15-463, 15-663, 15-862
Computational Photography, Spring 2023
Final project instructions

Key deadlines

- Apr 21: Project ideas due (email the instructor and cc the TAs).
- May 10: Project proposal due on canvas. No change of project after this date
- May 24: Mid term progress report due on canvas.
- May 30: Project video due on canvas.
- Jun 5: Project report PDF due on canvas.

Key logistics

Teams: Final projects must be done individually, no teams are allowed. If you want to work on a team (maximum 2), the work has to be significantly stronger than a single project and both students have to identify their individual contributions and submit their individual contributions separately.

Imaging hardware: Final projects can (and are encouraged) to make use of imaging hardware (cameras, projectors, lights, depth sensors, light field cameras, special lenses, and so on). If you already have access to such equipment, then great! If not, the teaching staff will likely be able to provide it, but you should talk to us in advance. Shipments to Hanover are taking significantly longer than expected. Therefore, please follow up with the instructor/TAs meticulously to get the hardware on time.

Project ideas (Apr 21)

Each student will email the teaching staff up to three ideas (at least one) for a final project. The subject of the email should be CS73/273: final project. The description of each idea should be short, about one paragraph. The teaching staff will follow up on the emails, with feedback on each idea (whether it is of the right scope for a final project, whether it is too ambitious given the project timeline, and so on). We encourage you to submit the maximum number of ideas, so that you have more options for your eventual project proposal.

Type and scope of final projects: These are intentionally left very open-ended. It could be re-implementing and thoroughly evaluating a published computational photography research paper in scenaria not covered in the paper itself. It could be creating a new computational photography algorithm to produce some visual effect you find interesting. It could be using simple or advanced imaging equipment in some unconventional way. It could be proposing a modification to an existing computational photography system (software, hardware, or both) that you believe could result in some significant improvement. Especially in a field such as computational photography, the possibilities are very diverse and numerous. **Note:** It

cannot be something you already built for a previous course or project. If you want to use the final project to aid a current project you are working on, you are welcome to do that. However, please mention the same to the teaching staff.

Coming up with project ideas: Imagining something exciting and new to do as a project is *hard*, which is why we encourage you to start early. Below are a few pointers that can help you come up with exciting and important ideas. You should also take advantage of office hours between now and the due dates for your ideas and proposal, to discuss potential final project topics with the teaching staff.

- Most lectures (often near their end) include teasers of advanced subjects that relate to the lecture's overall theme. These subjects are not discussed in detail, but the references at the end of the lecture provide pointers to related literature. You can follow up on those pointers.
- If the overall theme of some lecture strongly appealed to you, you can do a literature search to find more recent papers in that area, and peruse those for ideas. Good starting points for your literature search are the related sections in the Szeliski textbook (listed at the end of lecture slides as references), as those almost always discuss key recent advances and papers. Google Scholar is also your friend, especially the option to show citations of a paper, which you can use to search through recent research on topics and papers we discuss in class lectures.
- You can look at final projects from previous offerings of CMU computatational photography course (Fall 2020, Fall 2021), as well as other, related, courses.
- You can binge-watch videos on the ICCP YouTube channel, to find talks and related papers and research topics that strongly appeal to you.

Below are some pointers to specific topics that the teaching staff find intriguing and suitable for a final project for this class (most of them make some use of hardware).

- **Fun with projectors:** direct-global separation, dual photography, structured light 3D scanning, optical computing, optical gradient descent.
- **Fun with speckle:** seeing through stuff, motion tracking, tampering detection.
- **Fun with flashes:** flash no-flash pairs, non-photorealistic camera.
- **Fun with polarization:** depth sensing, dehazing.
- **Fun with lightfields:** unstructured lightfields, pinhole lightfield camera, build your own plenoptic camera, motion estimation, shape estimation, reconstructing transparent objects, schlieren photography.
- **Fun with motion blur:** flutter shutter.
- **Fun with apertures and defocus:** coded aperture, confocal stereo, extended depth of field, focal flow, depth from focus on your phone, depth from defocus in the wild.
- **Fun with cheap lenses:** imaging with cheap lenses, depth from cheap lenses.
- **Fun with stereo and dual pixels:** edge-aware stereo, depth from dual pixels, synthetic defocus on stereo and monocular mobile phones.
- **Fun with shading:** exemplar-based shape and material, shape, illumination, and reflectance from shading, near-light photometric stereo.
- **Fun with lensless cameras:** diffuser cam.
- **Fun with hyperspectral cameras:** DIY hyperspectral imaging-1, computational periscopy, accidental pinholes.
- **Fun with photography:** wide-angle portraits, computational zoom, white balancing on mobile phones.

- **Fun with the image processing pipeline:** implement your own, invert it.

Project proposal (May 10th)

The written project proposal should be a PDF of size between 1-2 pages, to be submitted on canvas. It should have at least the following sections and content:

- **Title.** Provide the title of your project.
- **Summary.** Summarize your project in no more than 2-3 sentences. Describe what you plan to do and what will be learned.
- **Background.** Describe in 1-2 paragraphs why this project is hard, useful, and/or interesting.
- **Resources.** Describe the resources (cameras and other imaging hardware, starter code, dataset, any special computing resources, etc.) you will use. If you are building off of an existing codebase, or an existing hardware setup, please explicitly say so. If there are any books or papers that you are using as references, please provide the citations. Make sure to explain what data (images, videos, etc.) you will use to evaluate your results. If you are doing a hardware project, explicitly mention so and list what equipment you will need. Please also explain whether you already have access to these resources, or whether you would like teaching staff to provide them to you.
- **Goals and deliverables.** Describe the deliverables or goals of your project. Make sure to separate your goals into what you *plan to achieve* (that is, the minimum set of goals you believe must be reached for the project to be successful), as well as what you *hope to achieve* (additional goals you would like to see happen if the project goes really well).
- **Schedule.** Provide a tentative schedule for your project. List what you plan to get done each week from now until the project due date.

Midterm report (May 24th)

Your midterm report, should be a PDF of length up to 2 pages (for CS73) or up to 4 pages (for CS273), plus any additional pages for references. Your report should be written as a CVPR paper, both in terms of content and in terms of formatting (you can use the CVPR author kit for the formatting. The report should clearly mention the progress made so far and the next steps for the remaining 6 days. This report is not evaluated but you will loose 5% of the project credit if the report is not submitted on time. The goal of this report is to keep the teaching staff aware of the current state of your project

Final deliverables: video (May 30) and project report (Jun 5)

There are two final deliverables for your project: A project report, and a project presentation video. Both should be submitted on Gradescope.

Project report: Your final report, should be a PDF of length up to 4 pages (for CS73) or up to 8 pages (for CS273), plus any additional pages for references. Your report should be written as a CVPR paper, both in terms of content and in terms of formatting (you can use the CVPR author kit for the formatting).

Project presentation video: You should prepare a video of duration 5 minutes where you record yourself presenting your final project. This will require preparing a set of presentation slides and a narration script. Think of the video as a recording of a presentation you would give about your project to an audience consisting of your instructors and classmates. You can use the ICCP 2022 video instructions for technical information on how to prepare your video (e.g., formatting, file extension, recording software). Obviously, the ICCP time limits do not apply to you.

Special Thanks

Most of the writeup is verbatim from Ioannis Gkioulekas 15-463: Computational Photography and used with his permission. Some of this write-up is inspired from Kayvon Fatahalian's final project instructions for 15-769: Visual Computing Systems.