

## Course Syllabus

CP411 Computer Graphics

Department of Physics and Computer Science, Faculty of Science, Waterloo

Fall | 2019

*I acknowledge that in Kitchener, Waterloo, Cambridge and Brantford we are on the traditional territory of the Neutral, Anishnawbe, and Haudenosaunee peoples.*

### Instructor Information

Dr. Muhammad Muddassir Malik | N2086

[mmalik@wlu.ca](mailto:mmalik@wlu.ca) [Please use this email, do not use MyLearningSpace email]

Weekly Office Hours listed on MyLearningSpace or by appointment

### Course Information

N1044, 2:30pm to 3:50pm, Tuesday and Thursday

### Course Overview and Approach

In this course we will study the basic building blocks of computer graphics and learn how to use them to create models and simple animations. We will study the entire programmable graphics pipeline and students will learn to write shaders for GPU. Assignments will augment the class lectures. To ensure the development of the necessary competencies, assigned homework includes the development of program solutions to problems of adequate complexity and relevance.

### Course Goals and Learning Outcomes

Students will learn to: Create drawing primitives, transform objects and concatenate transformations, create 3D scenes, animate and transform 3D objects, perform texture mapping and illuminate environments, and write shaders for GPU.

By the end of this course students should be able to:

- Describe graphics pipeline
- Describe the computer graphics constructs and algorithms for rendering.
- Develop programs to implement 3D scenes.
- Articulate where computer graphic algorithms fit in the provision of computer-based solutions.
- Develop ability to learn and use modern tools and technologies for graphics applications

### Course Tools and Learning Materials

- Links to online learning articles and study materials shared in lectures
- Material shared on Laurier's MyLearningSpace page
- Reference Book: Edward Angel and Dave Shreiner: Interactive Computer Graphics with WebGL, 2014
- Reference Book: Hearn and Baker; Computer Graphics with Open GL, 2010

- Reference Book: Kouichi Matsuda and Rodger Lea; WebGL Programming Guide: Interactive 3D Graphics Programming with WebGL 2013
- Reference Book: Jos Dirksen; Learning Three.js: The JavaScript 3D Library for WebGL, 2013
- Laurier [Library](#)

### Weekly Schedule(s)

Week	Topic / Chapter	Assignments / Project
Week 1 - Sep. 1	GPU Architecture and graphics pipeline GLSL programming fundamentals	
Week 2 - Sep. 8	JavaScript Fundamentals 2D transformations. Translation, rotation, scaling. Compositing 2D transformations. Reflection, Sheer. Compositing	
Week 3 - Sep. 15	3D transformations Camera analogy and spaces Texture mapping	
Week 4 - Sep. 22	Parallel and Perspective projections Projection normalization Visible surface determination. z-buffer and a-buffer	Assignment <b>1</b> due – <b>Sat. Sep. 28</b>
Week 5 - Sep. 29	Light sources and theory of lights Ambient, diffuse and specular lights Flat shading, Gouraud shading	
Week 6 - Oct. 6	Phong shading, Toon shading Introduction to Three.js	
Week 8 - Oct. 20	Introduction to Three.js Introduction to Unity 3D DDA and Bresenham's line drawing algorithm	
Week 9 - Oct. 27	Bresenham's line drawing algorithm Mid-point circle generation algorithm <b>Midterm: Thursday Oct. 31, 2019</b>	Assignment <b>2</b> due – <b>Sat. Nov. 2</b>
Week 10 - Nov. 3	Mid-point ellipse generation algorithm Scan line polygon filling Splines with 4 control points Continuity and splines	
Week 11 - Nov. 10	Line clipping Polygon clipping	Assignment <b>3</b> due – <b>Sat. Nov. 16</b>
Week 12 - Nov. 17	Blending Marching squares algorithm	
Week 13 - Nov. 24	Overview of Information visualization and volume rendering	Project due – <b>Sat. Nov. 30</b>
Final exam Review		

The educational materials developed for this course, including, but not limited to, lecture notes and slides, handout materials, examinations and assignments, and any materials posted to MyLearningSpace, are the intellectual property of the course instructor. These materials have been developed for student use only and they are not intended for wider dissemination and/or communication outside of a given course. Posting or providing unauthorized audio, video, or textual material of lecture content to third-party websites violates an instructor's intellectual property rights, and the Canadian Copyright Act. Recording lectures in any way is prohibited in this course unless specific permission has been granted by the instructor. Failure to follow these instructions may be in contravention of the university's Code of Student Conduct and/or Code of Academic Conduct, and will result in appropriate penalties. Participation in this course constitutes an agreement by all parties to abide by the relevant University Policies, and to respect the intellectual property of others during and after their association with Wilfrid Laurier University.

### Student Evaluation

Assessment	Weighting
Assignments	20%
Quizzes	20%
Project	15%
Midterm	15%
Final Exam	30%
<b>Total</b>	<b>100%</b>

*Note: Students must pass the combined weighted average for midterm and final exams to pass the course.*

### University and Course Policies

- 1. Academic Calendars:** Students are encouraged to review the [Academic Calendar](#) for information regarding all important dates, deadlines, and services available on campus.
- 2. Special Needs:** Students with disabilities or special needs are advised to contact Laurier's Accessible Learning Centre for information regarding its services and resources.
- 3. Plagiarism:** Wilfrid Laurier University uses software that can check for plagiarism. If requested to do so by the instructor, students are required to submit their written work in electronic form and have it checked for plagiarism. (Approved by Senate May 14, 2002) . The department penalty for the first case of an academic integrity issue is 0 (zero) for the component in question and -5% (minus five percent) on your final grade; penalty applies to all parties involved.
- 4. Academic Integrity:** Laurier is committed to a culture of integrity within and beyond the classroom. This culture values trustworthiness (i.e., honesty, integrity, reliability), fairness, caring, respect, responsibility and citizenship. Together, we have a shared responsibility to uphold this culture in our academic and nonacademic behaviour. The University has a defined policy with respect to academic misconduct. As a Laurier student you are responsible for familiarizing yourself with this policy and the accompanying penalty guidelines, some of which may appear on your transcript if there is a finding of misconduct. The relevant policy can be found at Laurier's [academic integrity](#) website along with resources to educate and support you in upholding a culture of integrity. Ignorance is not a defense.
- 5. Classroom Use of Electronic Devices:** see [Policy 9.3](#) (Approved by Senate March 8, 2012).

