Found OpenGL: /Library/Developer/CommandLineTools/SDKs/MacOSX12.3.sdk/System/
Library/Frameworks/OpenGL.framework found components: OpenGL
-- Configuring done
-- Generating done
-- Build files have been written to: /Users/steven/Homework/GP/geometry-processing-introduction/build
[steven@stevendeMacBook-Air build % make
[ 4%] Building C object _deps/glad-build/CMakeFiles/glad.dir/src/glad.c.o
[ 8%] Linking C static library ../../lib/libglad.a
[ 0%
[ 65%] Building C object _deps/glfw-build/src/CMakeFiles/glfw.dir/nsgl_context.m
[ 0%
[ 69%] Building C object _deps/glfw-build/src/CMakeFiles/glfw.dir/egl_context.c
[ 0%
[ 73%] Building C object _deps/glfw-build/src/CMakeFiles/glfw.dir/osmesa_context
.c.o
[ 78%] Linking C static library ../../lib/libglfw3.a
[ 78%] Built target glfw
[ 82%] Building CXX object CMakeFiles/core.dir/src/edges.cpp.o
[ 86%] Building CXX object CMakeFiles/core.dir/src/euler_characteristic.cpp.o
[ 91%] Linking CXX static library libcore.a
[ 91%] Built target core
[ 95%] Building CXX object CMakeFiles/introduction.dir/main.cpp.o
[100%] Linking CXX executable introduction
[100%] Built target introduction
steven@stevendeMacBook-Air build % |
```

## 测试introduction



能够成功打开introduction，证明环境已经配置好。

紧接着将 src/edges.cpp 与 src/euler\_characteristic.cpp 两个文件的内容补全

edges.cpp

```
// ADD YOUR CODE HERE
int row = F.size()/2;
E.resize(row,2);
int i = 0;
for(int j=0; j<F.outerSize(); j++) // 按行存储返回行数
{
    for(Eigen::MatrixXi::InnerIterator it (F,j) ; it ; ++it)
    {
        if(it.row()<it.col()) //只需要上三角
        {
            E(i,0) = it.row();
            E(i,1) = it.col();
            i++;
        }
    }
}
return E;
```

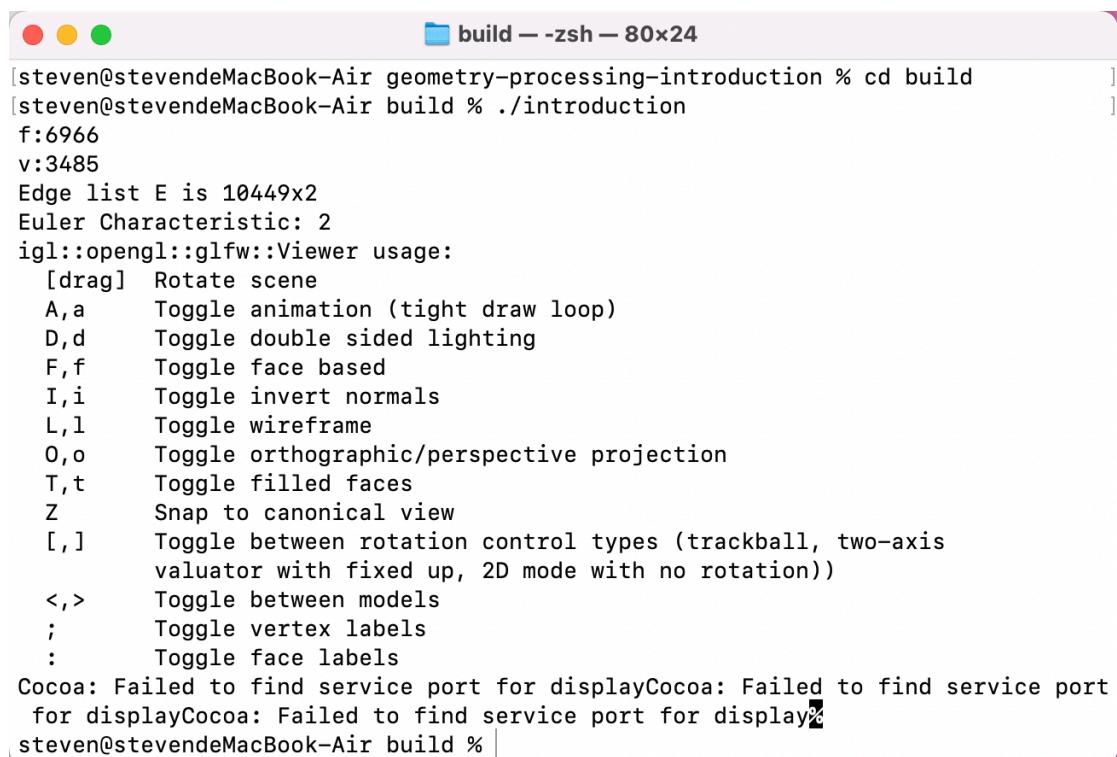
## Euler\_characteristic.cpp

