

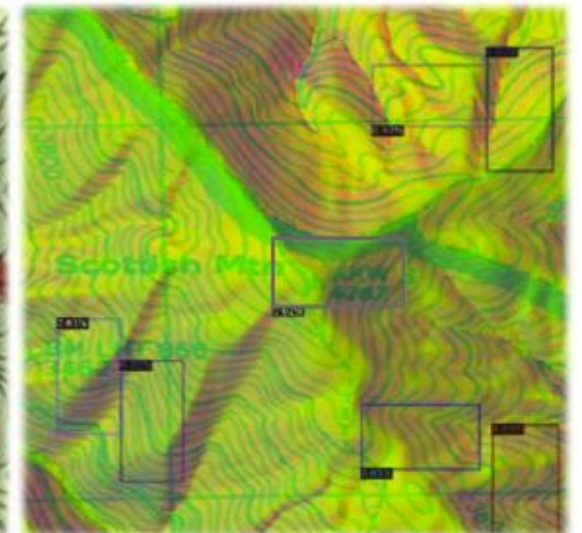
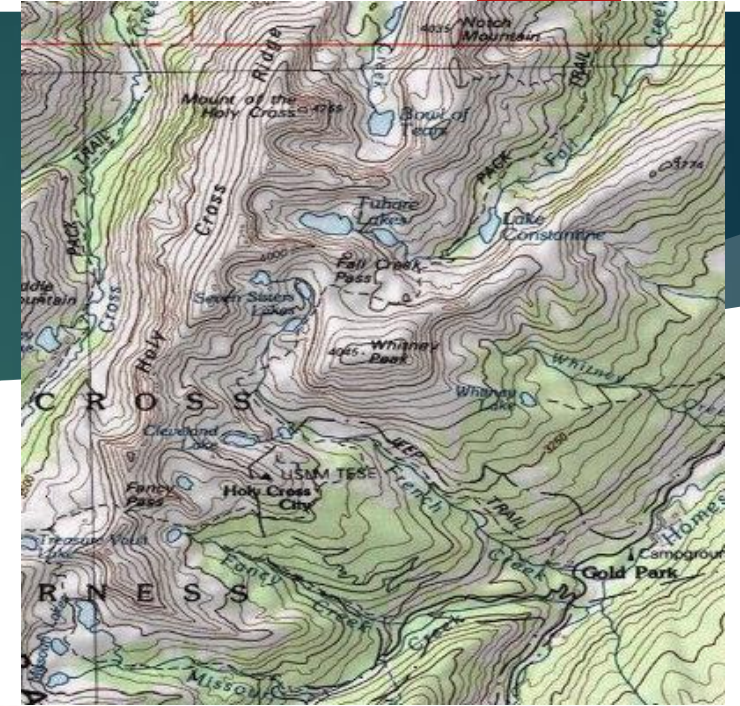
GeoAI advances in specific landform mapping

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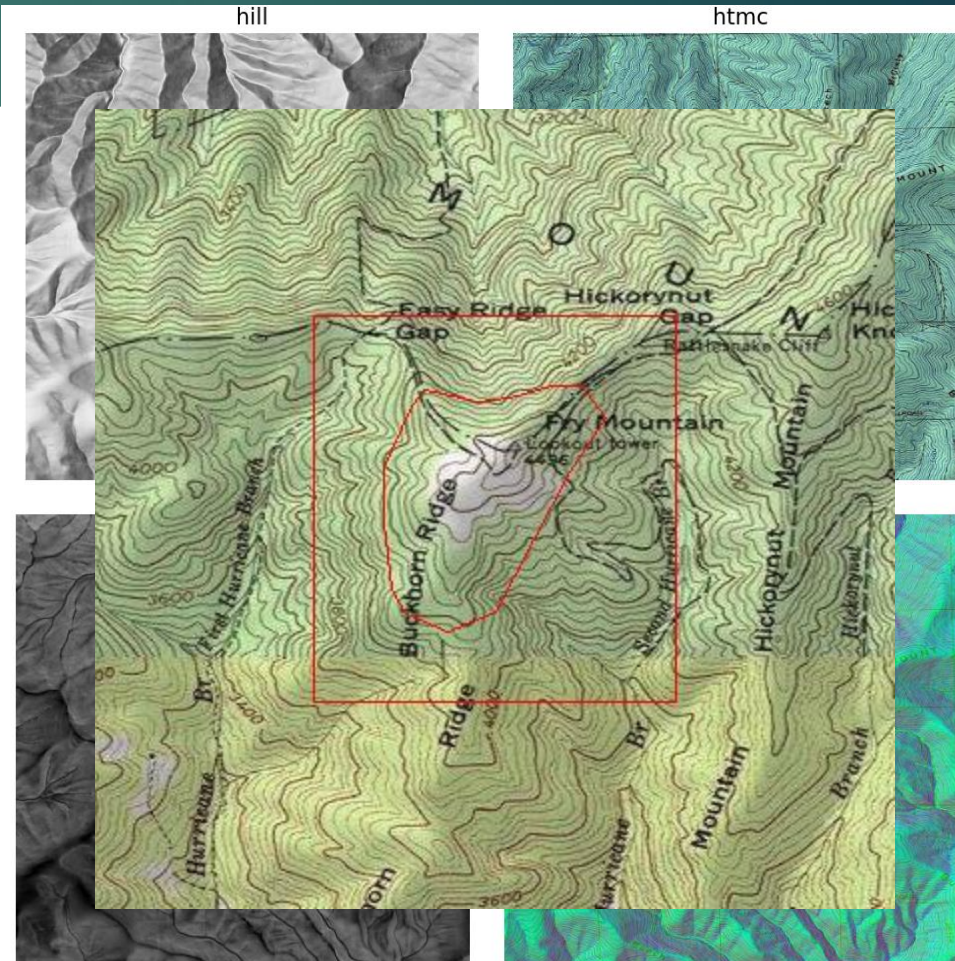
Landform Mapping

- ▶ Specific landform mapping is the process of mapping the extent and location of specific instances of different types of landform classes such as ridges, valleys, peaks, and depressions. USGS has a large undigitized Historical Topographic Map Collection (HTMC) covering a wide range of specific landforms.
- ▶ We plan to expand upon previous work to digitize specific landforms in the HTMC to create an operational database of landform extents and locations.