6. **Late Assignment Policy:** Late assignments are not accepted. Students who are ill and who miss the deadline for assignments must submit a doctor's note to the instructor to have the work accepted. Work that is not submitted to the proper Dropbox will not be marked.
7. **Final Examinations:** Students are strongly urged not to make any commitments (i.e., vacation) during the examination period. Students are required to be available for examinations during the examination periods of all terms in which they register. Refer to the Handbook on Undergraduate Course Management for more information.
8. **Foot Patrol, the Wellness Centre, and the Student Food Bank:**

**Multi-campus Resource:**

- Good2Talk is a postsecondary school helpline that provides free, professional and confidential counselling support for students in Ontario. Call 1-866-925-5454 or through 2-1-1. Available 24-7.

**Kitchener/Waterloo Resources:**

- [Waterloo Student Food Bank](#): All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.
- [Waterloo Foot Patrol](#): 519.886.FOOT (3668). A volunteer operated safe-walk program, available Fall and Winter daily from 6:30 pm to 3 am. Teams of two are assigned to escort students to and from campus by foot or by van.
- [Waterloo Student Wellness Centre](#): 519-884-0710, x3146. The Centre supports the physical, emotional, and mental health needs of students. Located on the 2<sup>nd</sup> floor of the Student Services Building, booked and same-day appointments are available Mondays and Wednesdays from 8:30 am to 7:30 pm, and Tuesdays, Thursdays and Fridays from 8:30 am to 4:15 pm. Contact the Centre at x3146, [wellness@wlu.ca](mailto:wellness@wlu.ca) or @LaurierWellness. After hours crisis support available 24/7. Call 1-844-437-3247 (HERE247).

**Brantford Resources:**

- [Brantford Student Food Bank](#): All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.
- [Brantford Foot Patrol](#): 519-751-PTRL (7875). A volunteer operated safe-walk program, available Fall and Winter, Monday through Thursday from 6:30 pm to 1 am; Friday through Sunday 6:30 pm to 11 pm. Teams of two are assigned to escort students to and from campus by foot or by van.
- [Brantford Wellness Centre](#): 519-756-8228, x5803. Students have access to support for all their physical, emotional, and mental health needs at the Wellness Centre. Location:

Student Centre, 2nd floor. Hours: 8:30 am to 4:15 pm Monday through Friday. After hours crisis support available 24/7. Call 1-884-437-3247 (HERE247).

### **Guidelines for Technology use During Class and During Course Assessment**

- Adhering to the University's policy on the use of electronic devices (see above) it is important for you to realize that the use of electronic devices such as cellphones, laptops, and tablets for non-academic use during lectures, labs, and assessments is prohibited.
- Answering messages, using social networking sites, or gaming are distracting practices that reduce the ability for you to learn the material that is provided. You are a distraction to others in the room as well as the instructor, so electronic devices will only be used for academic purposes.
- I'll request that your cellphone is turned off and put away during lectures, midterm and exams so you do not distract others, and so that your potential for learning is increased. If you have personal reasons that require the use of a cellphone for emergency contact reasons, please contact me to discuss them so we can make appropriate arrangements

### **General Regulations**

#### **Course Drop Dates**

Please refer to the Undergraduate Academic Calendar - Academic Dates Fall term 2019 - for details of course add/drop dates, etc.

#### **Accessible Learning Centre**

Students with disabilities or special needs are advised to contact Laurier's Accessible Learning Centre for information regarding its services and resources. Students are encouraged to review the Calendar for information regarding all services available on campus.

#### **Learning Services**

There is a range of academic learning support services offered at Laurier designed for all students who want to improve their academic achievement in the classroom. These services include the following specific areas:

- Central Academic Advising Office
- Mathematics Assistance Centre
- Study Skills and Supplemental Instruction Centre
- Writing Centre

Visit the Learning Services web page for detailed information.

#### **Laurier Email Account**

Our official means of communication is with your Laurier email account. Students are expected to regularly check their Laurier email account for important notices from the university community. Students are also expected to send emails to official members of the university community from their Laurier email account in order to ensure delivery.

### **Missed Assignments**

An assignment not handed in receives a mark of 0, unless there is a documented reason. If a documented reason is supplied, the weight of the missing assignment is shifted to the final exam. A copy of the documented reason must be given to and approved by the instructor.

### **Other course policies**

- Students will have two weeks after a mark is posted to dispute the mark. After two weeks, no changes will be made. It is the responsibility of the student to ensure all grades are posted in MyLearningSpace.
- Grades will not be changed after the final exam has ended regardless of circumstances. If you are missing your marks email the instructor immediately.
- If you are unable to write the midterms please contact your Course Instructor.
- Students must pass the combined weighted average for midterm and final exams to pass the course.

For other potential course policies refer to the [Academic Calendars](#) or The Handbook on Undergraduate Course Management.