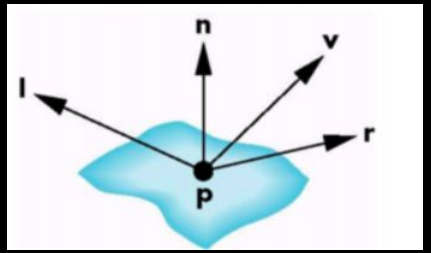
HW3

2021 Introduction to Computer Graphics

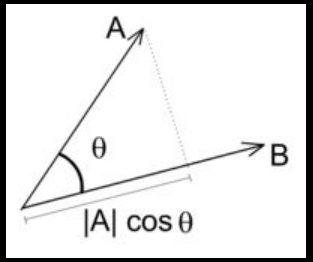
How to determine light intensity

- We can simply use the included angle of the reflection and view vectors.



- L is a vector towards the light source
- V is a vector towards the camera position
- R is a vector which is the reflection of L
- N is a vector which is the normal of the point P

How to determine light intensity

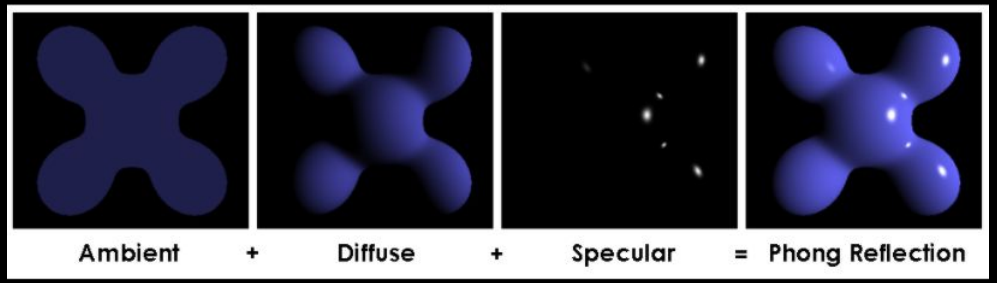


- If two vectors are unit vectors. Then we can get cosθ by doing dot products of the two vectors.
  A. $B = |A||B| \cos \theta$

- The smaller θ is, the larger cos θ is. According to the Phong reflection model, we can determine the light intensity based on cos θ.

- If cos θ < 0, θ must bigger than 90°. In this case, this position cannot be illuminated.

Phong shading



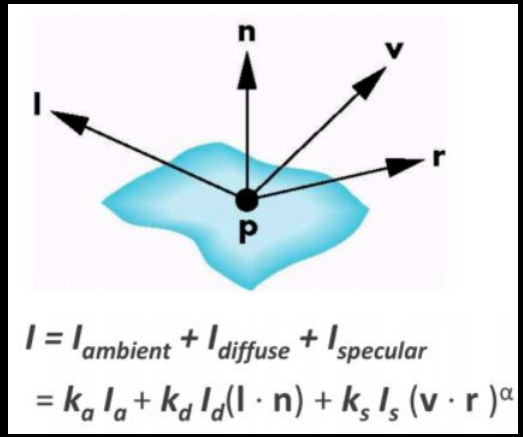
K is the reflectivity of each component of the material

- Parameters of model material:
  1. Ambient reflectivity (Ka) : 1 1 1
  2. Diffuse reflectivity (Kd) : 1 1 1
  3. Specular reflectivity (Ks) : 1 1 1

L is the intensity of each component of the light.

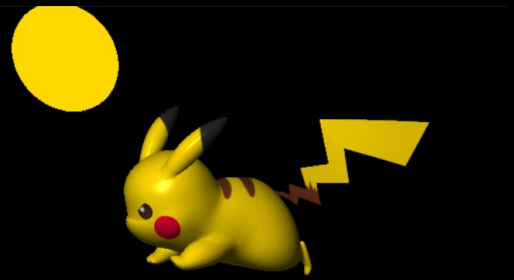
- Parameters of light:
  1. Ambient intensity (La) : 0.2 0.2 0.2
  2. Diffuse intensity (Ld) : 0.8 0.8 0.8
  3. Specular intensity (Ls) : 0.5 0.5 0.5
  4. gloss (Specular shininess factor) : 25

α is the glossiness of the material.



