

Spring 2020

CS 438-002: Interactive Computer Graphics

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CS 438 002: Interactive Computer Graphics

Instructor

- **Instructor:** Assoc. Prof. Dr. Przemyslaw Musialski
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- **Office:** GITC 4407
- **Office Hours:** Tu, Th, 2:30pm-4:00pm, or by appointment

Communication

This course uses Canvas for announcements and discussion. If you have questions about the class materials or assignments, requests for clarification, or other issues that may be of interest to the class as whole, post them to the [General Discussion Forum](#). If you have any further questions that you are certain do not belong on Canvas, drop me a message using canvas messaging system: <https://njit.instructure.com/conversations>.

Course Description

This course introduces fundamental concepts of interactive computer graphics and real-time rendering applications like computer games, interactive visualization, virtual and augmented reality, or computer-aided design systems. Topics include the modern GPU graphics processing pipeline, 2d and 3d drawing, geometric data structures and meshes, linear algebra background, transformations and projections, lighting and shading, sampling, interpolation, rasterization, and screen space effects. This course will also discuss a selection of special topics in computer graphics.

Prerequisites

CS 114 or CS 116. The course assignments will be implemented in WebGL which is integrated within the HTML5/CSS/JavaScript environment, thus basic knowledge in programming is required.

Learning Outcomes

The main objective of this course is to teach students the fundamental concepts of interactive rendering in computer graphics. Upon completion of this course students will be able to:

- Understand the stages of the interactive graphics rendering pipeline on the GPU
- Understand the underlying mathematical concepts (linear algebra and geometry)
- Write GPU shaders
- Implement modern interactive rendering applications in WebGL

Textbooks and Material

- **Fundamentals of Computer Graphics, 4th Edition, Publisher: A K Peters/CRC Press; ISBN: 978-1482229394**
by Steve Marschner (Author), Peter Shirley (Author)
- **Interactive Computer Graphics: A Top-Down Approach with WebGL , 7th Edition, Publisher: Pearson; ISBN: 978-0133574845**
by Edward Angel (Author), Dave Shreiner (Author)
- After each lecture, slides and further reading will be posted on CANVAS.

Grading Policy

The final grade is computed as a weighted sum of the programming assignments (Homework), a midterm exam, and a final exam.

- 4 programming assignments (50%)
- Midterm exam (25%)
- Final exam (25%)
- Active class participation is a bonus

Final grade will be composed of 50% programming assignments and 50% exams. The grading scale normalized to 100 is as following (might be subject to adjustments): A: 100-90, B+: 90-80, B: 80-70, C+: 70-60, C: 60-50, D: 50-40, F: 40-0.

Exams

Material allowed for exams (now online in CANVAS in quiz form) is **one letter-size sheet with own, hand-written notes** and a non-programable calculator. Exams will have a duration of 60 minutes.

Assignments

Assignments will have 3-4 tasks where selected code needs to be completed (usually only several lines). Each assignment has its own detailed instructions. Own research on the details of the implementation needs to be conducted. Assignment need to be completed in 10-14 days and submitted via Canvas. On several assignments, bonus points might be accumulated to come up for lost points in previous tasks. The total number of regular points in all assignments cannot be exceeded.

Honor Code

A set of ethical principles governing this course:

- It is okay to share information and knowledge with your colleagues, but
- **It is not okay** to share the code,
- **It is not okay** to post or give out your code to others (also in the future!),
- **It is not okay** to use code from others (also from the past) for this assignment!

Any noticed disregard of these principles will be sanctioned as per the Academic Integrity Policy of NJIT (see below).

Late Policy

- There will be a -7.5% penalty of total regular points for every day the assignment is late.
- Max late submission is 7 days late.

Academic Integrity / Institutional Policies

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: <http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf>.

Please note that it is the professional obligation and responsibility of the instructor to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F,

and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

Schedule*

| Lecture | Week | Date | Topic | Homework |
|---------|---------|-------------|---|--|
| 1 | Week 1 | 1/21 | Introduction | |
| 2 | | 1/23 | Object Representation: Meshes | |
| 3 | Week 2 | 1/28 | Graphics Pipeline | |
| 4 | | 1/30 | Graphics Programming (WebGL) | A1: Setup WebGL and Simple Drawing |
| 5 | Week 3 | 2/4 | Linear Algebra and Geometry (1) | |
| 6 | | 2/6 | Linear Algebra and Geometry (2) | |
| 7 | Week 4 | 2/11 | Transformations (1) | |
| 8 | | 2/13 | Transformations (2): Assignment 2 | A2: 3D Content and Transformations |
| 9 | Week 5 | 2/18 | Projections and Viewing (1) | |
| 10 | | 2/20 | Projections and Viewing (2) | |
| 11 | Week 6 | 2/25 | Lighting and Shading (1) | |
| 12 | | 2/27 | Lighting and Shading (2) | |
| 13 | Week 7 | 3/5 | Assignment 3 Overview | A3: Camera Setup and Shading |
| | Week 8 | 3/10 | Midterm Review | |
| | | 3/12 | Midterm Exam (canceled due to COVID 19 shutdown) | |
| | | <i>3/17</i> | <i>Spring Recess</i> | |
| | | <i>3/19</i> | <i>Spring Recess</i> | |
| 14 | Week 9 | 3/24 | Texture Mapping (1) | |
| 15 | | 3/26 | Texture Mapping (2) | |
| 16 | Week 10 | 3/31 | Bump Mapping | |
| | | 4/2 | Midterm Exam | |
| 17 | Week 11 | 4/7 | Environment Mapping | |
| 18 | | 4/9 | Assignment 4 and Exam Review | |
| 19 | Week 12 | 4/14 | Rasterization, Clipping | |
| 20 | | 4/16 | Clipping, Antialiasing, Culling | A4: Texture and Normal Mapping |
| 21 | Week 13 | 4/21 | Screen Space Effects | |
| 22 | | 4/23 | Geometry and Tessellation Shaders | |
| 23 | Week 14 | 4/28 | Ray Tracing and Global Illumination | |
| 24 | | 4/30 | Final Exam Review | |
| | | 5/11 | Final Exam, Room 221, 11:30am | |

*Please note it could be subject to adjustments.