

automatic_mask_generator_SAM

December 12, 2023

1 Automatically generating object masks with SAM

The notebook is adapted from [segment-anything/notebooks/automatic_mask_generator_example.ipynb](#)

1.1 Install dependencies

Uncomment and run the following cell to install the required dependencies.

```
[ ]: !pip install segment-geospatial
```

Collecting segment-geospatial
 Downloading segment_geospatial-0.10.2-py2.py3-none-any.whl (50 kB)
 50.8/50.8 kB
1.5 MB/s eta 0:00:00
Collecting segment-anything-py (from segment-geospatial)
 Downloading segment_anything_py-1.0-py3-none-any.whl (40 kB)
 40.2/40.2 kB
2.3 MB/s eta 0:00:00
Collecting segment-anything-hq (from segment-geospatial)
 Downloading segment_anything_hq-0.3-py3-none-any.whl (52 kB)
 53.0/53.0 kB
4.7 MB/s eta 0:00:00
Requirement already satisfied: opencv-python in
/usr/local/lib/python3.10/dist-packages (from segment-geospatial) (4.8.0.76)
Requirement already satisfied: pycocotools in /usr/local/lib/python3.10/dist-
packages (from segment-geospatial) (2.0.7)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.10/dist-
packages (from segment-geospatial) (3.7.1)
Requirement already satisfied: huggingface-hub in
/usr/local/lib/python3.10/dist-packages (from segment-geospatial) (0.19.4)
Requirement already satisfied: geopandas in /usr/local/lib/python3.10/dist-
packages (from segment-geospatial) (0.13.2)
Collecting rasterio (from segment-geospatial)
 Downloading rasterio-1.3.9-cp310-cp310-manylinux2014_x86_64.whl (20.6 MB)
 20.6/20.6 MB
48.8 MB/s eta 0:00:00
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-
packages (from segment-geospatial) (4.66.1)
Requirement already satisfied: gdown in /usr/local/lib/python3.10/dist-packages

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(from segment-geospatial) (4.6.6)
Requirement already satisfied: xyzservices in /usr/local/lib/python3.10/dist-
packages (from segment-geospatial) (2023.10.1)
Requirement already satisfied: pyproj in /usr/local/lib/python3.10/dist-packages
(from segment-geospatial) (3.6.1)
Collecting leafmap (from segment-geospatial)
  Downloading leafmap-0.29.6-py2.py3-none-any.whl (1.8 MB)
      1.8/1.8 MB
52.3 MB/s eta 0:00:00
Collecting localtileserver (from segment-geospatial)
  Downloading localtileserver-0.7.2-py3-none-any.whl (12.1 MB)
      12.1/12.1 MB
69.0 MB/s eta 0:00:00
Collecting timm (from segment-geospatial)
  Downloading timm-0.9.12-py3-none-any.whl (2.2 MB)
      2.2/2.2 MB
59.6 MB/s eta 0:00:00
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-
packages (from gdown->segment-geospatial) (3.13.1)
Requirement already satisfied: requests[socks] in
/usr/local/lib/python3.10/dist-packages (from gdown->segment-geospatial)
(2.31.0)
Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages
(from gdown->segment-geospatial) (1.16.0)
Requirement already satisfied: beautifulsoup4 in /usr/local/lib/python3.10/dist-
packages (from gdown->segment-geospatial) (4.11.2)
Requirement already satisfied: fiona>=1.8.19 in /usr/local/lib/python3.10/dist-
packages (from geopandas->segment-geospatial) (1.9.5)
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-
packages (from geopandas->segment-geospatial) (23.2)
Requirement already satisfied: pandas>=1.1.0 in /usr/local/lib/python3.10/dist-
packages (from geopandas->segment-geospatial) (1.5.3)
Requirement already satisfied: shapely>=1.7.1 in /usr/local/lib/python3.10/dist-
packages (from geopandas->segment-geospatial) (2.0.2)
Requirement already satisfied: certifi in /usr/local/lib/python3.10/dist-
packages (from pyproj->segment-geospatial) (2023.11.17)
Requirement already satisfied: fsspec>=2023.5.0 in
/usr/local/lib/python3.10/dist-packages (from huggingface-hub->segment-
geospatial) (2023.6.0)
Requirement already satisfied: pyyaml>=5.1 in /usr/local/lib/python3.10/dist-
packages (from huggingface-hub->segment-geospatial) (6.0.1)
Requirement already satisfied: typing-extensions>=3.7.4.3 in
/usr/local/lib/python3.10/dist-packages (from huggingface-hub->segment-
geospatial) (4.5.0)
Requirement already satisfied: bqplot in /usr/local/lib/python3.10/dist-packages
(from leafmap->segment-geospatial) (0.12.42)
Requirement already satisfied: colour in /usr/local/lib/python3.10/dist-packages
(from leafmap->segment-geospatial) (0.1.5)

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Requirement already satisfied: duckdb in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (0.9.2)

Requirement already satisfied: folium in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (0.14.0)

Collecting geojson (from leafmap->segment-geospatial)

 Downloading geojson-3.1.0-py3-none-any.whl (15 kB)

Requirement already satisfied: ipyevents in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (2.0.2)

Requirement already satisfied: ipyfilechooser in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (0.6.0)