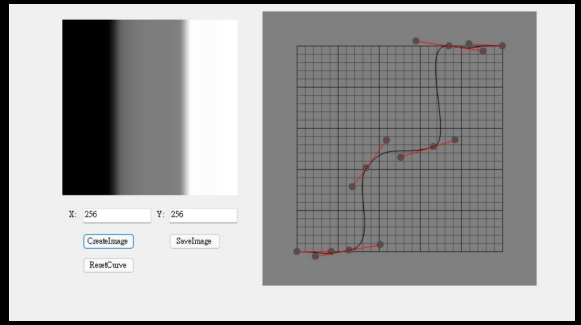
Phong shading - pseudocode

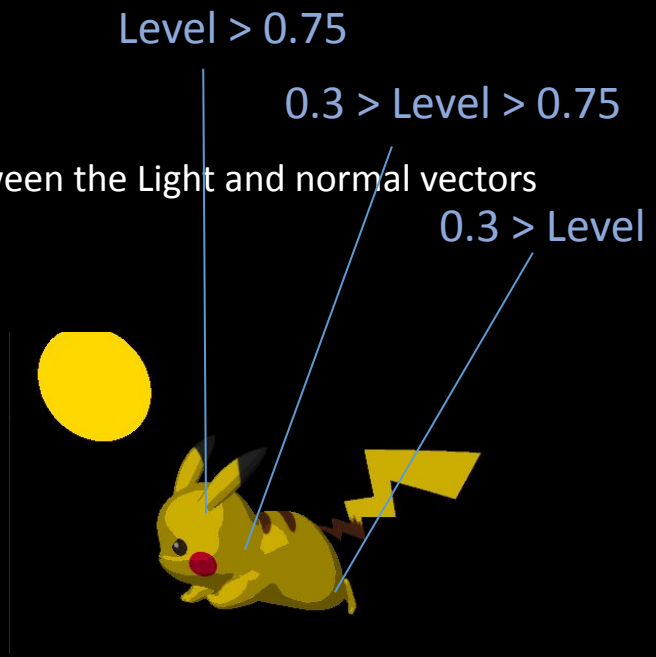
```
void main()
{
    object_color = texture2D(Texture, texcoord);

    ambient = La * Ka * object_color;
    diffuse = Ld * Kd * object_color * dot(L,N); // must > 0
    specular = Ls * Ks * pow(dot(V,R), gloss);

    color = ambient + diffuse + specular;
}
```



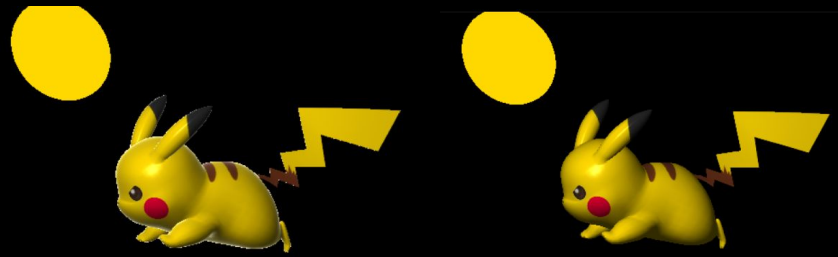
Toon shading - pseudocode

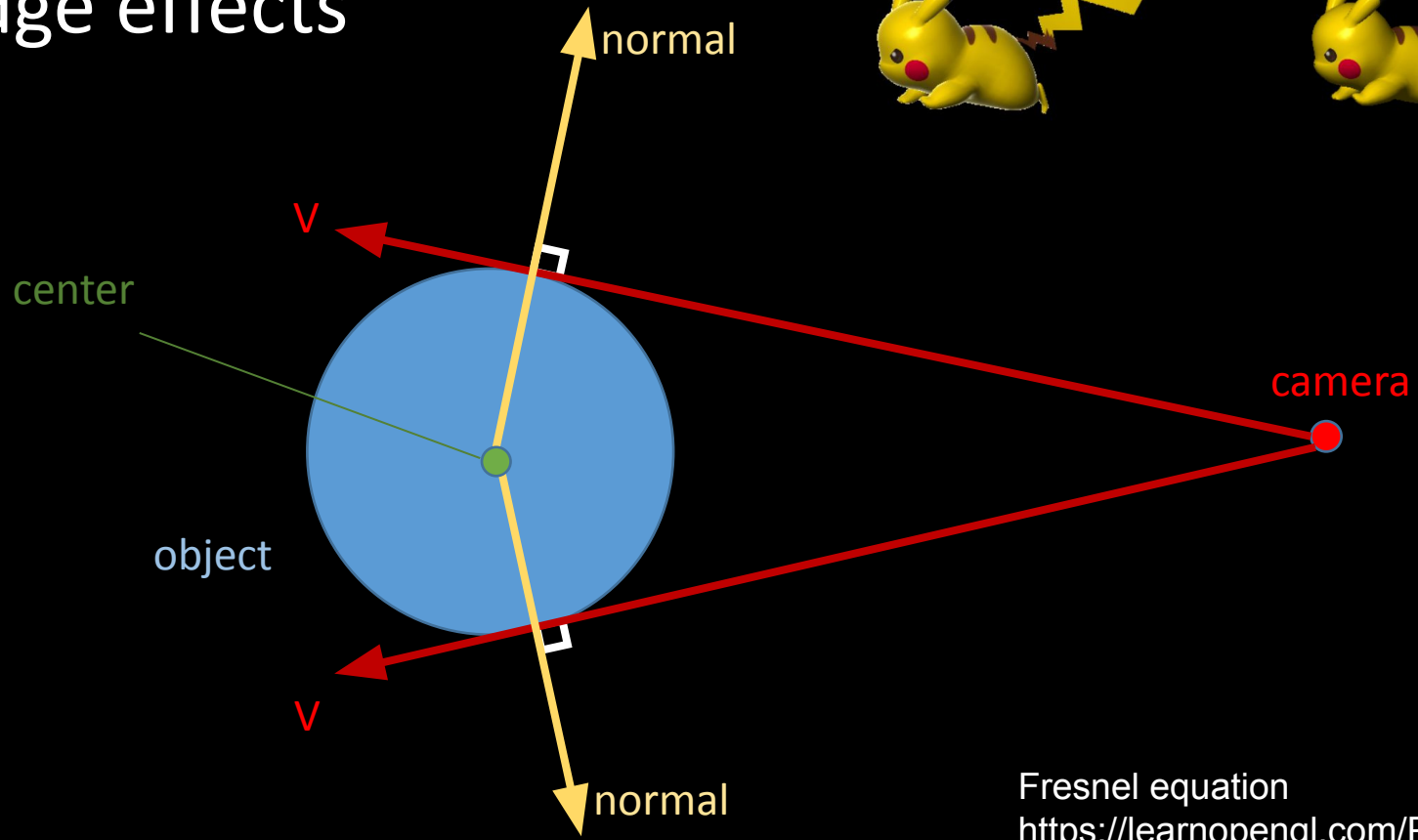
```
void main()
{
    object_color = texture2D(Texture, texcoord);

    Decide a level by calculating the included angles between the Light and normal vectors

    if (level > 0.75) intensity = 0.8;
    else if (level > 0.30) intensity = 0.6;
    else intensity = 0.4;

    Color = Kd * object_color * intensity ;
}
```





