Water Body Mapping using Image Segmentation

Please make this document anonymous. Your team name should be anonymous.

Team name: ***Watermap***

Note: when submitting this document to Gradescope, make sure to add all other team members to the submission. This can be done on the submission page after uploading (top right).

If you need to find team members, please use the thread under 'Final Project - Find Teammates' on Ed—pitch an idea!

Proposal Instructions

For your project proposal, please submit a one-to-two page document answering the questions below.

- What are the skills of the team members? Conduct a skill assessment!
  - Team Member 4
    - Experience in TensorFlow
    - Deep learning
    - Lots of free time
  - Team Member 2
    - Solid background in cloud computing, we'll need a lot of compute horsepower (multi-GPU training)
    - Familiar with TensorFlow, PyTorch frameworks
    - Took Deep Learning (CS1470) Machine Learning (CS1420)
  - Team Member 3
    - knowledge on subject matter
    - Object detection algorithm
    - Idea pitching
    - took Deep learning class and taking machine learning for Environment (EEPS 1960D)
  - Team Member 1
    - A few experience in Tensorflow
    - Full-stack development

- What is your project idea?

  Our project idea is identify bodies of water using semantic segmentation of satellite images. The ecosystem of the Earth depends on surface water. It is necessary for the survival of all living things and serves as a good indication of environmental change. Many scientific tasks, such as surface water inventory mapping, water estimation for drinking and irrigation purposes, land use/land cover (LULC) mapping and change, rely on accurate and up-to-date information about the spatial distribution of surface water. It is very important to regularly update the surface water map to track trends over time. Manually masking water bodies is a very time consuming task, so automating this task would be very useful.

  There are multiple strategies for semantic segmentation. One simple method is use thresholding. However, this runs into problems because it may incorrectly classify shadows as water, resulting in poor performance in urban or hilly areas. Therefore, we will attempt to use deep learning to help to classify water bodies and extract them efficiently with higher accuracy. More specifically, we will aim to construct a modified U-Net model, with an encoder and a decoder.

- What is the socio-historical context that this project lives in?

  Usable land is coming at more and more of a premium, as humanity continues to take over more and more. With this, it is very helpful to keep track of how we are using the limited land and water resources we have available. Perhaps we will be able to identify and correct sources of inefficiency.

- Please list three groups of people that your project could impact, and describe how it could impact them.

  - Research Institute: Our data will be base data for researcher and hydrologist to do more research, Our data can be used for studying change in water bodies over time. It can be used for studying environmental change
  - Government: Government can use our data mapping inventory, Land use/land cover mapping which will be base map for developmental works.
  - Farmers: Farmers and policy maker will use our data for water estimation for drinking and irrigation purposes.

- What data will you use?

  We have two datasets: One is Super resolution Landsat satellite imagery which was obtained from Planet data(3m) and another is water mask for labelling the data obtained from 30m resolution satellite imagery

  - 30 meter resolution Landsat satellite imagery: This data comes with masks identifying the bodies of water.
  - 3 meter resolution Landsat satellite imagery: This data is not labelled, but is more detailed.

- What software/hardware will you use?

  Software

  - Python/Tensorflow

  Hardware

  - Local machines for preliminary-development
  - GCP for training the models at at later stage
  - One of our team member has a Nvidia RTX-3090 GPU, this will really accelerate the training times.

- Who will do what?

  - **Data Prep**
    - **Image Labelling** - We will need to manually create masks for our unlabelled data: Evenly distributed
    - **Splitting images** - Because the data contains very large images, we will need to split them into smaller pieces (perhaps 600x600): Team Member 1
    - **Creating test and training split**: Team Member 2
  - **Implementation** - Assuming we will create an architecture based on U-Net:
    - **Model design**:Team Member 3
    - **Pre-processing**: Team Member 4
    - **Encoder**: Team Member 4
    - **Decoder**: Team Member 4
  - **Data Analysis**: Team Member 3
    - **Accuracy Assessment**: Testing on the data which was not used during training: Team Member 2
    - **Compare results to thresholding**: Team Member 1

- How will you know whether you have made progress? What will you measure?

  We can calculate loss by comparing the generated masks with the labelled masks we created. We can then measure the loss while doing training. If the loss gets smaller we can say that our algorithm is making progress.

- What technical problems do you foresee or have?

  - Lack of time for training the algorithm – the images, in particular the super-resolution ones, are very large, and may cause our model to train very slowly. One possible workaround for this is to manually split the images into smaller ones and then stitch them back together at the end.
  - low number of labelled data
  - Under-fitting if low data, Over-fitting without regularization

- Is there anything that we can do to help? E.G., resources, equipment.

  - Theoretical and some implementation help from the TA's who have taken the class
  - Some more GCP credits for training the models at at later stage

Feel free to use these as paragraph headings, and also please include any media, references, etc.

After Proposal Submission

Proposal Swap

After handing in your project proposal, your team will receive another team's proposal, and they will receive yours (remember to make your document anonymous).

Given the other team's proposal, your team must critique their understanding of their project's impact, and devise a list of potential socially-responsible computing concerns with their project. These should be written up in a document, and submitted on Gradescope the same day Progress Report 1 is due.

The other team will do the same for your team's proposal and project idea.

Your team will then receive the other team's critique of your project proposal. Your team must respond to this critique as a graded part of your Final Project Report.

TA Assignment

After handing in your project proposal, your team will also be assigned a TA to assist you. You should aim to meet with your TA once a week; this replaces TA office hours.

If you haven't heard from your TA a few days after the project proposal handin, please make a private Ed post and let us know which team you're on.

In your first meeting with your TA, your goal is to have your idea sanity-checked:

- Do you actually have the data?
- Do you actually have the compute?
- Is there code you need but don't have access to?
- Is there an area where you need help?

Some of these things will be outlined in your proposals, but talking through it with your TA as soon as possible will help you find potential road blocks and get the ball rolling.