

# **Introduction to Computer Graphics**

## **0. Overview**

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# About the course

- ▶ Course title: Introduction to Computer Graphics
- ▶ Lectures:
  - ▶ EC115, 10:10~12:00(Mon.) & 9:00~9:50 (Wed.)
- ▶ Pre-requisites:
  - ▶ Computer programming skills in C/C++. (with data structures, such as arrays, trees, linked lists)
  - ▶ Essential concepts of matrix computation.
  - ▶ **Pass the "basic programming" course/test** (通過基礎程式設計測驗)
- ▶ Teacher:
  - ▶ I-Chen Lin (林奕成), Associate Professor
  - ▶ Email: [ichenlin@cs.nctu.edu.tw](mailto:ichenlin@cs.nctu.edu.tw)
  - ▶ Office: EC 704 (工程三館)
  - ▶ Tel ext: 56684

# About the course (cont.)

## ▶ TAs:

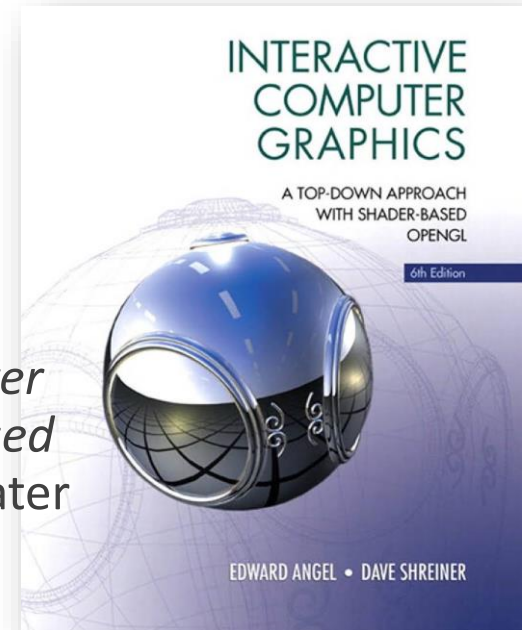
- ▶ 邱怡華、林陽 等 (李芷佳、于兆良、許振揚)。
- ▶ Office: EC229b
- ▶ Phone ext.: 56676

## ▶ Course web page: E3new (e-Campus, NCTU)

- ▶ <https://e3new.nctu.edu.tw>

## ▶ Text book:

- ▶ Edward Angel, Dave Shreiner, *Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL*, 6th Edition, 5th Ed., Pearson, 2012 (or later versions).



# About the course (cont.)

## ► References:

- Donald D. Hearn, M. Pauline Baker, Warren Carithers, *Computer Graphics with OpenGL* (4th Edition), Pearson, 2010.
- J. D. Foley, A. van Dam, S. K. Feiner, J. F. Hughes, R. L. Phillips. *Introduction to Computer Graphics*, Addison-Wesley, 1993.
- Joey de Vries, *Learn OpenGL: Learn modern OpenGL graphics programming in a step-by-step fashion*, Kendall & Welling, 2020.

