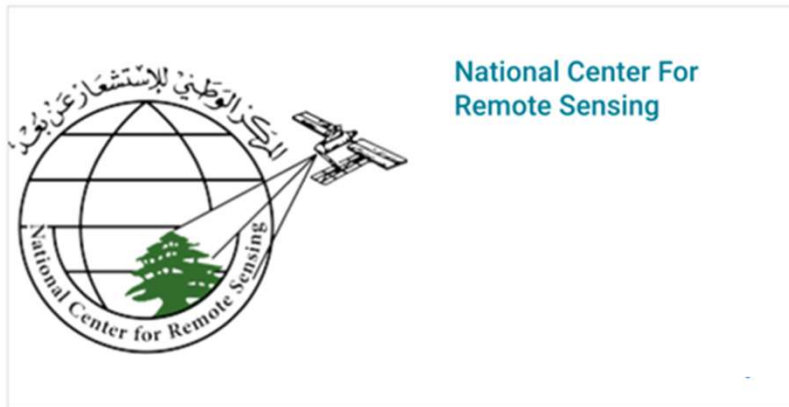
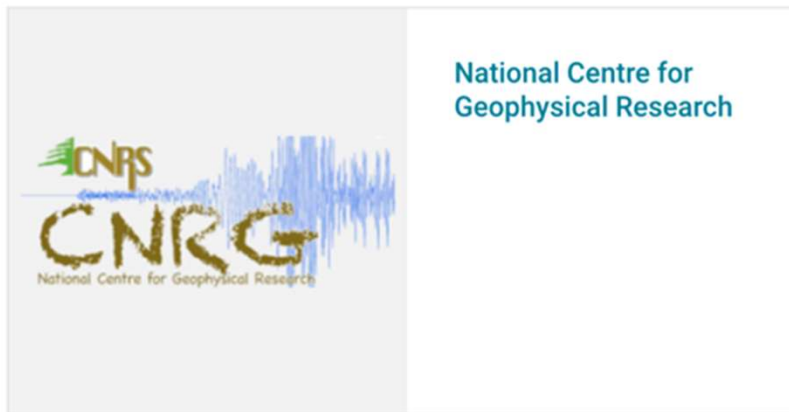


How SAM would revolutionize geospatial applications?

Ali Ghandour, PhD

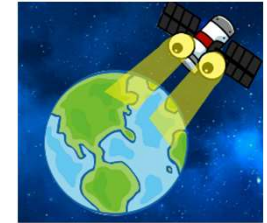
26 May 2023

CNRS-L Research Centers

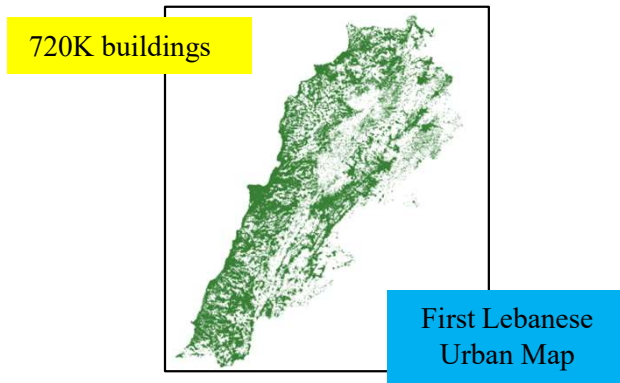


GEOspatial Artificial Intelligence (GEOAI)

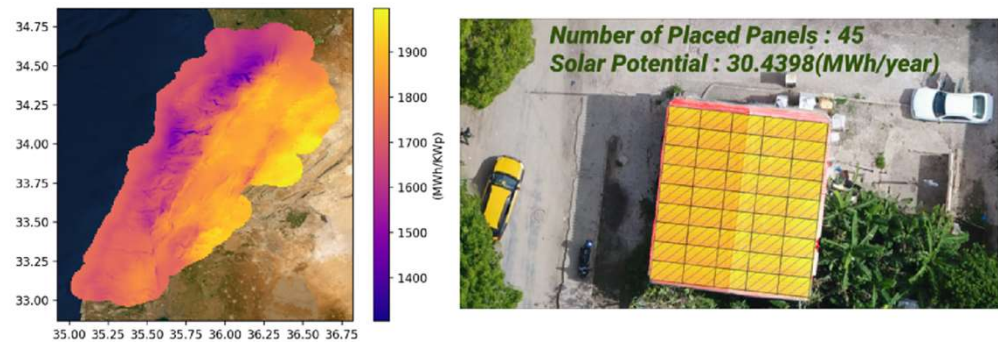
www.geogroup.ai



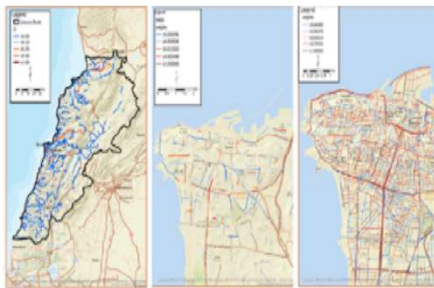
Urban-AI Mapping



Solar rooftop potential map



Road Crashes Observatory



Water Body Monitoring



Crop Monitoring



The idea and practice of looking down at the Earth's surface emerged in the 1840s