Requirement already satisfied: ipyleaflet in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (0.18.0)

Requirement already satisfied: ipywidgets in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (7.7.1)

Requirement already satisfied: numpy in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (1.23.5)

Requirement already satisfied: plotly in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (5.15.0)

Requirement already satisfied: pyshp in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (2.3.1)

Collecting pystac-client (from leafmap->segment-geospatial)

 Downloading pystac_client-0.7.5-py3-none-any.whl (33 kB)

Requirement already satisfied: python-box in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (7.1.1)

Requirement already satisfied: scooby in /usr/local/lib/python3.10/dist-packages (from leafmap->segment-geospatial) (0.9.2)

Collecting whiteboxgui (from leafmap->segment-geospatial)

 Downloading whiteboxgui-2.3.0-py2.py3-none-any.whl (108 kB)

108.6/108.6

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Requirement already satisfied: click in /usr/local/lib/python3.10/dist-packages (from localtileserver->segment-geospatial) (8.1.7)

Requirement already satisfied: flask<3,>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from localtileserver->segment-geospatial) (2.2.5)

Collecting Flask-Caching (from localtileserver->segment-geospatial)

 Downloading Flask_Caching-2.1.0-py3-none-any.whl (28 kB)

Collecting flask-cors (from localtileserver->segment-geospatial)

 Downloading Flask_Cors-4.0.0-py2.py3-none-any.whl (14 kB)

Collecting flask-restx>=0.5.0 (from localtileserver->segment-geospatial)

 Downloading flask_restx-1.3.0-py2.py3-none-any.whl (2.8 MB)

2.8/2.8 MB

107.5 MB/s eta 0:00:00

Collecting large-image[rasterio]>=1.22.2 (from localtileserver->segment-geospatial)

 Downloading large_image-1.26.2-py3-none-any.whl (85 kB)