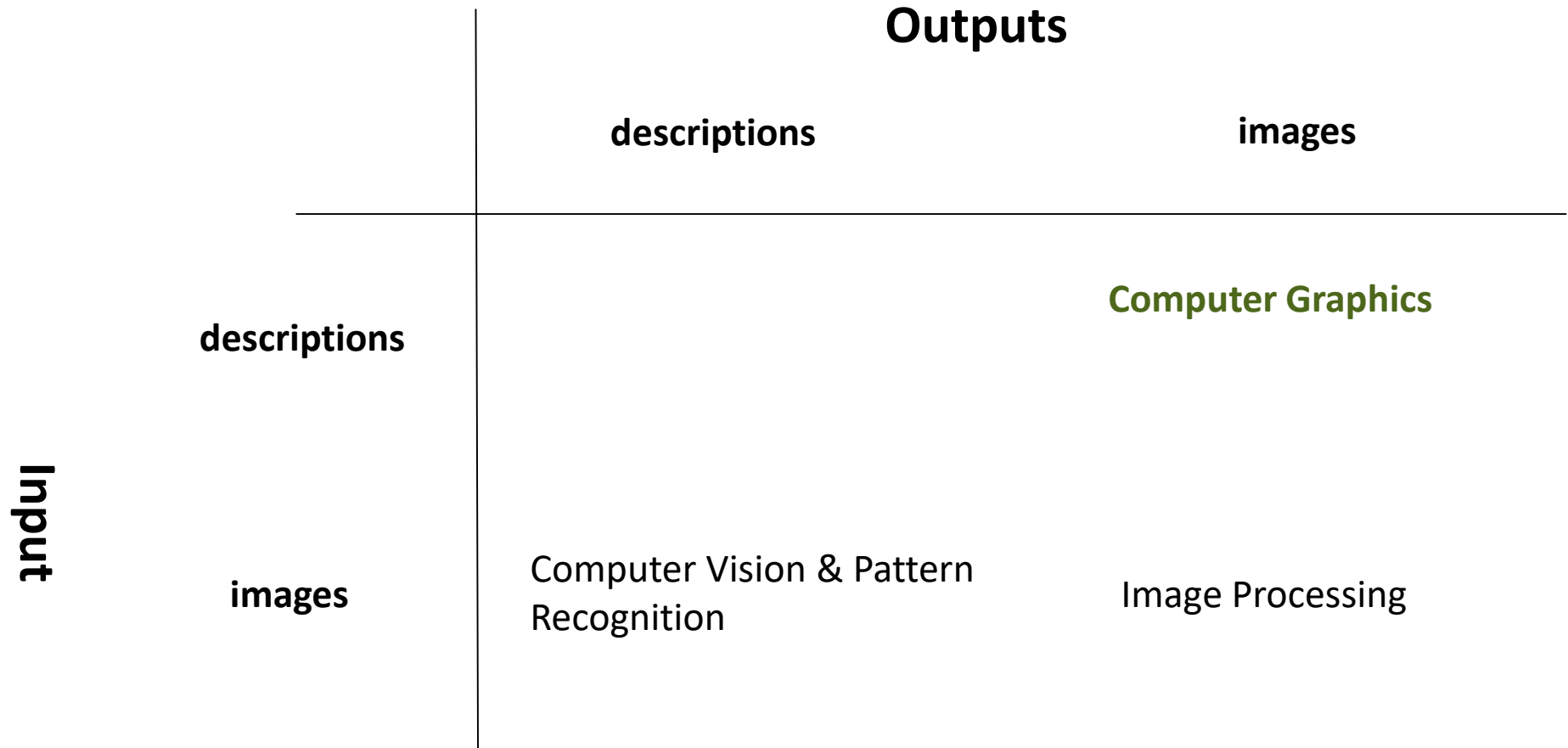
# What's CG?

- ▶ Computer Graphics.
  - ▶ Mainly focuses on 3D graphics.
  - ▶ Displays a realistic virtual environment by computers.
  - ▶ Or synthesizes virtual objects in the real world.

# What's CG? (cont.)

- ▶ Or demonstrates a virtual world with specific styles. (e.g. non-photorealistic rendering)
- ▶ CG tech. is the foundation of modern 3D animation, special effects and games.

