Syllabus

Computational Fabrication — CSE 556 Winter 2025

Summary

This course introduces students to the new and exciting field of computational design and fabrication, which is currently laying the foundations on which the next generation of manufacturing workflows and systems will be built. We will cover the essential computational tools of every stage in the computational fabrication pipeline: from hardware and its abstraction to the high level specification methods of design and their interactions with designers and engineers. Topics include concepts of hardware abstraction languages, geometry processing fundamentals, physics-based simulation, optimization techniques, data-driven design methods, and algorithms for high-performance interactive applications.

Instructor: Adriana Schulz, She/Her
TA: Amy Zhy, She/Her

Prerequisites

- A good working knowledge of Python programming
- Basic linear algebra (matrices and vectors)
- Some mathematical sophistication
- No prior knowledge of manufacturing is assumed

Communication

- See website for updates on lecture topics, calendar and lecture slides: `https://courses.cs.washington.edu/courses/cse556/25wi`
- Assignments will be posted and submitted via CANVAS
- We will use Ed for a discussion board (link available via CANVAS)

1 Policies

This syllabus is designed to be a guideline for the course and these policies are subject to change.

Grades

- 40% Assignments
- 45% Course Project
- 15% Participation
- No final exam

Note on grade curves: The number and level of difficulty of the assignments was designed to avoid needing to create curves when mapping percentages to a 4.0 scale. We reserve the right to curve the grades if needed (this is, after all, the first version of the class) but we want to note that this is not our intention from the beginning. We have no exams and ample opportunity for extra credit; we therefore expect to be able to use a linear scale.

Assignment Policies

- Initial code and libraries will be provided for all assignments. A writeup should be submitted via CANVAS for each assignment, with all code pushed to your course-assigned individual repositories, by the due date.
- **Collaboration policy** Discussions are encouraged but implementations and write-ups must be done *individually*. Students are encouraged to meet up and discuss assignments. They can write ideas or pseudo-code on paper or a whiteboard during discussions but they may *not* take any code or notes away from those conversations. A good rule of thumb is the Gilligan's Island Rule[1]. Please indicate in your writeup any discussion group you participated in.
- **Late policy** Assignments must be submitted by 7:59pm on the listed due date. Late days are measured in periods of 24 hours. You have 5 late days with no penalty for the whole quarter but can use no more than 3 for any given assignment. Beyond this, late assignments will lose 25% credit per day (additive). Days are measured in periods of 24 hours (no special considerations about weekends outside of the fact that the TA may not respond to Ed questions during that period). Please read the details carefully under **"Don't suffer in silence"** below.

1.1 Course Project

Groups of 3 or 4 are required; special accommodations may be possible. The project is worth 45 points (45% of the final grade). There will be 3 presentations, each worth up to 5

[1]The Gilligan's Island Rule: This rule says that you are free to meet with fellow student(s) and discuss assignments with them. Writing on a board or shared piece of paper is acceptable during the meeting; however, you should not take any written (electronic or otherwise) record away from the meeting. After the meeting, engage in a half hour of mind-numbing activity (like watching an episode of Gilligan's Island), before starting to work on the assignment. This will assure that you are able to reconstruct what you learned from the meeting, by yourself, using your own brain.

points, and all the students in the group will receive the same grade for the presentations. Not all students need to present. The presentations are as follows: project pitch (5 points), mid-quarter check-in (5 points), and final presentation (5 points). The project outcomes will be worth $30 \times N$, where N is the number of students in the group. Students will submit the rubric for grading the outcomes when they submit the pitch. Students can decide how the points will be distributed among the members of the group. Below is the rubric for the presentations. Below is the rubric for the presentations:

Project Pitch (5 pts)

- Students should propose what they want to do for their final project. Meetings with the instructor prior to the pitch are encouraged.
- Students should prepare one slide and speak over it for exactly 1 minute. They may have additional supporting slides to reference if requested during the Q&A.
- Grading Rubric:
  - **Motivation (1 pt):** Is the topic well-motivated? Does it align well with the course topic? Does the proposal include a novel component (e.g., simply implementing existing work would not qualify as a good project)? Do the students understand the state of the art? Is the proposal well-scoped?
  - **Presentation Quality (2 pts):** Were the students able to convey their ideas clearly? Were the illustrations appropriate? When answering questions, did the students demonstrate deep thought about solving the problem and mitigation plans if things go wrong?
  - **Presentation Time (1 pt):** 0 points if the talk exceeds the allotted time.
  - **Q&A (1 pt):** Were the students able to answer questions effectively and thoughtfully?
- There will be one grade for the presentation, and all students in the group will receive that grade, regardless of group size.
- Students should also submit a rubric with their pitch. This will not be graded, but if the instructors have issues with it, they will provide feedback and iterate upon it with the students.

Project Update (5 pts)

- Students should present an update showing that they have made sufficient progress on the project. This presentation will occur two-thirds of the way through the quarter, and students should have a working prototype by this time.
- The presentation should also include a list of next steps, clearly outlining how the project will be completed.

