cs805 Assignment 2

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Abstract

This assignment is written in literate programming style, generated by noweb, rendered by LaTex, and compiled by clang++ with c++ 11 standard.
assignment paper is at latex/as2.pdf
c++ programs are at src/*
binary executable for OS X 10.8 is inside bin

1 function implementation

```
<<src/util.cpp>>=
#include "util.h"
#include <math.h>

ImagePanel foreach_pixel_exec(ImagePanel img, std::function<int(Vector)> ray_func)
  int i = 0;
  for (auto& pixel: img) { //foreach pixel in empty_img
    pixel = ray_func({1.0,1.0,1.0});
    i++;
  }
  return img;
}

//initialize img panel to all 0s
ImagePanel init_img_panel(ImagePanel img) {
  for (auto& pixel: img) { //foreach pixel in empty_img
    pixel = 0;
  }
  return img;
}

//translate ray equation to an 0~255 shading value
int ray_tracing(Vector ray) {
  Intersection p = ray_objects_intersection(ray);
  return shading(p);
}

//calculate the ray object intersection point
Intersection ray_objects_intersection(Vector ray) {
  return {1,2,3,
          4,5,6,
          1.0};
}

//calculate shading value from 0~255 accordingly to intersection info
```

```
int shading(Intersection p) {
  return 1;
}

//==========helpers==========

//Translate 2D array index of row column to 1D index.
//Notice that x, or column index, starts with 0.
//If return value is -1 then there is an out-of-bounce error.
int to_1d(int x, int y) {
  if (x >= IMG_X || x < 0)
    return -1;
  if (y >= IMG_Y || y < 0)
    return -1;
  return (IMG_Y*y + x);
}

//Translate 1d array index to 2d
std::array<int, 2> to_2d(int x) {
  if (x>=(IMG_X*IMG_Y) || x < 0) {
    return {-1,-1};
  }
  int y_ = x / IMG_X;
  int x_ = x % IMG_X;
  return {x_, y_};
}

//prints the img panel
void print_img_panel(ImagePanel img) {
  std::cout<<std::endl;
  for (auto& pixel : img) {
    std::cout<<pixel<<", ";
  }
  std::cout<<std::endl<<"Array size: "<<img.size()<<std::endl;
}

@
```

2 header

Here is an header file for typedefs and function declarations.

```
<<src/util.h>>=
#ifndef UTIL_H
#define UTIL_H

//define global vars
#define IMG_X 512
#define IMG_Y 512
#define IMG_LEN ( IMG_X * IMG_Y )

#include <array>
#include <functional>
#include <iostream>
typedef std::array<int, IMG_LEN> ImagePanel;
typedef std::array<float, 3> Point;
typedef std::array<float, 3> Vector;
typedef struct {
Point intersection; /* intersection point */
Vector normal; /* intersection polygon normal vector */
float kd; /* diffuse reflection coefficient of the surface */
} Intersection;

ImagePanel foreach_pixel_exec(ImagePanel, std::function<int(Vector)>);
ImagePanel init_img_panel(ImagePanel);
int ray_tracing(Vector);
Intersection ray_objects_intersection(Vector);
int shading(Intersection);

//helpers
int to_1d(int, int);
std::array<int, 2> to_2d(int);
void print_img_panel(ImagePanel);
#endif
@
```

3 main funciton

```
<<src/main.cpp>>=
#include <iostream>
#include <typeinfo>//debugging only
#include "util.h"

int main () {
  ImagePanel resultImg;
  resultImg = init_img_panel(resultImg);
  //resultImg = foreach_pixel_exec(resultImg, [](Vector x){return ray_tracing(x);}
  resultImg = foreach_pixel_exec(resultImg, ray_tracing);
  print_img_panel(resultImg);

  //unit tests
  std::cout<<to_1d(0, 1)<<std::endl;
  std::cout<<to_2d(512)[0]<<std::endl;
  std::cout<<to_2d(512)[1]<<std::endl;
  std::cout<<to_1d(1, 1)<<std::endl;
  std::cout<<to_2d(513)[0]<<std::endl;
  std::cout<<to_2d(513)[1]<<std::endl;
  std::cout<<to_1d(511, 1)<<std::endl;
  std::cout<<to_2d(1023)[0]<<std::endl;
  std::cout<<to_2d(1023)[1]<<std::endl;
  std::cout<<to_1d(512, 1)<<std::endl;
  std::cout<<to_2d(512*512)[0]<<std::endl;
  std::cout<<to_2d(512*512)[1]<<std::endl;
  return 0;
}
@
```

4 compile script

Furthermore, this is the command to link these files. Notice that I am using -std=c++11 flag to enable c++ 11 features. The output binary executable is bin/run

```
<<compile.sh>>=
clang++ -std=c++11 -stdlib=libc++ -o bin/run src/main.cpp src/util.cpp
@
```