neat-EO.pink :
Computer Vision framework for GeoSpatial Imagery

@o_courtin
Cybernetic Loop, Norber Wiener, ~1940s
Earth Observation

** Widely Used:** Govs Agencies, NGOs, Scientists, Companies, Farmers...

**Huge Data:** ~100To / Day

**Wasted Data:** ~80% of acquired pixels remains unused
From Pixels to Insights
Supervised Learning

Input -> Neurals Network -> Output

Loss Function
Supervised Learning

Output

Input

Neurals Network

Trained Model

Loss Function

Output
A Trained model?

\[ a_0 + a_1 X^1 + a_2 X^2 + \cdots + a_n X^n \]

Polynom

Weighted Graph

Lossy Data Compression

Grey Box
Computer Vision framework for GeoSpatial Imagery
Neurals Network

Input

Trained Model

Loss Function

Output

Alternate DataSet

Quality Analysis

Compare
Neat WebUI to ease compare

Pink: Predicted by trained model

Green: Alternate dataset

Grey: Both agree

Spotify significative differences
Change Detection

Neurals Network

Loss Function

Trained Model

Output

Input

Alternate Input

Output

Alternate Output

Compare
Command Line Interface

Tools:

- **neo cover** Generate a tiles covering, in csv format: X,Y,Z
- **neo download** Downloads tiles from a remote server (XYZ, WMS, or TMS)
- **neo extract** Extracts GeoJSON features from OpenStreetMap .pbf
- **neo rasterize** Rasterize vector features (GeoJSON or PostGIS), to raster tiles
- **neo subset** Filter images in a slippy map dir using a csv tiles cover
- **neo tile** Tile raster coverage
- **neo dataset** Perform checks and analyses on Training Data Set
- **neo train** Trains a model on a dataset
- **neo export** Export a model to ONNX or Torch JIT
- **neo predict** Predict masks, from given inputs and an already trained model
- **neo compare** Compute composite images and/or metrics to compare several XYZ dirs
- **neo vectorize** Extract simplified GeoJSON features from segmentation masks
- **neo info** Print Neat-EO.pink version informations
Easy to deploy

pip3 install neat-EO
- Install neat-EO
- Download data
- Data Preparation
- Training
- Inference
- Compare to OSM
- Spotify differences areas
- Vectorize features

https://github.com/datapink/neat-eo.pink/blob/master/docs/101.md
So all you need is:

- Imagery → any file format readable by GDAL
- GPU → NVIDIA > 8Go VRAM
- Labels → usually the key point
Quality Analysis on DataSet Training

Output

Input

Neural Network

Loss Function

Trained Model

Output

Labels

Compare
WebUI BuildIn Binary Selector
What’s new?
Metatiles option on predict

Without

With (but x3 time slower)
Multi GPUs efficient scaling

neo train
neo predict

Allow to scale to x8 GPUs
Including auto weighted unbalanced classes option
- Predict Imagery DataSet must be quite related to the training one

- Still need about thousands labels per class (as a rule of thumb)

- Don’t deal (for now) with topology, so behave badly on connected stuff (as roads)
Request For Funding

- Increase again accuracy
  - Low Resolution
  - Topology

- Reduce significantly amount of needed labels (weakly supervised)

- Improve again performances
Open Source AI4EO

**rastervision**
An open source framework for deep learning on satellite and aerial imagery.

**eo-learn**

**RoboSat**
Generic ecosystem for feature extraction from aerial and satellite imagery

**Solaris**
An open source ML pipeline for overhead imagery by CosmiQ Works
Why using neat-EO.pink?

- GIS Standards compliancy
- Easy Data Preparation
- Build-In WebUI
- Modular and extensible
- Handle MultiBands Imagery and DataFusion
- High Performances
- Accurate (state of art Computer Vision)
Human Learning

https://neurovenge.antonomase.fr/NeuronsSpikeBack.pdf

http://cs231n.stanford.edu/

http://www.numerical-tours.com/python/

http://www.math.ens.fr/~feydy/Teaching/culture_mathematique.pdf  [FR]
Extract insights from GeoSpatial data with Deep Learning

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Take Away

- Industrial OpenSource AI4EO Imagery framework available

- Performances already OK to use it on regions or countries

- No need anymore to be a Computer Vision expert to use it

- Plain OpenData can be use to train accurate model

- Funding and Pull Requests can make the difference