GOAL
Given a portrait image as input, and a user-specified lighting configuration - produce a new version of the image where the original illumination of the portrait has been changed so that it corresponds with the new, desired lighting configuration.

STRETCH GOAL Extend the project to work for both still images and video streams.

RELATED LITERATURE
GENERATING A 3D MODEL FROM A 2D IMAGE


**ADDRESSING EXISTING LIGHTING CONDITIONS**


**STYLE TRANSFER**


**GENERAL APPROACH**

Of the many methods that could apply to this project, e.g. CNN transfer learning, I am most interested in a hybrid geometry- and image-based approach. A tentative approach is as follows, though the specifics may change with further research:

1. use existing computer vision libraries to extract feature data from the image
2. use this feature data to (a) estimate body/facial positioning and (b) construct a rough 3D model of the subject
3. construct a GUI (or plug-in for modeling software) that allows a user to place and manipulate lights, and save lighting configurations
4. given a lighting configuration as input, apply it to the 3D model
5. matching the 2D feature data to their corresponding points on the 3D model,
   (a) remove as much of the original lighting as possible, then (b) transfer the color/lighting of the 3D model back to the 2D image

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*For example, a lighting configuration could correspond to an array of lights (directional, point, or spot light), where each light contains information about (a) direction, (b) distance, (c) intensity, and (d) hue.*
TIMELINE

There are 12 weeks remaining in the semester. I propose the following timeline:

RESEARCH/EXPLORATION (3 weeks) (September 19 - October 10)

1. Various methods have been proposed to construct 3D models from a single portrait image. A selection of these methods are mentioned at the top of this proposal. During this research phase, I plan to consolidate and explore these different methods, comparing their relative feasibility and successes - and ultimately single in on a method or combined method to use within this project (ideally at least two methods, to cross-compare results).
2. Further research methods to address sub-components of this project. In particular, research feasible methods for: hair modeling, removing lighting information from a 2D portrait image, dynamically separating the figure/portrait from the image background, and how to address/modify the background so that it still appears cohesive with new portrait lighting.

EXECUTION (7 weeks) (October 10 - November 28)

1. Implement the method(s) settled upon during the research phase. Connect all components of the project into one, consolidated pipeline.
2. Document project process through short write-ups every other week (or, if beneficial, more frequently), and images/screenshots of visual progress.
WRITE-UP, CLEAN-UP (2 weeks) (November 28 - December 12)
(1) Consolidate and clean-up project code.
(2) Write-up (5-10 pages) a paper that describes the different components of the project, difficulties, and end results.

DELIVERABLES
(1) A 5 to 10-page report, structured like an academic paper, that describes the project goal, process, difficulties, relevant literature, results and future research.
(2) Resulting code, and documentation describing (a) how to run the code, (b) how the code works, (c) any necessary packages, and (d) information about the machine/setup used to achieve results described in the report.