



## Comp4302/Comp 6909 – 3D Graphics

### Course Outline – Winter 2021

#### Department of Computer Science

**Course Instructor:** Dr. Oscar Meruvia-Pastor

Office Hours: Available on Webex by appointment (send Email).

Email: Use MUN's online course shell's email:

OMeruvia@online.mun.ca (include the title "Comp 4302 or Comp6909" in the subject)

Classroom Lectures:

**Online Delivery**

**Teaching Assistant:** To be announced in MUN's course shell, a.k.a. Brightspace/D2L

Email: Use the D2L Comp 4302/6909 course shell

**Short Course Description:** Comp 4302/6909 is an introduction to 3D Computer Graphics Fundamentals.

**Prerequisite:** COMP 3301

#### **Calendar Description:**

3D Computer Graphics introduces the student to the state-of-the-art concepts and developments in 3D computer graphics. The underlying algorithms, as well as the basic techniques to develop interactive 3D graphics systems including games and simulators, are presented. Topics of the course include 3D geometrical transformations, 3D projections, 3D modeling and rendering, 3D graphics languages and systems. Advanced photorealistic rendering and image-based rendering techniques may also be covered.

**Course Textbooks** (recommended, not required):

Interactive Computer Graphics, 8th Ed.

Editions: Both eText & Loose leaf are available & suitable.

Authors: Edward Angel & David Shreiner

Editorial: Addison Wesley

ISBN: 9780135217733

<http://www.mypearsonstore.com/bookstore/pearson-etext-for-interactive-computer-graphics-access-013525826X>

**Reference Texts** (for the keeners):

Real-Time 3D Graphics with WebGL 2: Build interactive 3D applications with JavaScript and WebGL 2 (OpenGL ES 3.0), 2nd Edition, Kindle Edition

Authors: Farhad Ghayour & Diego Cantor

ISBN: 1788629690

<https://www.amazon.com/Real-Time-Graphics-WebGL-interactive-applications-ebook/dp/B07GVNQLH5>

Learn Three.js: Programming 3D animations and visualizations for the web with HTML5 and WebGL, 3rd Edition.

Jos Dirksen (Author)

Editorial: Packt Publishing

ISBN: 1788833287

<https://www.amazon.com/Learn-Three-js-Programming-animations-visualizations-ebook/dp/B07H2WJD1P/>

### **Educational Goals:**

Successful students will:

1. Acquire an understanding of the basic principles of 3D computer graphics.
2. Learn the concepts of perspective, display transformations, rendering, shading and illumination, texture mapping and languages and graphics systems.
3. Understand the typical graphics Pipeline, learning WebGL and Javascript, and how to use it to execute 3D graphics programs.

### **Prerequisites and expected skills:**

The calendar pre-requisite (Comp 3301) and the 3<sup>rd</sup> year standing are meant to ensure the student has the necessary skills to be successful in the course. The course examples and programs are in WebGL. The WebGL API is accessed through JavaScript code in HTML5 browsers. It will be important for students going into the course to have: good programming skills in JavaScript, Python, C, C++, or Java; an understanding of basic data structures (arrays, linked lists, trees); and a rudimentary knowledge of trigonometry and linear algebra, particularly matrix-by-matrix and vector-by-matrix multiplications, which are fundamental in applying viewing transformations.

<b>Evaluation for Comp 4302:</b>		<b>Evaluation for Comp 6909:</b>	
In-class participation (TopHat) .....	25%	In-class participation (TopHat) .....	25%
Assignments .....	15%	Assignments .....	10%
Midterm Exam .....	25%	Midterm Exam .....	25%
Final Assignment .....	10%	Final Project .....	15%
Final Exam .....	25%	Final Exam .....	25%

The midterm exam will be held according to the Semester Plan below. The final exam will be scheduled by the Registrar's Office later in the term and will be administered using the Proctorio extension in TopHat. In the event of university closure on the day of a test, the test will be given in the next available lecture day with no special announcement. For other exemptions, see the policies and important notes below.

The D2L website (<https://online.mun.ca/>) is used for posting all assignments and you are required to check regularly regarding assignment announcements and due dates. All assignments are due at the time and dates specified in the assignment sheet. Late submissions will not be accepted. All assignments must be submitted online via Desire2Learn.

If, for special circumstances (such as medical, accidental or bereavement) a student misses an examination, a quiz or an assignment, the student should notify the instructor as soon as possible (within a week), providing any related documentation, in accordance with University policies, in which case, the percentage will be distributed to the corresponding evaluation category (exams, assignments or participation). If the student wishes to write a make-up examination, it is the responsibility of the student to initiate contact to ask for the make-up examination within the first week of the missed examination and be ready to write the examination as soon as possible. Failure to notify within one week will result in a mark of 0% for that work or examination. The information required for medical notes in the case of a missed final exam is established in the University Calendar's general academic regulations section 5.14.4.

## **Student Resources**

We want to see each committed student succeed in the course. All students are encouraged to regularly consult with the professor and teaching assistant for help or clarification with the topics presented in class, lab or tested in the examinations. However, before asking for help, students are expected to read the assignment sheets and complete the necessary work as much as possible.

## **Notes**

1. Important news and all course communication should be directed through the online shell for the course, available through the following link:  
<https://online.mun.ca/>
2. For the schedule of activities and the course slides to read from each text refer to the semester plan shown below.
3. Special dedication should be given to the assignments, as they are essential for success.
4. Online course materials will be available through the Brightspace/Desire2Learn (D2L) system. The lectures provided in this course, including any visual or audio recording thereof, are subject to copyright owned by Drs. Minglun Gong and Oscar Meruvia and, in some cases, the authors of the supplemental materials used in the course. They are meant solely for academic use by the students registered in the class. It is prohibited to record, copy or republish by any means, in any format, openly or surreptitiously, in whole or in part, in the absence of express written permission from the course instructor, any of the lectures or materials provided or published in any form during or from the course.

