

CS 6953-001 Spring 2025 Deep Learning Capstone

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List of 3 Projects

1. **PhotoNodes Project** - Intelligent Simple Object Detection and Anonymous Privacy Protection Feature for unclassified images/photographs loaded to a project and gallery
2. **Blyncsy** - Deep Learning-Driven 3D Reconstruction, Data Synthesis, and Size Estimation for Road Signs
3. **Blyncsy** - Deep Learning for Estimating Lane Line Quality Using Retroreflectometer Ground Truth

PhotoNodes Project

My interest in this project comes from the fact that I will be able to create an end-to-end pipeline for privacy detection from model training to implementing a rule-based frontend for Admin UI. I am also excited about the synthetic data generation, and I think the biggest challenge for this project comes in creating this data that lets the model generalize to complex scenarios. This of all the projects, I think, will end up having a lot of immediate application which is motivating to me.

Qualifications/Background

I have some experience during research in working with deep learning in computer vision specifically in contrastive learning and image generation tasks. I understand the complete process of training a deep learning model in general and understand from pre-training the contrastive models that, there are a few well trained open source models that can be used by fine-tuning on the current task. From my coursework in Natural Language Processing and working on my own LLM based projects I'm well trained on working with state of the art token based transformer models, of which there are a lot of impressive models available open source. From my hobby, I am also well versed in building general

web applications using frameworks like react, nextjs which will make it easy in building the UI tool.

Strategy

1. Synthetic Data Generation

- a. My approach for data generation would be to use python libraries like OpenCV, PIL to create these images.
- b. We can use parameterized 3D models using blender which with various parameters will produce different views of the credentials
- c. We can have various 3D models of different real life credential tags and apply them to various background images
- d. We can apply transformations to simulate real life distortions like changing the lighting conditions, transformations, background noise, camera angles etc.
- e. We can super-impose these credentials onto real life backgrounds.

2. Deep Learning Model Development

- a. Credential Detection – We can use transformer based models like *Segment Anything (SAM)* to segment different objects in the image and identify the credentials.
- b. Text Recognition – We can use any popular OCR model to identify the text from the segments obtained during credential detection
- c. Privacy Protection – Using the information obtained from above we can build a model that uses the text/image information to predict if the credential should be protected.
- d. Also based on the information above we can either use a classification model or a generative model to do automated tagging and metadata generation to then apply it on to image.
- e. Using web frameworks like Django, Flask we can build the whole pipeline which based on the rules performs tasks to apply protection on only certain things.

I am clearly missing a lot of implementation details right now, but as I progress, I believe I am skilled enough to find the relevant information from my peers and resources online.