API Reference

FastAPI

API Version: 0.1.0

Before consuming the endpoints set the variable MODEL_DIRECTORY in .env to a directory that contains model checkpoints (.ckpt). Models outside of this directory can't be used for inference via endpoints.

Command for running the server:

(venv) username@pc:~/lumen-geoguesser$ python3 src/app/main.py

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API

1. AVAILABLE MODELS

All available models from the MODEL_DIRECTORY directory defined in the .env file

1.1 GET /models

Get Models

Returns names of all available models on the server. You must use model names for all POST request predictions. Model name is a stem of the model checkpoint, e.g. model with filename my_model.ckpt has the name my_model. Models are fetched from the directory MODEL_DIRECTORY which is defined in the .env file. Only models with the extension MODEL_EXTENSION are fetched. Model names will be returned instead of the model filenames.

REQUEST

No request parameters

RESPONSE

STATUS CODE - 200: Successful Response

RESPONSE MODEL - application/json

2. PREDICT

Endpoints used for predicting latitude and longitudes for given data.Curl example for multiple images:

curl -i \-F "images=@data/raw/images/train/e788b3d1-9d20-466c-9dee-97982f0f9a3b/0.jpg" \-F "images=@data/raw/images/train/e788b3d1-9d20-466c-9dee-97982f0f9a3b/0.jpg" \http://0.0.0.0:8090/model/Golf_76__haversine_0.0098__val_acc_0.47__val_loss_1.98__05-04-03-36-32/predict-images

2.1 POST /model/{model_name}/predict-images

Predict Images

Infers latitude and longitude for multiple images. If you have a group of images where each image represents one cardinal direction (north, east, south, and west) ("0.jpg", ... , "270.jpg") you should use the `/model/{model_name}/predict-cardinal-images endpoint

REQUEST

PATH PARAMETERS

NAME	TYPE	DESCRIPTION
*model_name	string	

FORM DATA PARAMETERS

NAME	TYPE	DESCRIPTION
images	array of string	

RESPONSE

STATUS CODE - 200: Successful Response

RESPONSE MODEL - application/json

NAME	TYPE	DESCRIPTION
ARRAY OF OBJECT WITH BELOW STRUCTURE		
latitude*	number	
longitude*	number	

STATUS CODE - 422: Validation Error

RESPONSE MODEL - application/json

NAME	TYPE	DESCRIPTION
OBJECT WITH BELOW STRUCTURE		
detail	array	
loc*	array	
ANY:OF	object	
prop0	string	
prop1	integer	

NAME	TYPE	DESCRIPTION
msg*	string	
type*	string	

2.2 POST /model/{model_name}/predict-directory

Read Model

Infers latitude and longitude for all images in the directory (dataset_directory_path) which contains subdirectories (uuid) with images for each cardinal direction. This structure is the same as the structure of the original dataset. Exactly 4 images must be sent per subdirectory and each image filename must match image's cardinal direction ("0.jpg", "90.jpg", "180.jpg", "270.jpg"). E.g northen image should be named "0.jpg". If csv_filename is provided, results will also be saved to a .csv file.

REQUEST

PATH PARAMETERS

NAME	TYPE	DESCRIPTION
*model_name	string	

REQUEST BODY - application/json

NAME	TYPE	DESCRIPTION
csv_filename	string	
dataset_directory_path*	string	

RESPONSE

STATUS CODE - 200: Successful Response

RESPONSE MODEL - application/json

NAME	TYPE	DESCRIPTION
ARRAY OF OBJECT WITH BELOW STRUCTURE		
uuid*	string	
latitude*	number	
longitude*	number	

STATUS CODE - 422: Validation Error

RESPONSE MODEL - application/json

NAME	TYPE	DESCRIPTION
OBJECT WITH BELOW STRUCTURE		
detail	array	
loc*	array	
ANY:OF	object	
prop0	string	
prop1	integer	
msg*	string	
type*	string	

2.3 POST /model/{model_name}/predict-cardinal-images

Predict Cardinal Images

Infers latitude and longitude for a single location which is defined by exactly 4 images, each for one cardinal direction. Exactly 4 images must be sent and each image filename must match image's cardinal direction ("0.jpg", "90.jpg", "180.jpg", "270.jpg"). E.g northen image should be named "0.jpg". This structure is the same as the structure of the original dataset.