Dataset

- ▶ USGS has HTMCs at varying zoom levels as well as co-registered hillshade and slope images.
- ▶ USGS has also created a labeled dataset of summit landform extents

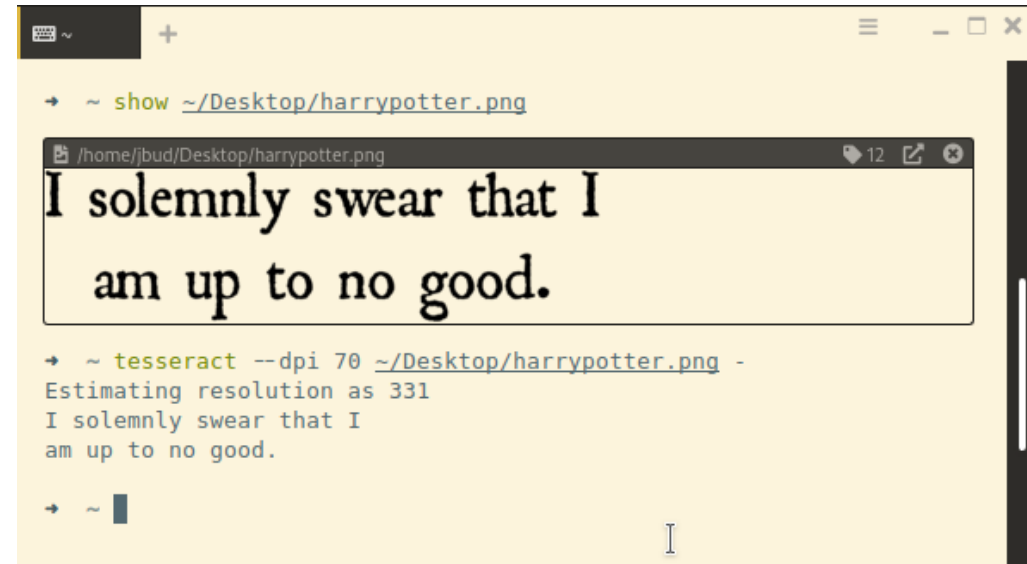


Approach

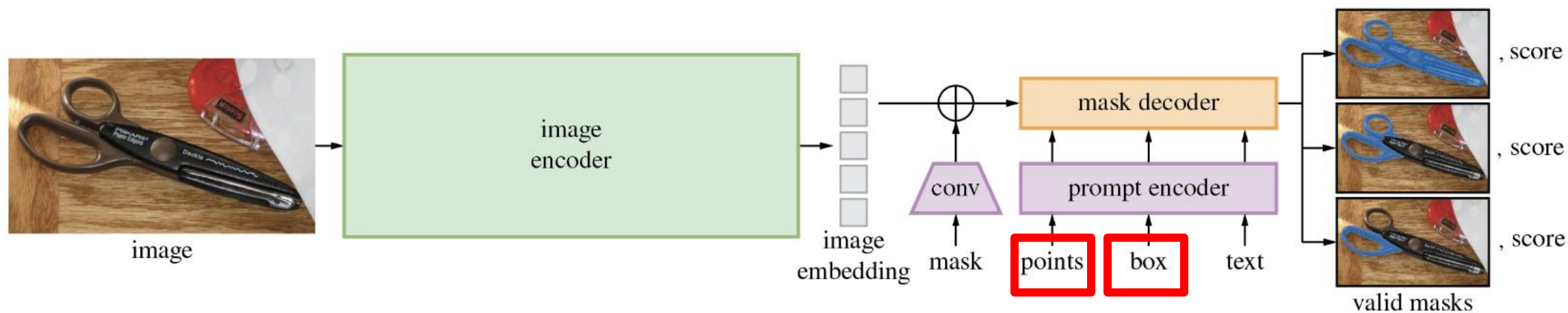
- ▶ Segmentation using physical information
 - ▶ Facebook's Segment Anything Model
 - A pretrained model that can segment imagery from a variety of sources automatically or with chosen "prompting" points or bounding box.
- ▶ OCR of landform names and location
 - ▶ Tesseract
 - Pretrained model that performs OCR and produces bounding boxes around text along with extracted text.
- ▶ Combine these two approaches to produce landform extents and names.