85.3/85.3 kB

13.0 MB/s eta 0:00:00

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Collecting server-thread (from localtilserver->segment-geospatial)
  Downloading server_thread-0.2.0-py3-none-any.whl (8.5 kB)
Requirement already satisfied: werkzeug in /usr/local/lib/python3.10/dist-packages (from localtilserver->segment-geospatial) (3.0.1)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib->segment-geospatial) (1.2.0)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib->segment-geospatial) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib->segment-geospatial) (4.45.1)
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib->segment-geospatial) (1.4.5)
Requirement already satisfied: pillow>=6.2.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib->segment-geospatial) (9.4.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib->segment-geospatial) (3.1.1)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.10/dist-packages (from matplotlib->segment-geospatial) (2.8.2)
Collecting affine (from rasterio->segment-geospatial)
  Downloading affine-2.4.0-py3-none-any.whl (15 kB)
Requirement already satisfied: attrs in /usr/local/lib/python3.10/dist-packages (from rasterio->segment-geospatial) (23.1.0)
Requirement already satisfied: cligj>=0.5 in /usr/local/lib/python3.10/dist-packages (from rasterio->segment-geospatial) (0.7.2)
Collecting snuggs>=1.4.1 (from rasterio->segment-geospatial)
  Downloading snuggs-1.4.7-py3-none-any.whl (5.4 kB)
Requirement already satisfied: click-plugins in /usr/local/lib/python3.10/dist-packages (from rasterio->segment-geospatial) (1.1.1)
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (from rasterio->segment-geospatial) (67.7.2)
Requirement already satisfied: torch>=1.7 in /usr/local/lib/python3.10/dist-packages (from segment-anything-hq->segment-geospatial) (2.1.0+cu118)
Requirement already satisfied: torchvision>=0.8 in /usr/local/lib/python3.10/dist-packages (from segment-anything-hq->segment-geospatial) (0.16.0+cu118)
Requirement already satisfied: safetensors in /usr/local/lib/python3.10/dist-packages (from timm->segment-geospatial) (0.4.1)
Requirement already satisfied: Jinja2>=3.0 in /usr/local/lib/python3.10/dist-packages (from flask<3,>=2.0.0->localtilserver->segment-geospatial) (3.1.2)
Requirement already satisfied: itsdangerous>=2.0 in /usr/local/lib/python3.10/dist-packages (from flask<3,>=2.0.0->localtilserver->segment-geospatial) (2.1.2)
```

Collecting aniso8601>=0.82 (from flask-restx>=0.5.0->localtileservers->segment-geospatial)

Downloading aniso8601-9.0.1-py2.py3-none-any.whl (52 kB)

52.8/52.8 kB

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Requirement already satisfied: jsonschema in

/usr/local/lib/python3.10/dist-packages (from flask-restx>=0.5.0->localtileservers->segment-geospatial) (4.19.2)

Requirement already satisfied: pytz in /usr/local/lib/python3.10/dist-packages (from flask-restx>=0.5.0->localtileservers->segment-geospatial) (2023.3.post1)

Requirement already satisfied: importlib-resources in /usr/local/lib/python3.10/dist-packages (from flask-restx>=0.5.0->localtileservers->segment-geospatial) (6.1.1)

Requirement already satisfied: cachetools in /usr/local/lib/python3.10/dist-packages (from large-image[rasterio]>=1.22.2->localtileservers->segment-geospatial) (5.3.2)

Collecting palettable (from large-image[rasterio]>=1.22.2->localtileservers->segment-geospatial)

Downloading palettable-3.3.3-py2.py3-none-any.whl (332 kB)

332.3/332.3

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Collecting large-image-source-rasterio>=1.26.2 (from large-image[rasterio]>=1.22.2->localtileservers->segment-geospatial)

Downloading large_image_source_rasterio-1.26.2-py3-none-any.whl (18 kB)

Requirement already satisfied: sympy in /usr/local/lib/python3.10/dist-packages (from torch>=1.7->segment-anything-hq->segment-geospatial) (1.12)

Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-packages (from torch>=1.7->segment-anything-hq->segment-geospatial) (3.2.1)

Requirement already satisfied: triton==2.1.0 in /usr/local/lib/python3.10/dist-packages (from torch>=1.7->segment-anything-hq->segment-geospatial) (2.1.0)

Requirement already satisfied: MarkupSafe>=2.1.1 in /usr/local/lib/python3.10/dist-packages (from werkzeug->localtileservers->segment-geospatial) (2.1.3)

Requirement already satisfied: soupsieve>1.2 in /usr/local/lib/python3.10/dist-packages (from beautifulsoup4->gdown->segment-geospatial) (2.5)

Requirement already satisfied: traitlets>=4.3.0 in /usr/local/lib/python3.10/dist-packages (from bqplot->leafmap->segment-geospatial) (5.7.1)

Requirement already satisfied: traitlets>=0.0.6 in /usr/local/lib/python3.10/dist-packages (from bqplot->leafmap->segment-geospatial) (0.2.1)

Requirement already satisfied: ipykernel>=4.5.1 in /usr/local/lib/python3.10/dist-packages (from ipywidgets->leafmap->segment-geospatial) (5.5.6)

Requirement already satisfied: ipython-genutils~0.2.0 in /usr/local/lib/python3.10/dist-packages (from ipywidgets->leafmap->segment-geospatial) (0.2.0)

Requirement already satisfied: widgetsnbextension~=3.6.0 in /usr/local/lib/python3.10/dist-packages (from ipywidgets->leafmap->segment-geospatial) (3.6.6)

Requirement already satisfied: ipython>=4.0.0 in /usr/local/lib/python3.10/dist-packages (from ipywidgets->leafmap->segment-geospatial) (7.34.0)

Requirement already satisfied: jupyterlab-widgets>=1.0.0 in /usr/local/lib/python3.10/dist-packages (from ipywidgets->leafmap->segment-geospatial) (3.0.9)

Collecting cachelib<0.10.0,>=0.9.0 (from Flask-Caching->localtileserver->segment-geospatial)

Downloading cachelib-0.9.0-py3-none-any.whl (15 kB)

Requirement already satisfied: branca>=0.6.0 in /usr/local/lib/python3.10/dist-packages (from folium->leafmap->segment-geospatial) (0.7.0)

Requirement already satisfied: tenacity>=6.2.0 in /usr/local/lib/python3.10/dist-packages (from plotly->leafmap->segment-geospatial) (8.2.3)

Collecting pystac[validation]>=1.8.2 (from pystac-client->leafmap->segment-geospatial)

Downloading pystac-1.9.0-py3-none-any.whl (181 kB)

181.6/181.6

kB 26.2 MB/s eta 0:00:00

Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown->segment-geospatial) (3.3.2)

Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown->segment-geospatial) (3.6)

Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown->segment-geospatial) (2.0.7)

Requirement already satisfied: PySocks!=1.5.7,>=1.5.6 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown->segment-geospatial) (1.7.1)

Collecting uvicorn (from server-thread->localtileserver->segment-geospatial)

Downloading uvicorn-0.24.0.post1-py3-none-any.whl (59 kB)

59.7/59.7 kB

9.9 MB/s eta 0:00:00

Requirement already satisfied: ipytree in /usr/local/lib/python3.10/dist-packages (from whiteboxgui->leafmap->segment-geospatial) (0.2.2)

Collecting whitebox (from whiteboxgui->leafmap->segment-geospatial)

Downloading whitebox-2.3.1-py2.py3-none-any.whl (72 kB)

72.1/72.1 kB

12.2 MB/s eta 0:00:00

Requirement already satisfied: jupyter-client in /usr/local/lib/python3.10/dist-packages (from ipykernel>=4.5.1->ipywidgets->leafmap->segment-geospatial) (6.1.12)

Requirement already satisfied: tornado>=4.2 in /usr/local/lib/python3.10/dist-packages (from ipykernel>=4.5.1->ipywidgets->leafmap->segment-geospatial)

(6.3.2)

Collecting jedi>=0.16 (from ipython>=4.0.0->ipywidgets->leafmap->segment-geospatial)

Downloading jedi-0.19.1-py2.py3-none-any.whl (1.6 MB)