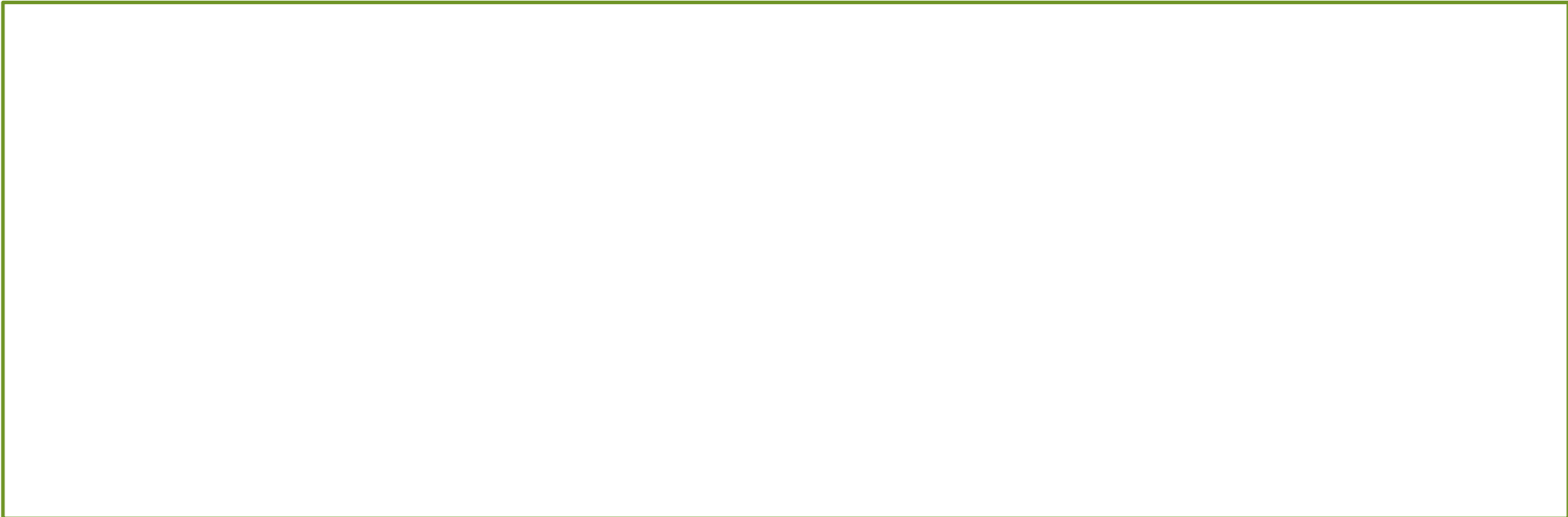
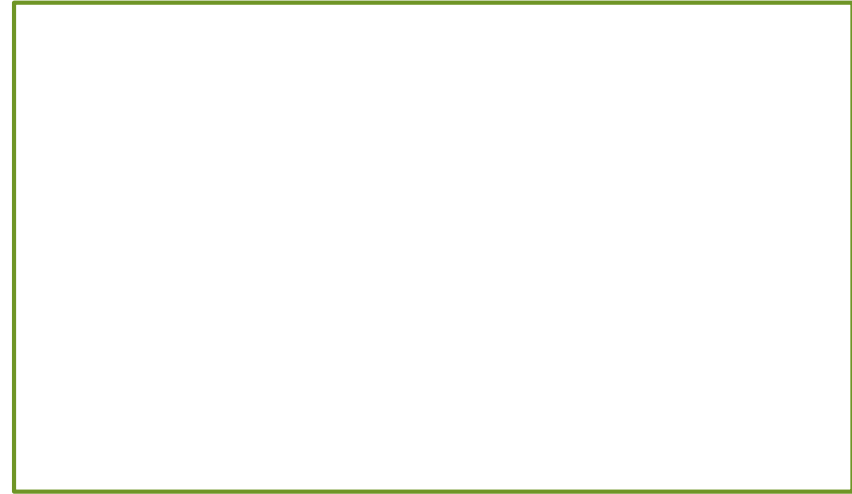
# Graphics and related fields



*Nevertheless, the boundaries between these fields, especially CG and CV, are getting indistinct.*