Tesseract Background

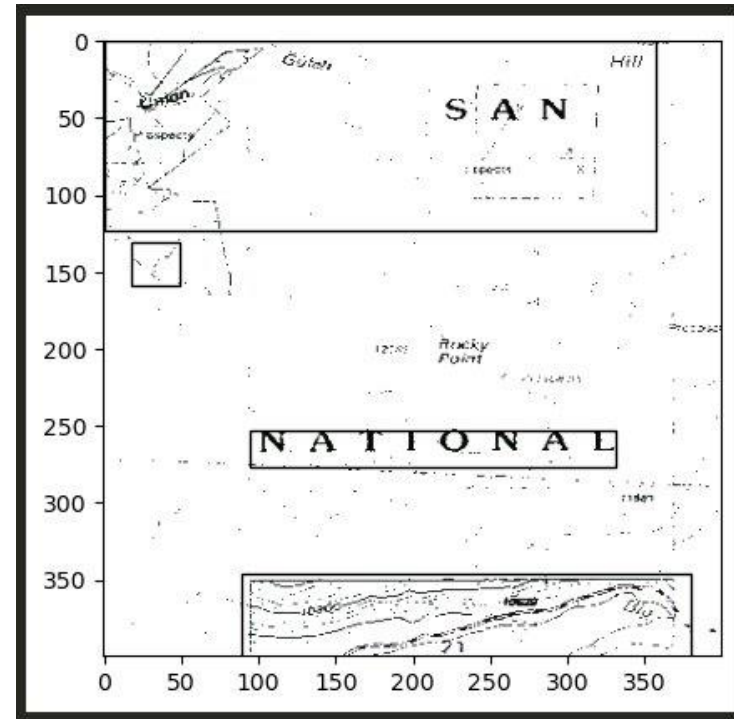
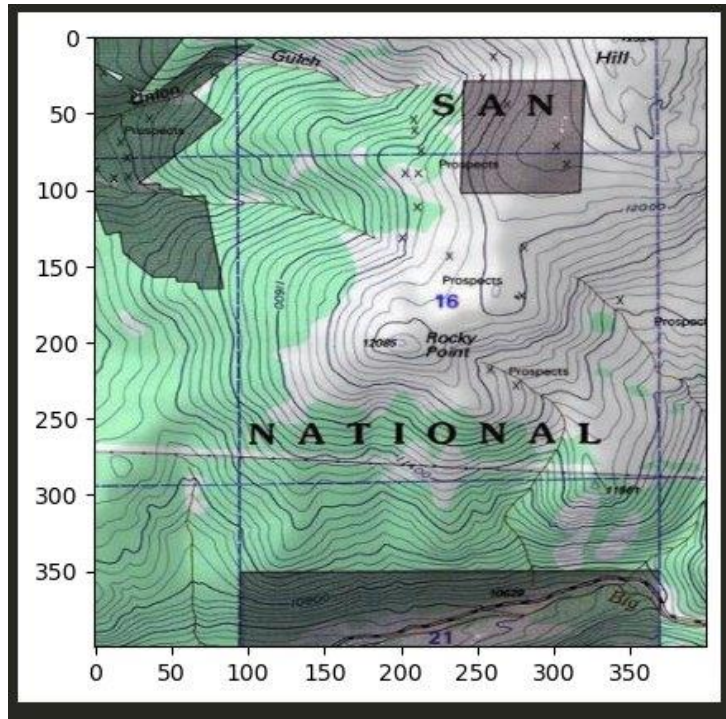
- ▶ Long running model focused more on documents/computer generated text.
- ▶ Developed in the 1980s, but has been continually updated and is still in use today.
- ▶ Version 5 uses LSTMs and other techniques.



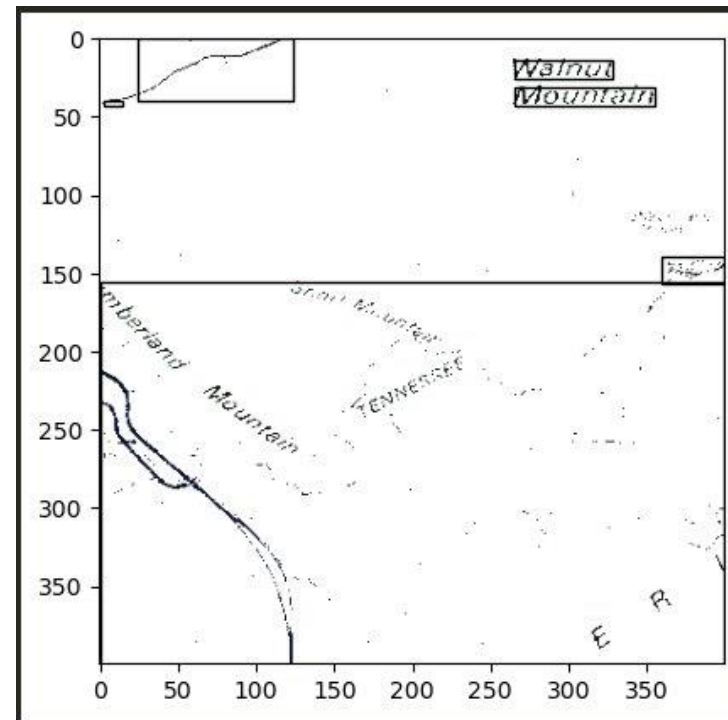
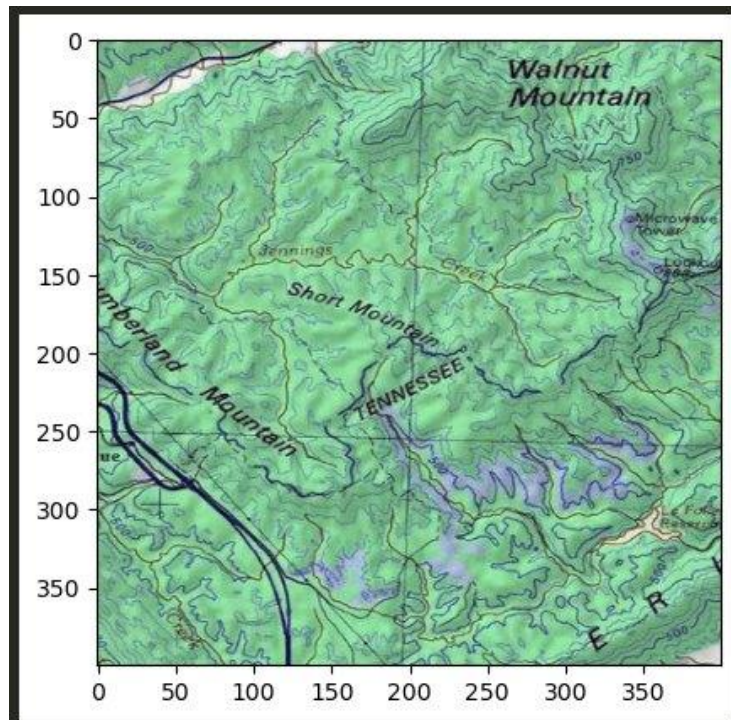
Meta's Segment Anything