1.6/1.6 MB

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Requirement already satisfied: decorator in

/usr/local/lib/python3.10/dist-packages (from

ipython>=4.0.0->ipywidgets->leafmap->segment-geospatial) (4.4.2)

Requirement already satisfied: pickleshare in /usr/local/lib/python3.10/dist-packages (from ipython>=4.0.0->ipywidgets->leafmap->segment-geospatial) (0.7.5)

Requirement already satisfied: prompt-toolkit!=3.0.0,!3.0.1,<3.1.0,>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from

ipython>=4.0.0->ipywidgets->leafmap->segment-geospatial) (3.0.41)

Requirement already satisfied: pygments in /usr/local/lib/python3.10/dist-packages (from ipython>=4.0.0->ipywidgets->leafmap->segment-geospatial) (2.16.1)

Requirement already satisfied: backcall in /usr/local/lib/python3.10/dist-packages (from ipython>=4.0.0->ipywidgets->leafmap->segment-geospatial) (0.2.0)

Requirement already satisfied: matplotlib-inline in

/usr/local/lib/python3.10/dist-packages (from

ipython>=4.0.0->ipywidgets->leafmap->segment-geospatial) (0.1.6)

Requirement already satisfied: pexpect>4.3 in /usr/local/lib/python3.10/dist-packages (from ipython>=4.0.0->ipywidgets->leafmap->segment-geospatial) (4.9.0)

Requirement already satisfied: jsonschema-specifications>=2023.03.6 in /usr/local/lib/python3.10/dist-packages (from jsonschema->flask-

restx>=0.5.0->localtileserver->segment-geospatial) (2023.11.2)

Requirement already satisfied: referencing>=0.28.4 in

/usr/local/lib/python3.10/dist-packages (from jsonschema->flask-

restx>=0.5.0->localtileserver->segment-geospatial) (0.31.1)

Requirement already satisfied: rpds-py>=0.7.1 in /usr/local/lib/python3.10/dist-packages (from jsonschema->flask-restx>=0.5.0->localtileserver->segment-geospatial) (0.13.2)

Requirement already satisfied: notebook>=4.4.1 in

/usr/local/lib/python3.10/dist-packages (from

widgetsnbextension~3.6.0->ipywidgets->leafmap->segment-geospatial) (6.5.5)

Requirement already satisfied: mpmath>=0.19 in /usr/local/lib/python3.10/dist-packages (from sympy->torch>=1.7->segment-anything-hq->segment-geospatial)

(1.3.0)

Collecting h11>=0.8 (from uvicorn->server-thread->localtileserver->segment-geospatial)

Downloading h11-0.14.0-py3-none-any.whl (58 kB)

58.3/58.3 kB

9.2 MB/s eta 0:00:00

Requirement already satisfied: parso<0.9.0,>=0.8.3 in

/usr/local/lib/python3.10/dist-packages (from

jedi>=0.16->ipython>=4.0.0->ipywidgets->leafmap->segment-geospatial) (0.8.3)

Requirement already satisfied: pyzmq<25,>=17 in /usr/local/lib/python3.10/dist-packages (from


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notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (23.2.1)
Requirement already satisfied: argon2-cffi in /usr/local/lib/python3.10/dist-
packages (from
notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (23.1.0)
Requirement already satisfied: jupyter-core>=4.6.1 in
/usr/local/lib/python3.10/dist-packages (from
notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (5.5.0)
Requirement already satisfied: nbformat in /usr/local/lib/python3.10/dist-
packages (from
notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (5.9.2)
Requirement already satisfied: nbconvert>=5 in /usr/local/lib/python3.10/dist-
packages (from
notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (6.5.4)
Requirement already satisfied: nest-asyncio>=1.5 in
/usr/local/lib/python3.10/dist-packages (from
notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (1.5.8)
Requirement already satisfied: Send2Trash>=1.8.0 in
/usr/local/lib/python3.10/dist-packages (from
notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (1.8.2)
Requirement already satisfied: terminado>=0.8.3 in
/usr/local/lib/python3.10/dist-packages (from
notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (0.18.0)
Requirement already satisfied: prometheus-client in
/usr/local/lib/python3.10/dist-packages (from
notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (0.19.0)
Requirement already satisfied: nbclassic>=0.4.7 in
/usr/local/lib/python3.10/dist-packages (from
notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (1.0.0)
Requirement already satisfied: ptyprocess>=0.5 in
/usr/local/lib/python3.10/dist-packages (from
pexpect>4.3->ipython>=4.0.0->ipywidgets->leafmap->segment-geospatial) (0.7.0)
Requirement already satisfied: wcwidth in /usr/local/lib/python3.10/dist-
packages (from prompt-toolkit!=3.0.0,!<3.0.1,<3.1.0,>=2.0.0->ipython>=4.0.0-
>ipywidgets->leafmap->segment-geospatial) (0.2.12)
Requirement already satisfied: platformdirs>=2.5 in
/usr/local/lib/python3.10/dist-packages (from jupyter-core>=4.6.1-
>notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (4.0.0)

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Requirement already satisfied: jupyter-server>=1.8 in /usr/local/lib/python3.10/dist-packages (from nbclassic>=0.4.7->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (1.24.0)

Requirement already satisfied: notebook-shim>=0.2.3 in /usr/local/lib/python3.10/dist-packages (from nbclassic>=0.4.7->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (0.2.3)

Requirement already satisfied: lxml in /usr/local/lib/python3.10/dist-packages (from nbconvert>=5->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (4.9.3)

Requirement already satisfied: bleach in /usr/local/lib/python3.10/dist-packages (from nbconvert>=5->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (6.1.0)

Requirement already satisfied: defusedxml in /usr/local/lib/python3.10/dist-packages (from nbconvert>=5->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (0.7.1)

Requirement already satisfied: entrypoints>=0.2.2 in /usr/local/lib/python3.10/dist-packages (from nbconvert>=5->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (0.4)

Requirement already satisfied: jupyterlab-pygments in /usr/local/lib/python3.10/dist-packages (from nbconvert>=5->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (0.3.0)

Requirement already satisfied: mistune<2,>=0.8.1 in /usr/local/lib/python3.10/dist-packages (from nbconvert>=5->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (0.8.4)

Requirement already satisfied: nbclient>=0.5.0 in /usr/local/lib/python3.10/dist-packages (from nbconvert>=5->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (0.9.0)

Requirement already satisfied: pandocfilters>=1.4.1 in /usr/local/lib/python3.10/dist-packages (from nbconvert>=5->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (1.5.0)

Requirement already satisfied: tinycss2 in /usr/local/lib/python3.10/dist-packages (from nbconvert>=5->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (1.2.1)

Requirement already satisfied: fastjsonschema in /usr/local/lib/python3.10/dist-packages (from nbformat->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (2.19.0)

Requirement already satisfied: argon2-cffi-bindings in /usr/local/lib/python3.10/dist-packages (from argon2-cffi->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (21.2.0)

Requirement already satisfied: anyio<4,>=3.1.0 in /usr/local/lib/python3.10/dist-packages (from jupyter-server>=1.8->nbclassic>=0.4.7->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (3.7.1)

Requirement already satisfied: websocket-client in /usr/local/lib/python3.10/dist-packages (from jupyter-server>=1.8->nbclassic>=0.4.7->notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (1.6.4)

Requirement already satisfied: cffi>=1.0.1 in /usr/local/lib/python3.10/dist-

