

CS488/688 - Introduction to Computer Graphics - Winter 2026

School of Computer Science, University of Waterloo

Instructor: Gladimir V. G. Baranoski, Office DC 3520.

Lecture Days/Times: Tuesday and Thursday, from 4-5:20pm (MC 2038).

Schedule

Week	Date	Activities
2	January 15, Thursday	Assignment A0
3	January 22, Thursday	Assignment A1
5	February 5, Thursday	Assignment A2
6	February 12, Thursday	Midterm (4pm, Room: MC 2038)
7	February 16-20	Reading Week
8	February 26, Thursday	Assignment A3
10	March 12, Thursday	Assignment A4
13	March 31, Tuesday	Project Files
13	April 2, Thursday	Project Awards

Important Notes:

- The deadline for the submission of assignments and project materials is **9AM** on the days specified above as their due dates.
- Assignment and project materials submitted after these deadlines will receive **ZERO** marks. See also Section 8.
- Assignments whose marking requires any action from the course staff to address student's submission mistakes (*e.g.* missing files, files with incorrect names and/or permissions, problems with makefiles ...) will also be treated as late assignments and receive **ZERO** marks.
- Students should contact course staff within the first two week of classes to resolve any issue related to lab access and account on lab machines. Assignments not submitted due to these issues will also receive **ZERO** marks.

• Course Staff

– Instructor:

* Gladimir V. G. Baranoski (gvgbaran@uwaterloo.ca). Office hours to be held on Friday, at 4pm in DC3520.

– Teaching Assistants (TAs):

* Matthew Avolio (mavolio@uwaterloo.ca), office hours: Tuesday, 1-2pm.

* Frank Fan (yuheng.fan@uwaterloo.ca), office hours: Wednesday, 1:30-2:30pm.

Note: TAs' office hours will be held in MC 3007. If a student cannot attend the course staff's office hours **due to time conflicts with regular lectures or tutorials from other courses**, this student should contact the instructor by January 16 to discuss alternatives.

1. Course General Resources

- Learn
- Piazza: <https://piazza.com/uwaterloo.ca/Winter2026/cs488>
- General website:
<http://www.student.cs.uwaterloo.ca/~cs488/Winter2026/index.html>
- Lessons website:
<http://pedrinho.cs.uwaterloo.ca/~gvgbaran/CS488/Winter26/CS488-W26.html>
 - The access to the lessons website is password protected.
 - The password will be released during the first week of classes. It may be subject to change during the term.

2. Course Description

Software and hardware for interactive computer graphics. Implementation of 3-D transformations, clipping and projection routines. Hidden surface removal, colour shading, ray tracing and additional topics if time permits.

3. Course Objectives

At the end of the course, students should be able:

- to write interactive 3D computer graphics programs;
- to understand how linear and perspective transformations are used in modeling and rendering in 3D computer graphics;
- to understand the processes of clipping, hidden surface removal, shading and other rendering techniques;
- to write a simple ray tracer.

4. Required Reading Materials

- CS488/688 Course Notes available in the course general website and selected reading materials (handouts) to be made available in the course Lessons website. For additional reading materials, please refer to the next section.

5. Additional Reading Materials

- A list of selected books covering course contents is available through to library course reserves for CS488/688, Winter 2026. To access reserved e-books, students can use either the course reserves link in Learn or the course reserves link on the library website.

6. General Overview of Topics

- The Graphics Environment
- Mathematical Underpinnings
- Transformations
- Hidden Surfaces and Shading
- Ray Tracing
- Realistic Rendering
- Splines
- Animation

7. Marking Scheme

- Programming component:
 - Assignments: 30%
 - Project: 20%
- Examination component:
 - Midterm: 20%
 - Final: 30%
- General notes:
 - Students must average at least a 50% in both the programming and examination components of the course to pass. Bonus marks obtained in one component are not carried over to the other component. If a student fails to obtain a passing grade on either component, his/her **final grade** is going to be the **grade obtained in that failed component**.
 - The instructor reserves the right, where appropriate, to adjust raw marks downward in the case of cheating and upward in other situations.