```
// ADD YOUR CODE HERE
int f = F.rows();
int v = F.maxCoeff() + 1;

std::cout << "f:" << f << std::endl;
std::cout << "v:" << v << std::endl;

Eigen::MatrixXi E = edges(F);
int e = E.rows();
Chi = v - e + f;
return Chi;
```

## 验证函数结果



```
[steven@stevendeMacBook-Air geometry-processing-introduction % cd build
[steven@stevendeMacBook-Air build % ./introduction
f:6966
v:3485
Edge list E is 10449x2
Euler Characteristic: 2
igl::opengl::glfw::Viewer usage:
[drag] Rotate scene
A,a Toggle animation (tight draw loop)
D,d Toggle double sided lighting
F,f Toggle face based
I,i Toggle invert normals
L,l Toggle wireframe
O,o Toggle orthographic/perspective projection
T,t Toggle filled faces
Z Snap to canonical view
[,] Toggle between rotation control types (trackball, two-axis
valuator with fixed up, 2D mode with no rotation))
<,> Toggle between models
; Toggle vertex labels
: Toggle face labels
Cocoa: Failed to find service port for displayCocoa: Failed to find service port
for displayCocoa: Failed to find service port for display%]
steven@stevendeMacBook-Air build % ]]
```

## 四、总结分析

因为bunny.off是一个封闭曲面，满足欧拉多面体公式，所以得2

## 五、代码

```
"edges.cpp" 24L, 475B

#include "edges.h"
#include <iostream>

Eigen::MatrixXi edges(const Eigen::MatrixXi &F)
{
    Eigen::MatrixXi E;
    // ADD YOUR CODE HERE
    int row = F.size()/2;
    E.resize(row,2);
    int i = 0;
    for(int j=0; j<F.outerSize(); j++) // 按行存储返回行数
    {
        for(Eigen::MatrixXi::InnerIterator it (F,j) ;
it ; ++it)
        {
            if(it.row()<it.col()) //只需要上三角
            {
                E(i,0) = it.row();
                E(i,1) = it.col();
                i++;
            }
        }
    }
    return E;
}
```

"euler\_characteristic.cpp" 19L, 368B

```
#include "euler_characteristic.h"
#include "edges.h"
#include <iostream>

int euler_characteristic(const Eigen::MatrixXi &F)
{
    int Chi = 0;
    // ADD YOUR CODE HERE
    int f = F.rows();
    int v = F.maxCoeff()+1;

    std::cout<<"f:"<<f<<std::endl;
```

```
std::cout<<"v:"<<v<<std::endl;

Eigen::MatrixXi E = edges(F);
int e = E.rows();
Chi = v - e + f;
return Chi;
}
```

指导教师批阅意见:

成绩评定:

指导教师签字:

2022 年   月   日

备注:

注: 1、报告内的项目或内容设置, 可根据实际情况加以调整和补充。  
2、教师批改学生实验报告时间应在学生提交实验报告时间后10日内。