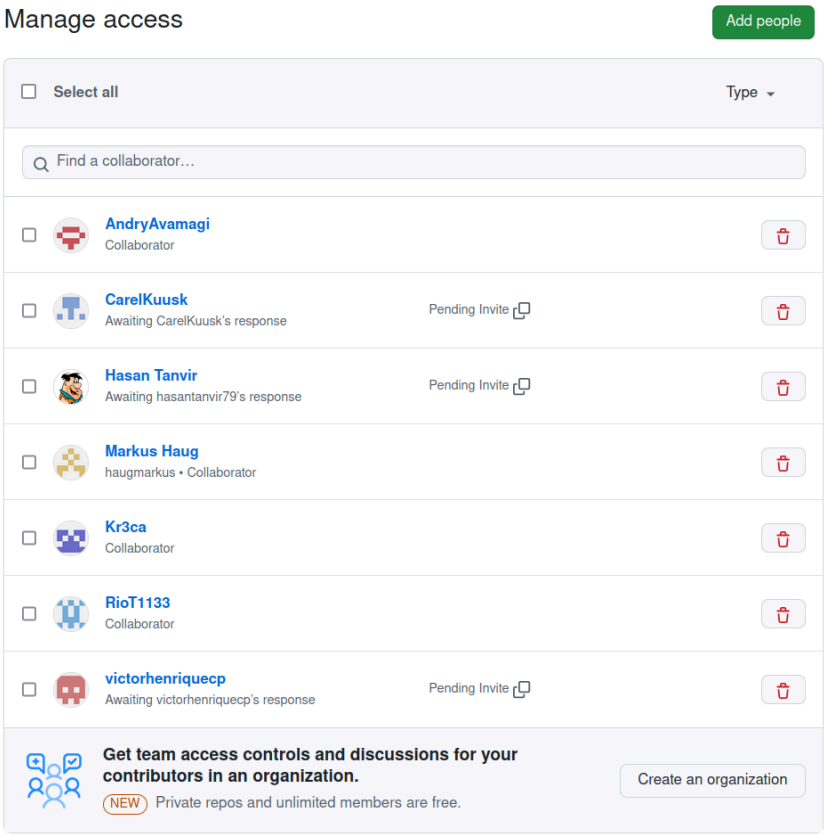
TASK1



Repository link: https://github.com/toomasherodes/orthophoto_mapping

TASK2

Identifying business goals

Background

In Estonia there are laws that permit/disallow building on private/public land. The buildings that need special permits need to be registered and documented in Land Cadastre (Ehitisregister) - that means that almost all big enough buildings are registered in Estonia. All registered objects are also mapped. This is all public information.

Business goals

Identify all man-made buildings from orthophotos with machine learning. Ideally also find all buildings that should be registered but are not.

Business success criteria

We have built a machine learning model that can identify and report all man-made objects on an orthophoto. We have analyzed the model and its results.

Assessing your situation

Inventory of resources

Data about buildings:
https://livekluster.ehr.ee/ui/ehr/v1

Orthophotos:
https://geoportaal.maaamet.ee/est/ruumiandmed/ortofotod-p99.html

Requirements, assumptions, and constraints

With gathered data we assume that each building that is registered has the correct corner coordinates, orthophotos that are publicized as orthophotos are indeed orthophotos (viewpoint straight down, not under an angle) and data is consistent between different government sites. Constraints - we mostly have to rely on registered buildings as adding building coordinates manually is time-consuming.

Risks and contingencies

The model will start identifying all objects or areas of the orthophoto that do not look natural. These include roads, quarries or systematically deforested areas (lageraie) for example.

Terminology

- Building is a structure with a roof and walls, such as a house or factory.
- Orthophoto is an aerial photograph or satellite imagery geometrically corrected ("orthorectified") such that the scale is uniform
- A cadastre or cadaster is a comprehensive recording of the real estate or real property's metes-and-bounds of a country.
- A geographical coordinate is a set of numerical values that specify the exact location of a point on Earth's surface.

Costs and benefits

Orthophotos are free and public data. We do not plan to buy any computing power. We do not plan to use this project within a profitable business. Maybe if the results are really good, we can open-source it.