Edge effects

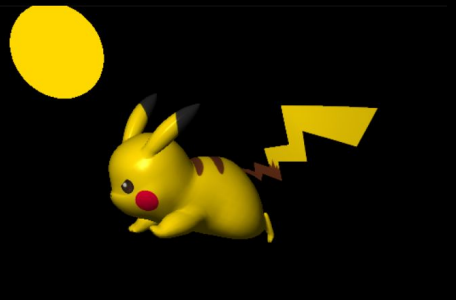




Fresnel equation
https://learnopengl.com/PBR/Theory

Homework 3

- Goal :
  1. Phong shading
  2. Toon shading
  3. Phong shading + Edge effects & Toon shading + Edge effects



Phong shading

Toon shading

Edge effects

Demo Video

Homework 3 (配分)

1. create shaders and programs you need and can switch them correctly.(5%)
2. Pass all variable to shaders and trigger by Uniform(5%)
3. Implement **Phong shading** via shader (40%)
4. Implement **Toon shading** via shader(30%)
   # at least define 3 levels.
5. Implement **Edge effects with Phong & Toon shading** via shader(10%)
   # must clearly see the edge
   # The color of the edge is not specified
6. Report (10%)

Homework 3 (report)

- Please specify your name and student ID in the report.

- Explain how you implement the above shading/effects.
  (ex: how I get the vector L. I do dot(L, N) for what……etc.)

- Describe the problems you met and how you solved them.

Homework 3 (繳交規則)

1. DeadLine: 2022/ 1 / 10 23: 59:59

2. Penalty of 10% of the value of the assignment per late week.

   If you submit your homework late, the score will be discounted.

   submit between (1/11 - 1/17) : Your final score * 0.9

   submit between (1/18 - 1/23) : Your final score * 0.8

Restrictions !!

- Your GLSL version should >= #version 330
- Deprecated shader syntaxes are not allowed, e.g. attribute, varying
- You are only allowed to pass uniform data to shader using glUniform* series function
- Using built-in uniform variables in shader is forbidden!
  - (That is, you cannot use gl_ModelViewMatrix or gl_NormalMatrix …etc)
  - The only gl_XXX term should be in your shader code is gl_Position.

Restriction modification (12/22) : you can define variable in shader but don’t hard code it (Ex."WorldLightPos" = “particular” if in some situation)

Upload Format

1. If your uploading format doesn't match our requirement, there will be penalty to your score. (-5%)

2. Please hand in the whole project file and report (.pdf) as HW3_<yourstudentID>.zip to e3 platform.

   e.g. HW3_0716XXX.zip

#project file要載下來就可以demo

Reference

Learning OpenGL : https://learnopengl.com/Lighting/Basic-Lighting

E3 Forum : https://e3.nycu.edu.tw/mod/forum/view.php?id=251401

#tool

- GLSL language integration :

  https://marketplace.visualstudio.com/items?itemName=DanielScherzer.GLSL