5. Any e-mail messages to the instructor should be sent through the Brightspace/D2L course shell. Brightspace/D2L email will be checked within three working days, typically during office hours. Only when extraordinary circumstances (emergencies) arise, you can email your professor at [oscar@mun.ca](mailto:oscar@mun.ca).
6. Important dates (such as drop and add dates) can be found in the University Diary (<http://www.mun.ca/regoff/calendar/sectionNo=GENINFO-0086>).
7. Grading of work will follow the scale laid out in the general regulations in the University Calendar, general regulations section 5.8.
8. Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities (<http://www.mun.ca/policy/site/policy.php?id=239>). Students who may need an academic accommodation are asked to initiate a request with the Glenn Roy Blundon Centre at the earliest opportunity ([www.mun.ca/blundon/](http://www.mun.ca/blundon/)).
9. All written materials delivered must comply with the expectations set out in the University Calendar regulations for good writing (section 5.8.3).
10. Cheating will not be tolerated. Students are expected to complete the material on their own and need to prove they personally understand the course material. If an assignment is found to be copied from other student or any other source, it will receive a mark of zero. In addition, students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University, in accordance with the University Regulations for Academic Misconduct (<https://www.mun.ca/regoff/calendar/sectionNo=REGS-0748>).
11. Although changes to this document are not intended at this time, any part of this course outline can be subject to change, and more so within the first two weeks of classes. Changes will be announced in class and/or posted over Brightspace/D2L.

### 3D Graphics - Semester Plan for Lectures & Reading - Winter 2021

Week	Monday	Tuesday	Wed	Thursday	Fri
1	<b>January 11</b> <i>Lectures Begin</i> <i>Course Overview &amp; Introduction to Graphics</i>	12 <b>Chapter 1</b> <i>WebGL Sample Light, color, and photography</i>	13	<b>Chapter 1 14</b> <i>Image Formation Models &amp; Architectures -The Graphics Pipeline (CG03)</i>	15
2	<b>Chapter 2 18</b> <i>Introduction to WebGL Programming</i>	<b>Chapter 2 19</b> <i>Programming WebGL 2D (CG05)</i>	20	<b>Chapter 2 21</b> <i>Programming WebGL 3D</i>	22
3	<b>Chapter 3 25</b> <i>Input and Interaction (CG07)</i>	<b>Chapter 3 26</b> <i>GL callbacks (CG08)</i>	27	<b>Chapter 3 28</b> <i>Picking and Display Lists Defining Objects' Geometry (CG09) (CG10)</i>	29
4	<b>Chapter 4 Feb 1</b> <i>Spatial Frames of Reference (CG11)</i>	<b>Chapter 4 2</b> <i>Transformations (CG12)</i>	3	<b>Chapter 4 4</b> <i>Transformations in WebGL (CG13)</i>	5
5	<b>Chapter 4 8</b> <i>Topology of 3D models (CG14)</i>	<b>Chapter 5 9</b> <i>Viewing (CG15)</i>	10	<b>Chapter 5 11</b> <i>Views and Projections (CG15)</i>	12
6	<b>Chapter 5 Feb 15</b> <i>WebGL Cameras, Projection (CG16)</i>	<b>Chapter 5 16</b> <i>Specifying projection matrices (CG17)</i>	17	<b>Chapter 5 18</b> <b>Midterm 1</b>	19
7	Feb 22 <i>Winter Break</i>	23 <i>(no lectures)</i>	24	25 <i>Winter Break</i>	26
8	<b>March 1</b> <i>Lighting and Shading (CG 18)</i>	<b>Chapter 6 2</b> <i>Shading and the Phong model (CG19)</i>	3	<b>Chapter 6 4</b> <i>Shading in WebGL (CG20)</i>	5
9	8 <i>Midterm Review</i>	<b>Chapter 6 9</b> <i>Vertex and Fragment Shaders (CG23)</i>	10	<b>Chapter 7 11</b> <i>Texture Mapping &amp; Rendering Buffers (CG24)</i>	12
10	<b>Chapter 7 15</b> <i>WebGL Texture Mapping (CG25)</i>	<b>Chapter 7 16</b> <i>WebGL Texture Mapping 2 (CG25)</i>	17	<b>Chapter 7 18</b> <i>Environment Reflection and Bump Maps</i>	19
11	<b>Chapter 8 22</b> <i>Framebuffers intro (CG27)</i>	<b>Chapter 8 23</b> <i>Compositing and Blending (CG27)</i>	24	<b>Chapter 8 25</b> <i>Compositing and Blending</i>	26 Sat. Lec->
12	<b>Chapter 8 29</b> <i>Off-Screen Rendering Picking (CG28)</i>	<b>Chapter 8 30</b> <i>Shadow Maps and Projective Textures</i>	31	<b>Chapter 9 April 1</b> <i>Hierarchy &amp; Scene Graphs (CG29)</i>	2 Good Fri.
13	5 <b>Chapter 9</b> <i>Hierarchy &amp; Scene Graphs</i>	6 <b>Chapter 9</b> <i>Hierarchy &amp; Scene Graphs</i>	7	April 8 <i>Final Review</i> <b>Lectures End!-&gt;</b>	9
14	12	13 <b>Final Exams Start -&gt;</b>	14	15	16
15	19	20	21	22 <b>Final Exams End -&gt;</b>	23