CSC418H1F/CSC2504 Computer Graphics, Spring 2010

Assignment 4 (programming component) (10% of course grade)

Due 11:59pm on Friday 2 April 2010.
(please talk with instructor about late policy)

[50 marks in total]

For the final project, you will implement a more advanced ray-tracer. Since this programming assignment is somewhat open-ended, you have a considerable say in what you implement and what the final result will look like. Be careful to manage your time, implement one element at a time to simplify debugging, and focus on the most important elements and those you understand clearly. If your solution is well organized before you begin to code and debug it, you should be able to complete it within a reasonable number of hours. There is no starter code for this assignment, but you are encouraged to reuse code from the previous assignment. If your programs for previous assignment did not work, please let the course instructor or TA know.

Extend the basic ray tracer that you wrote for Assignment 3 to include the following:

- [10 marks] Recursive ray tracing to show secondary reflection with specularities (so you can see one object reflected in another).
- [5 marks] Shadows.
- A subset of the following (*i.e.*, as many as you need to get to 35 marks):
  1. [20 marks] Handling a non-trivial compound object, containing quadric surfaces (e.g., a cone or cylinder). Spheres, ellipses, planes and patches thereof don't count.
  2. [25 marks] Handling arbitrary surface mesh geometry.
  3. [25 marks] Handling piecewise bicubic surfaces.
  4. [10 marks] Anti-aliasing.
  5. [10 marks] Glossy reflections or other reflectance functions.
  6. [10 marks] Depth of field.
  7. [15 marks] Extended light sources, in order to to produce soft shadows.
  8. [15 marks] Texture-mapping (an interesting procedural texture is also acceptable).
  9. [5 marks] Adding environment mapping to item 7.
  10. [15 marks] Motion Blur.
  11. [15 marks] Refraction (*e.g.* glass spheres).
- *Bonus marks:* Up to 10 additional marks will be awarded for exceptional solutions. This may include extra features from the above list or some other feature altogether. In the latter case, marks will depend on our assessment of the effort involved (up to 10). Bonus marks may also be given for exceptionally creative or artistic work, on a case by case basis.

Notes:

- You cannot substitute secondary reflections and/or shadows with items 1-11 (or other bonus items). If you do not implement them, your maximum marks will be 35.
- You cannot get more than 60 marks for the assignment (but don't let that stop you–time permitting!).

- A small fraction of the marks (5 points) will be given for a brief report on what you did. See below for more information.
- You are encouraged to be creative in building an interesting and/or attractive scene. You are allowed to use geometry that is obtained from the web (*i.e.* you can download surface meshes), but the code to render that geometry must be written by yourself.
- If you do use someone else's geometry, you must acknowledge it.
- You are permitted to share code that solved Assignment 3 with someone whose code did not fully work. If you share code, all parties must indicate in their reports that that have done so. This extends *only* to code that solved the previous assignment. Code pertaining to this assignment cannot be shared.
- While somewhat open-ended, this assignment is strictly individual work–the course policy on Academic Honesty is still in effect.

Rendered Images

The program you hand in should produce the final result (which may be slow to compute). In addition to your program, hand in the following renderings of your scene:

- scene signature (filename: `sceneSig.bmp`)
- diffuse rendering (with no recursive ray bouncing) (filename: `diffuse.bmp`)
- diffuse rendering with shadows. (filename: `diffuseShadow.bmp`)
- recursive ray tracer with the recursive depth set to 1 and 2. (filename: `recurs1.bmp` and `recurs2.bmp`)
- your final result (filename: `final.bmp`)

Tip: Keep the recursion depth low (2 or 3) to speed up debugging. We recommend that you implement this project in stages, rather than attempting everything at once. *E.g.* make sure object geometry and intersections are correct. Then add other effects (like local shading, shadows, secondary effects, and texture mapping) one at a time.

Report

Your report should contain the following:

- A well-written, high level description description of the features you implemented.
- A listing of all of the images submitted, along with a brief description of what is shown in each.
- A brief list of where we should look in the submitted images to ascertain that you satisfied the requirements of the assignment (*e.g.* where to see refraction, shadows, *etc.*) Be sure to choose images that demonstrate the requirements.
- If you implemented anything notable beyond the assignment, explain what you did and where to see it in the images you submit.

What to turn in

- Your source code and any other files necessary for compilation (on CDF/Linux).
- The files *CHECKLIST* and *REPORT* contained in that directory. *Failure to complete these files will result in zero marks on your assignment*.
- Images that showcase your implementation.
- For convenience, we are providing a tarfile that builds the directory structure you should follow for your submission. There is a separate directory for code, images, etc. The tarfile also contains the CHECKLIST.txt and REPORT.txt files.

To pack and submit your solution, execute the following commands from the directory containing your code (i.e., *a4/code*):

```
cd ../../
tar cvfz a4-solution.tgz a2
submit -c csc418h -a A4 a4-solution.tgz   (if registered for CSC418)
submit -c csc2504h -a A4 a4-solution.tgz  (if registered for CSC2504)
```

Wooden Monkey Competition (you may work in groups of two students)

Make a cool animation or ray-traced images and submit it to the Wooden Monkey competition. We will judge the submissions based on technical merit/special effects, and attractiveness; the best submissions will win a prize (of sorts) and be displayed on the instructor's web page. Include a README file in the electronic submission stating who did the project and describing the contents of it; this does not need to be a detailed write-up. Be sure to describe any special effects or other features that we should know about.

You may augment your WM submission with source code and/or geometry obtained from other sources (such as the web). We will be much more impressed by scene elements that you created yourself. You must acknowledge in the README file any outside sources that you used (including code you wrote before this semester).

Submit your WM entry by the A4 due date/time using

```
submit -c csc418h -a WM <filename>   (if registered for CSC418)
submit -c csc2504h -a WM <filename>  (if registered for CSC2504)
```