REQUEST

PATH PARAMETERS

NAME	TYPE	DESCRIPTION
*model_name	string	

FORM DATA PARAMETERS

NAME	TYPE	DESCRIPTION
images	array of string	

RESPONSE

STATUS CODE - 200: Successful Response

RESPONSE MODEL - application/json

NAME	TYPE	DESCRIPTION
ARRAY OF OBJECT WITH BELOW STRUCTURE		
latitude*	number	
longitude*	number	

STATUS CODE - 422: Validation Error

RESPONSE MODEL - application/json

NAME	TYPE	DESCRIPTION
OBJECT WITH BELOW STRUCTURE		
detail	array	
loc*	array	
ANY:OF	object	
prop0	string	
prop1	integer	
msg*	string	
type*	string	

Technical documentation

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1.1 Notices:

Although you might be reading this documentation in the form of a PDF file, **we highly recommand that you open the README.md file in a markdown editor** (GitHub, VSCode, PyCharm, IDE...). As for the API documentation, after setting up the environment, we recommand you run the server with the `python3 src/app/main.py` command after which you can inspect API endpoints in browser (and execute them too!). Essentialy, the techincal documentation PDF is rendered from the README.md markdown file and export of the in-browser API documentation.

Few more notes:

- the documentation assumes you are located at the `.lumen-geoguesser` directory when running Python scripts
- all global variables are defined in `src/config.py` and `src/paths.py`
- other directories have their own `README.md` files which are hopefully
- you can run most python files with the `python3 program.py -h` to the sense of which arguments you can/must send and what the script actually does

1.2 Directory structure

Directory	Description
data	dataset, csvs, country shapefiles
models	model checkpoints, model metadata
references	research papers and competition guidelines
reports	model stat's, figures
src	python source code

1.3 Setup

1.3.1 Virtual environment

Create and populate the virtual environment. Simply put, the virtual environment allows you to install Python packages only for this project (which you can easily delete later). This way, we won't clutter your global Python packages.

Step 1: Execute the following command: - the command will initialize the `venv` if it doesn't yet exist

```
[ ! -d "venv" ] && (echo "Creating python3 virtual environment"; python3 -m venv venv)

pip install -r requirements.txt
```

1.3.2 Dataset setup

This project allows multiple datasets, therefore multiple dataset directories can usually be sent to `*.py` programs

Step 1: Rename directory `data` **to** `images` - The original dataset strucutre has a directory `data` (e.g `dataset_original_subset/data`) which contains subdirectories with uuids of locations (`dataset_original_subset/data/6bde8efe-a565-4f05-8c60-ae2ffb32ee9b`).

Dataset structure should look like this:

```
dataset_original_subset/
├── images
│   ├── 6bde8efe-a565-4f05-8c60-ae2ffb32ee9b
│   │   ├── 0.jpg
│   │   ├── 180.jpg
│   │   ├── 270.jpg
│   │   └── 90.jpg
│   ├── 6c0ed2ea-b31b-4cfd-9828-4aec22bc0b37
│   │   ├── 0.jpg
│   │   ├── 180.jpg
│   │   ...
│   ...
└── data.csv


dataset_external_subset/
├── images
│   ├── e61b6e5f-db0d-4f57-bbe3-4d31f16c5bc3
│   │   ├── 0.jpg
│   │   ├── 180.jpg
│   │   ...
│   ...
└── data.csv
```

Step 2: Setup datasets with `src/preprocess_setup_datasets.py` - Before running other scripts you have to properly setup new dataset structure using the `src/preprocess_setup_datasets.py` file. It's important to note that this file accepts multiple dataset directories as an argument and it will make sure to merge the datasets correctly. No changes will be done to your original directories.

```
python3 src/preprocess_setup_datasets.py -h

usage: preprocess_setup_datasets.py [-h] [--dataset-dirs dir [dir ...]] [--out-dir dir] [--copy-images] [--spacing
SPACING]

optional arguments:
  -h, --help            show this help message and exit
  --dataset-dirs dir [dir ...]
                        Dataset root directories that will be transformed into a single dataset
  --out-dir dir         Directory where compelte dataset will be placed
  --copy-images         Copy images from dataset directories to the new complete directory.
                        You don't need to do this as later on you will be able to pass multiple dataset directories
to various scripts.
  --spacing SPACING
                        Spacing that will be used to create a grid of polygons.
                        Different spacings produce different number of classes
                        0.7 spacing => ~31 classes
                        0.5 spacing => ~55 classes
                        0.4 spacing => ~75 classes
                        0.3 spacing => ~115 classes
```

Example of running the initial setup script:

```
python3 src/preprocess_setup_datasets.py --dataset-dirs data/dataset_original_subset data/dataset_external_subset
--out-dir data/dataset_complete_subset
```

`preprocess_setup_datasets.py` does all the necessary preprocessing. However, underneath the hood it calls other preprocessing scripts. What happens when you run this script?