# Applications

- ▶ Movies
- ▶ Games
- ▶ Virtual characters



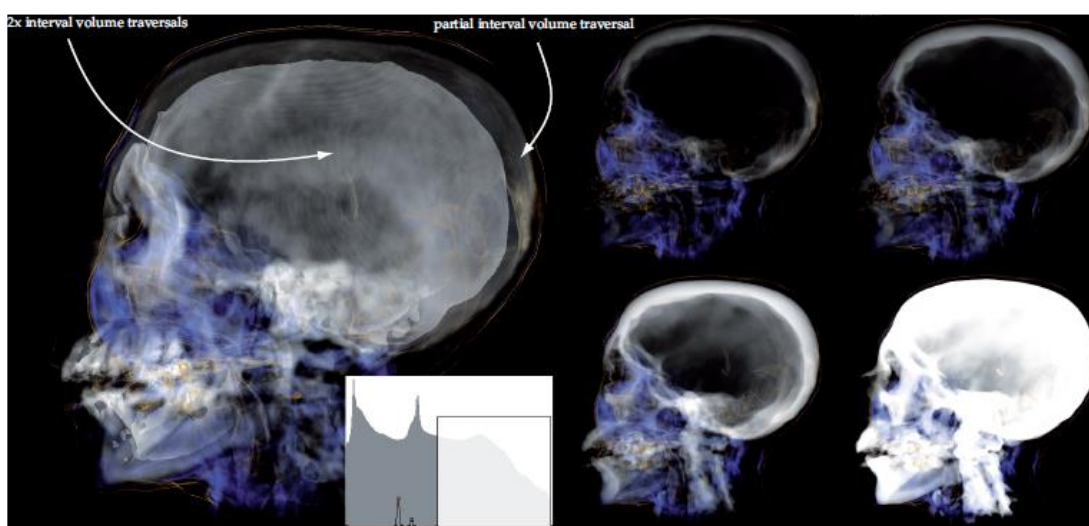


# Applications (cont.)

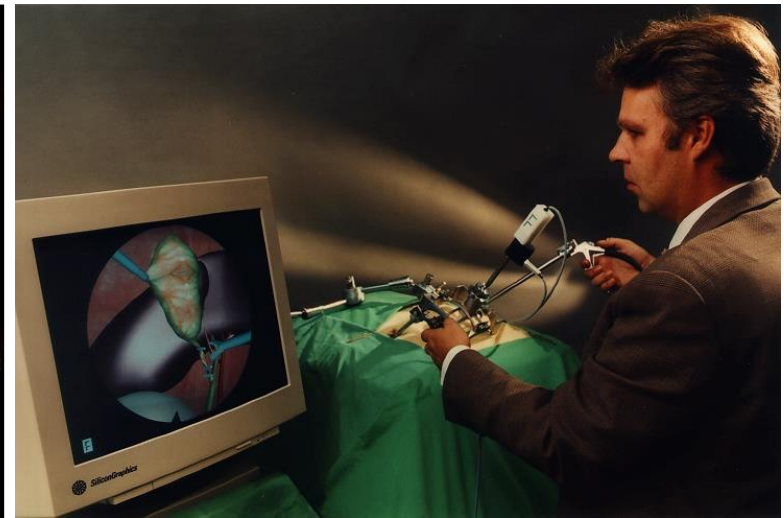
- ▶ Virtual reality (VR)

# Applications (cont.)

- ▶ Medical diagnosis.
- ▶ Virtual Surgery.