```

packages (from argon2-cffi-bindings->argon2-cffi->notebook>=4.4.1-
>widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (1.16.0)
Requirement already satisfied: webencodings in /usr/local/lib/python3.10/dist-
packages (from bleach->nbconvert>=5->notebook>=4.4.1->widgetsnbextension~=3.6.0-
>ipywidgets->leafmap->segment-geospatial) (0.5.1)
Requirement already satisfied: sniffio>=1.1 in /usr/local/lib/python3.10/dist-
packages (from anyio<4,>=3.1.0->jupyter-server>=1.8->nbclassic>=0.4.7-
>notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (1.3.0)
Requirement already satisfied: exceptiongroup in /usr/local/lib/python3.10/dist-
packages (from anyio<4,>=3.1.0->jupyter-server>=1.8->nbclassic>=0.4.7-
>notebook>=4.4.1->widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-
geospatial) (1.2.0)
Requirement already satisfied: pycparser in /usr/local/lib/python3.10/dist-
packages (from cffi>=1.0.1->argon2-cffi-bindings->argon2-cffi->notebook>=4.4.1-
>widgetsnbextension~=3.6.0->ipywidgets->leafmap->segment-geospatial) (2.21)
Installing collected packages: aniso8601, whitebox, snuggs, palettable, jedi,
h11, geojson, cachelib, affine, uvicorn, rasterio, pystac, large-image, server-
thread, large-image-source-rasterio, flask-cors, Flask-Caching, timm, segment-
anything-py, segment-anything-hq, flask-restx, pystac-client, localtileserver,
whiteboxgui, leafmap, segment-geospatial

```

ERROR: pip's dependency resolver does not currently take into account all
the packages that are installed. This behaviour is the source of the following
dependency conflicts.

lida 0.0.10 requires fastapi, which is not installed.

lida 0.0.10 requires kaleido, which is not installed.

lida 0.0.10 requires python-multipart, which is not installed.

```

Successfully installed Flask-Caching-2.1.0 affine-2.4.0 aniso8601-9.0.1
cachelib-0.9.0 flask-cors-4.0.0 flask-restx-1.3.0 geojson-3.1.0 h11-0.14.0
jedi-0.19.1 large-image-1.26.2 large-image-source-rasterio-1.26.2 leafmap-0.29.6
localtileserver-0.7.2 palettable-3.3.3 pystac-1.9.0 pystac-client-0.7.5
rasterio-1.3.9 segment-anything-hq-0.3 segment-anything-py-1.0 segment-
geospatial-0.10.2 server-thread-0.2.0 snuggs-1.4.7 timm-0.9.12
uvicorn-0.24.0.post1 whitebox-2.3.1 whiteboxgui-2.3.0

```

```

[ ]: import os
import leafmap
from samgeo import SamGeo, show_image, download_file, overlay_images,
↳tms_to_geotiff

```

1.2 Create an interactive map

```
[ ]: m = leafmap.Map(center=[41.062685, -101.135139], zoom=12, height="800px")
      m.add_basemap("SATELLITE")
      m
```

```
Map(center=[41.062685, -101.135139], controls=(ZoomControl(options=['position',
↪ 'zoom_in_text', 'zoom_in_title...
```

Pan and zoom the map to select the area of interest. Use the draw tools to draw a polygon or rectangle on the map

