Nick Harbeck
Xinyu Yao

DATS 6203 Group Proposal

For the DATS 6203 final project, we will explore public satellite images from the United Kingdom Defense Science and Technology Laboratory[1] to detect different classes of surface features, including:

1. **Buildings** - large building, residential, non-residential, fuel storage facility, fortified building
2. **Misc. Manmade structures**
3. **Road**
4. **Track** - poor/dirt/cart track, footpath/trail
5. **Trees** - woodland, hedgerows, groups of trees, standalone trees
6. **Crops** - contour ploughing/cropland, grain (wheat) crops, row (potatoes, turnips) crops
7. **Waterway**
8. **Standing water**
9. **Vehicle Large** - large vehicle (e.g. lorry, truck, bus), logistics vehicle
10. **Vehicle Small** - small vehicle (car, van), motorbike

Satellite image classification is a powerful tool for understanding our world and can help to accomplish tasks like mitigating the effects of climate change[2] or finding opportunities to increase efficiency in the energy sector[3].

The dataset contains 25 satellite images, 1km * 1km, in both 3-band and 16 band formats. Each picture has objects labeled and described in the form of polygons, making it a good opportunity to use a convolutional neural network (CNN) to do object detection and semantic segmentation.

Deep networks such as U-Net and Mask R-CNN will be used. We will try the standard form of the networks first, and then customize it according to certain difficulties for the dataset. The U-Net[4] and Mask R-CNN[5] paper will provide sufficient background on applying the chosen networks to satellite image interpretation.

Our project will use Pytorch to build a convolutional neural network customized and optimized for the dataset. Pytorch is convenient for creating CNN architecture and may offer higher

---

[1] Data from https://www.kaggle.com/c/dstl-satellite-imagery-feature-detection/overview
[2] Land use, land-use change, and forestry is an important greenhouse gas inventory sector that can sequester and release significant amounts of carbon emissions according to the United Nations Framework Convention on Climate Change (UNFCCC).
[3] "How AI Can Calculate our Oil Surplus...From Space." *Wired,* 2015, https://www.wired.com/2015/03/orbital-insight/.
[4] Mask R-CNN arXiv:1505.04597 [cs.CV]
[5] U-Net: Convolutional Networks for Biomedical Image Segmentation arXiv:1703.06870 [cs.CV]

classification accuracy through fine-tuning compared to other submissions for the original competition that relied on high-level Keras libraries. Pytorch will also allow us to customize the network for optimizing image classification by tuning the hyperparameters or modifying the network layers.

The Kaggle competition page contains many examples and resources to help guide our exploration, analysis, and model optimization. Similarly, the way that we will measure the performance of our model will also come from the Kaggle competition with the Jaccard Index.

The schedule for this project is below:

Exploratory analysis and data preparation: April 1-10
Model building and Optimization: April 11-17
Finish Report and Presentation: April 18-22