- Students should prepare one slide and speak over it for exactly 1 minute. They may have additional supporting slides to reference if requested during the Q&A.
- There will be one grade for the presentation, and all students in the group will receive that grade, regardless of group size.
- Grading Rubric:
  - **Progress (2 pts):** Have the students shown sufficient progress?
  - **Scope and Execution Plan (1 pt):** Do the students have a clear plan for completing the project? If the topic has shifted, is it still aligned with expectations?
  - **Presentation Quality (1 pt):** Were the students able to convey their ideas clearly? Were the illustrations appropriate?
  - **Presentation Time (1 pt):** 0 points if the talk exceeds the allotted time.

Final Project Presentation (5 pts)

- Students should prepare a slide deck to present their final results.
- Grading Rubric:
  - **Motivation Recap (1 pt):** Was the motivation clearly explained? Could all students understand it?
  - **Solution/Method/Results (1 pt):** Was the solution thoroughly discussed?
  - **Evaluation (1 pt):** Did the students validate their findings? Is it clear how the method performs, scales, or compares to prior work?
  - **Discussion (1 pt):** Are the limitations clearly understood?
  - **Presentation Time (1 pt):** 0 points if the talk exceeds the allotted time.

1.2 Lab Policies

- As part of the second module (fabrication) two lectures will be held in the fabrication labs. Attending these labs will not only be an exciting opportunity for hands-on fabrication experience, but it will also help complete the third homework. For this reason, students are strongly advised to not be absent.
- Students are welcome to use the lab space to work on their projects, provided they adhere to all safety guidelines and complete the required training protocols.

1.3 Participation Policies

- Engaging in class discussion is essential for one of the key learning objectives of this course: to reflect on computational solutions that will enable the next-generation design tools for manufacturing that fundamentally change what can be made, and by whom. **Since there are no scheduled exams and the coding assignments can only**

reflect a small portion of the topics discussed in class, the participation grade is designed to reflect this key learning objective.

- Students will be awarded one participation point for every lecture they are *actively* present, participation is measured using "Duck Points".

  Participating Ducks, or "Duck Points" Each student will receive one rubber duck at the beginning of the quarter, which they should keep and return by the end of the quarter. During each class, the student can throw the duck to the lecturer when they engage in class discussion — engagement means either asking or answering a question. The lecturer will keep the "participating ducks" at the front of the classroom until the end of class. At the end of the class, the TAs will take note of all the ducks that are up front and give their owner students a participation point for that lecture. **Note:** Adriana is known to have no chance at a career as a catcher. You will get your participation point whether or not she is able to catch your duck at the first throw, but she will be very excited if she is able to do it so you should try to make it easy on her ;)

- A full score will be given to students that accumulate at least 13 "Duck Points". Since there are 18 scheduled lectures this quarter (the last lecture will not count), this means that students can be absent for up to 5 lectures with no penalty. Under extenuating circumstances, students will be able to get a participation point for a missed lecture by submitting a report on the lecture they have missed. See the details under **"Don't suffer in silence"** below.

- There is no extra credit for participation. You can keep track of your grade on CANVAS (it is set up as 15 assignments where we drop the worse 5 grades). Please check CANVAS from time to time and let the TA know if there is a mistake (as these can happen with ducks flying around :).

Use of AI Tools Policy

Students are encouraged to utilize AI tools such as ChatGPT and Copilot to support their learning and homework completion. However, any work submitted must be original and must not be represented as the sole product of the student. When employing AI tools, students are required to include a detailed discussion that addresses the following points:

1. **Utilization of AI Tools:**

   - Detail how and where the tool was implemented. Elaborate on why the tool was chosen and whether it helped in achieving the set goals.
   - *Example:* What prompts were utilized to obtain the final result? Were there instances when the tool failed? Was there a need to iterate on prompts? Did the tool reduce development time or aid in resolving impediments? Was it instrumental in overcoming a block?

2. **Interpretation of Results:**

    - Explain the methods used to verify the correctness of the obtained result.
    - *Example:* Could you interpret what the generated code was intended to do and perform a sanity check to ensure it accomplished the goal? Or did you run the code and validate that it worked on the examples provided?

3. **Impact on Learning Experience:**

    - Reflect on how utilizing AI tools affected your grasp of the subject matter.
    - *Example:* Did it allow you to concentrate on core class concepts, such as geometric and mathematical ideas, with the AI handling computational details, or did it hinder learning by solving problems and eliminating the need to engage with key geometric insights?

2 Supporting Students

Extenuating circumstances: "Don't suffer in silence!"

We recognize that our students come from varied backgrounds and can have widely-varying circumstances. Our ultimate goal is to help every student be successful in the course. Extenuating circumstances can include physical or mental health and wellness, work-school-life balance, familial responsibilities, military duties, unexpected and unavoidable travel, or anything else beyond your control that may negatively impact your performance in the class. While we want to make sure all students feel comfortable reaching out to the staff under extenuating circumstances, we have two important concerns:

1. People come from diverse backgrounds and therefore may be more or less likely to feel comfortable asking for special accommodations. Policies that set up harsh deadlines but then are flexible to all students who reach out to ask for special accommodation lead to students not being treated equally and can impact students from diverse backgrounds negatively. To this end, we have decided to make policies for handling extenuating circumstances explicit as part of the syllabus. We also designed this policy so that students do not have to disclose specifics of their circumstances to the staff, which may cause additional discomfort.