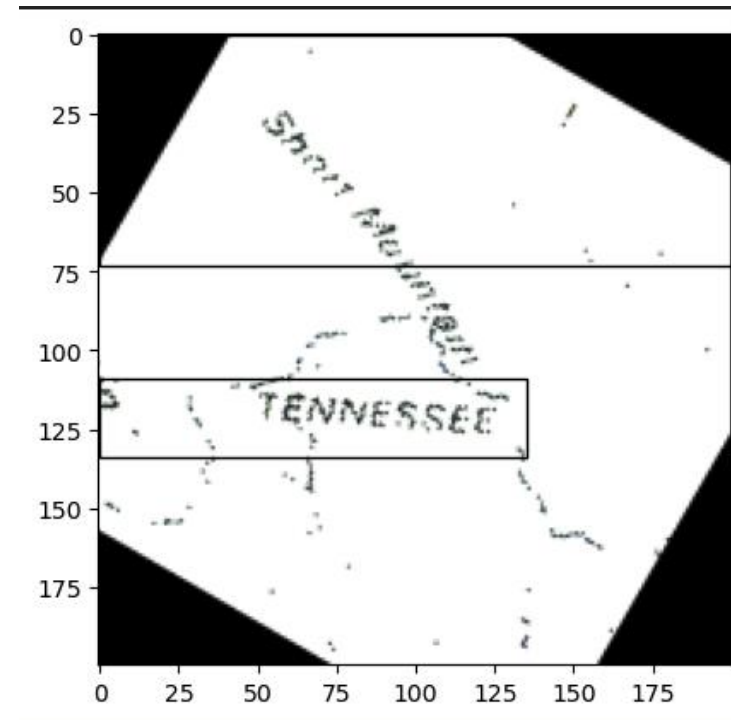
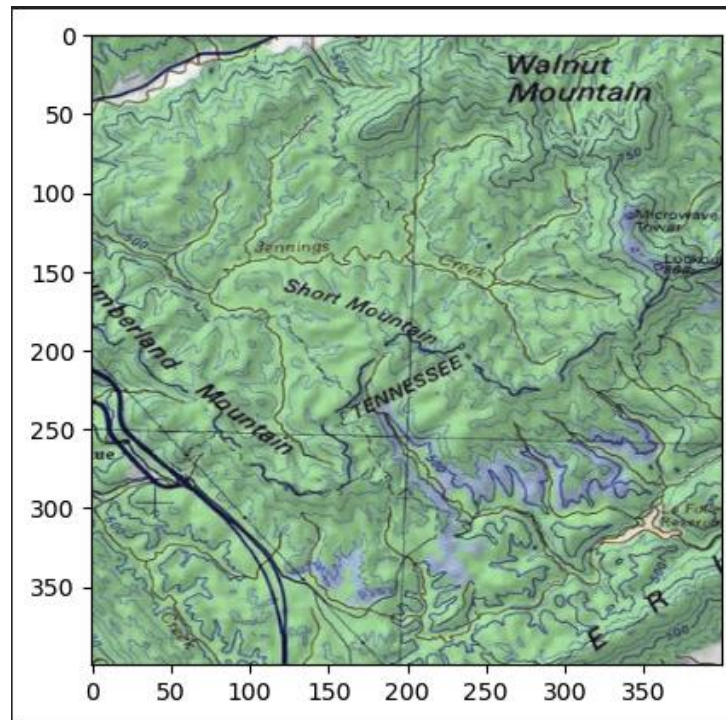
Results - Tesseract



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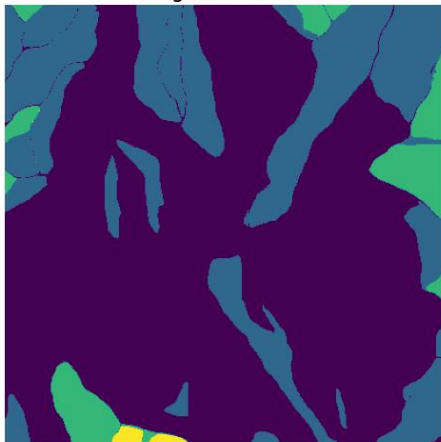


