

## Final Project

150 Points

**Overview:** The goal of this final project is to design, execute, and report on a computational experiment that makes use of deep learning models, methods, and workflows. You can choose to undertake a scene classification, semantic segmentation, or anomaly detection task. **You must propose a specific research question and design an experiment to answer this question. The instructor must approve your proposed research question. You must also select an appropriate dataset to use in your experiment. This also must be approved by the instructor.** You can use example datasets from the course webpage on WV View or find an alternative dataset. This is a great list of remote sensing/geospatial deep learning datasets:

<https://github.com/chrieke/awesome-satellite-imagery-datasets>.

Example experiments include:

1. Compare different base architectures (for example, UNet vs. DeepLabv3+, vs. UNet++ for semantic segmentation)
2. Compare different encoder backbones but the same base architecture for a semantic segmentation task (for example, ResNet-34 vs. ResNet-50 vs. MobileNetv2).
3. Augment a base architecture, such as by using alternative activation functions or adding additional module(s) (for example, replace ReLU with leaky ReLU or swish or add attention gates to UNet).
4. Compare different training strategies (for example, create/compare DataLoader samplers or means to balance the training set)
5. Compare different loss functions (for example, Dice vs. Tversky vs. Cross Entropy vs. weighted cross entropy)
6. Compare different learning rates or learning rate schedulers (consistent learning rate vs. one-cycle learning vs. oscillating)
7. Experiment with augmentation methods (for example, varying the number and intensity of augmentations)
8. Incorporate dropouts
9. Experiment with transfer learning
10. Etc.

## Deliverables

1. An .ipynb or Quarto file that contains all of the code to implement your experiment.
2. A website rendered from a .ipynb or Quarto file. The website should read like a research paper and include a Title, List of Authors, Introduction, Background, Methods, Results/Discussion, Conclusion, and List of References. The code will primarily be included in the Methods section and should include text that explains all components of the experiment using Markdown. You should include tables/figures throughout to explain your workflow, experiment, and results. All tables/graphics should be of publication quality.

## Grading

### Code

1. Your code is correct and commented throughout, and the experiment is correctly implemented. I would suggest providing your .ipynb/Quarto file without any text and with comments throughout. I would then create another version that includes all the text and with the code cleaned and simplified. (30 Points)

### Website

2. The website includes an Introduction section that clearly explains the purpose of the study. (Up to 15 Points)
3. A Background section is provided that describes the architectures, encoders, or general architecture components implemented. You should also discuss at least five other related studies. (Up to 20 Points)
4. A Methods section that clearly explains the methods used to conduct the experiment including input data characteristics, data partitioning, architecture configuration, training and assessment routines, and assessment metrics. This section should include your code (Up to 20 Points)
5. A Results and Discussion section that is aligned with your research question. (Up to 20 Points)
6. Quality figures and tables should be included throughout to enhance the text. They should be polished and of publication quality. All figures and tables must include captions and be cited in the text. (Up to 20 Points)
7. A Conclusion that clearly summarizes the findings. (Up to 5 Points)
8. Include a reference section and citations throughout. (Up to 10 Points)
9. Overall, the paper should be polished, coherent, and grammatically/stylistically professional. (Up to 10 Points)

**Note:** You can choose to use your own data for this final project. However, please discuss the data/project with the instructor beforehand to make sure they are suitable.

**Note:** You can propose an alternative final project. If so, you will need to submit an official proposal to the instructor that describes the research question being explored, the input data being used, and the general methods to implement. Alternative final projects must be approved by the instructor.