- Cameras secured to tethered **balloons** for purposes of topographic mapping
- **Pigeon fleet** as a novel platform that operated in Europe
- Cameras mounted on **airplanes** for aerial large views (military reconnaissance)



Balloons (1868)



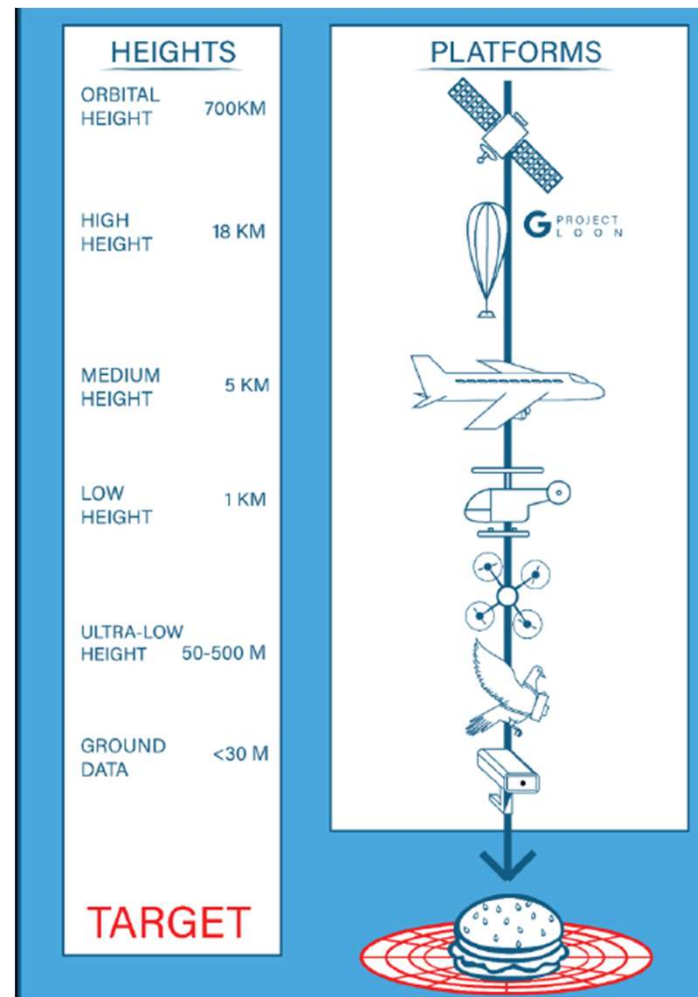
Pigeons (1903)



Airplane (1909)

source: <https://www.gabriele-cavallaro.com/teaching/parallel-and-scalable-machine-learning-for-remote-sensing-big-data-ws-2020-2021>

RS Platforms



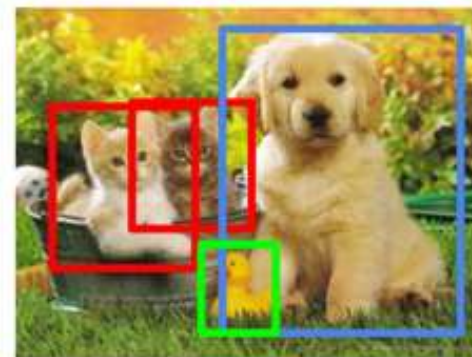
source: <https://www.gabriele-cavallaro.com/teaching/parallel-and-scalable-machine-learning-for-remote-sensing-big-data-ws-2020-2021>

■ Classification:



source: <https://www.geeksforgeeks.org/object-detection-vs-object-recognition-vs-image-segmentation/>

■ Detection:



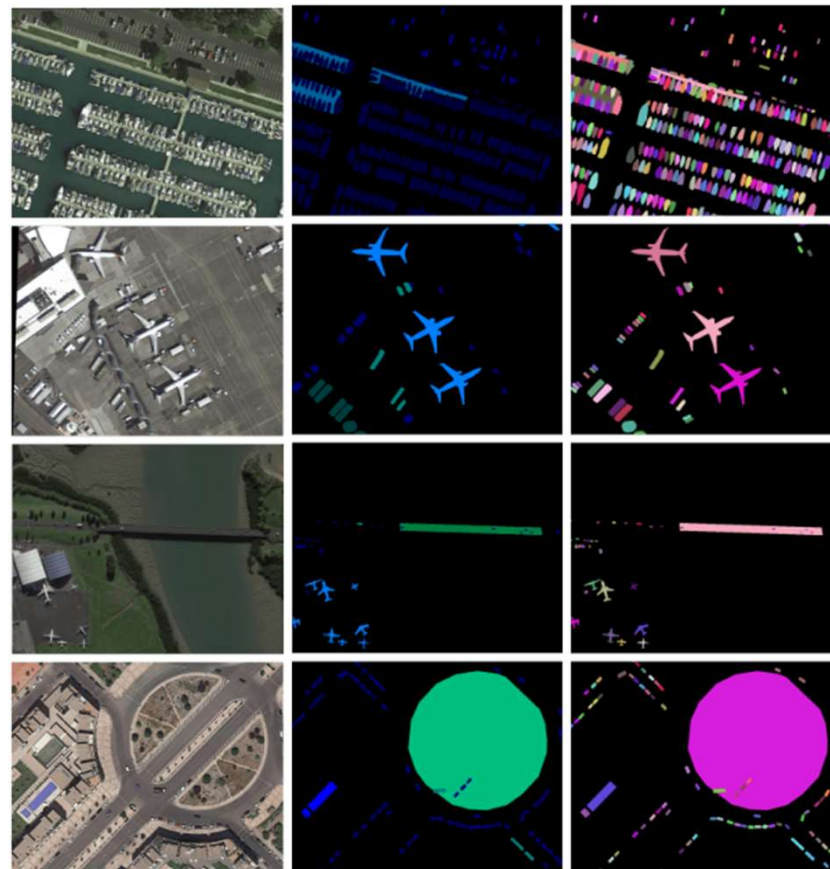
CAT, DOG, DUCK

■ (Semantic) Segmentation:



Source: <https://towardsdatascience.com/semantic-segmentation-of-aerial-imagery-using-u-net-in-python-552705238514>

■ (Instance) Segmentation:

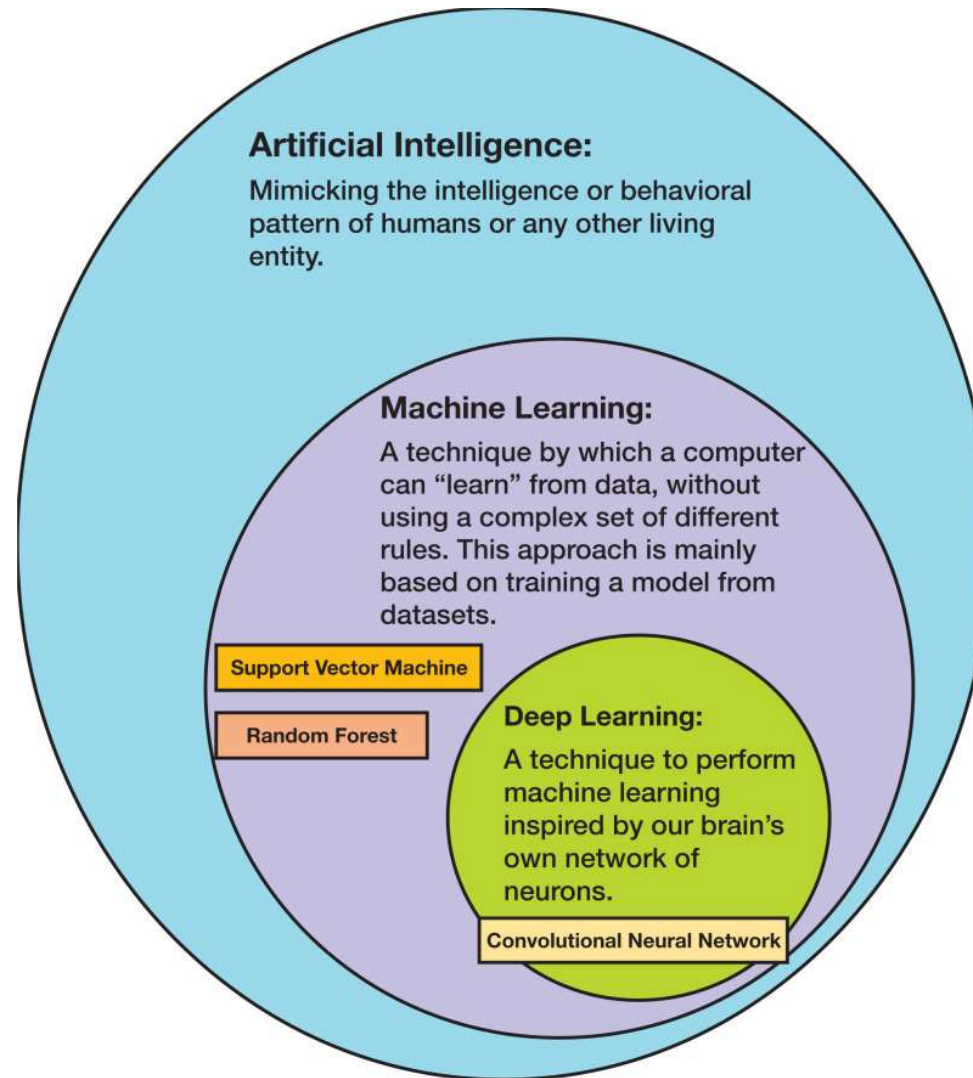


(a) Original image

(b) SS maps

(c) IS maps

Source: <https://arxiv.org/pdf/1905.12886.pdf>



Source: <https://www.ncbi.nlm.nih.gov/books/NBK570711/>

- model extracts the feature set by itself without supervision (**XAI field**):
 - faster
 - more accurate.