2. Students who are suffering from extenuating circumstances often require additional support. UW has many resources in place to support such students and it is our duty as instructors to make sure that students who are struggling do in fact reach out to those resources so that they can get the support they need. Therefore we clearly outline what types of exemptions we are willing to make directly and which ones cannot be granted without the supervision of staff dedicated to supporting students.

We outline such policies below.

Accommodating late assignments beyond the late day policy As previously mentioned you get 5 "free" late days to use throughout the quarter (no more than 3 per assignment). In case of unforeseen or extenuating circumstances when students need more time to finish the assignment beyond the free late days, students should email the staff mailing list, and say:

> "I am dealing with extenuating circumstances and need support for turning in my next assignment. I am already using Y of my "free" late days on this assignment, but I will need X days beyond that, so I am requesting to turn it in on the requested date = [due date + X + Y]. "

This request will be granted if the staff is able to accommodate the extra burden of grading (date $\leq$ March 13) and if one of the following is true:

- $X \leq 3$ and this is the first or second time in the quarter the student has reached out requesting extra time for an assignment. (This should support students who are struggling with a one-off unenforceable circumstance but do not require additional support).
- We receive an email from DRS requesting special accommodations (This should support students who need special accommodations.)
- A CSE academic advisor (or equivalent from another department) is cc'ed in the email and follows up to say "I have been in touch with the student and I am working with them to support them in this extenuating circumstance. I think it is appropriate for the Staff of CSE 556 to grant this exception if it is possible." (This should support students are dealing with extenuating circumstances but have reached out to the UW resources and are getting the appropriate support). I you need help getting in touch with advising, we would be happy to assist.
- A research advisor (or another faculty mentor within UW) is cc'ed in the email and follows us to say "I am aware of this request and think it is appropriate for the Staff of CSE 556 to grant this exception if it is possible." (This should support students who need special accommodations but are getting the appropriate support from another faculty mentor.)

Policy for accommodating missed lectures: If you have to miss lectures and want to make up for participation grade, you can submit a report on the lecture that you missed. Please note that we cannot guarantee that recordings will be available and you may need to reach out to colleagues or the TA for help understanding the lecture you missed. In case of unforeseen or extenuating circumstances, student should email the staff mailing list, and say: "Because of personal circumstances, I had to miss class X and I would like to submit this report (attached) to show that I understand the material that was covered." Please *include*the TAs and do *not* disclose the specific circumstances in your email. All reports must include all topics discussed in the class, and must be submitted by March 13. We will accept up to 5

reports. If you need to submit more that 5 reports (that means you will miss more that half of the quarter), we recommend you contact the advisors or DRS.

Policy for accommodating missed labs: Missed labs are very hard to make up and students will definitely miss out on the experience, so we urge students to try their very best to attend labs. That said, we will allow students to submit a report for a missed lab. In case of unforeseen or extenuating circumstances, student should email the staff mailing list, and say: "Because of personal circumstances, I had to miss lab X and I am submitting my report with extra details to show I understood what the lab was about." If you need to miss more than ONE lab, we recommend you contact the advisors or DRS.

Disability Resources for Students

Your experience in this class is important to us. If you have already established accommodations with Disability Resources for Students (DRS), please communicate your approved accommodations to the instructor at your earliest convenience so we can discuss your needs in this course. If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but are not limited to: mental health, attention-related, learning, vision, hearing, physical or health impacts), contact DRS directly to set up an Access Plan. DRS facilitates the interactive process that establishes reasonable accommodations. Contact DRS at disability.uw.edu.

Religious and Disability Accommodation Policy

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy. Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form. Please refer to university policies regarding religious and disability accommodation at the following links:
`http://depts.washington.edu/uwdrs/current-students/accommodations/`
`https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/`

Lecture Recordings

This course is scheduled to be fully in-person, but lectures will be recorded. Because technical issues with recordings may arise, we cannot guarantee that all lectures will be made available offline and therefore students are strongly encouraged to attend classes unless they are unable due to extraordinary circumstances.

Privacy Note: The recording will capture the presenter's audio, video, and computer screen. Student audio and video will be recorded if they share their computer audio and video during the recorded session. The recordings will only be accessible to students enrolled

in the course to review materials. These recordings will not be shared with or accessible to the public. The University and Zoom have FERPA-compliant agreements in place to protect the security and privacy of UW Zoom accounts. Students who do not wish to be recorded should: Change their Zoom screen name to hide any personal identifying information such as their name or UW Net ID, and not share their computer audio or video during their Zoom sessions.

Sick Policy

To keep everyone safe, please stay home if you are sick or feel sick. We will make special accommodations to ensure there is no incentive for students to come to class while sick.