8. Assignments and Project Policies

- There will be five assignments (A0 to A4) spread throughout the term. Their specifications will be provided in the course General website.
- A0 is optional. Although it will not be considered in the computation of the course final grade, its submission is recommended so that students can resolve any issue regarding assignment submission procedures. A1 to A4 have the same weight.
- Assignments must be done individually and submitted via **Learn**. In case of any issue related to their submission procedures, the student must contact the TAs before the day scheduled for the activity (assignment or project) using the appropriate means indicated below.
- **All assignments must run either on the graphics lab (MC 3007) Linux machines or in the provided virtual machine (VM) using Virtual Box (Windows) or VMWare Fusion (Mac).** If the student chooses the former, the student should explicitly indicate which lab machine was used for that purpose.
- The assignments employ several code libraries (*e.g.*, OpenGL, ImGui, etc.) whose behaviour can vary depending on the computing environment (*e.g.*, OS, drivers, etc.). It is the students' responsibility to ensure that their assignment code compiles and runs in the provided VM or in the lab machines. Assignments that do not execute in the VM or on one of the Linux PCs will receive **ZERO** marks.
- Students should contact the TAs about concerns with respect to the marking of assignments within two weeks of the date it was first returned to the students. If the issues cannot be resolved between the TA and the student, the TA will inform the instructor, who will make the final decision.
- In case of an infrastructure issue (*e.g.*, student cannot login on the lab machines) that may prevent a student to submit an assignment by its due date, the student must contact the TAs **at least 24h before** that deadline.
- In case of a medical issue preventing a student to submit a course material (*e.g.* assignment, course proposal ...) by its due date, the student should promptly notify the course instructor (before its due date) and provide the appropriate documentation.
- Due to the relatively intense sequence of course assignments, any deadline extension would only transfer and possibly magnify an issue by reducing the time available for the next assignment. Also, no assignment due date can be extended to the exam period due to university regulations. Thus, extensions are **NOT** going to be granted and credit will **NOT** be given to late assignments. Since this course is not mandatory, students should consider very carefully taking it or not the course this term, particularly if they already are planning to take several courses and have other time constraints.
- No assignment screening will be used in this course.
- Students that do not have access to any of the resources required to participate in this course (*e.g.*, Piazza, Learn, etc..) should contact course staff within the first two weeks of classes to address the situation. Students that enrol in the course after **January 16** should contact the course staff no later than **January 23**.
- Regarding lab usage, actions that may prevent or impair the use of the lab machines by other students (*e.g.*, locking one of them to reserve it for future use) are not acceptable. A student responsible for such an action will receive **ZERO** marks in his/her next due assignment or project.
- Although supporting information about software tools (*e.g.*, OpenGL and Lua) to be used in the assignments will be made available to the students in the course General -website, it is also the students' responsibility to be able to employ these tools during the term.

9. Use of Generative AI

- This course includes the independent development and practice of specific skills, such as graphics programming. Therefore, the use of Generative artificial intelligence (GenAI) trained using large language models (LLM) or other methods to produce text, images, or code, like Chat GPT, DALL-E, or GitHub CoPilot, is not permitted in this class, with some exceptions noted below. Unauthorized use in this course, such as running course materials through GenAI or using GenAI to complete a course assessment is considered a violation of Policy 71 (plagiarism or unauthorized aids or assistance). Work produced with the assistance of AI tools does not represent the authors original work and is therefore in violation of the fundamental values of academic integrity including honesty, trust, respect, fairness, responsibility and courage (ICAI, n.d.).
- However, GenAI may be used in the final project to produce assets that do not count as an objective (*e.g.* to generate a 3D model or an image for texture mapping). Students should provide proper acknowledgement of that GenAI use in the project write-up.
- Recommendations for how to cite generative AI in student work at the University of Waterloo may be found through the Library: https://subjectguides.uwaterloo.ca/chatgpt_generative_ai Please be aware that GenAI is known to falsify references to other work and may fabricate facts and inaccurately express ideas. GenAI generates content based on the input of other human authors and may therefore contain inaccuracies or reflect biases.

- In addition, students should be aware that the legal/copyright status of generative AI inputs and outputs is unclear. Exercise caution when using large portions of content from AI sources, especially images. More information is available from the Copyright Advisory Committee:
<https://uwaterloo.ca/copyright-at-waterloo/teaching/generative-artificial-intelligence>
- Students are accountable for the content and accuracy of all work that they submit in this class, including any work supported by GenAI.