Results – SAM – Mask Generator

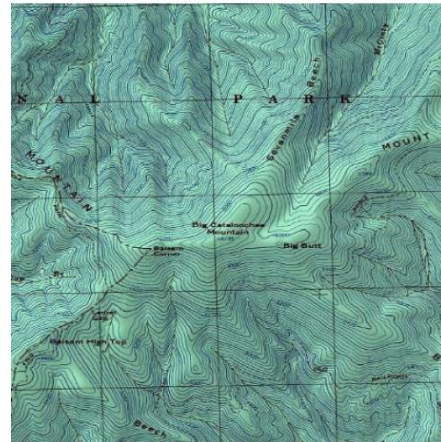
hill



Segmented hill



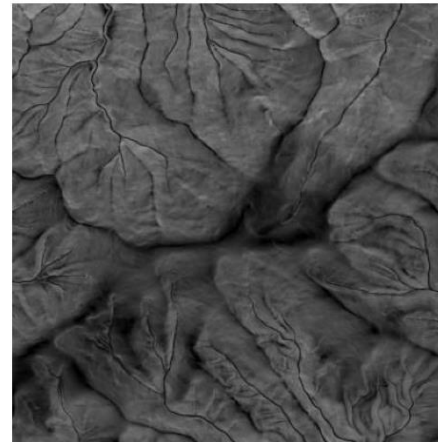
htmc



Segmented htmc



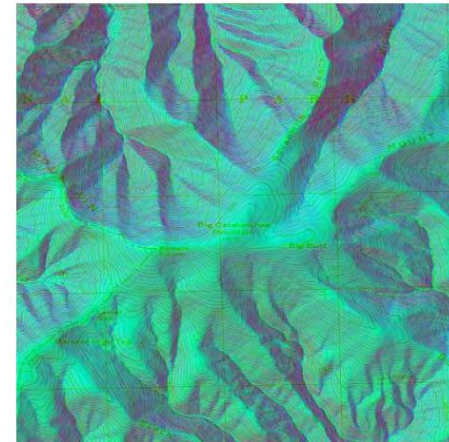
slope



Segmented slope



stacked

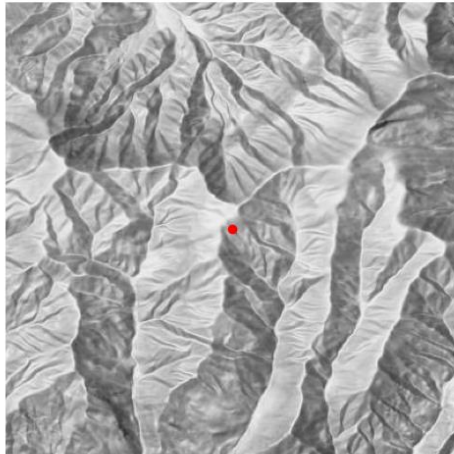


Segmented stacked

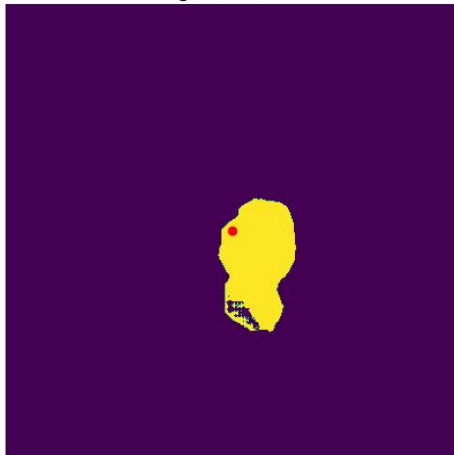


Results – SAM – Single Point Targets

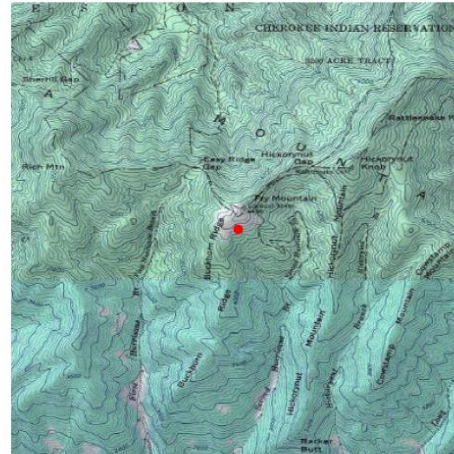
hill



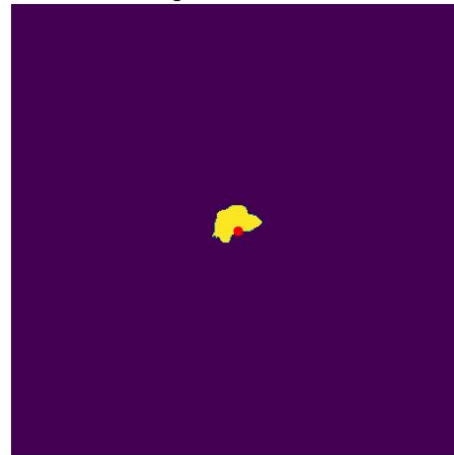
Segmented hill



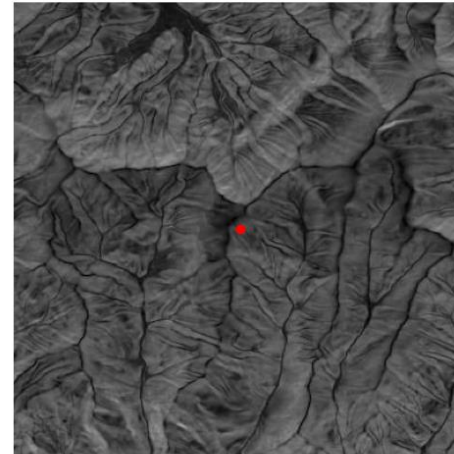
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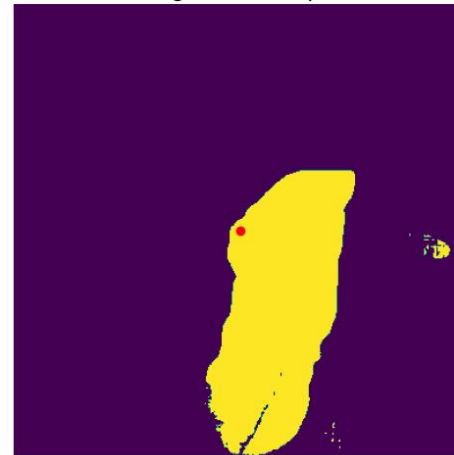
Segmented htmc