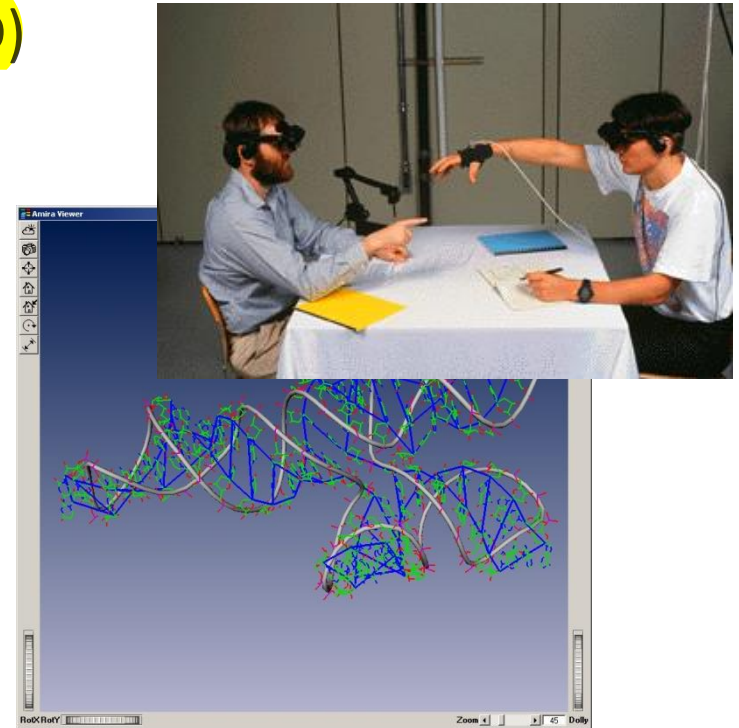
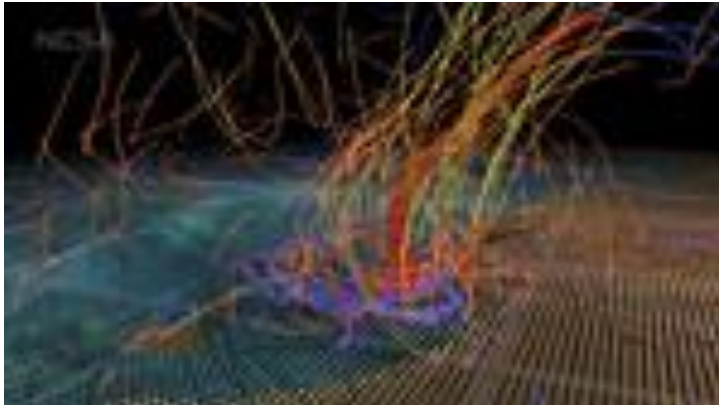
Direct Interval Volume Visualization, IEEE Vis'10



The Karlsruhe Endoscopic Surgery Trainer

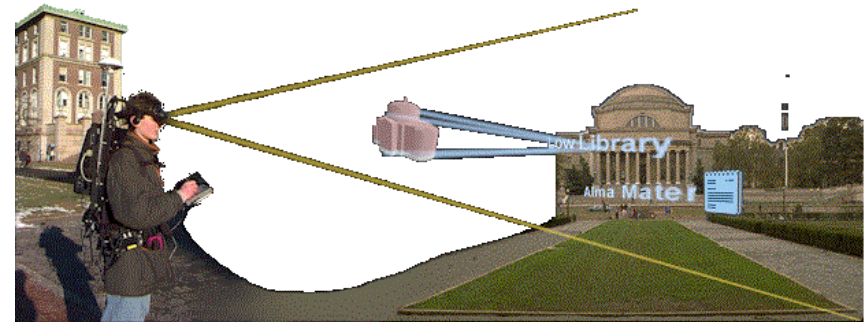
# Applications (cont.)

- ▶ Computer aided design (CAD)
  - ▶ Collaborating on cyberspace.
  - ▶ Ex. Cabin design (Boem Inc.)
- ▶ Visualization tools
  - ▶ Meteorology

