Deepness: Deep Neural Remote Sensing QGIS Plugin

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Space Data Management Workshop
Who we are

• I’m with the Poznań University of Technology, Institute of Robotics and Machine Intelligence, Computer Vision Lab
• Our research focus are intelligent, autonomous machines – perception, planning and action – with extensive use of AI
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Motivation – why?
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people without
machine learning knowledge
Motivation – why?

people without machine learning knowledge

people without machine learning knowledge who benefit from/want to use machine learning
Motivation – why?

people without machine learning knowledge who benefit from/want to use machine learning

our target users
Motivation – why?

*We want to democratize access to the potential created by deep learning applications by facilitating their use with remote sensing data without expert knowledge.*
How?

• We want appeal to a large base of users
  • Prioritize familiar user experience
  • Free, open-source software
  • Easily extendable with new models and functionalities
  • Provide quality documentation, tutorials etc.
How?

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  ✓ Prioritize familiar user experience
  ✓ Free, open-source software
  ✓ Easily extendable with new models and functionalities
  ❏ Provide quality documentation, tutorials etc.

• We can check the first three boxes with QGIS
  • Free, open-source GIS toolbox
  • Large user base
  • Easily extendable with plugins
  • Very wide range of applications
What?
Deepness: Deep Neural Remote Sensing QGIS Plugin

- Available through QGIS Python Plugin Repository for easy installation (reaching 3000 downloads)
  - https://plugins.qgis.org/plugins/deepness/

QGIS Python Plugins Repository

Deepness: Deep Neural Remote Sensing

<table>
<thead>
<tr>
<th>Version</th>
<th>Experimental</th>
<th>Minimum QGIS version</th>
<th>Downloads</th>
<th>Uploaded by</th>
<th>Date</th>
</tr>
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<tbody>
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</table>

Inference of deep neural network models (ONNX) for segmentation, detection and regression
Deepness: Deep Neural Remote Sensing QGIS Plugin

• Open-source, with GitHub repository
  • https://plugins.qgis.org/plugins/deepness/
• Anyone can contribute and is welcome to do so
  • All levels of expertise welcome, there’s always something we can improve
Deepness: Deep Neural Remote Sensing QGIS Plugin

- Comprehensive documentation with examples and tutorials
  - [https://qgis-plugin-deepness.readthedocs.io/](https://qgis-plugin-deepness.readthedocs.io/)
- Very important but often neglected part of any software
- Documentation for any type of user
  - Using the plugin
  - Developing NN models
  - Plugin development
Deepness: Deep Neural Remote Sensing QGIS Plugin

• QGIS supports a lot of data sources
  • Satellite, aerial and UAV
  • A range of modalities and data types
  • Maps, surveying results

• Anything that can be represented as a layer and rasterized, can be an input to the neural network
  • Input images
  • Annotations

• Outputs are also QGIS layers
Deepness: Deep Neural Remote Sensing QGIS Plugin

• Model support is provided for the portable QNNX format
• Uses a GPU if the system provides one (will install all necessary software automatically)
Deepness: Deep Neural Remote Sensing QGIS Plugin

• Deepness supports all major inference task types
  • Segmentation (binary, semantic, instance, …)
  • Detection (object bounding boxes, circles, …)
  • Regression (probability density, vegetation indexes, …)
  • You can set area of interest for all the above tasks

• Deepness enables easy export of data
  • Set the area of interest
  • Set channels of interest
  • Set tile size and stride
Deepness: Deep Neural Remote Sensing QGIS Plugin

• Typical Deepness workflow
  • Load data
  • Select input layers
  • Select a model for inference
  • Select model’s parameters (or stick with the defaults)
  • Run processing
  • Review/save results
# Deepness: Deep Neural Remote Sensing QGIS Plugin

- **Available models**

<table>
<thead>
<tr>
<th>Function</th>
<th>GSD [cm]</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land cover segmentation</td>
<td>40</td>
<td>Trained on landcover.ai data, with classes for woodlands, buildings, water, roads</td>
</tr>
<tr>
<td>Corn field damage segmentation</td>
<td>3</td>
<td>Trained on an in-house dataset of data containing annotations for wildlife-induced corn plants damage</td>
</tr>
<tr>
<td>Road segmentation</td>
<td>21</td>
<td>Uses Google Earth images as input, generates binary mask</td>
</tr>
<tr>
<td>Airplane detection</td>
<td>70</td>
<td>YOLOv7-tiny version trained on the Airbus Airplane Detection dataset</td>
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<tr>
<td>Oil storage tank detection</td>
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<td>YOLOv5-m version trained on Airbus Oil Storage detection dataset</td>
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<tr>
<td>Car detection</td>
<td>10</td>
<td>YOLOv7-m for car detection on aerial imagery, trained on ITCVD dataset</td>
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</table>
Summary

• We have the software up and running and it’s a good base for further development of deep learning models in a wide range of different Earth Observations tasks

• Additional models are on the way, most of them suggested by potential end users:
  • Forest fire probability prediction
  • Biomass content prediction for grazing
  • Heat islands detection and tracking in urban areas
  • Land fertility prediction from hyperspectral data

• We intend to shift focus to model development, but suggestions for additional functionalities are welcome

• We hope to increase the community involvement
Thank you for your attention

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