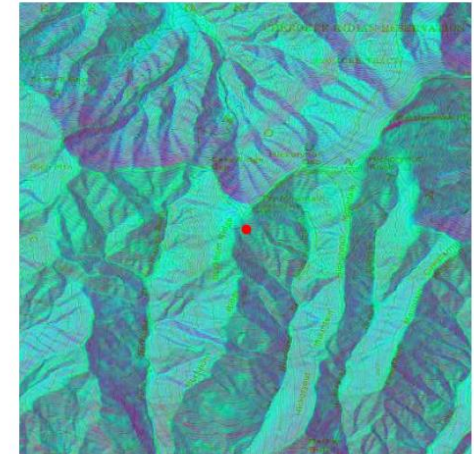
slope



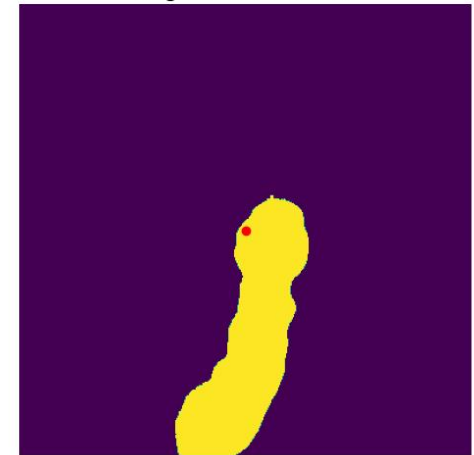
Segmented slope



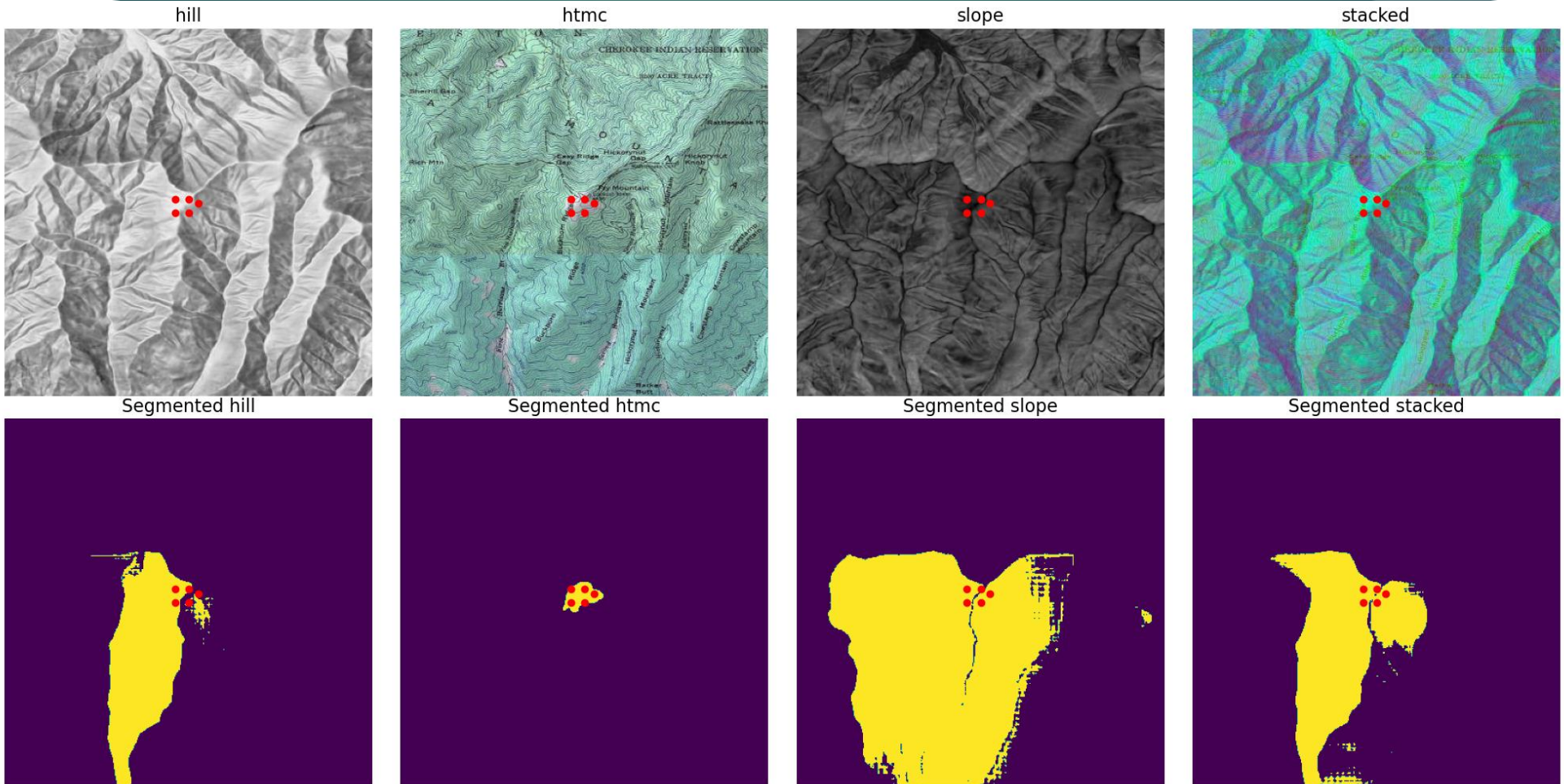
stacked



Segmented stacked

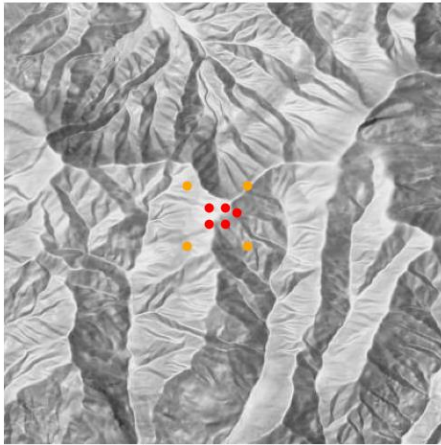


Results – SAM – Multi-point Targets

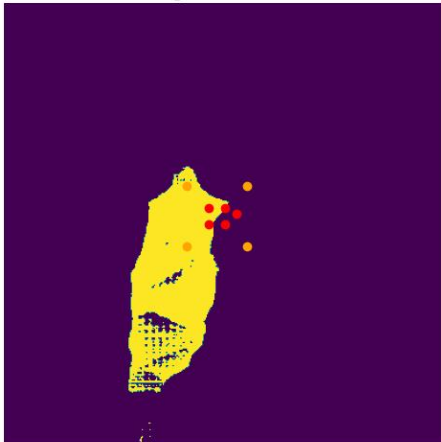


Results – SAM – Multi-point Neg/Pos Targets

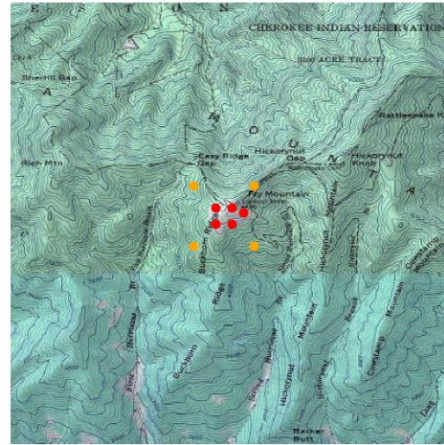
hill



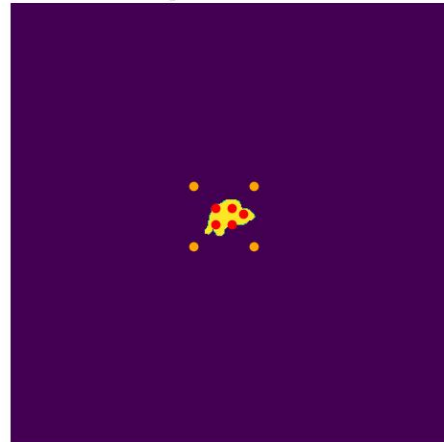
Segmented hill



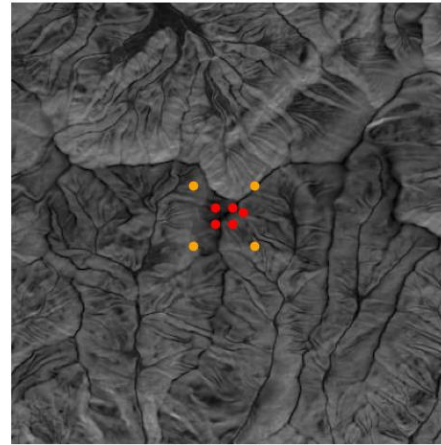