- Training set
- Validation set
- Test set

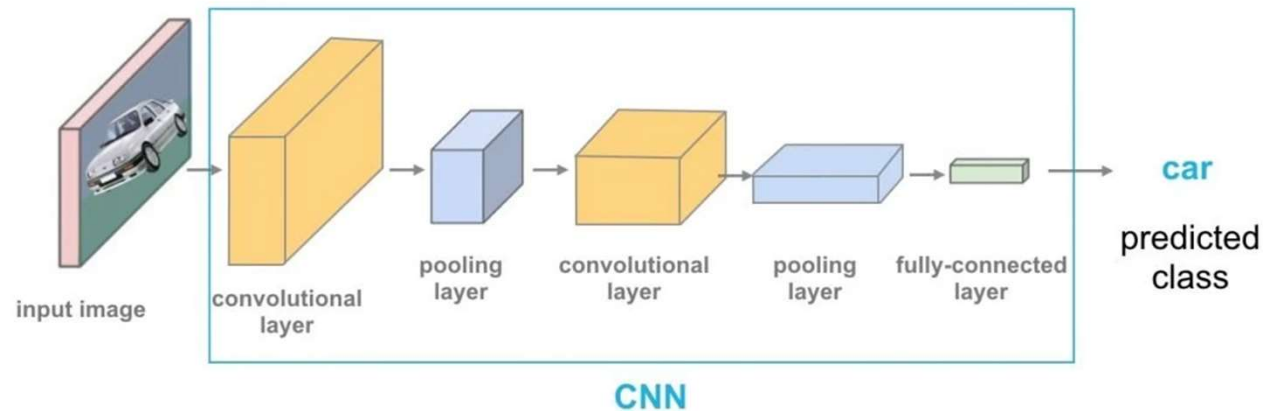
Source: <https://www.ncbi.nlm.nih.gov/books/NBK570711/>

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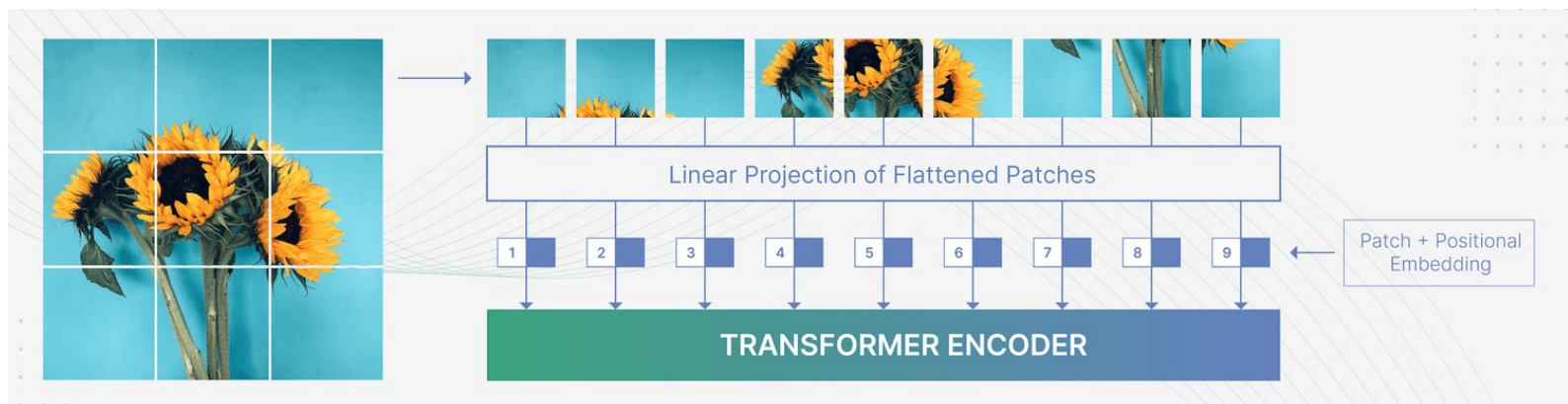
Source: <https://www.ncbi.nlm.nih.gov/books/NBK570711/>

■ CNN:



Source: <https://viso.ai/deep-learning/vision-transformer-vit/>

■ Transformers:



Source: <https://www.picsellia.com/post/are-transformers-replacing-cnns-in-object-detection/>

- Out-of-Distribution Generalization:
 - testing distribution is unknown and different from the training


Temporal effects



Spectral characteristics change over time

https://www.shutterstock.com/search/tree+all+four+seasons?image_type=illustration