10. Course Delivery Approach

- For this offering (Winter 2026), we will have in-person lectures. Course delivery will consist mostly of traditional lectures with occasional use of slides and technical demonstrations.
- The instructor may also release in the course Lessons website reading materials associated with the contents covered in each lecture. These materials will be made available **after** the respective lectures. For specific questions directly related to these materials, students should attend the instructor's office hours.
- If a student misses a lecture, or parts of a lecture, the student will be responsible for obtaining the information and materials provided by the instructor during the lecture.
- The course guidelines provided by the instructor (in this course outline or in class) regarding exams, assignments and project **supersede** course guidelines employed in previous terms.
- Absence from a lecture, or part of a lecture, will not be accepted as an excuse for not complying with the course guidelines provided by the instructor.
- In case of any issue regarding information provided by the instructor (in class or made available in the course websites) about course materials and/or activities (*e.g.* specifications for assignments or guidelines for the project), the students should contact the instructor directly to resolve it before the day scheduled for the given activity (*e.g.* exam, assignment hand-in or project submission).
- During the lectures, the use of personal computers (or other devices) is NOT allowed, except with explicit instructor's authorization for assessing or recording information being delivered by him during the lecture.

11. Course Communication Policies

- General questions about the contents of this course outline should be addressed to the instructor during his office hours within the first two weeks of classes.
- If a student has any concern about the course delivery procedures and policies, such a concern should be addressed directly with the instructor during his office hours.
- Questions directly related to assignments should be directed to the TAs as indicated in the remainder of this section.
- Assignment-related announcements from the course staff will be provided using Piazza. Piazza posts **NOT** directly related to the assignments will be **removed**.
- Students should use public Piazza posts **only** for general questions about assignments that may be of interest to other students in the course. Assignment implementation details (such as code particulars) must be addressed via private Piazza posts. A breach of this guideline will also be considered a violation of academic integrity and it will be dealt with according to the university procedures described in Policy 71, Student Discipline:
<https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71>.
- Piazza should be used only for issues directly related to the assignments. Piazza is **NOT** a forum for complaints or for feedback regarding the course delivery. Posts or comments on Piazza of this nature, or posts or comments with a negative undertone, **will be removed**. In the event of misconduct, the instructor may temporarily remove a student from Piazza in order to maintain a positive learning environment. In this case, the student should contact the instructor to schedule a meeting to resolve the situation.
- All other course-related announcements from the course instructor will be provided in class. **It is the students' responsibility to ensure that they are up-to-date on reading these announcements.**
- Use the course staff's email for specific issues (*e.g.*, questions about the marking of submitted work) pertaining only to you.
- Issues requiring detailed answers should be addressed during course staff's office hours.

12. Continuity Plans

- In case of a cancellation of in-person classes, the instructor will release in the course Lessons website required reading materials equivalent to the contents covered in each lecture. These materials can be regarded as illustrated transcripts of the traditional lectures. The contents equivalent to one lecture will be released on Tuesdays, and the contents equivalent to another lecture will be released on Thursdays. After the release of the materials for a given Lesson, an announcement will be posted on **Learn** and an email notification will be sent to the students.
- In case of a cancellation of in-person meetings, the course staff's office hours will be held online, with instructions for these virtual office hours (VOH) to be provided via **Learn**.
- During periods in which in-person lectures need to be cancelled, students that have specific questions about the required materials can send an email to the instructor (using the address gvgbaran@uwaterloo.ca, with the subject "CS488/688: Lessons Question"). For questions requiring detailed answers, the instructor will indicate that student should register and attend his virtual office hours.
- The graphics lab will be closed during periods in which in-person lectures need to be cancelled. It is strongly recommended that students prepare for this possibility by setting up the provided VM on their personal computer at the beginning of the term. Assignment deadlines will not be postponed so that students can troubleshoot the VM. Alternative project arrangements will be provided via **Learn**, if it becomes necessary.
- If a period of cancellation of in-person activities overlaps with the scheduled date for the midterm (February 12), the midterm will be replaced by quizzes, with instructions to be provided on the course Lessons website and also via **Learn**.
- If in-person activities are suspended during the final examinations period, the final exam will be carried out online via **Learn**, with instructions to be provided on the course Lessons website and also via **Learn**.
- During periods in which in-person lectures need to be cancelled, the procedures presented in Section 9 will be adjusted accordingly.