htmc



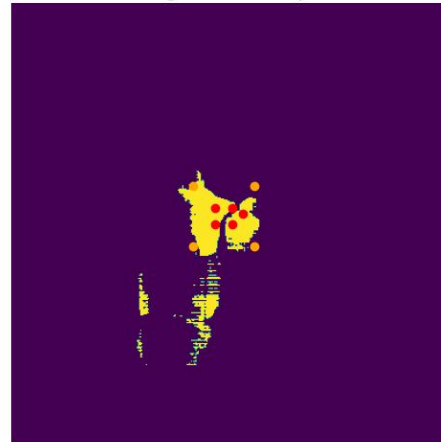
Segmented htmc



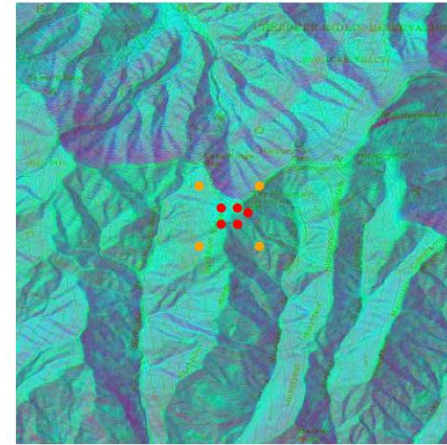
slope



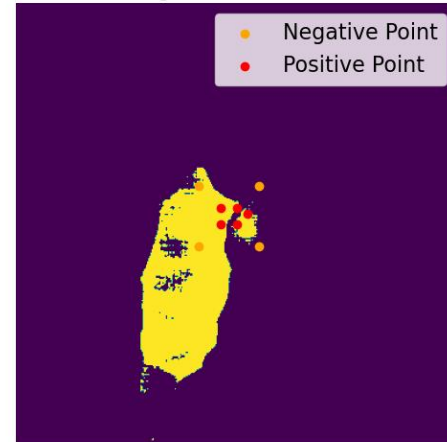
Segmented slope



stacked

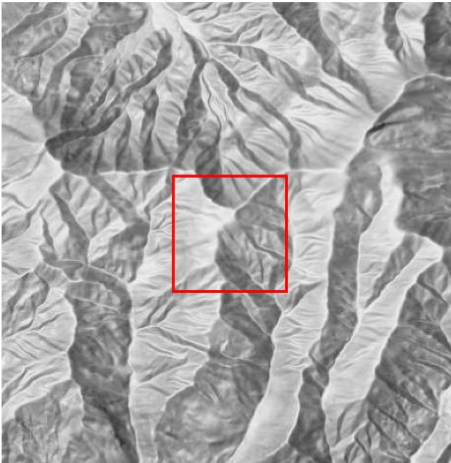


Segmented stacked

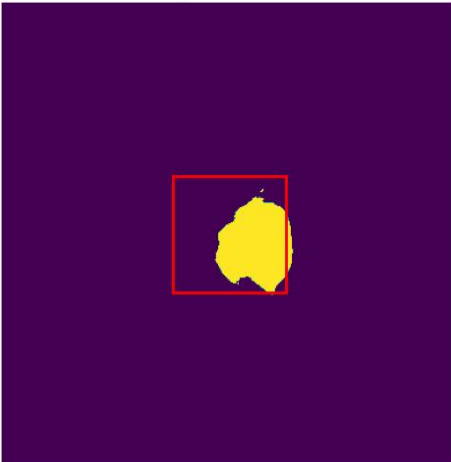


Results – SAM – Box Targets

hill



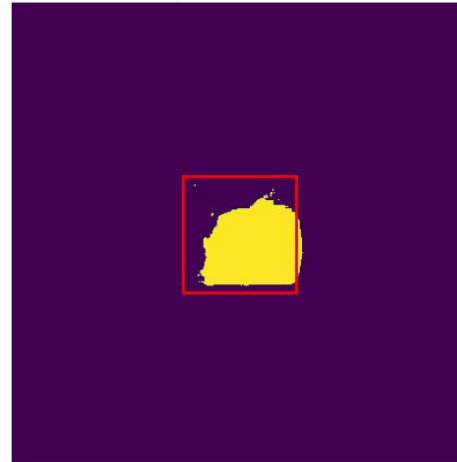
Segmented hill



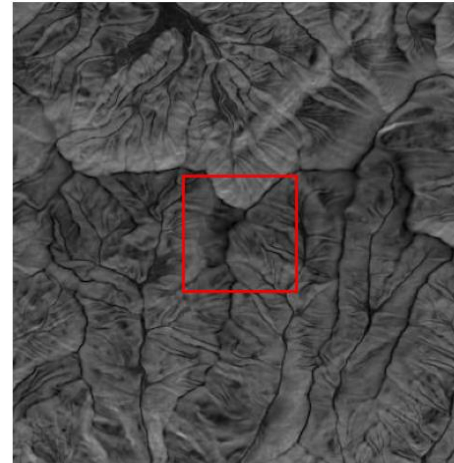
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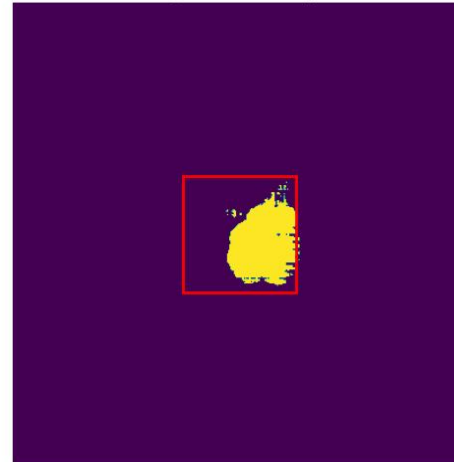