Spatial effects



Farm in California Farm in China

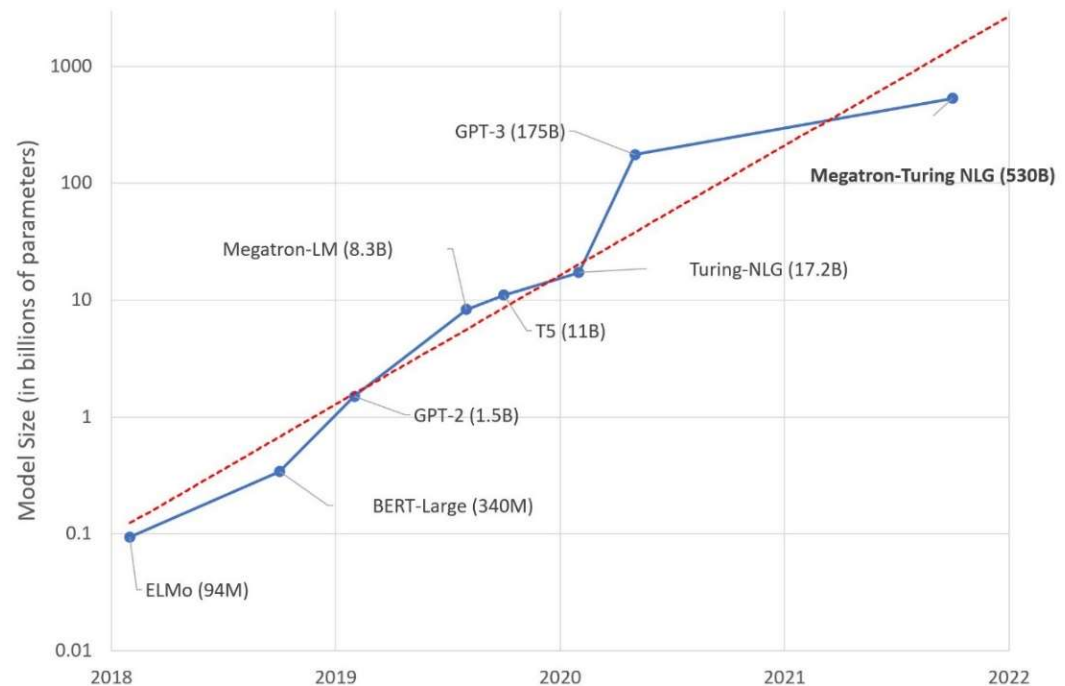
Different spectral characteristics of same class at the same time

source: <https://www.gabriele-cavallaro.com/teaching/parallel-and-scalable-machine-learning-for-remote-sensing-big-data-ws-2020-2021>

- coined in July 2022:
 - <https://arxiv.org/pdf/2108.07258.pdf>
 - Large (deep neural network) model
 - trained on broad data (generally using self-supervision at scale)
 - usually multimodal
 - can be adapted to a wide range of downstream tasks

Source: <https://huggingface.co/blog/large-language-models/>

- transformer model on a large scale.
- widely used in NLP: Large Language Models (LLMs)
- human brain:
 - ❑ ~86 billion neurons
 - ❑ 100 trillion synapses



Source: <https://huggingface.co/blog/large-language-models/>

- new model from Meta AI: April 2023
 - <https://arxiv.org/pdf/2304.02643.pdf>
- effectively segment any object in any image, without the need for additional task-specific or dataset-specific training

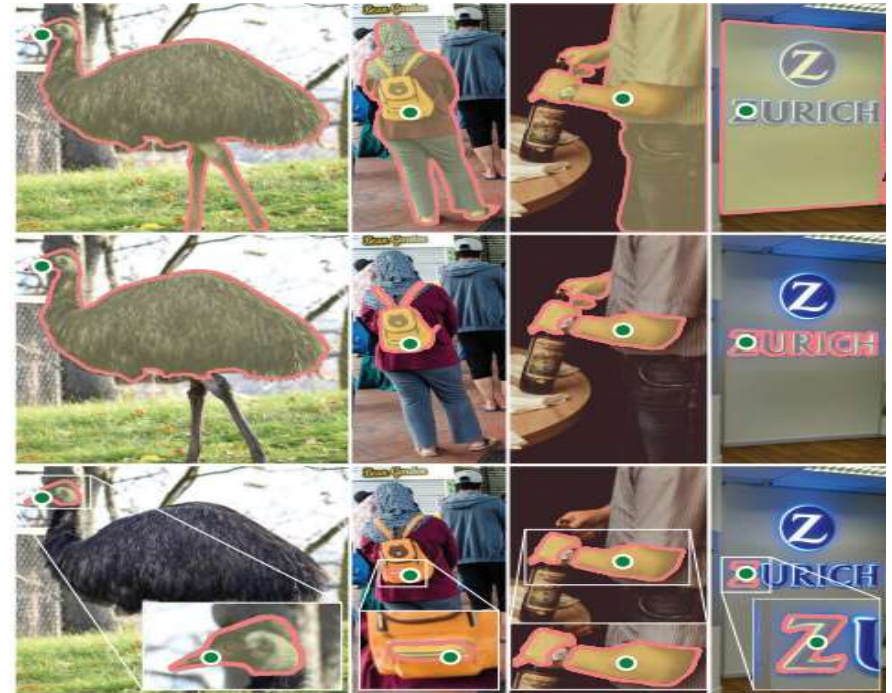


- various input prompts:

- points

- bounding boxes

- masks



- Ambiguity-Aware Design:

- handle ambiguous situations

- multiple masks for a single prompt

■ Dataset Composition:

- ❑ 11M diverse, high-res images (3300x4950 pixels)
- ❑ 1.1B segmentation masks (99.1% auto-generated)
- ❑ High-quality masks
- ❑ Significantly larger than any segmentation datasets



Zero-Shot Edge Detection



Figure 10: Zero-shot edge prediction on BSDS500. SAM was not trained to predict edge maps nor did it have access to BSDS images or annotations during training.