1. directory of the new (complete) dataset is created, images are copied if `--copy-images` flag was passed
2. `preprocess_csv_concat.main()` is called which concatenates multiple `data.csv`s into a single `data.csv`
3. this new (complete) `data.csv` is enriched by `preprocess_csv_create_rich_static.main()`. Here, regions (future classes) and their information (centroids, crs centroids...) are attached to each location. Enriched data is saved to a *Rich static CSV* file created called `data_rich_static__spacing_<float>_classes_<int>`.
4. Directory `images` in all directories (including the `complete` one) will be split into `train`, `val` and `test` directories. Note: directory `images` won't be deleted.

New dataset structure:

```
dataset_complete_subset/
├── data.csv
├── images <= exists if the --copy-images flag was passed
└── data_rich_static__spacing_0.5_classes_55.csv


dataset_original_subset/
├── data.csv
├── images
├── test
│   ├── c4a74f0d-7f30-4966-9b92-f63279139d68
│   │   ├── 0.jpg
│   │   ├── 180.jpg
│   │   ...
│   ...
├── train
└── val


dataset_external_subset/
├── data.csv
├── images
├── test
├── train
└── val
```

1.4 Training

After you prepared that new dataset structure you can start the *quick version* of training:

```
python3 src/train.py --dataset-dirs data/dataset_external_subset/ data/dataset_original_subset/ \
--csv-rich-static data/dataset_complete_subset/data_rich_static__spacing_0.7_classes_31.csv \
--quick
```

`--csv-rich-static` can be left out which fill force the *Rich static CSV* creation in the runtime (this will somewhat slow down the initial setup). You can perform the full training by removing the `--quick` flag. Some additional interesting arguments are listed below. Run the `python src/train.py -h` command to see all supported arguments.

```
--image-size
--num-workers
--lr
--dataset-dirs [dir1, dir2, ...]
--csv-rich-static
--unfreeze-blocks
--pretrained
--quick
--batch-size
--optimizer
--regression
```

Example of production training (in our case):

```
python3 src/train.py \
--accelerator gpu --devices 1 --num-workers 32 \
--dataset-dir data/raw/ data/external/ \
--csv-rich-static data/complete/data_huge_spacing_0.21_num_class_211.csv \
--batch-size 8 --image-size 224 --lr 0.00002 \
--unfreeze-at-epoch 1 --scheduler plateau
```

During the training a few things will occur in the `reports/` directory:

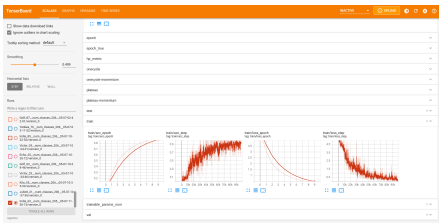
1. `reports/train_*.txt` files will be create which log everything that's outputted to the standard output
2. subdirectory `reports/<model_name>` will be created in which:
    1. `data_runtime.csv` will be created, serves as backup
    2. `version/0` directory which contains:
        1. `hparams.yaml`: details of hyperparameters
        2. `events.out.tfevents*`: log file which tensorboard consumes
        3. `checkpoints`: the most important subdirectory, contains model checkpoints (trained models)

```
reports/<model_name>/
├── data_runtime.csv
└── version_0
    ├── checkpoints
    │   ├── mymodel_checkpoint1.ckpt
    │   └── mymodel_checkpoint2.ckpt
    ├── events.out.tfevents.*
    └── hparams.yaml
```

1.5 Logs - Tensorboard

Tensorboard logging is enabled by default. To see training and validation logs, run the command bellow. Logs should be available in browser at `http://localhost:6006/`. For more options check `tensorboard -h`.

```
tensorboard --port 6006 --logdir reports/
```



1.6 Local server

Local server is useful when you are trying to do inference on a trained model. The sever code and config live in `src/app` directory.

Before running the sever set the variable `MODEL_DIRECTORY` in `src/app/.env` to a directory which contains (or will contain) model checkpoints (`.ckpt`). Models outside of this directory can't be used for inference via endpoints. We recommend creating new directory called `models` and copying model checkpoint files (e.g. `reports/<model_name>/version_0/checkpoints/mymodel.ckpt`) to this directory.

Step 1. copy model checkpoints to /models/

```
mkdir models
cp -r reports/<model_name>/version_0/checkpoints/* models/
```

Step 1.1. ensure that the `MODEL_DIRECTORY` variable is set in `src/app/.env` file:

```
cat src/app/.env
```

Step 2. run the server:

```
python3 src/app/main.py
```

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/openapi.json

Before consuming the endpoints set the variable `MODEL_DIRECTORY` in `.env` to a directory that contains model checkpoints (.ckpt). Models outside of this directory can't be used for inference via endpoints.

Command for running the server:

```
(venv) username@pc:~/lumen-geoguesser$ python3 src/app/main.py
```