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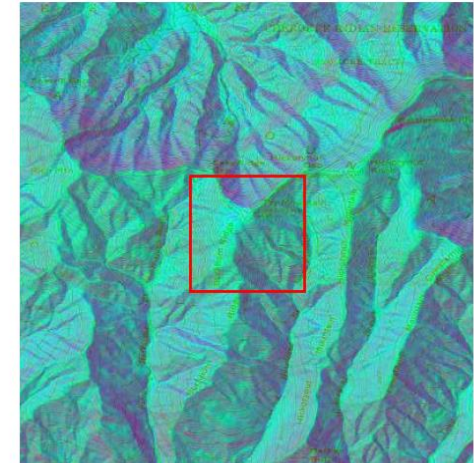
slope



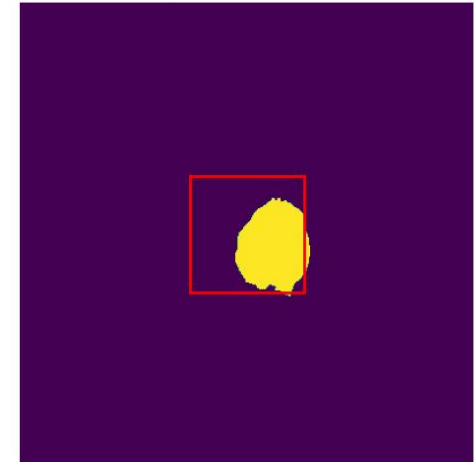
Segmented slope



stacked



Segmented stacked



Future Work

- ▶ Implement Mask TextSpotter and Detectron2.
 - Neural Network models targeting real world scenes for text extraction.
- ▶ Use encoder portion of SAM and fine tune decoder portion.
- ▶ Combine both approaches and evaluate combined results.