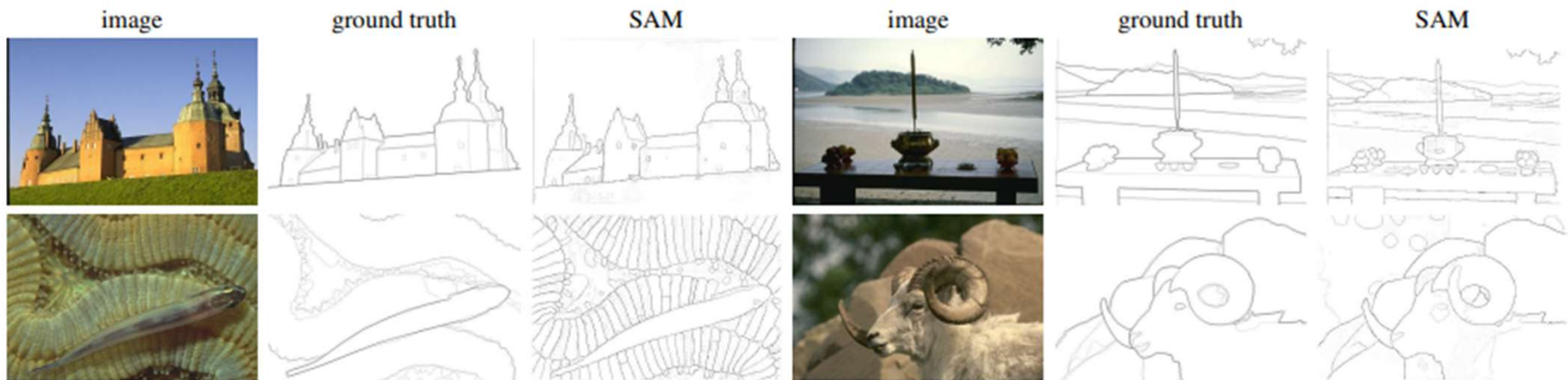


Figure 15: Additional visualizations of zero-shot edge predictions on BSDS500. Recall that SAM was not trained to predict edge maps and did not have access to BSDS images and annotations during training.

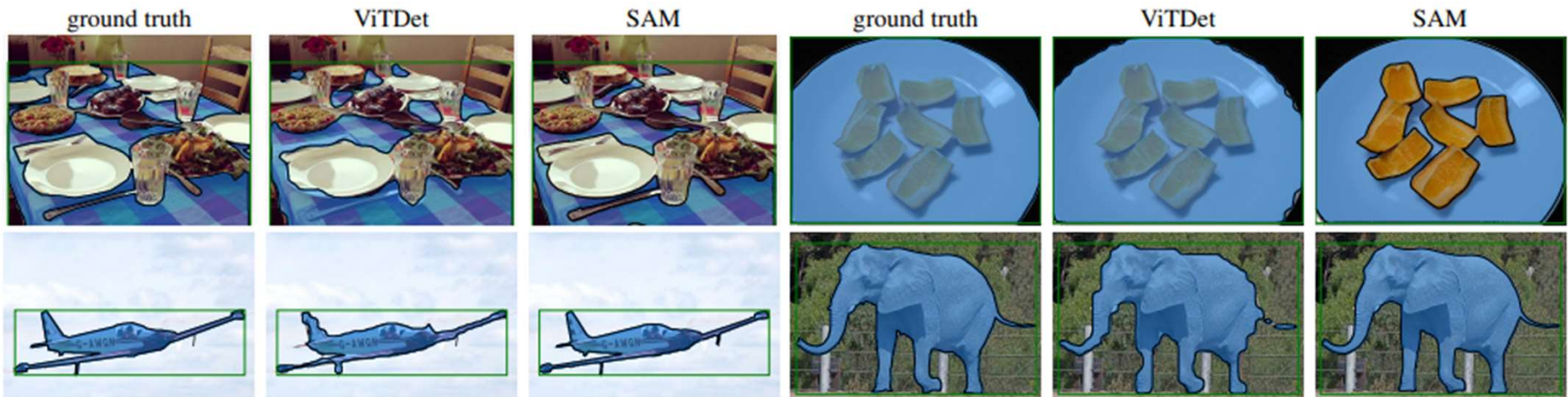


Figure 16: Zero-shot instance segmentation on LVIS v1. SAM produces higher quality masks than ViTDet. As a zero-shot model, SAM does not have the opportunity to learn specific training data biases; see top-right as an example where SAM makes a modal prediction, whereas the ground truth in LVIS is amodal given that mask annotations in LVIS have no holes.