```
[ ]: bbox = [-101.2212, 40.9905, -101.0482, 41.1326]
      bbox
```

```
[ ]: [-101.2212, 40.9905, -101.0482, 41.1326]
```

1.3 Download a sample image

```
[ ]: image = "satellite.tif"
      tms_to_geotiff(output=image, bbox=bbox, zoom=13, source="Satellite",
↪ overwrite=True)
```

```
Downloaded image 01/25
Downloaded image 02/25
Downloaded image 03/25
Downloaded image 04/25
Downloaded image 05/25
Downloaded image 06/25
Downloaded image 07/25
Downloaded image 08/25
Downloaded image 09/25
Downloaded image 10/25
Downloaded image 11/25
Downloaded image 12/25
Downloaded image 13/25
Downloaded image 14/25
Downloaded image 15/25
Downloaded image 16/25
Downloaded image 17/25
Downloaded image 18/25
Downloaded image 19/25
Downloaded image 20/25
Downloaded image 21/25
Downloaded image 22/25
Downloaded image 23/25
Downloaded image 24/25
Downloaded image 25/25
Saving GeoTIFF. Please wait...
```

Image saved to satellite.tif

You can also use your own image. Uncomment and run the following cell to use your own image.

Display the downloaded image on the map.

```
[ ]: m.layers[-1].visible = False
m.add_raster(image, layer_name="Image")
m
```

