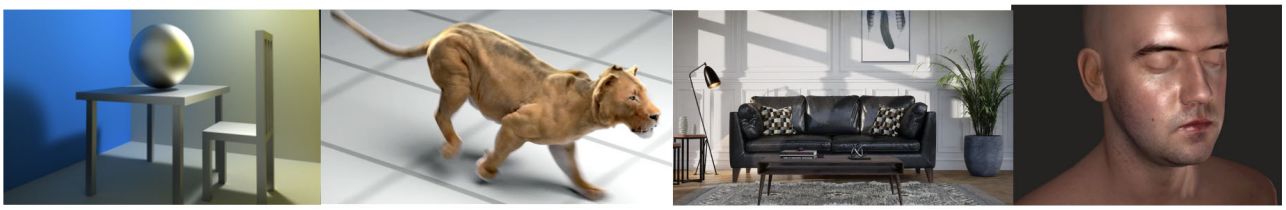
CPSC 314: Computer Graphics

Weekly schedule

2022W2 (Jan-Apr 2023) - UBC - Department of Computer Science

Course Description · **People** · **Lectures** · **Evaluation** · **Resources** · **Policies**



[https://madebyevan.com/webgl-path-tracing/] [Ziva Dynamics] [https://unrealengine.com] [https://threejs.org/examples]

1 Course Description

The course provides an introduction to computer graphics, with a focus on the fundamentals of modeling, rendering, and basic animation. We will learn the modern programmable graphics pipeline, with vertex and fragment shaders. Implementions will mainly use three.js, WebGL, and javascript. The focus will be on mathematical, conceptual, and algorithmic foundations of computer graphics.

Learning Goals — After this class, students can:

- explain the algorithmic steps used in rendering and animating 3D models
- interpret and explain (hierarchical) affine transformations using diagrams, linear algebra, and implement the related code in a common graphics API
- write code that implements the graphics pipeline, with an emphasis on vertex shaders and fragment shaders
- read, write, and modify code for graphics applications using a common graphics API
- explain the behaviour of common illumination models, and the assumptions they make with regard to physics and perception
- describe and appreciate the creativite potential of modern computer graphics and current capabilities and trends in computer graphics

Topics

- transformations, coordinate systems, and vertex shaders

    - 4×4 affine transformations: translation, rotation, scale, composition, scene hierarchies homogenous coordinates
    - camera specifications and transformations, perspective and orthographics projection, transforming normals
    - coordinate systems: local, world, viewing, normalized device, clipping, device
    - basic animation
- rasterization & interpolation
    - implicit, explicit, parametric representations for geometry
    - barycentric coordinates; interpolation during scan conversion
- culling, clipping, and visibility
    - back-face culling, view frustum culling, occlusion culling, raycasting, view frustum clipping, z-buffer visibility
- texture mapping:
    - texture coordinates, bump maps, procedural textures, enviroment maps, volumetric textures, tiling, multi-scale filtering
- lighting and fragment shaders
    - local illumination models, BRDFs, phong model
    - intro to global illumination
- color spaces
    - color perception; color spaces; gamut mapping, high-dynamic range cameras and displays, tone mapping
- current capabilities and trends in computer graphics
    - advances in global illumination, machine learning methods, AR/VR, fake images and video, VFX, games
    - simulations, editing images and geometry, 3D printing, generative design

2 People

Instructor	Michiel van de Panne, van@cs.ubc.ca, ICCS x865.
Teaching Assistants	(to be finalized)

3 Lectures

Monday	Wednesday	Friday
Lecture DMP 310 10:00-10:50am	**Lecture** DMP 310 10:00-10:50am	**Lecture** DMP 310 10:00-10:50am

Weekly schedule

Drop-by hours: Tue 4:30-5:30pm, ICCS x835 (equivalently: “office hours”)

Lectures and office hours will be in-person. Blank course notes will be available before class, as PDFs. Completed course notes will be posted as PDFs, up to several days later.

Labs: ICCS 005 — Tue 11am, Wed 12pm, 1pm, 3pm; Thu 11am, 2:30pm, 3:30pm

Piazza will be used to handle most questions. Sign up here

4 Evaluation

Component	Percentage
Assignments (6)	42%
Participation	8%
Quizzes	22%
Final	28%

- *Participation:*
- *Assignment 1 (6%):*
- *Assignment 2: (7%):*
- *Assignment 3: (7%):*
- *Assignment 4: (7%):*
- *Assignment 5: (8%):*
- *Assignment 6: (7%)*
- *Quiz 1:*
- *Quiz 2:*
- *Final Exam:*

5 Resources

In lieu of a course textbook, course notes and links to relevant online resources will be posted.

- three.js
- GLSL: available functions
- GLSL: OpenGL Shading Language
- Scratch-a-pixel: CG for the rest of us
- bkcore: live editing of fragment & vertex shaders
- more to be posted

6 Policies

COVID

Stay home if you are sick. Please see the full guidelines here. The classroom is likely to be quite full, and thus I generally prefer that students wear masks.

Illness

You are allocated three late days for the course to deal with unforeseen circumstances. If this is insufficient, further options may be available, so please discuss this with the instructor.

Special Accomodations

Please contact the instructor.