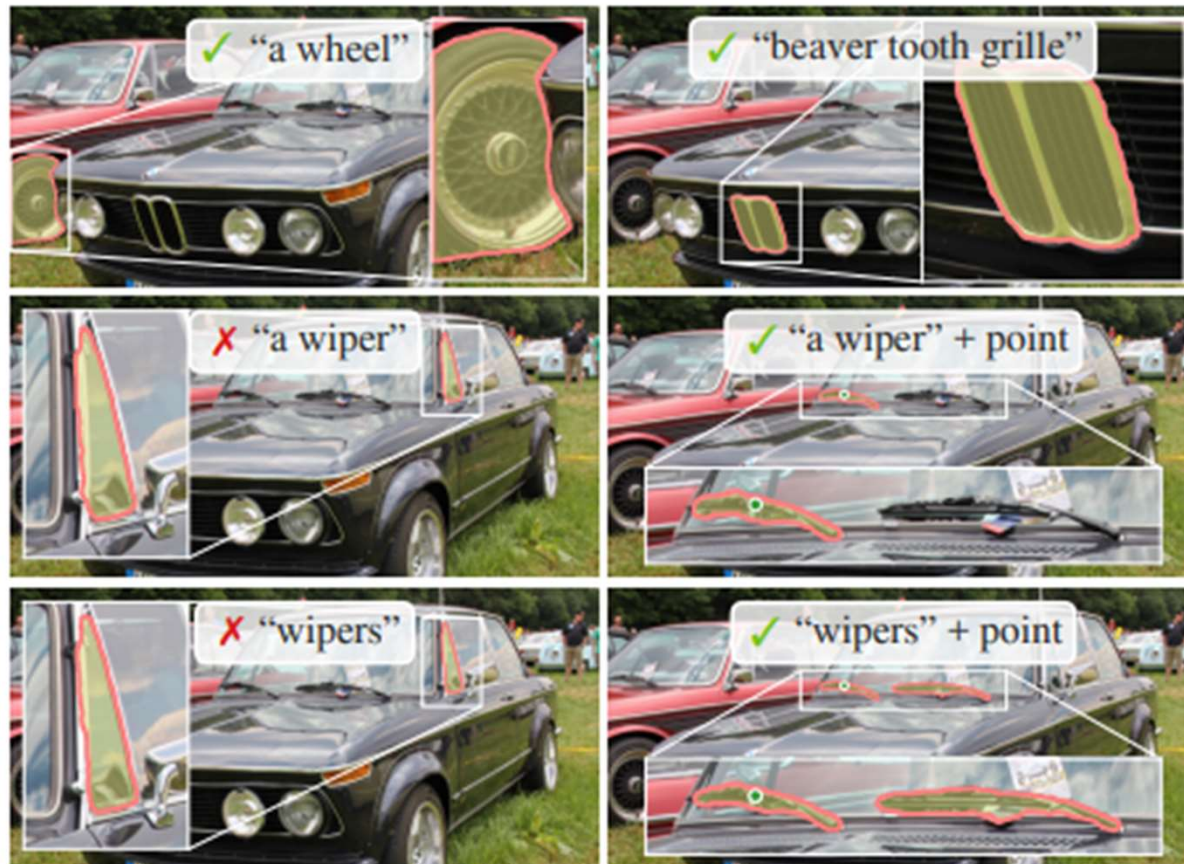


Figure 12: Zero-shot text-to-mask. SAM can work with simple and nuanced text prompts. When SAM fails to make a correct prediction, an additional point prompt can help.

Adaptation

Rohit S. • Following
 Director of Esri R&D Center India
 1h • Edited • 🌐

Segment Anything in ArcGIS!

Foundation models are coming to ArcGIS - Meta's Segment Anything Model (SAM) is now available as a Deep Learning Package on ArcGIS Living Atlas, along with 50 other GeoAI models for various feature extraction tasks.

The Segment Anything Model is unique in the sense that this one model can be used for feature extraction of all kinds of objects in imagery, whether they are buildings, roads, trees, or even roof segments in a DEM (for 3D reconstruction - see below for an example). Additionally, this model can work at various cell sizes and can be applied at scale for inferencing on large geographical extents with #ArcGIS taking care of image management, tiling and stitching the results. See results from #ArcGISPro using the SAM DLPK (deep learning package).

<https://lnkd.in/dc5hyfMu>

Raja Sivararajan • 2nd
 Data Science | Remote Sensing & GIS | Agri-Tech | AI for Social ...
 11h • Edited • 🌐

+ Follow

Are you looking to automate the process of segmenting satellite images into objects for GIS applications? Look no further than SAM tool and PyQGIS! By integrating SAM tool with PyQGIS for object detection, you can quickly and easily segment basemaps or satellite images into objects.

This powerful combination is perfect for a wide range of GIS applications, including land cover mapping, urban planning, and environmental monitoring.

#SAMtool #MetaAI #deeplearning #imagesegmentation #objectdetection #qgis #foss #PyQGIS

Aliaksandr Hancharenka and 202 others
 8 comments • 5 reposts

James Gallagher • 1st
Computer Vision | Technical Marketer @ Roboflow
3d • Edited

Trying out the new SAM Annotation feature in Roboflow Annotate on aerial imagery

To use:

1. Hover over an item of interest
2. Click to focus
3. Refine your annotation by clicking on any missed regions of interest
4. Press enter to save your annotation