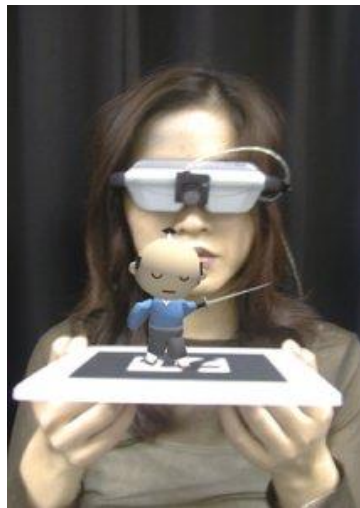


# Applications (cont.)

- ▶ Augmented reality (AR)
- ▶ Advanced human computer interfaces



AR, U. Columbia



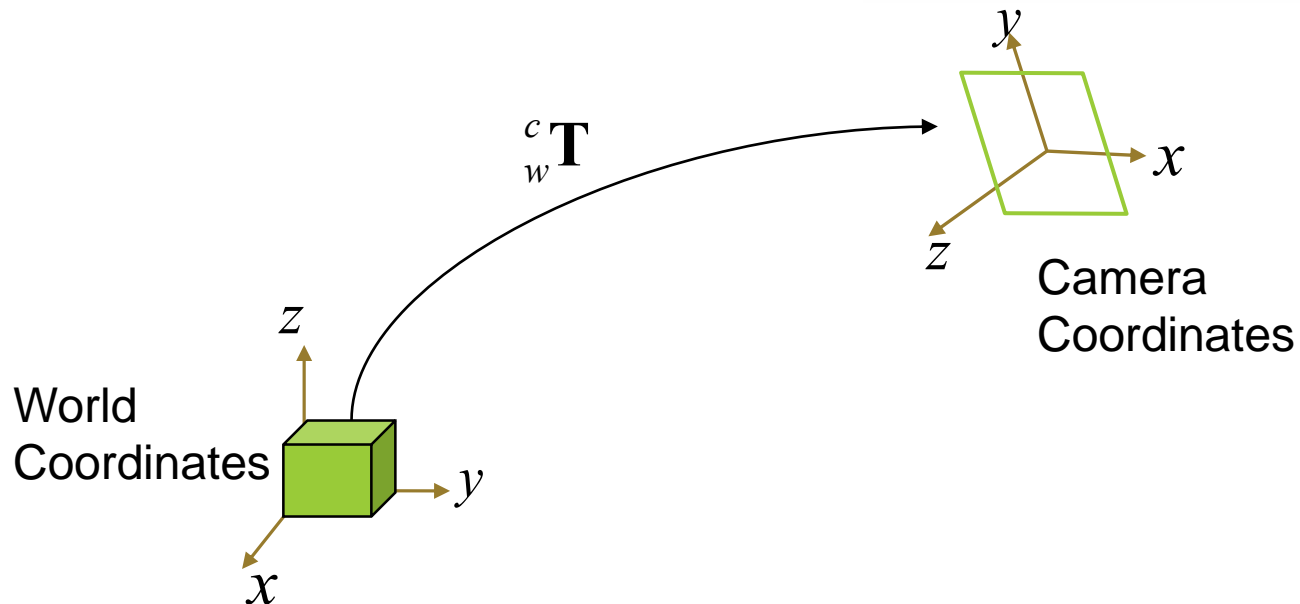
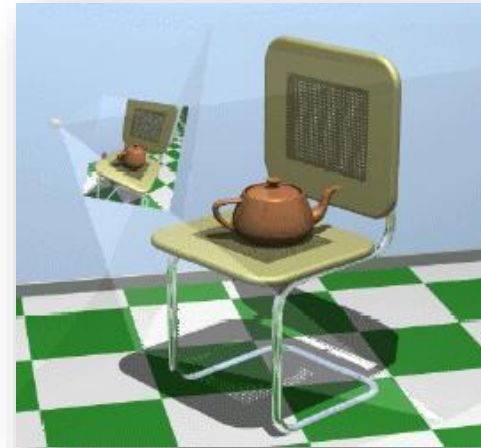
AR Toolkit