```
Map(bottom=393356.0, center=[41.047252515172424, -101.1018656837511],
     controls=(ZoomControl(options=['position...
```

1.4 Initialize SAM class

Specify the file path to the model checkpoint. If it is not specified, the model will be downloaded to the working directory.

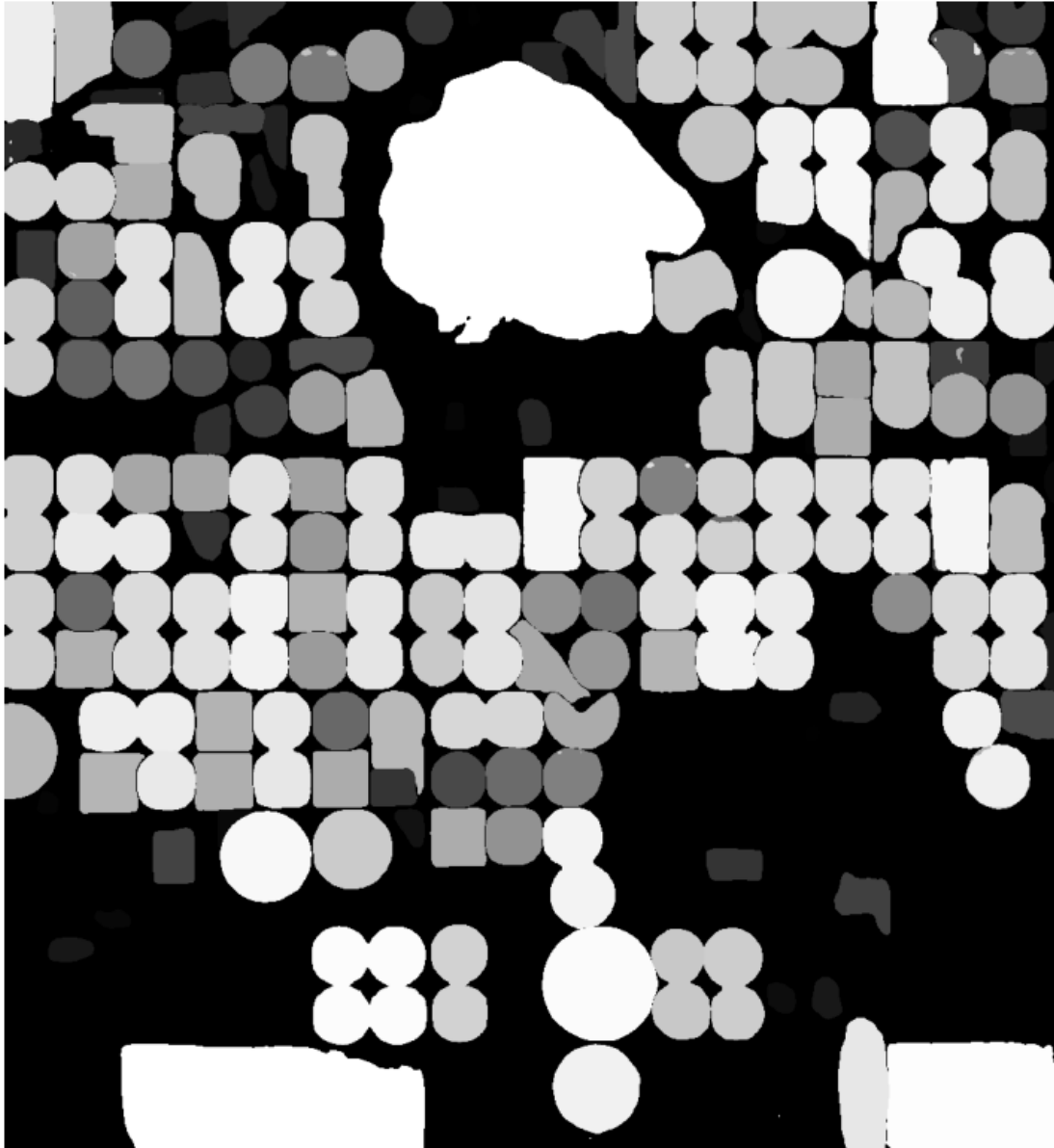
```
[ ]: sam = SamGeo(
    model_type="vit_h",
    sam_kwargs=None,
)
```

1.5 Automatic mask generation

Segment the image and save the results to a GeoTIFF file. Set `unique=True` to assign a unique ID to each object.

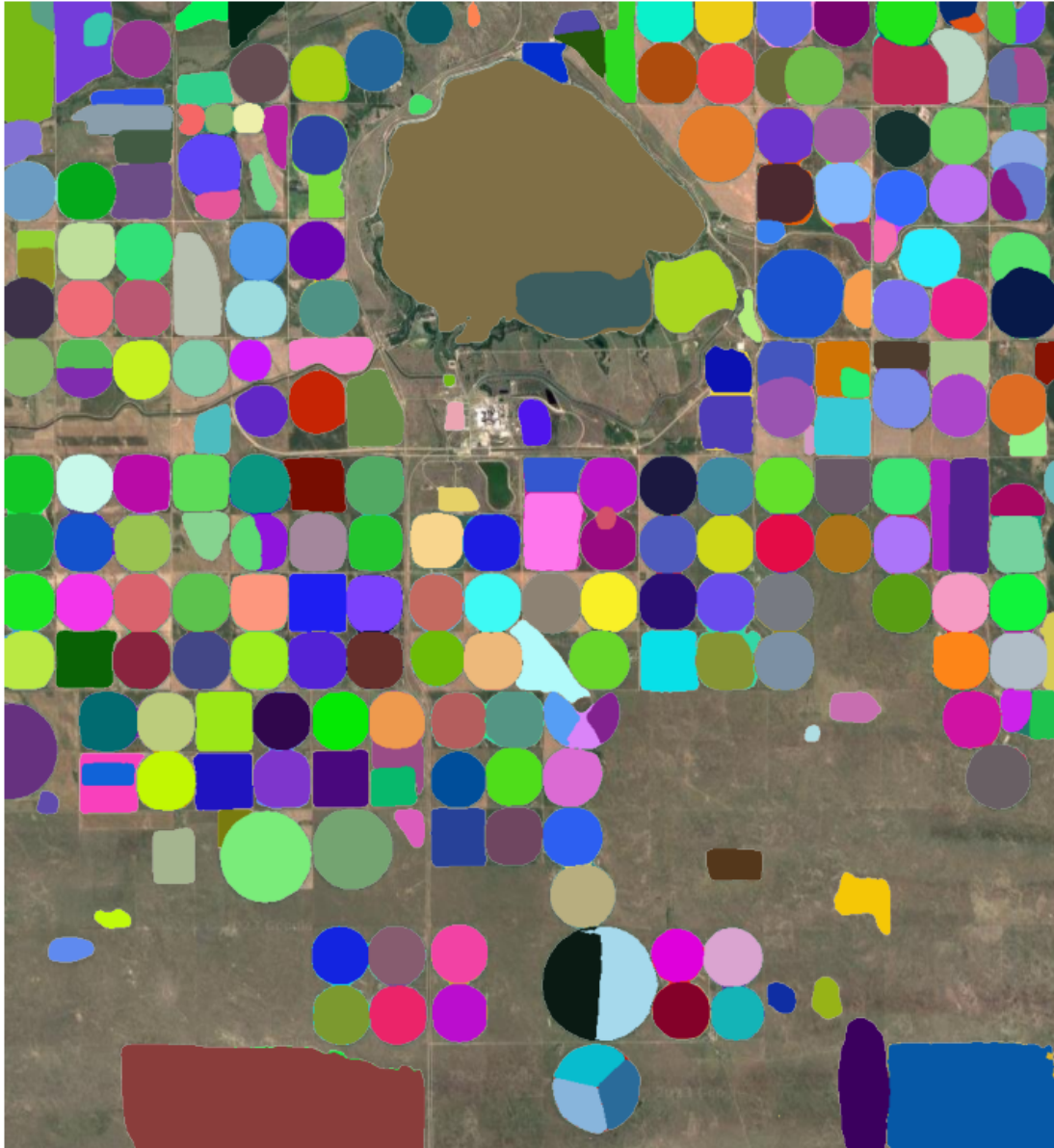
```
[ ]: sam.generate(image, output="masks.tif", foreground=True, unique=True)
```

```
[ ]: sam.show_masks(cmap="binary_r")
```



Show the object annotations (objects with random color) on the map.

```
[ ]: sam.show_anns(axis="off", alpha=1, output="annotations.tif")
```



Compare images with a slider.

```
[ ]: leafmap.image_comparison(  
    "satellite.tif",  
    "annotations.tif",  
    label1="Satellite Image",  
    label2="Image Segmentation",  
)
```

<IPython.core.display.HTML object>

Add image to the map.

