OPTI 600C: Computational Photography
Effective Spring Semester 2023

Course Description:

The modern cell phone has enormous image acquisition and computational power. Computational photography blends computer algorithms with traditional photography to create images that are not feasible with traditional digital imaging. This course examines several computational photography techniques to familiarize students with recent advances in the field.

Pre-requisites:

The course uses python and jupyter notebooks, with a preference for notebooks on Google Colab. See https://colab.research.google.com/notebooks/basic_features_overview.ipynb for an introduction to Colab. To use colab, students should be familiar with the basic structure of Python, as discussed for example in

- https://www.youtube.com/watch?v=rfscVS0vtbw
- https://www.youtube.com/watch?v=t8pPdKYpowI
- https://www.youtube.com/watch?v=XKHEtdqhLK8
- https://www.courseraorg/search?query=python& (all the links)

The course is not a programming course, however. Rather it uses short interactive Python scripts in Jupyter notebooks for camera data analysis and processing. Python libraries of particular importance to the course include numpy, scipy, scikit image, opencv-python, tensorflow, keras and pytorch. Students may find it useful to review online tutorials and videos relating to these libraries.

Number of Units/ component: 1
Instructor Information:

David J. Brady
Meinel 429

djbrady@arizona.edu
Office hours: By Appointment

Expected Learning Outcomes:

- Ability to manipulate digital images in software and to extract useful information from them.
- Apply computational techniques to create images that are infeasible with hardware alone.
- Understand algorithms used in photographic imaging
- Ability to use artificial neural networks in camera control and image processing

Required Texts:
Course notes will be available on the course website.

Topics and/or general calendar:

Tentative Lecture Schedule:

1. Sampling strategies used in digital imaging, representation of continuous images in discrete form.
2. Color filter arrays and video sampling
3. Artificial neural netoworks: CNN and attention
4. Control and reinforcement leaning
5. Focus, focus control and depth of field
6. Exposure control and high dynamic range imaging
7. Video sampling and high frame rate imaging
8. Array camera design
9. Image stitching
10. Focus in array cameras
11. Spectral imaging

Number of Exams and Papers:

Exams and papers will not be used for this class. Evaluation of knowledge will be done with a series of progressively more sophisticated homework assignments that require the student to implement the concepts discussed in that week's class and apply the knowledge to real world problems.

Course Policies:

Grading Policy

The final grade will be comprised of a total of five homework assignments.

Homework(5 assignments total)	100%
Total	100%

The grade will be determined according to the cumulative percentage earned such that 90-100% = A, 80-89% = B, 70-79% = C, 60-69% = D, below 60% = E.

Academic Integrity (http://web.arizona.edu/~studpubs/policies/cacaint.htm)

According to the Arizona Code of Academic Integrity, "Integrity is expected of every student in all academic work. The guiding principle of academic integrity is that a student's submitted work must be the student's own." Unless otherwise noted by the instructor, work for all assignments in this course must be conducted independently by each student. Co-authored work of any kind is unacceptable. Misappropriation of exams before or after they are given will be considered academics misconduct.

Misconduct of any kind will be prosecuted and may result in any or all of the following:

- Reduction of grade
- Failing grade

- Referral to the Dean of Students for consideration of additional penalty, i.e. notation on a student's transcript re. academic integrity violation, etc.

Attendance Policy

It is important to attend all classes, as what is discussed in class is pertinent to adequate performance on assignments and exams. If you must be absent, it is your responsibility to obtain and review the information you missed. This is especially important in this course where a substantial amount of course material will emerge through class discussion.

"All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion. Absences pre-approved by the UA Dean of Students (or Dean's designee) will be honored."

Classroom Behavior

The Arizona Board of Regents' Student Code of Conduct, ABOR Policy 5-308, prohibits threats of physical harm to any member of the University community, including to one's self. See: http://policy.web.arizona.edu/threatening-behavior-students.

Students with Disabilities

If a student is registered with the Disability Resource Center, he/she must submit appropriate documentation to the instructor if he/she is requesting reasonable accommodations. (http://drc.arizona.edu/instructor/syllabus-statement.shtml).

The information contained in this syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.