13. University Administrative Policies

- **Intellectual Property** Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo. Intellectual property includes items such as:
 - Lecture content, spoken and written (and any audio/video recording thereof);
 - Lecture handouts, presentations, and other materials prepared for the course (*e.g.* PowerPoint slides);
 - Questions or solution sets from various types of assessments (*e.g.* assignments, quizzes, tests, final exams);
 - Work protected by copyright (*e.g.* any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).
 - Course materials and the intellectual property contained therein, are used to enhance a student's educational experience. However, sharing this intellectual property without the intellectual property owner's permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for permission before uploading and sharing the intellectual property of others online (*e.g.* to an online repository).

Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.

Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online. The intellectual property rights owner deserves to know (and may have already given their consent).

- **Mental Health** If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support.
 - **On-campus Resources:**
 - * Campus Wellness <https://uwaterloo.ca/students/health-and-well-being>
 - * Counselling Services: counselling.services@uwaterloo.ca, phone: 519-888-4567 ext. 32655, Needles Hall North 2nd floor, (NH 2401);
 - * MATES: one-to-one peer support program offered by Federation of Students (FEDS) and Counselling Services: mates@uwaterloo.ca;
 - * Health Services service: located across the creek from Student Life Centre, phone: 519-888-4096.
 - **Off-campus Resources**
 - * Good2Talk (24/7): Free confidential help line for post-secondary students. phone: 1-866-925-5454;

- * Here 24/7: Mental Health and Crisis Service Team. Phone: 1-844-437-3247;
- * OK2BME: set of support services for lesbian, gay, bisexual, transgender or questioning teens in Waterloo. Phone: 519-884-0000 ext. 213.

- **Diversity:** It is our intent that students from all diverse backgrounds and perspectives be well served by this course, and that students learning needs be addressed both in and out of class. We recognize the immense value of the diversity in identities, perspectives, and contributions that students bring, and the benefit it has on our educational environment. Your suggestions are encouraged and appreciated. Please let us know ways to improve the effectiveness of the course for you personally or for other students or student groups. In particular:
 - We will gladly honour your request to address you by an alternate/preferred name or gender pronoun. Please advise us of this preference early in the semester so we may make appropriate changes to our records.
 - We will honour your religious holidays and celebrations. Please inform of us these at the start of the course.
 - We will follow AccessAbility Services guidelines and protocols on how to best support students with different learning needs.

14. Additional Information on University Administrative Policies

- **Mental Health:** At the University of Waterloo, we are dedicated to supporting your mental and emotional well-being. Our Counselling Services offer confidential support, including individual counselling, workshops, and crisis intervention. If you're struggling, please reach out for help at 519-888-4096 or visit their website for more information: <https://uwaterloo.ca/students/health-and-well-being/counselling-appointments>
- **Academic integrity:** In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility.
- **Grievance:** A student who believes that a decision affecting some aspect of their university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, <https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70>. When in doubt, please be certain to contact the departments administrative assistant who will provide further assistance.
- **Discipline:** A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for their actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (*e.g.* plagiarism, cheating) or about rules for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate associate dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline: <https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71>. For typical penalties, check Guidelines for the Assessment of Penalties: <https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties>
- **Appeals:** A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes they have a ground for an appeal should refer to Policy 72, Student Appeals: <https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72>
- **Note for students with disabilities and disabling conditions:** The University of Waterloo recognizes its obligations under the Ontario Human Rights Code to accommodate students with known or suspected disabilities and disabling conditions (*e.g.* medical conditions, injuries, impacts of trauma such as from violence or discrimination) to the point of undue hardship. To support this obligation, AccessAbility Services (AAS, <https://uwaterloo.ca/accessability-services/>) collaborates with all academic departments and schools to facilitate academic accommodations for students with disabilities and disabling conditions without compromising the academic integrity of the curriculum. If you believe you may require academic accommodations (*e.g.* testing accommodations, classroom accommodations), register with AAS as early in the term as possible by completing the online application: <https://uwaterloo.ca/accessability-services/students/documentation-information-forms>
Students already registered with AAS must activate their accommodations for each of their courses at the beginning of each term using AAS' online system. If you require assistance, contact AAS by phone (519-888-4567 ext. 35082), email (access@uwaterloo.ca) or in-person (Needles Hall North, 1st Floor, Room 1401).
- **Turnitin.com:** Text matching software (Turnitin) may be used to screen assignments in this course. Turnitin is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (*e.g.* scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin in this course.
It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit alternate assignment.