Defining data-mining goals

Data-mining goals

1) We gather data about registered buildings within a certain area (Tartu)
2) We clean the data, remove all unnecessary features. In our case we get all corner coordinates of all buildings in Tartu and use that as our target training data.
3) We gather orthophotos from a certain area (Tartu). Use them as training data, as we have the correct coordinates of all building corners.
4) We build the model based on gathered data

Data-mining success criteria

We have built a model based on gathered data, that has a recall of 0.9.

TASK3

Gathering data

Data requirements

Two types of data are gathered. Firstly, orthophotos from our area of interest will be downloaded from Maa-amet's webpage, the photos will be in .tif format. We are planning to use photos of some areas in Tartu, but more cities will be used if that proves useful. Secondly we will download data of the buildings in Estonia from Ehitisregister in .csv format and extract coordinates for the corners of buildings. We will filter out the buildings in the regions we are interested in and map them to the photos, providing us with the necessary training data of photos with data about buildings on them. We are planning to go over the photos manually and verify the buildings are correctly marked, dealing with problematic areas if necessary. We are planning to repeat the process with photos from different years to avoid overfitting to a specific year's photos.

Data availability

The data needed is publicly available and can be downloaded for free. The terms of usage also permit using the data for the purposes we intend to. The orthophotos can be downloaded from Maa-amet's webpage, an area code needs to be inserted and a zip file containing the photo will be provided. Data about corners of buildings is not readily available online but can be requested from Ehitisregister. The first 100 lines of the file are available as a sample in our project repository.

Selection criteria

From the orthophoto download page, we are planning to use the area with the code 54752. The csv file with info about buildings contains many unneeded columns such as building id, gis code, entrance coordinates etc. We will only be using the building type column to filter out buildings we are not interested in detecting (for example structures too small), the coordinates of the corners of the building and the date of the building being entered into the system.

Describing data

We have the orthophotos needed for the project. The quality is good and for a human, the houses are easily detectable. We also have the data about buildings in Tartu in csv format. For every building, there is the type, coordinates for all corners and the date it was entered. The coordinates are in WKB format that can be decoded using Python. Filtering out the buildings that are located in Tartu reduced the amount of entries in the file from over two million to about ten thousand. Many of the buildings in the file will still be removed later.

Exploring data

The orthophotos look good and the quality is high. The area covered in a single photo is 25 square kilometers. The data about the buildings in the csv file contains many building types such as “hoone”, “elamu”, “õppehoone”. The date of entry ranges between 2010 and 2023. Below is a line in the csv file corresponding to the Delta building.

Tartu Ülikooli Delta
õppehoone,0103000000010000000700000033333B3F41E2441713D0A3726B35841295C
8F42811F244114AE47E10CB35841AE47E1FA8E1F244114AE47110EB358418FC2F5A84E
1F244148E17A9424B35841295C8FC2AF1F2441C3F528FC2CB3584114AE4761B61F2441
8FC2F5F836B35841333333B3F41E2441713D0A3726B35841,2022-05-28 06:23:03.727344

When decoded, the coordinates of the building are:
[(659322.35, 6474904.86), (659392.63, 6474803.52), (659399.49, 6474808.27), (659367.33, 6474898.32), (659415.88, 6474931.94), (659419.19, 6474971.89), (659322.35, 6474904.86)]

Manually searching them on the Maa-amet map proves that they indeed correspond to the corners of the building.

TASK4

Detailed plan of the project:

- Gather info about all the registered buildings within a defined area from the csv file
    - ~50 hours

- Use this data to generate all the target training data (black and white images - white indicates a building and black indicates no building)
    - ~10 hours, will be done by Rio
- Gather and process orthophotos from the defined area using this api. This will become the input training data for the model.
    - ~10 hours
- Pair the orthophotos with the target training data
    - ~20 hours
- Choose a model to train with this data (deeplabv3 or an U-Net model for example)
    - ~5 hours
- Prepare the model for training
    - ~10 hours
- Tweak the model if necessary (probably necessary)
    - ~15 hours
- Prepare a poster to introduce the project
    - ~5 hours