Microsoft HoloLens

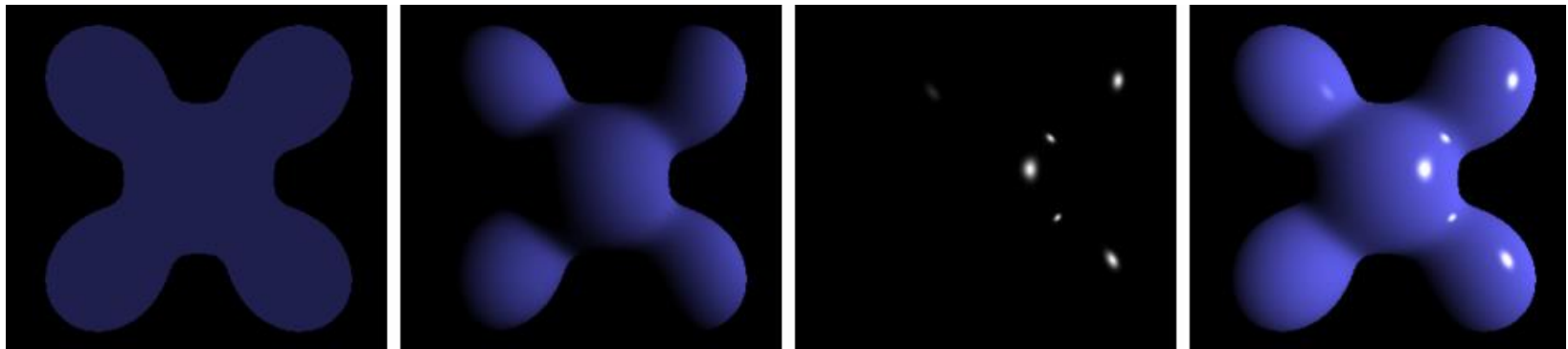
# Syllabus

- ▶ Introduction.
- ▶ Graphics primitives 原始
- ▶ Geometric transformations
- ▶ Viewing in 3D



# Syllabus (cont.)

## ► Illumination and surface <sup>渲染</sup>rendering



Ambient

周圍

+

Diffuse

擴散

+

Specular

高光

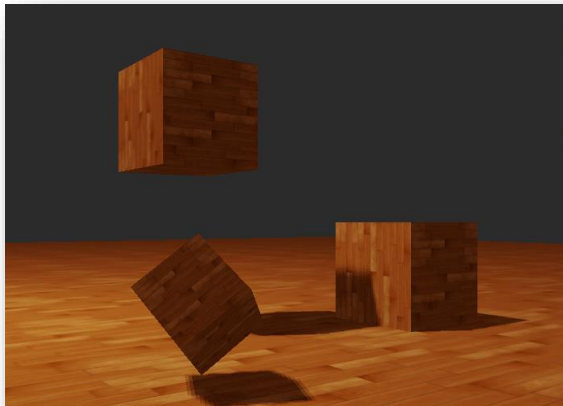
= Phong reflection

## ► Visible-surface detection



# Syllabus (cont.)

- ▶ Texture mapping
- ▶ Programming with Graphics processing unit (GPU)
- ▶ Global illumination



Samples from <http://leanopengl.com>



[http://www.ozone3d.net/tutorials/bump\\_mapping.php](http://www.ozone3d.net/tutorials/bump_mapping.php)



the Chartres Cathedral  
[www.graphics.cornell.edu](http://www.graphics.cornell.edu)