```
[ ]: m.add_raster("annotations.tif", alpha=0.5, layer_name="Masks")
m
```

```
Map(bottom=98449.0, center=[41.24373975746002, -100.93551635742189],
    controls=(ZoomControl(options=['position'...
```

Convert the object annotations to vector format, such as GeoPackage, Shapefile, or GeoJSON.

```
[ ]: sam.tiff_to_vector("masks.tif", "masks.gpkg")
```

1.6 Automatic mask generation options

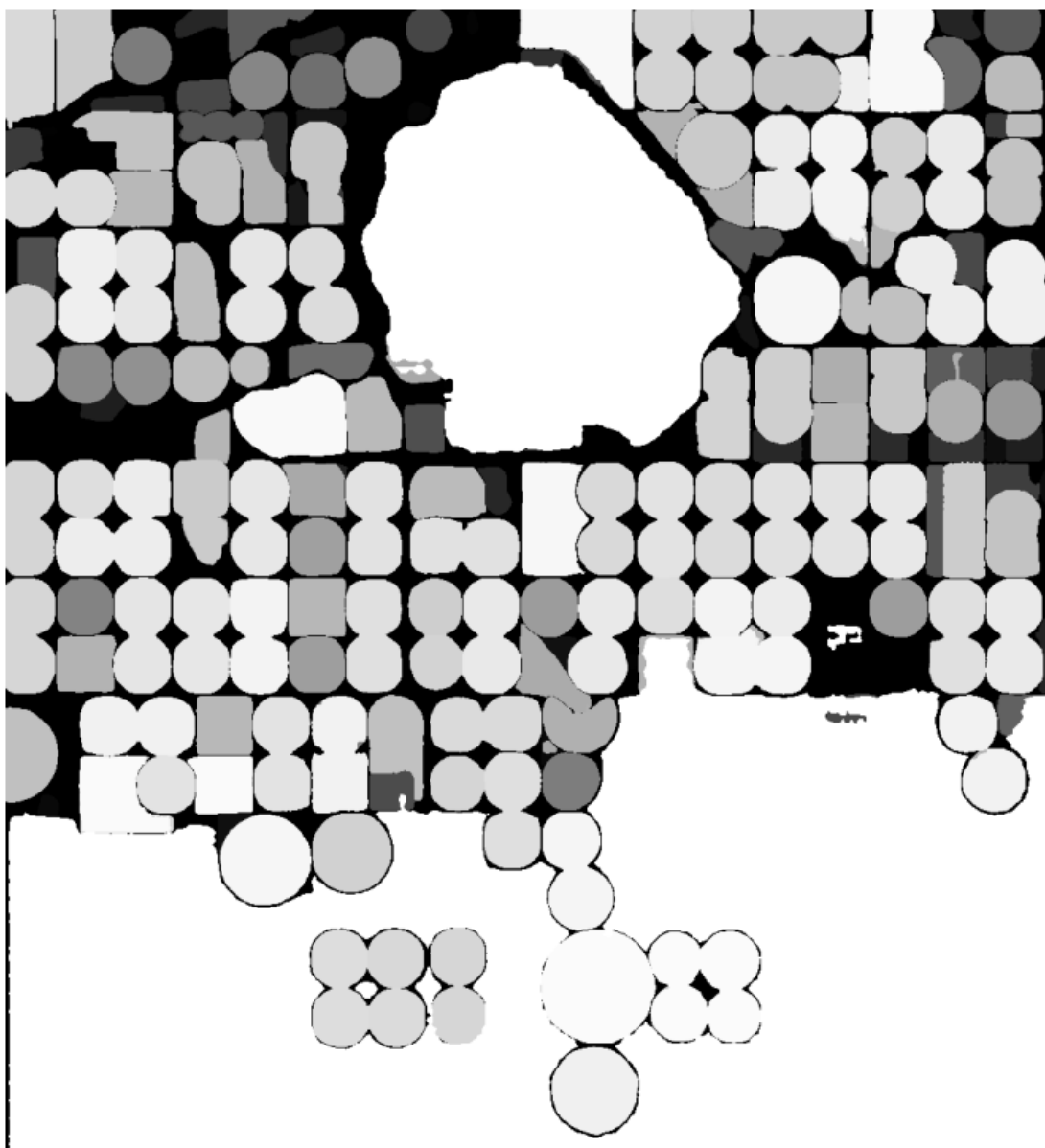
There are several tunable parameters in automatic mask generation that control how densely points are sampled and what the thresholds are for removing low quality or duplicate masks. Additionally, generation can be automatically run on crops of the image to get improved performance on smaller objects, and post-processing can remove stray pixels and holes. Here is an example configuration that samples more masks:

```
[ ]: sam_kwargs = {
    "points_per_side": 32,
    "pred_iou_thresh": 0.86,
    "stability_score_thresh": 0.92,
    "crop_n_layers": 1,
    "crop_n_points_downscale_factor": 2,
    "min_mask_region_area": 100,
}
```

```
[ ]: sam = SamGeo(
    model_type="vit_h",
    sam_kwargs=sam_kwargs,
)
```

```
[ ]: sam.generate(image, output="masks2.tif", foreground=True)
```

```
[ ]: sam.show_masks(cmap="binary_r")
```

```
[ ]: sam.show_anns(axis="off", opacity=1, output="annotations2.tif")
```