Picterra
5,352 followers
2d

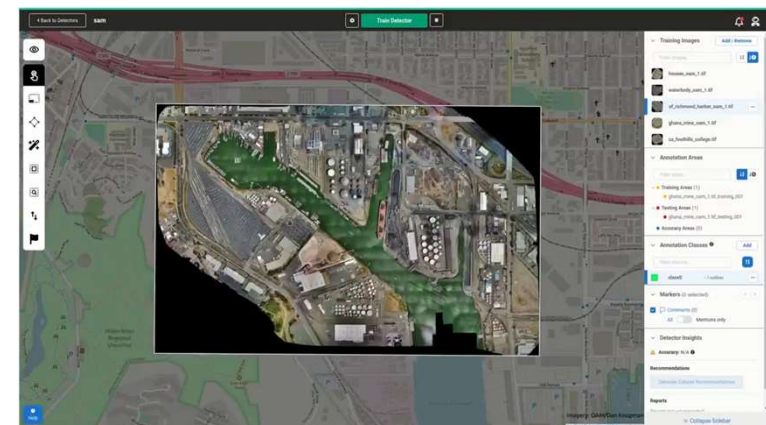
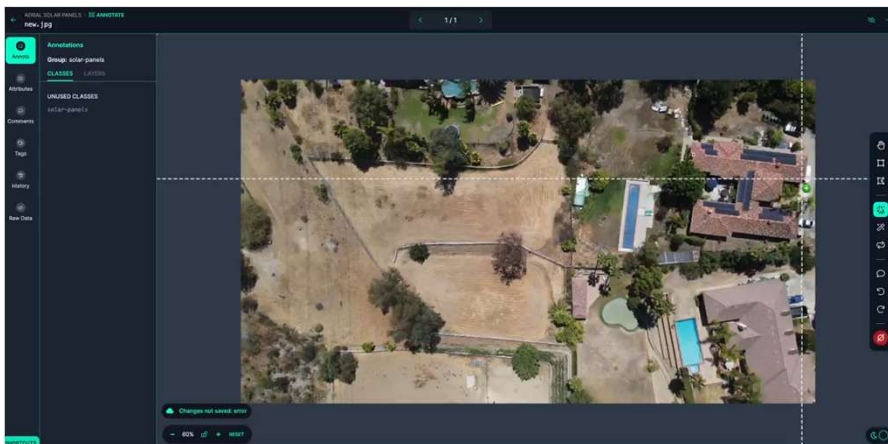
BREAKING: Picterra is thrilled to announce that we are the **FIRST** geospatial company to integrate the groundbreaking Segment Anything Model (SAM) by **Meta AI** into its platform! Read on for more details about this industry-first release.

- What is SAM?

Launched just last week, SAM is a new AI model from Meta AI that can "cut out" any object, in any image, with a single click. The model is already making big waves in the tech industry & we're excited to be the first to bring it to the **#geospatial** realm.

- How does the integration with Picterra work?

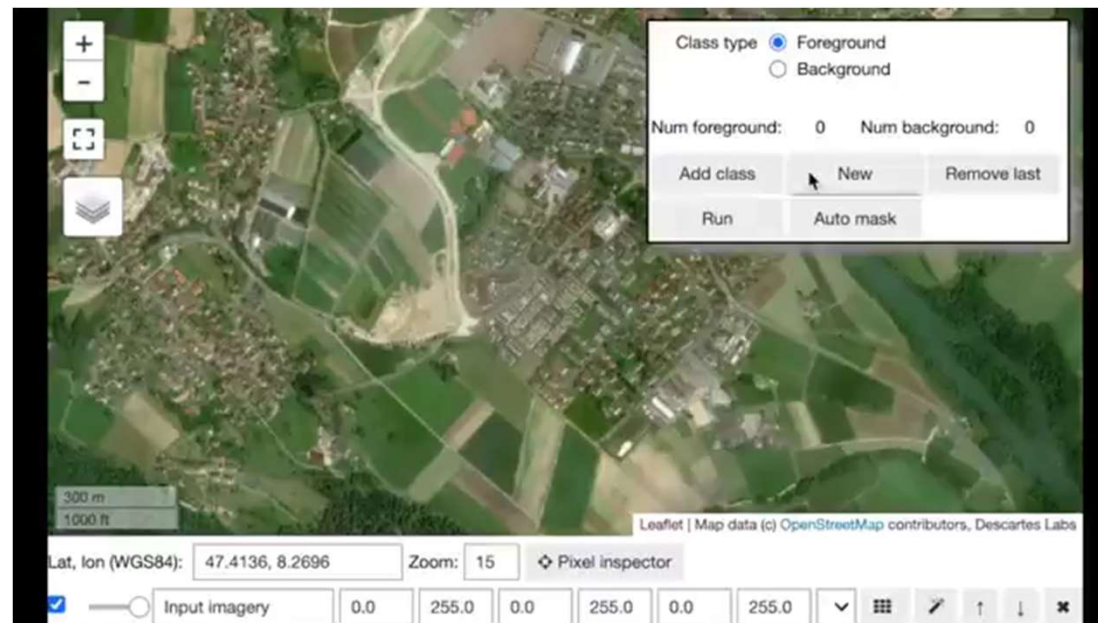
As our users know, annotating objects in the Picterra platform is already quick, thanks to our easy-to-use & efficient drawing tools. Integrating **#SAM** gives our users a supercharged AI magic wand to make annotating complex objects in **#EarthObservation** imagery possible with just a single click.





...

Video of the Descartes Labs technology incorporating the Segment Anything Model (SAM), showing fast prototyping leveraging SAM powered by the Descartes Labs platform to retrieve imagery & display vectorized output in an interactive way.



■ TrackSAM:



Live Demo!

- Ali: graduate student at GEOAI group
- Hasan: research engineer at GEOAI group





Thank you!