# Syllabus (cont.)

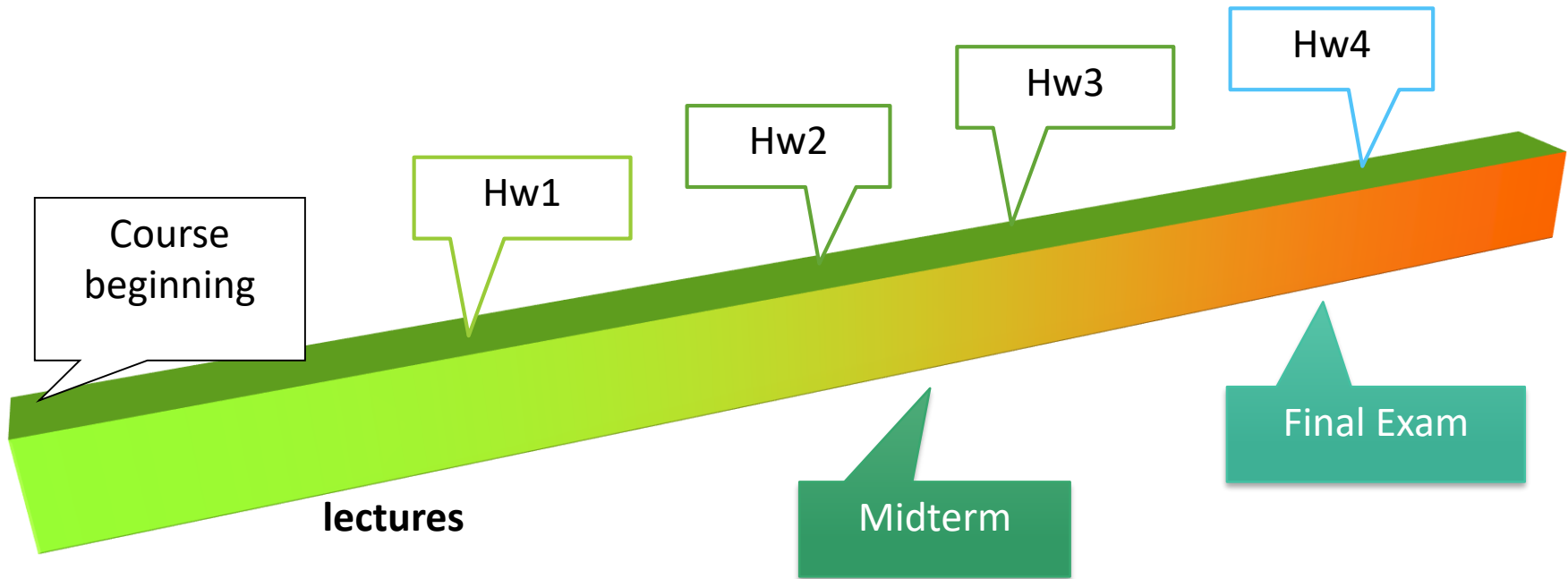
- ▶ Curves and surfaces
- ▶ Advanced topics and research in CG
- ▶ (Note: advanced graphics-related courses in NCTU)
  - ▶ 3D game programming
  - ▶ Advanced computer graphics
  - ▶ Computer animation and visual effects
  - ▶ Image manipulation techniques and visual special effects
  - ▶ Interactive shape manipulation
  - ▶ Real-time rendering
  - ▶ Texture synthesis
  - ▶ .....



# About the course (cont.)

- ▶ Grades: (provisional)
  - ▶ Homework (4 programs)
    - ▶ OpenGL viewer: transformation.
    - ▶ GLSL viewer: transformation + texture.
    - ▶ Shading with GLSL.
    - ▶ To be announced (last year: a short animation using GLSL).
- ▶ Exam
  - ▶ Midterm (20%  $\pm$  5%)
  - ▶ Final (20%  $\pm$  5%)
- ▶ Class participation: bonus

# Schedule



# What can I obtain in this course?

- ▶ Fundamentals of computer graphics techniques.
- ▶ Programming ability for 3D graphics.
- ▶ Preliminary concepts about graphics-related topics, e.g. 3D games, animation, VFX movies.

# Conclusion

- ▶ The role of graphics people in CS
  - ▶ Improving faithfulness or visual effects
  - ▶ Speed-up of CG generation
  - ▶ Exploring the use of graphics.
  - ▶ (by computer techniques)

*We give “wizards” the “wands” and “spells” !*